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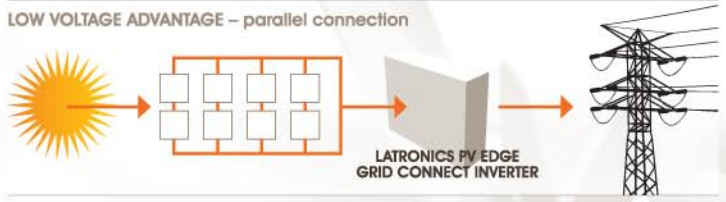

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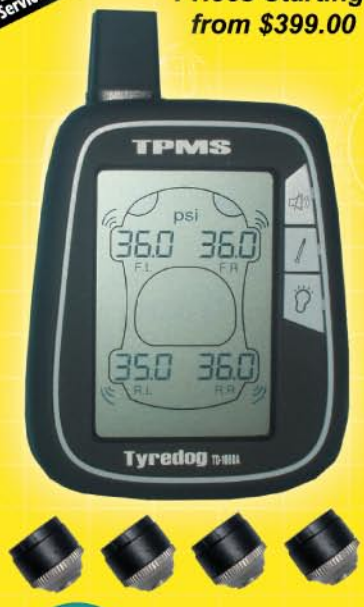

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Speaking from experience – making a green choice with a solar company you can trust.

There are plenty of factors driving Australians to make the switch to solar energy these days. Often, what starts as an environmental consideration gains momentum once people start researching the very real cost savings that can be made.

This was certainly the case for Brad Page (pictured) and his family, who recently had a system installed in their home by Solar Shop Australia.

"As well as helping to reduce our carbon footprint, we wanted a sustainable way to reduce our power bills," said Brad, "But from doing a little research on the web we realised that not all solar panels were equally as efficient."

Once the decision has been made to go solar, what sometimes surprises householders is the vast number of suppliers to choose from.

As solar energy has gained in popularity in Australia, the number of companies offering installations has increased rapidly; but the levels of service and expertise you can expect from from those companies varies quite widely.

With such an important decision ahead of them, the Page family were not about to take any chances. "There were a lot of companies out there offering solar panels. But because it was such a large investment to us, we wanted to make sure that we chose one that could provide the best quality products, long warranties and a system that was most suited to our needs. Solar Shop Australia was one of the larger companies, with more than ten years of experience in providing solar power systems. They also had an office in our local area and provided great customer service," said Brad.

Right from the start, Brad and Jane were impressed by the level of service and the thorough nature of Solar Shop Australia's approach. "They did an on-site inspection and provided a comprehensive plan as to how the panels would look and fit on the roof. There were no hidden costs. They explained in detail the 'ins and outs' of the different system options and left us with enough answers to make a well-informed decision… there was no hard sell."

As a national provider with representatives all over the country, Solar Shop Australia is very much in tune with the various Bonus Schemes and Feed-in Schemes, which vary from state to state. In addition to assistance in choosing the right system, customers will receive a thorough explanation of the benefits poetential savings they can expect.

The Page family is very happy with the end result. "We installed a 2.5KW system four months ago," says Brad, "So far we've been in credit, with no power bills. In fact, our electricity supplier owes us over $1,000! We're expecting the system to pay for itself in less than four years. It's one of the best investments we've made."

Solar Shop Australia may be contacted on 133 765 or by visiting solarshop.com.au

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October—December 2010

features

It's compact, but these Berlin residents have very low energy and water use and they are completely off-the-grid. Page 30.

Yep, it's a car, and not even a particularly pretty one. But it's electric. We explain how, page 68.

How much value do sustainable features add to your home? Find out the surprising answer on page 20.

Photo: Nick Stephenson

You don't have to spend big to live sustainably. See how one group is working together to live lighter on the earth. Page 48.

Cover up this summer! Find out how to stop your solar hot water system from overheating. Page 72.

regulars

What can be made from the remains of a car headlight? Salvage It! Page 94.

A bike made in part from bamboo. One of the interesting new ideas in 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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Contributions are welcome, guidelines available at www.renew.org.au or on request.

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

Ignore the politics, just do it yourself

In 2007 Australia had what many called the climate change election. Even here, in these pages of *ReNew*, we wrote about the great hope we had for some real climate change action in the form of an emissions trading scheme or a carbon tax with the election of a new government.

Well folks, three years on and perhaps we've had the real climate change election, with a hung parliament suggesting that both major parties lacked vision on key issues, including climate change. At the time of going to print around ten days after the federal election we don't know who will form a minority government. But there are signs that a hung parliament might be better for climate change policy, with the balance of power spread in the Senate and the House of Representatives. A good term of parliament would include an emissions trading scheme and greater investment in renewable energy…but we'll leave the speculation there for now.

What works in the bush

This issue of *ReNew* has a bit of an off-grid theme, which is quite timely really given some of the post-election discussion in Australia about what it means to live in the bush. The battery buyers guide is a good read for anyone planning an independent power supply, quite common for those living remotely. And Alexia's house in rural NSW is a prime example of off-grid living on a budget.

And if the new federal government needs guidance on how to shift to a green economy and help regional areas at the same time, then the tale of Eureka's Future on page 18 might provide some inspiration. A co-operatively run factory will manufacture solar hot water units in the coal mining-dependent Latrobe Valley, shifting some workers to more sustainable employment.

As for the future, if you want climate change action keep doing it first at home. Join community climate change action groups and keep sending the message to government that they have to act soon.

Jacinta Cleary

P.S. For extra reading visit www.renew.org.au where you'll find articles on low-energy cooking, an update on Merri Solars bulk buy group, Australia's smart grid demonstration city and more.

Cover photo by Nick Stephenson, taken at Murrnong. Article page 48.

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VIC Permit No: 10/2784.

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. Edwards Solar Hot Water reserves the right to change specifications without notice.
4. Paid ATA staff, members of the ATA board, Edwards staff, Edwards dealers and members of their immediate families are ineligible to enter.
5. Entrants must be aged 18 years and over.
6. The competition runs from 17 September 2010 to 5pm on 1 December 2010, and subscriptions/memberships must be paid in full by this time and date.
7. The competition will be drawn at 11am on Wednesday 8 December 2010 at the Alternative Technology Association, Level 1, 39 Little Collins St, Melbourne VIC 3000.
8. The winner will be contacted by phone and will be notified in writing. The winner's name will be announced in ReNew 115 and Sanctuary 14, released in March and February 2011 respectively.
9. The competition is open to individuals only. Corporate entities, collectives and organisations are ineligible.
10. To enter, subscribe or join the ATA using the subscription form in ReNew or Sanctuary, visit our websites (www.ata.org.au or www.renew.org.au or www.sanctuarymagazine.org.au), or call the ATA on (03) 9639 1500.
11. The competition is only open to Australian entries and includes delivery and installation within 200 kilometres of Australian capital cities. Edwards Solar Hot Water will cover standard install costs in other locations.
12. Edwards Solar Hot Water reserves the right to change the brand/model of the system depending on the water conditions.
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14. The winner agrees to assign any REC's (Renewable Energy Certificates) generated on this system to Rheem Australia.
15. Edwards agrees to promote the subscription offer on their website. ATA to provide the text.
16. Authorised under Vic Permit No. 10/2784.

The *ReNew*/Edwards Solar Hot Water subscriber competition is proudly sponsored by Edwards Solar Hot Water, ph:1300 765 277, www.edwards.com.au

Up front

Scottish tidal turbine's

The world's largest tidal turbine was unveiled in Scotland in August.

The turbine, which generates electricity through tidal currents, is to be installed on the sea bed and connected to the local grid in coming months.

The company behind the development of the turbine, Atlantis Resources Corporation, claims it will generate enough energy for more than 1000 homes.

The tidal turbine is of considerable size, weighing in at 130 tonnes with a height of almost 23 metres. The sheer size of the structure is expected to make it capable of withstanding the harsh environment and strong winds off the Scottish coast.

Consisting of an 18 metre diameter rotor with two sets of blades, it is capable of producing 1MW of power at a water velocity of 2.65m/s during both ebb and flow tides.

The chief executive of the project said the blades operate at an incredibly slow, and therefore safe, speed of just six to eight revolutions per minute. This means marine life is at little risk and there should be zero impact on the surrounding environment.

Largest tracking system

The development of Australia's largest solar tracking system has been completed in WA, delivering much-needed solar power to rural communities.

The installation is located on two sites in the east Pilbara region, in the townships of Marble Bar and Nullagine. The power stations will generate about 1000 megawatt-hours of solar energy per year, producing 60 to 90 percent of daily electricity needs for those towns.

The system uses the most efficient solar panels available, as well as flywheel technology. The flywheel is used to smooth the energy from the solar panels and stabilise power quality between the diesel power station and the solar farm.

Reef rescue

A project to improve water quality flowing into the Great Barrier Reef lagoon has made significant improvements to the nearby land, according to new information released in June.

The project, called Reef Rescue, is part of a five-year partnership between resource management groups and rural farmers aiming at improving the water which flows into the reef.

Just two years into the project, it was announced over half a million hectares of land have benefitted from improved management practices.

This has been achieved by 1480 farmers and land managers who have changed their farming practices to save the Great Barrier Reef from further damage. Techniques used include fencing to minimise erosion, fertilising techniques and improved soil and nutrient management.

Queensland Farmers Federation CEO Dan Galligan has called the Reef Rescue as a "win win situation" for both farmers and the environment.

There's wind in Sunshine

Earlier this year Brimbank city council engaged the ATA to assess the wind resource available at the aptly-named Sunshine Energy Park in Melbourne's western suburbs. The former landfill site was once investigated for its potential for electricity generation using landfill gas.

ATA volunteers helped install the wind monitoring mast late last summer. The data logger went online in April and has been logging the data from all five sensors every 10 minutes since then.

Currently four months of data has been collected with 12 months data needed to fully assess the wind resource, allowing insight into the seasonal variation in wind speeds and direction. However, an estimation of the wind energy at this site can be done with the currently collected data, so stay tuned—the results of this analysis, along with a sneak peek into the measured wind data, will appear in *ReNew* soon.

Ride the Talk news

As mentioned in *ReNew 112*, ATA employee John Knox is on a two-wheeled odyssey, presenting talks on energy efficiency and how to reduce our indi-

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Aral Sea: who pulled out the plug?

Previously one of the four largest inland seas in the world, the Aral Sea in Uzbekistan is steadily shrinking in size, causing local climate change and pollution problems. *ReNew* reader Ted Ronayne visited the area earlier this year and gives his perspective on what is occuring there.

Photo: Ted Ronayne

Cattle wandering the bed of the Aral Sea.

Our taxi dodged potholes in the bitumen strip as we crossed a plain scarred with white salt pans and scattered scrub. Past a shallow artificial lake, freshly painted, white-walled houses, their doors and gates in duck egg blue, welcomed us to Muynak, once the largest fishing port on the Aral Sea.

"They were painted for the visit last month of United Nations Secretary-General Ban Ki-moon," Dilya, my guide, explained.

Despite the paint job, Ki-moon observed, "The depletion of the Aral Sea is one of the planet's most shocking disasters."

In a crumbling, angular civic hall faded paintings and photographs told of Muynak's thriving harbour, bumper fishing catches and bustling canning factories, all now gone. The Aral Sea has shrunk 75% in volume over 40 years, killing all the fish and half the bird species.

The vast salt plains left behind have reportedly changed the climate, making summers hotter and drier and winters cooler and longer, and generated toxic dust storms causing high rates of cancer and respiratory illness amongst the local population.

Outside the town, rusting ships on waves of sand, are cast high and dry by the retreating Aral Sea. Down among the graveyard of stranded wrecks I picked at rust and peered into holds now full of sand, not fish, and kicked sea shells around spiky, dust-covered, desert shrubs. There was no sign of water and, squint as I might, I could not see the 180 kilometres to the new shoreline.

Weaving back to *Nukus*, I asked Dilya what had caused to sea to shrink.

She turned away and mumbled, "In Kyrgystan and Tajikistan they have dammed the *Amu Darya* River and take the water."

Her excuse was wrong. In 1918 Soviet planners decided to use the *Amu Darya* and *Syr Darya* rivers which feed the sea to irrigate the desert. By the 1960s most of the water to the Aral Sea had been diverted, and despite evaporation and leakage from poorly built canals, cotton became Uzbekistan's biggest export and transformed the region's economy. The *Amu Darya* River, which in 329, BC Alexander the Great's army took five days to cross, is now a sluggish stream in a cracked river bed.

Today, despite decades of international talkfests at the highest level, a solution to the problem of the shrinking Aral Sea remains a distant dream.

Green landlords award

Rental properties shouldn't be neglected when it comes to sustainability. Tell us about your green investment property and go in the running to win *ReNew's* Green Landlord Award!

To enter send us a description of what you've done to make your investment property more water and energy efficient for your tenants and the benefits of these changes. Note the entries can come directly from landlords, or tenants can nominate landlords to us.

Email entries of less than 300 words to renew@ata.org.au by Friday November 5.

ReNew's Green Landlord will win two 65 watt, 12 volt solar panels, total prize value $700, with the winner announced in *ReNew* 114.

Many thanks to renewable energy retailers Low Energy Developments for the generous prize. www.lowenergydevelopments.com.au

vidual carbon footprint to towns across the nation.

John set out in late July, and at the time of writing was pedaling along the Hume from the town of Yass to Gundagai in NSW. He's covered a lot of miles, averaging about 100km each day. Having been a cycle commuter for the last 30 years has certainly helped John prepare for this arduous task.

He has given a handful of talks already, and has planned an average of about four per week for the rest of the trip. "The highlights have been the people I have met, stayed with and connected with during the talks. And also the wonderful scenery I am passing through, lots of flooding noticeable today along the Sturt Hwy" said John.

Off-grid alternative to power lines

The Victorian Bushfires Royal Commission wrapped up in July, with several key recommendations, including one potentially costly one to replace power lines with aerial bundled cabling, underground cabling or other technology. ATA has recently pushed for renewble energy to be part of the solution, as it is cheaper and more sustainable than costly network upgrades.

ATA Energy Policy Advocate Craig Memery says that some remote power lines could be replaced with stand alone power supplies (SAPS) powered by renewable energy, possibly saving hundreds of millions of dollars from the cost of the solutions proposed by the Bushfire Royal Commission.

"Many homes are connected to the grid because decades ago when the power lines were built, it was a cheaper option than owning a SAPS. Now the cost of SAPS components such as solar panels has dropped significantly, and at the same time the cost of new power lines, along with the cost of electricity, has increased dramatically."

"There are many existing connections where the cost of upgrading the power line for just one home would be in the hundreds of thousands of dollars, whilst the cost of a SAPS, with most of its energy sourced from solar or wind power, is a fraction of that cost."

The ATA has recommended a voluntary program that would run alongside a powerline replacement program.

The voluntary program would offer households a grant to 'opt out' of being connected to the grid, where the cost of grid connection is higher than the cost of installing a stand-alone power system, as is likely to be the case in many rural locations. Households would use the grant to purchase a SAPS.

Open house day success

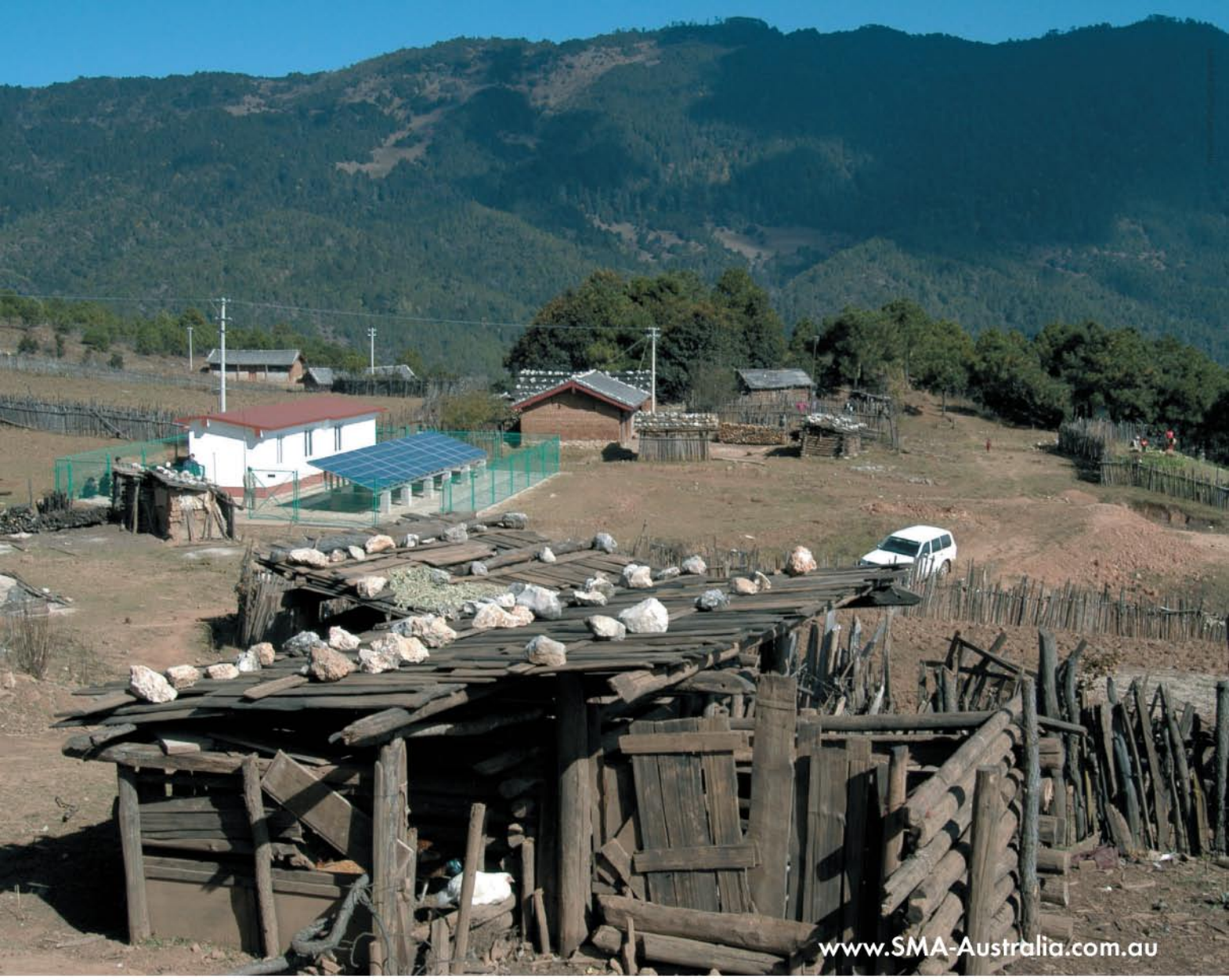
Thanks to the 350 people who attended *ReNew's* Open House Day and Q&A session in Castlemaine, held in conjunction with the Mt Alexander Sustainability Group and the State of Design festival. The four properties were open in excellent solar conditions for a July day. Visit www.renew.org.au for photos from the day.

Recent fun

Last issue we celebrated 30 years of ATA and *ReNew* magazine with a special commemorative timeline and a look back at the last three decades. Since then the ATA has had a very geeky but fun party to celebrate the last 30 years, with a trivia night in August. Three valued ATA members, Alan Strickland, Chris Moss and Michael O'Connell were honoured with lifetime memberships to the organisation, while Michael Harris' lifetime membership was formally recognised. Guests at the trivia night were invited to make robots, with one such creature pictured to the right. The trivia questions were, let's say specific, including how much rainwater could be collected from a certain-sized roof in a leap year, to how many blades does a wind turbine have and why. By the way the answer is three and one of the reasons is aesthetic.

Photo: Nick Stephenson

A robot 'created' at ATA's 30th birthday.



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Letters

Rainwater tank heat storage

I am writing in response to Terrence Thompson's question in *ReNew 111* regarding using the water in his rainwater tank as a heat source in winter and a heat sink in summer. I have not tried it but there are a few things to consider.

Firstly, the concept of using a liquid as a source of heat is used in farm dairies where the milk is placed in a refrigerated vat and heat is withdrawn from the milk. The heat is normally dissipated into the atmosphere but in Terrence's case it could be used for house heating, so a second-hand bulk milk storage vat could provide a source of suitable equipment if he wants to pursue this concept.

This concept is also used in heat pumps that source heat or dissipate heat within the earth. There have recently been various articles on this source of heat transfer.

Secondly, as with all ideas of this type, it pays to attach a few mathematical calculations to them before venturing any further.

If the split system is rated at 3kW we need to know if that is the electrical power required to run it or the heating or cooling ability of the system. An air conditioner that draws 3kW of electrical power will produce about 9kW of heating or cooling. When the air conditioner is in cooling mode the water will receive approximately 9 kilowatt-hours of heat energy each hour.

Supposing Terrences' tank has 8000 litres of water in it (though it is likely to be less in summer), for each hour that his air conditioner runs it will put 9kWh of energy into the water. The formula for connecting energy input to water volume and temperature change is:

Energy in the water = Specific heat of water x mass x change in temperature.

Wh = 1.18W/kg/°C x 8000 litres x Δt (temp difference °C) or kWh = 1.18W/kg/°C x 8000 litres x Δt ÷ 1000

This means that in Terrence's system: Δt (temp difference) = (9kWh x 1000)/(1.18 x 8000 litres) = 9/9.4 = 0.96°C

So for every hour the air conditioner runs it will increase the water temperature by roughly 1°C. If the air conditioner were to run for several days in a row and the starting temperature of the water was, say, 20°C, after 15 hours the water temperature would have reached about 35°C. There would be some heat loss through the walls of the tank at night if the ambient air temperature fell below the temperature of the water in the tank, but this heat loss would be very small. So as the water temperature increases and approaches the ambient air temperature any benefit of using the water as a heat sink rather than the air is lost.

And the water temperature has now been pushed to a level that is ideal for the development of Legionella, a bacterium that causes Legionaire's disease.

If Terrence were to use the tank for extracting heat in the winter time, the starting temperature of the water is likely to be 10°C, so, on the same basis it would not take long before he started turning the water in the tank into ice.

In either case it would seem an undesirable idea. A ground source of heat absorption or heat removal is more practical if Terrence does not want to have the atmospheric air as the receiver of heat in summer or the source of heat in winter.

Andrew Blair
Healesville VIC

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

Ending population growth

It's great to celebrate the Alternative Technology Association's 30th birthday.

In 1980, when ATA kicked off, Australia's population was 14.69 million. In 2010 we have grown to 22.41 million, an increase of 53 percent.

Those 7.72 million people, at an average of 25 tonnes per capita, have increased Australia's carbon emissions by 193 million tonnes per year. Today, Australia grows by one person every one minute and 13 seconds.

I work hard to reduce my individual carbon emissions, my water consumption and my footprint on the planet. I'm sure all ATA members are doing the same.

ATA lobbies national and state governments on energy and water policy. Is it time ATA lobbied towards sustainable population and immigraton policies?

David ZPG Hughes
Southbank VIC

Power saving on a fridge

Firstly, thanks for a great magazine. I have every copy and they are getting ratty from being re-read heaps.

My fridge is an average type of 370 litre capacity. On checking the power factor with an el-cheapo power meter it was 0.45, which to me is lousy. After testing several size capacitors on it I found a 10uf, 400V motor start capacitor balanced it to 1, as is best.

Checking my power use on the house meter for the last 14 days, it shows a daily average of 6.4kWh. Prior to the capacitor being installed the daily average was 7.75kWh. My power use has not changed in other areas. This equates to $26 saved on the next three-monthly bill. The capacitor only cost $20.

I am quoting the house meter as I dont trust the el-cheapo meter readings. And let's face it, the house meter sets the bill.

The cap must be installed on the compressor motor itself. Please advise

Will my solar system give me power when the grid fails?

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me if you think I am wrong but this seems an easy way to save power.

Frank Smith
Colly Blue NSW

Adding a power factor correction capacitor shouldn't change the energy you are billed for as your house meter is not supposed to record reactive power, only real power. It could be that having a capacitor right on the motor is allowing the motor to run slightly more efficiently, but it seems unlikely.

The thing that affects fridge energy use most is ambient temperature, so if that has changed over the monitoring period, that would explain the difference. The only way to be sure is to use a good quality energy meter just on the fridge and check it both with and without the capacitor.

If anyone else out there has more information on this, we would love to hear about it!

Incidently, motor starting caps are not designed to be run continuously, use a motor run capacitor instead.

Lance Turner

Fluff up those batts

I have recently been installing fibreglass ceiling batts in our owner built solar passive home. After opening the plastic compression wraps I found that the batts were not expanding to anywhere near the nominal thickness of 165mm as stated on the wrapping. Most were only reaching about half of that, some less than half, even after three or four weeks of being opened.

On checking with the manufacturer, they confirmed that the rated R-value would not be achieved at anything less than the nominal thickness or at least something very close to it. They could not say what the R-value would be at any other thickness.

My Australian made batts were 16 months old from date of manufacture to installation, which would seem to be far too long a time in their compression wrapping. I had them stored on site for 12 months.

An owner-builder friend was experiencing the same problem and he found that by physically 'fluffing up' each individual batt they would reach and maintain their nominal thickness. I have done the same with what appears to be good results, but it was a very tedious process.

I want to pass this information on to anyone about to insulate their home or to anyone who has recently done so and has been disappointed with the result. If the installer was not aware of this possible problem or simply did not care about it, then it is likely that the expected R-value will not be achieved and the hoped-for outcome will not be as good as it could.

Russell Gray

Power companies still getting it wrong

I can sympathise with Marie Cook (Letters, *ReNew 112)*, who wrote in regarding incorrect billing by her energy company.

I installed a grid-connect solar system in January 2008 and to date it is my belief that I have not yet received a correct power bill. In January 2009 I was sent a bill that was definitely incorrect; the power meter reading on the bill stated the meter reading as of 24/01/09 as 115 units, when on the day I received the bill (29/01/09) my meter reading was only 100 units.

I spent numerous hours finding out how power meters work, and then having lots of phone conversations, at times bordering on insulting from the Synergy representative, being told repeatedly that I didn't understand how to read a meter. Half of the people on the other end of the phone did not even know what a solar panel is!

In July 2009 I was eventually informed that Synergy had pinpointed the problem and a small compensation payment was credited to my account and all appropriate credit would appear on my next bill.

Upon receiving the next bill I was fuming—it was wrong again. I decided to take a couple of weeks to try and calm myself as if I contacted another Synergy representative I was afraid of what I might say.

It was at this point I decided to leave it in the hands of the WA Energy Minister. It is still ongoing.

After leaving it in the Energy Minister's hands for nearly six months, with my account repeatedly on hold with Synergy, I lodged a formal complaint with the ombudsman.

I still haven't received a correct power bill and it's now two and a half years since my installation.

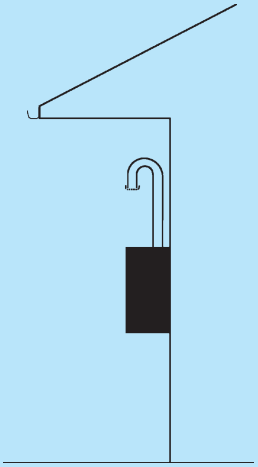
On top of all this, Synergy have decided that from September 2009 they won't supply power meter readings for all grid-connect customers. I find this unbelievable. It is a requirement under the current code. I have since been told by the energy ombudsman that there is

Passive inverter ventilation

Further to Terry O'Leary's letter in *ReNew 111* regarding ventilation of overheating inverters, I struck the same problem. With a few PVC pipes I simply ventilated the inverter enclosure so that no rainwater could enter.

I used some flyscreen to cover the openings to keep out wasps and other insects. My inverter box was on an outside wall and I used 100mm pipe at the top and just holes at the bottom. Convection did the rest.

Bor Ybsens
Woolgoolga NSW



little they can do to make Synergy supply me with a power meter reading.

To add insult to injury the Western Australian Energy Minister announced a net feed-in tariff—40 cents per kWh funded by taxpayers and just seven cents funded by Synergy. Not only are WA taxpayers funding the net feed-in tariff, but after ten years we as grid-connect customers will then receive seven cents per unit for power exported to the grid (prior to the net feed-in I was receiving 27cents). I might add that Synergy will be selling this same green energy for 44 cents. How the people that make these decisions can sleep at night I often wonder.

I made the decision to install a solar grid-connect system in the hope of doing something positive for the environment, and secondly to eliminate a large part of, if not all of my power bill. This has been one of the most stressful decisions that I have undertaken. Not because of the solar panels themselves but by the lack of understanding by people within the power industry and the lack of legislation to promote and grow and support this industry. What should have been a wonderfully uplifting experience has turned into a disaster thanks to Synergy and the energy policy setters for WA.

It's not all bad—at least my system is still producing green power for me and others to utilise and therefore decreasing my CO_2 emissions.

Thanks to the ATA for keeping up the fight.

Josh Berry
jenoshua@aapt.net.au

I totally understand your frustrations and you are not alone in your difficulties with the energy companies. I have tried to respond to a couple of the points above to provide a little more clarification if that helps.

Firstly, I can confirm that WA is the only place I have ever heard of on the planet that is attempting to run a feed-in tariff from consolidated revenue (i.e. the state budget). Feed-in tariffs are always market-based schemes, with the cost of the tariff contributed to by electricity consumers through electricity bills (i.e. Synergy are unlikely to be actually paying that seven cents, they'll be collecting it from their customers). Market-based feed-in tariffs allow for much greater, longer term certainty over the scheme itself. Budgets change year-on-year, depending on the political whims of the day, and offer little certainty over the longer term.

I also do not understand why Synergy will not send out a meter reader. Potentially, this is because the new meter you have has remote communications capabilities, however this means that Synergy should still be getting accurate meter data (remotely) and your bills should be accurate.

Ultimately, I wish you all the luck you'll need in your dealings with the Energy Minister and Synergy. If they just went down the path of setting up a proper feed-in tariff over there that we advocated for, things should have been a lot smoother.

Damien Moyse
ATA Energy Policy Manager

Eureka! From coal to solar

One clever Latrobe Valley enterprise is helping workers switch to low carbon employment, writes Sasha Shtargot.

Drive east out of smog-bound Melbourne along the Princes Highway and before long you are in the haze that perpetually sits in the Latrobe Valley.

Pitted with brown coal mines, the valley has long been in the firing line as the dirty heart of Victoria's power generation system. It is home to Hazelwood, the most polluting power station in Australia, pumping out over 16 million tonnes of greenhouse gases each year.

Yet the area that has long depended on jobs from brown coal has started heading in the opposite direction—towards a manufacturing base in clean technology. More precisely, the making of solar hot water units.

Eureka's Future, a co-operatively run factory, is set to start operating next year with 50 workers in Morwell. With the support of Dandenong manufacturer Everlast and Douglas Solar, it will produce stainless steel tanks with Solar Mio flatplate collectors, Grundfos pumps and Bosch boosters. By the end of 2011, it is expected to be making 500 solar hot water units a month. With rebates and including installation, a Eureka's Future gas-boosted tank will cost country homeowners $2655 and city dwellers $2755. And it will come with a 10-year guarantee.

Photo: Latrobe Valley Express

Dave Kerin is helping to set up the Latrobe Valley solar hot water factory by early next year.

Enterprising model

Dave Kerin is the project worker for Eureka's Future. A long-time unionist and former union organiser in the building, mining and electrical trades, he says the factory will run on a social enterprise model. Money made from sales will go back into the co-op and the community. Through partnerships with community banks, superannuation funds and local councils it will support social ventures like housing for homeless people and women's refuges in the Latrobe Valley.

An interim board overseeing the start of the project is chaired by RMIT University professor Peter Fairbrother and includes representatives from Environment Victoria, the Victorian Local Governance Association, the Latrobe Valley branch of the Construction and Mining Union and Trades Hall. Set up funding is coming from the Victorian and federal governments.

Dave Kerin is confident the co-operative will succeed. He points to the existence of 11,000 workers' co-ops in North America and 80,000 in Venezuela as evidence of the model's strength. Eureka's Future is to eventually operate with a horizontal organisational structure, with the workers trained in conflict resolution, group dynamics, decision making and social sector theory.

"We want to see communities work towards economic systems that are more democratic, where people have greater control over their workplaces and their lives," he says.

Union support

With strong union support behind the project, the plan is for Eureka's Future tanks to be included in union-employer enterprise bargaining agreements where workers can trade off part of their wage for solar hot water. There are 400,000 union members in Victoria, Dave Kerin says, noting the strength of the union movement despite an overall decline in recent decades.

The communities of the Latrobe Valley were decimated in the 1990s when the State Electricity Commission of Victoria (SECV) was dismantled and the power industry privatised. The valley's power generating workforce dropped

from 11,000 to 2000 and towns like Moe and Morwell became synonymous with hopelessness and depression. Now the valley's brown coal industry is under long-term threat as Victoria moves towards a low-carbon economy. The state government's recent white paper signalled a shift from coal and a 20% carbon emissions reduction by 2020.

From coal to clean

Dave Kerin sees the push for renewable energy as an opportunity for the Latrobe Valley to transform itself into a clean technology manufacturing centre. But he says it won't be private companies leading the charge.

"The private sector is incapable of bringing manufacturing back into the Australian economy and making a profit. Most Australian jobs are now in the service sector, which is a dangerous precipice because we're dependent on resource extraction. If that slows down or there's a drop in the price of commodities, much of the service sector will crumble," he says.

"We can reintroduce manufacturing and grow renewables if we put it in the hands of a social sector that's working for the common good, rather than the profit of the few."

Perhaps surprisingly, Dave Kerin says most people he speaks to in the valley are positive about a green makeover for the area. Mostly, the idea for Eureka's Future has met with praise and encouragement.

Everlast stainless steel tanks are one component of the solar hot water systems along with Solar Mio flatplate collectors, Grundfos pumps and Bosch boosters.

"When you talk about social enterprises and co-ops, they get it. What they want to know is who's going to do it and where the money's going to come from," he says.

"People who are 40 years or older can remember how things were before privatisation. The SECV did everything in the valley—they built the towns, did all the gardens, built the hospital—you even bought your car and fridge through them. It was a thriving, planned economy.

"There's been a great amount of support in the valley. The excitement and the hope is building." ✻

Project features

- A stainless steel solar hot water unit with a 10-year warranty
- Permanent jobs in the coal areas of Gippsland, developing across Australia
- Owned by communities through social enterprises; all surplus profit is put back into the enterprises
- Reduced household energy bills by 26%
- Unionists ability to purchase through their Enterprise Bargaining Agreements; employers receive the Renewable Energy Certificates as incentive
- Percentage of profit towards community needs.

Sustainable but not selling

What are home buyers willing to pay for properties with value-for-money technologies such as solar panels? Sigrid Parker reports.

When ATA member Michael Cahill put his Brisbane home on the market earlier this year he was surprised to discover that prospective buyers were not placing any value in the sustainable technologies he had installed.

Michael and his French wife, Isabelle Derouet, had spent five years transforming a house in suburban Brisbane into an energy-generating sustainable home for them and their three children. They wanted to sell to someone who would continue what they had started so they listed the property on various enviro-friendly real estate websites. They marketed it 'Sustainable Living in Suburbia' but received no bites.

With nowhere else to go, they turned to a low-commission agent to try to get back as much as possible on their original investment.

"We were stressing the fact that we wanted to sell it as an eco house," Michael says. "But I could see from the feedback we were getting from the agents that they really weren't taking into account what was on the roof, or the low energy aspect or low water use."

Why is it that buyers still value a nice kitchen and bathroom over value-for-money technologies? And will new legislation to be introduced in 2011 be enough to change public perceptions?

Michael and his family originally chose the site in leafy Mt Gravatt, eight kilometres south of Brisbane's CBD, for its position high on a hill and mature macadamia and mango trees. Over time, Michael invested in a 1kW grid-connected photovoltaic (PV) system, solar hot water and a 13,000 litre rainwater tank. He also insulated the roof with foil under the sloping part, put bulk insulation between the joists, installed low-energy lighting, diverted all the greywater and planted fruit and vegies throughout the backyard.

Michael had hoped his house would stand out from the crowd given the increasing discussion on the environment. Common sense suggested reduced running costs would generate interest and add value to the property.

Photos: Sigrid Parker

Michael and Isabelle's former home (above) featured a 1kW solar system, large rainwater tank, solar hot water plus other energy-smart retrofits. The couple (right) have started retrofitting again at their new property.

"Eventually we actually took off the 'eco friendly' banner because it didn't seem to be having that much of an impact," says Michael. The agent rebranded it 'value-packed' and the house sold.

"What most people were looking for, or what put most people off, was that the bathroom and kitchen weren't done," Michael says.

The experience was frustrating. Michael had put a house on the market where the new owner would not have to outlay capital yet would reap instant financial benefits. "I suppose there is something missing in our system when we can't get that information out there to people who are interested," he says.

Public perception

Architect Rob Andary, who runs his own business and lectures on sustainability and renovations for Archicentre Building Advisory Service in Perth, says there is a gap in the discussion about the environment. "What people are thinking when they see 'sustainable design' or 'environmental design' is that it's code for no air-con, no heating.

"What's missing is the conversation about people knowing they can have all the things that they want and all the mod cons." What people do not get yet, he says, is that it just means your house performs brilliantly for 95% of the year.

Seeing is believing

Professor David Doepel, director of the Research Institute for Resource Technology at Murdoch University in Western Australia, agrees the demand for a sustainable package is not there, whether for new or existing homes.

Things that are perceived to be important in a home, he says, are still the fixtures and fittings. "If it's a choice between a nice kitchen or high efficiency, the nice kitchen probably still wins," he says.

"You would assume that if someone had PVs on their roof, and they could demonstrate that it was reducing their electricity bill month by month, that the value of that should be factored in to the sale price of the house. Because it has a value. And I would say probably more value than a granite counter top in a kitchen."

Doepel says the resale value of a home should reflect the investment made in PV and other energy efficient technologies. "This is particularly important when many people will sell their home before such investments have reached their payback number."

For priorities to change the public needs to have "in your face evidence," he says. It has worked with cars. "People will choose a more efficient vehicle because the cost of running a car is much more present and you feel it every week when you stick the nozzle in the tank."

"We can sell it there but we don't sell it at the home level," Doepel says.

Government initiative

The Alternative Technology Association's energy policy manager Damien Moyse says the government's financial incentives have encouraged many to embrace alternative technologies. He says the uptake rates of systems such as PV cells and solar hot water have increased four-or five-fold in recent years, thanks largely to the subsidies.

The good news is more households are contacting the association for information on how to improve the footprint of their households and Moyse is seeing a change in attitudes.

But he says there is no evidence at the moment that sustainable technologies are adding value to a property. "It should but I haven't seen any evidence or data suggesting that at the moment. Whilst people may be interested in that area I'm not sure if the market is actually experiencing increased value and sales of houses because of those things."

"Whether it makes a difference to housing prices overall is probably fairly subjective still at the moment," says Moyse.

2011 federal legislation

But things are likely to change across the nation from next May when the Federal Government introduces a scheme requiring all vendors in Australia to disclose the energy and water efficiency of their properties at the point of sale using a star system.

The new scheme will be based on one currently operating in the ACT. According to ACT Real Estate Institute president Michael Wellsmore, the rating program has been a hot topic among his members. The scheme has been running for a while but he says the market is simply not interested. Put simply, high star ratings are not necessarily adding value to a house.

"When it gets to the fundamental of someone deciding about two houses it's usually a lot of other issues that make that decision," he says.

Real estate agents are not marketing sustainability he says because it does not feature in most buyers' decision-making process. "We are really, in our position as agents, just reflecting where the market is at," Wellsmore says. "If we believed that it was going to make a difference then we would say so."

What next year's mandatory disclosure will achieve, though, is increased public awareness as the debate will become a nationwide issue. Home-buyers, says Moyse, will be forced to take notice and over time potential buyers will become aware of the savings of running a household.

"I would say over the next two years you will see (the debate) becoming quite mainstream in the way people think about purchasing properties and it will factor in their decision-making."

This, says Moyse, is just the first step. Mandatory reporting is providing information only but it does not require existing houses to be upgraded. He says the next step should be to force people to act on that awareness: "To go from mandatory reporting to actually mandatory upgrading of the building before

it can be sold."

With increasing public discussion over the ratings of houses, both in terms of measuring thermal properties and the energy use of the occupants, the debate clearly has a long way to go.

Back in Brisbane, Michael, Isabelle and their children have moved a few suburbs away. They have better access to public transport and can cycle to work and school. "It is also an area where people are more active in sustainability," says Michael.

The family bought their new house through a real estate agent but could not find what they were looking for with sustainable features. They have already started work on a new vegie patch and are planting fruit trees in the garden.

"It is a bit difficult starting all over again," says Michael. ✻

Sigrid Parker is a freelance journalist.

Rental market experience different

PUTTING energy-efficient technologies into an investment property can create a marketable edge, as ATA chief operating officer Don Batson found out.

Tenants at his suburban Melbourne investment property are staying longer says Batson, because they are experiencing firsthand the savings from running an energy-smart home and they know they are on to a good thing.

Don Batson replaced halogen downlights with energy efficient LEDs at his investment property, as shown in *ReNew 111*.

"It's been a really good selling point for getting people in the door because you say 'Hey, the running cost of the house is so much cheaper'".

Batson identified the energy weaknesses of the investment property and made a few changes with maximum impact. He took the low-hanging fruit approach and tackled hot water and lighting, changing to solar hot water and replacing traditional downlights with energy-efficient LED downlights.

Solar hot water was a massive improvement. "You say 'You'll have a third less of the cost for heating hot water. That is a cost reduction that people could understand and get straight away," says Batson.

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DIY solar water pumping system

Want to have solar power but can't because you're a renter? Lance Turner shows us his self-contained system that's portable and versatile.

Being renters, my partner and I haven't had the opportunity to do as much with renewables as we would like. I had played around with a few solar projects, but nothing of any real use, so I thought it was about time I did something worthwhile. Fortunately, I had a couple of standard 12 volt, 80 watt solar panels, so these were earmarked for reuse in a new battery based independent power system.

Around the same time we installed a 2100 litre rainwater tank under one of the rusted downpipes. We were tired of seeing all the water from the roof just flooding out onto the concrete at the rear of the house, so in went the tank and it was soon full.

It was rapidly approaching winter, so what to do with all that water when the garden didn't need it? The simplest solution was to use it to flush the toilet. The loo is right near the tank and all that was needed was a small pumping system and a power supply.

Doing it on a budget

Like all projects, it makes sense to have an idea of how much you want to spend. I considered the water tank/pump and the solar power supply to be two separate projects. Each had a budget of $1000.

As it turned out, the water system went under budget and the solar system slightly over. Costings can be seen in the 'What it all cost' box later in this article. There were some real bargains in both systems, so if you don't have the inclination to shop around and take a few chances, then you'll probably end up paying more than we did.

The water system

The first thing we needed was the water tank. I often resort to eBay when looking for bargains as many companies will put end-of-run or slightly marked stock up there to get rid of it quickly. I found just such a bargain in a 2100 litre black poly tank. It came complete with fittings, bucket tap and water gauge, all delivered for $440—not bad really.

The complete power system. The bundle of wire hanging below the inverter is the solar regulator temperature sensor, waiting to be attached to the battery.

The hardest part of installing the tank was moving it from the front yard, where the delivery guy left it, around to the rear. Both sides of the house have fences and gates enclosing the rear yard and there was only one gate wide enough to fit the tank through—after I removed the gate and hinges!

I found a couple of old metal poles in the workshop and strapped them together to make a sling a bit narrower than the tank. We used this to carry the

tank around to the rear yard, although the garden suffered a bit as there were some narrow spots where the tank had to go through the plants.

The tank was positioned on the flattest piece of concrete that still allowed it to sit under the hole in the downpipe. One edge of the tank had no support on it, which I was initially worried about, as a tank full of water weighs a lot and the water weight can damage an incorrectly seated tank. But we have had no problems after almost a year of the tank being full, so it seems poly tanks are stronger than they look.

To the outlet of the tank I fitted a Y adaptor. This screwed straight onto the main tank fitting and has two screw fittings which take standard garden hose fittings. To one of these we fitted a garden hose and to the other a hose tail that was to feed the pump. The Y fitting also has a ball valve in each branch so that you can control them separately.

The pump was another eBay bargain. It is a rather agricultural looking cast iron unit made in China. Originally I suspected it might not last long, but it seems to be quite robust, for reasons I will get to shortly.

It costs around $87 plus $15 shipping from a local supplier. But it wasn't just the price that attracted me to this pump. The other issue was that most Australian made and more expensive imports have high powered motors. It seems most are made to pump mains pressure water to a whole house, but if you only need to supply one outlet or fitting, they are a gross overkill. There's no point buying a pump with an 800 or 1200 watt motor for such a small task. Doing so means you would need a much larger inverter to drive it, greatly increasing system costs.

The little Chinese pump has a rated power draw of just 250 watts. In practice, it runs very close to this at around 280 watts. But what really amazed me is that the power factor of the pump motor, rather than being really poor like I expected, is in fact around 0.98 according to my Powermate Lite meter. This means there must be power factor correction caps inside the motor somewhere, as there are none outside of it. Or, the inverter is doing an excellent job at power factor correction!

Pressure storage

The pump came complete with a tiny 1.5 litre pressure tank, but this wasn't adequate so I added a 24 litre tank. This was also an ebay buy from the same supplier as the pump and cost around $90.

Pressure tanks are used in mains pressure water supplies to prevent the pump turning on every time a small amount of water is needed. Without one, the pump will cycle many times per day and will wear itself out faster. It also uses more energy due to the greater number of starts.

A pressure tank is a steel or fibre composite cylinder that contains a rubber bladder. The tank is pressurised with air and the water fills the bladder until the pressure trips the pump's pressure switch. The actual volume of water that will flow into and out of the tank, i.e. the volume 'buffer', depends on the volume of the tank and the pressure in it (too much or too little reduces the effectiveness of the tank) and the hysteresis of the pump's pressure switch.

The rest of the system just consisted of hose fittings and some garden hose to plumb up the pump and pressure tank to the rainwater tank and toilet. I simply turned off the wall tap below the cistern and removed the flexible hose that runs from the tap to the cistern. I connected the hose from the pump to this flexible hose via a plastic irrigation hose tail fitting and a brass adaptor, running the hose through the window, which is always open for ventilation.

When looking around for fittings I discovered that finding decent quality hose tail fittings with standard 15mm screw threads was rather difficult. My local hardware stores had nothing except poly irrigation fittings and I didn't want to drive around trying to find the right fittings from irrigation suppliers.

A quick search online didn't turn up much either so I settled for the poly fittings and whatever screw thread adaptors were needed, which are readily available. The threads in the pump castings were not easy to seal as cast iron doesn't machine very cleanly. Thread tape wouldn't do it, so I resorted to some gasket sealant left over from my automotive days. This stuff sets hard and

Above: The pump and pressure tank with the styrofoam cooler removed for the photo. Note the tiny inbuilt pressure tank which was next to useless. At right you can see the pump and tank from another angle, this time with the cover in place.

will seal just about anything. Amazingly, despite being in the toolbox for over 20 years, the sealant was still perfect!

The hose was clamped at each fitting with a worm drive hose clamp. Despite the cheapness of the hose, there has only been one leak, which was fixed by tightening the clamp slightly.

To protect the pump from the weather I sat it up on two bricks, using an old styrofoam cooler as the cover. The pump sits on the lid of the cooler and the cooler body drops over the pump. Two slots were cut for the pump inlet and outlet. This keeps the pump dry from any rain that gets on it. The pressure cylinder is yet to get a cover itself, but it is less critical as it is not electrical!

Solar power

The solar power system was much more involved. This was also done by bargain hunting. I already had the two 80 watt panels, so I sized the system around those with the aim of finding out just what I could run on the system.

After a quick calculation I decided I needed a battery of around 200Ah. This is a little small, as the panels can produce about 30Ah input on average, but there was a budget to work to and a 200Ah battery was about the largest I can realistically move on my own.

Once again I resorted to eBay and found an Exide Energystore 12RP200. It was oldish stock, out of the box, but supposedly as new, so I bought it for $200 plus $66 delivery. Not bad for a battery that normally sells for around $700.

The last large component of the system was the inverter. I really wanted a sinewave inverter as they are more versatile and motors run from them as they were designed to do. There are a lot of cheap Chinese made sinewave inverters available but having seen some of them die a quick death when running inductive loads, I thought I would have to resort to one of the high quality Australian made units. The only problem there was the price—they would well and truly blow the budget.

So, off I went looking online again and found a solar installer in Maryborough, K and C Stork, selling some European made units that had 400 watt continuous and 1200 watt surge rated capacity and even came with an inbuilt temperature compensated 20 amp solar regulator! The only drawback with them was that they didn't have autostart, so they would be running all the time, but in the end that turned out to be an advantage.

The inverter was a steal at $200 plus shipping. Once I had that, I had to decide how it was to all fit together. I wanted the unit to be semi-portable as we will be moving out of this house in the not too distant future. The final layout was pretty simple and can be seen in the lead photo.

The battery was enclosed in a plastic tub which has a locking lid for safety. The tub was ventilated using the rose section of two old but identical flexible pet showers I found hanging up in the workshop. I separated the rose plate from the shower head and drilled out the holes to 3mm. Three screws hold each one in place over a 40mm hole. One vent is at the bottom of one end of the tub, the other is at the top of the other end. This ensures good ventilation should the battery produce any hydrogen.

A spare piece of 8mm thick MDF was attached to one side of the battery tub. Because this was too flexible (I used it because it was there and had been getting in the way for three years), I made it more rigid by screwing a 1 metre long piece of 120mm x 20mm thick pine to the back of it. Mounted on the outside of the battery tub is a 100 amp HRC sealed fuse, which is also used to disconnect the battery from the rest of the system. This was another eBay find and cost just $15 plus postage.

The inverter was mounted on the MDF board along with a sealed enclosure that was used to hold the meters, current shunt, circuit breakers/fuses, buss bars and a spare merit socket, so that 12 volts is accessible if required.

The enclosure is one of a range available from Jaycar Electronics. I bought a unit much bigger than required as I was originally going to have to include a solar regulator in it. The extra space will be useful should the inverter need to be replaced and a separate regulator have to be added later.

Inside the case I fitted a sheet of 4mm MDF and mounted everything on it. It is hinged at one edge and the other has two strong magnets attached which hold

Inside the control box. There's plenty of space for expansion.

The meters only light when the button is pressed. This prevents them being left on and excessively discharging the battery. Note the merit socket, switch and circuit breaker below the voltmeter.

the panel closed against two steel angles inside the case. A handle for easy opening was made from a nylon bolt.

Wiring

The wiring is very simple. The battery connects to the buss bars via 22mm^2 (4GA) automotive cable which is run inside 18mm flexible conduit. I chose this cable because it was easy to get and easy to work with because it is very flexible. It also has thick insulation for good protection. At the battery box end I used sealed cable glands to prevent any hydrogen finding it's way into the control box—unlikely, but you never know. The conduit was sealed to the cable glands at the battery box end using self-amalgamating tape. This is a non adhesive tape that melds into itself when stretched. It has a million uses, is high voltage rated and is one of the most useful materials you can have in your toolbox.

The two meters and the merit socket connect to the buss bars via their associated fuse and circuit breaker respectively. The merit socket has a 12 amp circuit breaker and a 25 amp DC switch for durability. The meters, another low cost eBay buy, were easy to wire up. The voltmeter is designed to run directly from the supply it is reading, so it was connected directly to the buss bars via the 1A fuse. The ammeter requires a power supply that's isolated from the supply it is measuring, so to achieve that I added a 1 watt DC-DC converter, also available online at low cost. This has 1000V isolation and was ideal.

The ammeter came with a 100A, 75mV shunt and this was bolted to the negative buss bar. The other end of the shunt is where the battery connects to. This means all current into and out of the battery is displayed on the meter. When the system is discharging the battery the display is negative. When the battery is charging, the display goes positive. Some people find this backwards, but to reverse the display you just swap the two monitoring wires on the shunt.

The rest of the system consists of very little. There's a mechanical timer that only allows the pump to run between 7am and 11pm and a temporarily fitted Powermate Lite to tell me how much energy the pump is using.

The system is also earthed. There was no convenient earthing point available except for an outdoor power point. After testing the power point for correct wiring, I ran an earth lead from the inverter's earthing point to the earth pin on the power point and fitted a plug-in RCD (safety switch) to the inverter's output socket.

Lastly, there's the signage. It is easy to print such signs using basic software, even the average word processor can manage it. Print them in colour and laminate them and you're done.

Performance

Initially the pump system worked flawlessly and it was great to see collected rainwater being pumped into the toilet by solar electricity. We did have one potentially serious glitch though.

At some point the main valve from the water tank was inadvertantly closed, so the pump had no access to water. When the pump started it couldn't pressurise the system and it just kept running. Indeed, it ran continuously until the battery went flat and the inverter shut down (this was before I added the timer to the system).

I discovered this the next morning when nothing was working. I initially thought the battery had gone flat due to the run of cloudy days, so I plugged the pump into an outdoor power point instead. But the pump didn't start, so I went to see if anything was visibly wrong and noticed that it was humming. Realising it was jammed, I headed back to the power point but the pump started before I could get there. But nothing was pumping so it was then that I realised it wasn't getting water and a quick check of the tank explained why. I opened the valve again and turned the pump back on and all went okay, although the pump seems to take a little longer to pressurise the system now, so I expect the

What it all cost

The costings for both systems can be seen below.

Water tank and pump

Tank	$440
Hose and plumbing fittings	$50
Pump	$102
Pressure tank	$90
Total	**$682**

2 x 80W solar panels	$528
Exide 12RP200 battery	$266
Battery tub	$20
Cable and terminals	$43.50
Buss bars	$14
Lockable plastic case	$70.40
Meters and shunt	$33
DC-DC converter for meters	$11
100 amp fuse and fuse block	$20
Merit socket	$7
Cable glands and conduit	$22
Assorted materials, switches, circuit breakers, timer etc	$0
Total	**$1034.90**

Suppliers

Fuses, energy meter etc: stores.ebay.com.au/buy-it-before-it-goes
Inverter: www.kcsolar.com.au
Panel meters and shunt: stores.ebay.com.au/sureelectronics
Solar panels: www.lowenergydevelopments.com.au
Cable, case, buss bars etc: www.electusdistribution.com.au (wholesale) or www.jaycar.com.au (retail)
Water pump and pressure tank: stores.ebay.com.au/supasalesonline

impeller suffered a little bit of wear. Considering how cheap a pump it was, it's impressive that it still works so well after running dry for so long.

So far, despite the horrible grey winter in Melbourne this year, the system has performed well. The pump, timer and Powermate are consuming a combined 100Wh or so a day—a tiny amount really. The inverter is rated to draw 0.2 amps maximum when idling. As mentioned earlier, this is not an autostart inverter. If it were, I would not have been able to use a mechanical timer on it.

Once we start getting some sun again, we should be able to use the system for other things. I plan to see if it will run the front loader washing machine. Being a modern unit it has low power requirements—maximum surge draw on spin cycle is around 650 watts, well within the range of the inverter's capacity.

The pump itself has hummed along nicely. It has been a set-and-forget system really, apart from the battery flattening episode.

The system will have lots of uses, especially as the weather warms up and we spend more time outside. I expect it will be used for outdoor lighting, running the pump to water the garden and whatever else outdoor power is needed for.

As can be seen from the costings table, the rainwater system came in under budget while the solar system went over slightly. The solar system was helped by the fact that some items were bought wholesale, as well as by the online bargains.

Also, many of the small parts like switches, fasteners, crimp terminals etc were items I already had. I often buy components when they are being run out as excess stock. I can't say how much their value is but they wouldn't have cost much. I hate paying retail price for this sort of gear, and rarely do.

The solar system, although outside, is situated under a very wide eave that has never had rain get under it, even in bad storms. I am confident that the system will stay dry. However, it could easily be mounted inside a small shed or similar enclosure, with the battery box relocated outside. *

Adding an energy meter

If you want to record how much energy is going out of your inverter then you could use an energy meter like a Powermate Lite. However, for long-term monitoring, you don't want to tie up such a useful device indefinitely so another option is required.

While buying other components for the solar power system I came across small DIN rail mountable kilowatt-hour meters. These are designed to fit inside electrical breaker boxes alongside the circuit breakers, so that individual circuits can be monitored.

Normally these meters sell for $100 or more but the supplier I bought the fuse and some other equipment from had some nice little meters for less than half that. I bought one, plus one of their 2-pole enclosures for a few dollars, added a spare extension cord and made myself an energy meter for less than $50.

Unlike a Powermate, these meters have no modes. They simply display accumulated kilowatt-hours used on a backlit LCD. There's also a LED that glows green and flashes red with each output pulse of the meter; the meter has a pulse output for datalogging purposes. The meter is not resettable as far as I have discovered, but that's not an issue, as you can just note the start reading and the end reading and subtract the former from the latter.

The only drawback with making a meter like this yourself is that you need to be competent in mains wiring. However, it's not rocket science. One end of the meter has active in and active out connections, the other has commoned neutral connections. The two pulse outputs you just ignore. The wiring diagram is even printed on the side of the meter for you.

When wiring mine up I found it easiest to cut the extension cord in half, strip off about 90mm of outer sheath from each end of the lead and strip the required insulation from each wire. For reliable connections I always strip off twice the length of insulation and twist the wire tightly, then fold it back on itself. This gives the meter screw terminals a very strong grip on the leads—they will never come out when done this way. Do the same for the earth wire of course, using a BP connector to rejoin the two ends of the earth wire.

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Check with your relevant state and local authorities on what rebates are available and whether they apply to your particular application/installation. For most installations, the Solar Credits Scheme would apply.

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How It Works

1. Renewable energy is provided in the form of sunlight, which is collected by the solar panels and converted into DC electricity.
2. This DC electricity is fed through a solar charge controller to charge a deep cycle battery bank.
3. DC power stored in the batteries is converted into 240VAC power through an inverter, which is suitable for running most normal household appliances,
4. Some suitable DC appliances can be powered directly from the battery bank, with an option for load control.
5. A 240V generator can be incorporated into the system to provide auxiliary power to charge the batteries and power the 240VAC appliances.

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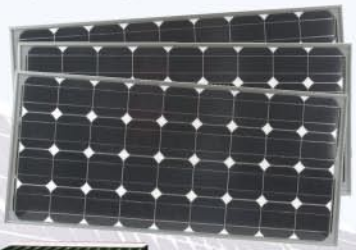
- Invertek 1500W (3000W max) 24V SuperCombi inverter charger (35A charging)
- SunStar 45A solar charge controller
- CombiNet data connection cable, 3m
- Required cabling and connectors for 10m from solar panels to charge controller

NEW

x6



x2

Suitable for	Not Suitable for
• Most moderately powered household appliances for short periods (under 2000W)	• Electric oven/stove
• Efficient lighting (LED, compact flouro, etc)	• Resistive heaters
• Efficient DC or AC fridge	
• Small DC water pump	
• Laptop, LCD TV, DVD player, stereo	
• Pedestal fan, compact flouro (energy saver) lights	
• Efficient washing machine on a sunny day	

Performance
• Approx. 3.5kWh average solar charging daily.
• 3 days autonomy with 3.0kWh daily power useage

Note: Solar panel mounting hardware not included.

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Features of the SuperCombi Inverter Charger

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Features of the Powerstack Battery Bank

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- AGM, maintenance free batteries
- Deep discharge capability
- Each Powerstack includes 6 x 2V cells complete with modular racking system, connectors & accessories
- Cycle life: 4000
  @ 20% DoD, 2000
  @ 50% DoD, 1200
  @ 80% DoD
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Off-grid living in Berlin

This European community lives in the middle of the city as independently as possible. Article by David Rowe and Corinna 'Elektra' Aichele.

For the last few years I have been working with Elektra on various projects including developing wi-fi networks. Elektra lives in a modified truck-trailer in a squatter community in Berlin where she uses solar electricity to power a home constructed from recycled materials, all in a climate where the temperature dips to minus 20°C in winter. Elektra lives in the middle of Berlin completely mortgage-free, with a lifestyle that helps many people around her. Her lifestyle fascinated me, so when I was in Germany for business in March I just had to visit her and learn more.

Photos: Corinna 'Elektra' Aichele

The residents make clever use of space within the trailers.

Trailer site

Elektra lives in a trailer site community in Berlin-Friedrichshain, a district in the centre of Berlin just to the east of the former Berlin Wall. When visiting the place it feels like you are in the countryside, however, a few steps away is a busy modern city with supermarkets, shops, a major train station and four-storey apartment blocks.

The people living here include engineers, audio technicians, movie crews, artists, architects and families. Decisions are made by means of grassroots democracy, aiming for consent rather than majority-rule, allowing any member of the trailer site to call a plenum. There is no boss or chief, neither informal nor elected. Sometimes they are asked by the authorities for 'the person responsible here,' demonstrating a funny clash of civilisations.

The residents are very active on social issues and actively improve the lives of people around them, for example, by deploying free internet via wifi networks. The call themselves 'freaks' in a non-judgemental sense to emphasise their uniqueness.

Home construction

Trailer site dwellers live in DIY modified trucks and trailers, similar to holiday campers or motor caravans. However, most living here don't like the typical camping look and style and require much better insulation as they live in their homes all year. The warmest day during my stay was 4°C! However Elektra's trailer was warm and cosy, in fact more comfortable than my home in Australia during our mild winter. This proves Europeans really know much more about insulation and comfort during exceptionally cold winter months.

Elektra's trailer consists of a steel frame and an aluminium house made in Germany in the 1950s, cost just €1200 ($2000) to buy, and was already insulated.

It is 8m long, 3.8m tall and 2.5m wide and was originally used to transport furniture. It is very well insulated, with 10cm of styrofoam in the floor, walls and roof. Despite these features Elektra is dissatisfied with her windows, as only two have double glazing, with double glazing the standard in a modern house in Europe.

Elektra's heater is a gas-fuelled Trumatic 3002S designed for caravans, with a thermostat and electronic ignition powered by two AA cells. The heater draws air through a hole in the floor and pipes the exhaust gases (CO_2 and water vapour) through a small chimney. The heater is fuelled by 11kg propane/butane gas bottles and the overall comfort is comparable to central heating.

The Trumatic has a 3kW maximum heat output and consumes 30g to 280g of gas per hour. When the temperature is around -20°C the gas bottle lasts four days; at temperatures around 5°C it lasts two weeks.

PV solar system

The trailer site has a water supply but no other services like electricity or gas. Each trailer is powered entirely by so-

lar electricity in a Northern European climate, with much less sunlight than Australia. Elektra runs her entire home on no more than 300 watt-hours of solar electricity each day.

She uses a maximum power point tracker (MPPT) to get the most from her solar panels. The MPPT is an intelligent and efficient DC/DC converter that keeps the solar panels operating at their maximum power point. It also regulates the charging process. It is uncommon to have MPPT on small PV systems, so Elektra designed and built her own. She builds and sells these units at a modest cost to other people running small PV systems as a community service.

Electricity is stored in 12 volt VRLA (valve-regulated lead-acid) batteries, rated at 240Ah storage capacity when new. These are now 10 years old and nearing the end of their life.

This impressive off-grid system generates 240kWh/year. In the Northern European climate the amount of solar radiation varies by 10:1 between summer and winter, compared to say 4:1 in Australia, so supplemental electricity from small generators is required for around one month in winter. Elektra uses a tiny 12 volt petrol generator she constructed to recharge the battery bank, consisting of a brushless DC motor used as an alternator and a 25cc Honda 4-stroke engine. It produces 25 amps at 14 volts and consumes 0.17 litres of fuel per hour.

Almost everyone owns a bike in Berlin. This trailer is made from recycled materials.

Most appliances run on 12VDC, with small inverters where 230VAC is required, like the video projector the residents use for their public outdoor cinema on Wednesdays!

Free internet

The trailer site community serves free food onsite every Wednesday. Squats or legalised squats call this service Volksküche, which translates to 'peoples' kitchen'.

Internet access is provided by a wireless community mesh network named Freifunk or free radio. Freifunk covers a large section of Berlin using roof-level antennas and mesh networking and is free to use for anyone that registers. In some districts of Berlin Freifunk coverage is quite ubiquitous.

The network consists of hundreds of modified wifi routers that share data with each other, meaning that your router will relay the internet for your neighbour, expanding the wifi range far beyond the range of one router. The trailer site dwellers can connect to internet gateways via this community network, even though they are several kilometres away, by passing through multiple wireless 'hops'. Mobile phones are used for telephone access.

Members of the Berlin squatter communities pioneered this advanced mesh networking technology. They have been using mesh technology since 2003 to provide internet access and have been actively involved in the development of mesh routing software and open-source firmware for wireless routers. Since they believe in the principle of mutual aid their software products are free to download and published under

Behind the lady in the tyre is a modified truck trailer, with WiFi antennas on the right.

open-source licence.

Wireless mesh networking technology based on routing software created by German squatters has now spread to developing countries to help provide internet access.

Trailer site status

The term 'trailer park' has a negative connotation in the English speaking world. The German term for these alternative lifestyle sites actually translates to 'trailer site' which is 'wagenplatz' in German. Having said that, one of Elektra's favourite television shows is the Canadian mockumentary Trailer Park Boys, which depicts the lives of people in stereotyped American trailer parks.

Some trailer site communities call themselves 'wagenburg' which means 'circle of trailers', others prefer the term 'wagendorf' which is 'trailer village'. Living in a trailer site isn't exactly legal in central Europe, so some trailer sites call themselves 'circle of trailers' to show that they are determined to defend their way of living. Even if the trailer site dwellers rent or own the land they live on, building laws can be enforced to prohibit their lifestyle. Building laws differ slightly from country to country and from state to state, but almost everything imaginable is strictly regulated.

This old Mercedes truck from the '60s belongs to a resident who works in film, with the Lolita lettering added for a movie.

Trailer site dwellers have been asked to show a building licence for parking their trailers and trucks on their sites, because 'the trailers are conjoined with the ground by gravity', and that the materials that their trucks and trailers are made of 'are not approved and certified for the construction of buildings'. The officials have told them that if they did apply for a building licence there would be no chance that the application would be granted. These communities currently exist in a tenuous legal position.

This doesn't mean that trailer sites cannot be legalised as Berlin's building legislation has a law for alternative, experimental dwellings. In essence, the existence or eviction of a trailer site is a matter of political struggle. ✻

Recumbent pedelec

Elektra has fitted an electric motor and battery system to a HP Velotechnik Scorpion, a German tadpole three-wheel recumbent bike. The bike has a weight of about 17kg, with the propulsion system of two 12V VRLA batteries and a motor generating 150W adding about 11kg. It is a pedelec so the idea is that the rider gently pedals rather than the electric motor doing all the work. I test-drove this pedelec while I was in Berlin; it's fun and with easy pedalling it cruises at 30km/h. Riding a recumbent at 30km/h close to the ground feels really fast! Travelling at 30km/h the range is about 40-45km. I want one!

We'll be looking at this pedelec in more detail in the next issue of *ReNew*.

Elektra and her solar-powered recumbent bike.

Mum, what was the Great Barrier Reef like?

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Zero emissions councils

It's quite an achievement but at last some municipalities are going carbon neutral, writes Sarah Dailey.

The town of Woking in the UK is probably not one you have heard of, or even visited. It is located 37 kilometres out of London and until the last decade was only known as the town the martians landed in HG Wells' novel, *War of The Worlds*. But as of a few years ago, Woking has been put on the map for a much more reassuring reason: it has become one of the benchmarks for carbon-neutral living by adopting greener energy technologies. The town shifted to cogeneration and trigeneration decentralised energy systems, renewable energy and fuel cells, along with smaller changes such as solar-powered parking ticket machines, wind-powered street lamps and even waterless public toilets. Woking soon became known as the most energy efficient local authority in the UK.

The shift in Woking began in the early 1990s, and by 2004 the town's CO_2 emissions were reduced by 77.5%, with water consumption also cut by a stunning 43.8%. The town has become somewhat of a blueprint for other cities across the world, most recently London, and now Sydney.

Sydney City Council recently declared itself 'Australia's first carbon-neutral council', referring to the council's operations, not households. Even though Sydney City is probably the best-known Australian carbon neutral municipality, a handful of other councils across the country are also making a notable effort, including the port city of Fremantle in WA and Darebin, a council in Melbourne's north.

Carbon neutral

The term 'carbon neutral' is often bandied about and attached to everything from rock festivals to toilet paper, but what does it actually mean and how can this illustrious status be achieved?

Fremantle mayor Brad Pettit gets close to the windpods on Fremantle Town Hall roof.

There is no single global standard for what it actually means to be carbon neutral, making it pretty easy for anyone to claim the tag as their own. However, there are some common guidelines that are usually agreed upon to support the attachment of the label, and to avoid such grand claims without any evidence.

According to the International Council for Local Environmental Initiatives, in pretty loose terms, carbon neutrality can be defined as a state where no net greenhouse gas emissions are produced by an entity or activity during a particular time period. Carbon neutrality, or having a net zero carbon footprint, can therefore be as complex as doing everything possible to reduce your emissions to zero and using only renewable energies that don't produce any greenhouse gases, or simply paying to carbon offset everything you do, meaning paying a premium to compensate all of your emission creating behaviours.

For an individual to be carbon neutral is quite difficult and takes a lot of perseverance. So if it's that hard for us to do it, just how on earth does an entire council go carbon neutral?

Sydney—Australia's first

Sydney's shift to carbon neutral is just one part of their quest for a more ambitious target, a plan for a Sustainable Sydney by 2030. The city is aiming to source at least a quarter of power used in the local government area from renewable energy, as part of its larger target of reducing carbon emissions by 70% by 2030, based on 2006 levels.

Sydney City Council has appointed the man in charge of Woking's success, Allan Jones, to help with their enterprising goal. A specialist in renewable energy production and alternatives to

coal-based energy, Allan was awarded an MBE for his services to energy and water efficiency and was responsible for Woking being awarded the 2001 Queen's Award for Enterprise for the development of local sustainable energy systems. Allan has been employed by Sydney City as Chief Development Officer of Energy and Climate Change to help achieve similar environmental kudos.

Currently, about 80% of Sydney's emissions come from the production of electricity by coal-fired power stations in the Hunter Valley. A majority of the fuel being used by these stations is wasted, as heat from the cooling towers and in the electricity transmission through power lines.

The goal is to eventually produce 70% of the city's energy needs from trigeneration plants—local generators that use waste heat from electricity production to both heat and cool buildings, which is three times more energy efficient than coal-fired power plants. It was with the implementation of localised energy systems such as this trigeneration and cogeneration, renewable energy, fuel cell technology, microgeneration and low carbon transport systems that Allan achieved such spectacular emissions cuts in the UK.

According to Nik Midlam, Manager of Environmental Strategy, Sydney made the swing to carbon neutral in less than a year, proudly declaring themselves Australia's first council to do so in August 2008.

Nik says Sydney council could easily have delayed the process and spent less money and more time, but felt the urgency of climate change was reason enough to speed ahead. "The council took the view that the urgency of climate change warranted immediate action, and that it was essentially like applying a self-imposed carbon tax—making the business case for energy efficiency programs more viable."

For them, it meant all activities in Sydney from collecting garbage, to running libraries and street lights would have no net carbon emissions. Where emissions could not be eliminated, the City of Sydney purchased carbon offsets and GreenPower, with plans to move beyond this.

"Previously the City purchased 100% GreenPower equal to its mains electricity use and other accredited offsets for the remaining emissions. Recently, the council endorsed a plan to divert funding previously used to purchase GreenPower into local renewable energy installations at council owned sites. The City still supports the use of GreenPower but our rationale is that we have a corporate and community goal to have 25% renewable energy by 2020, five percent above the federal target and therefore need to start investing into local projects," said Nik.

In addition, the city has set aside a $2 million a year budget and is taking tenders for a five-year rolling plan to install photovoltaics.

Darebin

Although not quite there yet, the council of Darebin, in Melbourne's north, is making progress.

Darebin won the Achievement in Sustainability award in the Environs Australia Awards for climate change action for the programs and actions undertaken by council.

Darebin is a community known for being culturally diverse and crammed with artists, students and families as well as musicians and writers. Being environmentally aware is perhaps something else that typifies this community and was part of the reason this council made plans to go carbon neutral. Darebin wanted to demonstrate leadership in climate change action and to end their contribution to global warming, so consulted extensively with residents to develop an action plan.

Public meetings were held and surveys distributed. Reference and focus groups were also assembled to cover a broad cross-section of the community, to ensure council plans fitted in with the ethos of the community.

After that much consultation it's not surprising that Darebin has already met its 2010 target to reduce greenhouse gas emissions by 20% on 1995 levels, and is well on the way to ensuring its 2020 target of zero net emissions.

According to Libby Hynes, Executive Manager of Environmental Sustainability with Darebin, council has implemented a highly successful energy efficiency program and purchased 100% GreenPower to meet the target.

Allan Jones and the Sydney branch

IN July, Allan Jones delivered a presentation to the ATA's Sydney Central branch. His presentation outlined how he implemented decentralised energy in the UK, as well as the action plan for decentralised energy master plans in Sydney.

Allan spoke about the inefficiencies of producing power at locations at great distance from where the power is actually used. He also talked about the changes he helped make in Woking and London using "off-the-shelf" cogeneration and other decentralised systems to greatly reduce energy consumption and also reduce emissions. He also gave a brief summary of building retrofits, tri-generation, LED lighting, waste management and other projects underway in the City of Sydney. Most of the Sydney Central ATA members live in Sydney and in fact, cities are where most Australians live. Allan's talk re-emphasised that cities can and should be part of the solution, both for reducing our emissions and for finding alternate and more efficient ways to meet our future energy needs.

Mary Hendriks - ATA Sydney Central committee member

"The energy efficiency program targets council's eleven top energy using buildings. To date it has reduced emissions by over 1000 tonnes and is saving council more than $180,000 a year in energy bills compared to 2006/2007 before the new program was implemented," said Libby.

Beyond these changes made within the council, Darebin is supporting local residents to make their own changes. The council commenced a climate-wise business program to support local industry to improve energy efficiency, and employed a sustainable business officer. They have also undertaken a competitive process to select the most energy efficient hot water systems for residents, resulting so far in more than 170 households installing the systems, and many more considering the same. Through this same program Darebin has also installed five solar hot water systems at five local day care centres.

On top of all this hard work, Darebin is supporting low income and vulnerable members of the community to improve energy efficiency and weather proofing in their homes via the Victorian government's 'Energy and Water Taskforce' program. "To date more than 400 households have had free assessments and installations. Darebin has also contributed funding so that around 150 Darebin Home Support clients will benefit from fitted blinds in living areas and bedrooms where required," said Libby. She predicts households participating in this scheme can save about $200 a year on energy bills.

Beyond this, the council has exciting plans in the pipeline, planning to implement cogeneration at the Northcote aquatic and recreation centre, as well as upgrading the street lighting to energy efficient T5 fluoros and planning for all new council buildings to be designed for carbon neutrality. It looks like Darebin are well on their way.

Fremantle

The port city of Fremantle, in Western Australia, was the first in that state to grasp the carbon neutral tag in July last year.

It's not surprising really, considering Fremantle's notoriety as a diverse population of Greens voters, hippies, cyclists and artists. This leftie reputation has a lot to do with Fremantle's long history of environmental campaigns, and going carbon neutral was part of their overall approach to reducing the impact on the environment. Fremantle Council uses the four steps: measure, reduce, switch and offset to ensure zero net carbon emissions.

Brad Pettit, Mayor of Fremantle, says: "Our community has a reputation for being environmentally aware and, like many local governments, we've been putting progressively more and more effort into monitoring and reducing our greenhouse gas emissions. It was a natural next step to work towards achieving carbon neutrality. There's a definite financial cost to the city, but we feel that this is well worth it. All the feedback we've received since becoming carbon neutral last year has been positive, so we clearly have the support of our residents."

Each year the council uses federal carbon accounting calculation methods, and supplies all details of direct emissions, from electricity used by street lights to business travel and even waste produced, to ensure carbon neutrality is met.

The city has its own wind turbine, a 1kW windpod, as well as a large photovoltaic solar farm, which was the first of its kind to be installed in the state.

"Recent projects have included the selection of efficient IT equipment and reducing the size of our small vehicle fleet," said Brad. "On the renewable energy front we installed a 30kW solar photovoltaic farm, made the first commercial windpod installation, and have another 2kW solar PV installation at one of our community facilities as part of a demonstration sustainable house."

This house is known as The Meeting Place. It has been retrofitted to display how homeowners can make their homes more sustainable, which can be quite a challenge considering the number of historical and even heritage-listed homes in the area.

The city also purchases offsets, investing the money back locally. "Most of the offsets that we've bought have been from a local waste organisation, South Metropolitan Regional Council (SMRC), which diverts organic matter from landfill for compost," said Brad.

"We're also trialing the use of a fuel additive that has the potential to increase our large fleet fuel efficiency by up to six per cent, we will retrofit some of our office lights with electronic ballasts for automatic daylight dimming and we will install a new type of evacuated panel solar water heater on one of our community swimming pools."

Fremantle has budgeted to continue its green efforts well into the future. "This year's budget has provision to install a voltage reduction device in our administration building which should reduce power consumption by nine per cent. The other major project is pool heating. While evacuated solar panels look like a great technology able to provide more than 75 per cent of the annual heat load, they will probably be cost prohibitive. But we've allocated $100,000 to install a test system on one of our smaller, but hotter pools. If this

Ten council network

NAGA, a network of ten councils in Melbourne's north, undertakes innovative projects to reduce greenhouse gas emissions. Their strategic blueprint *Towards Zero Net Emissions for the NAGA Region* outlines plans to substantially reduce emissions in an area that includes 25% of Melbourne's population, showing what can be done when councils join forces. For more information go to www.naga.org.au

performs worse than expected, then we'll probably go with geothermal energy to run the Fremantle Leisure Centre. If it does a lot better, then we could potentially install a much larger solar system. Either way, renewable heating for the pools is one of the key actions for the next three years and we'll be actively working to achieve it."

Brad claims the conversion to carbon neutral was relatively easy and enthusiastically encourages other councils across Australia to do the same, and even to call upon him for advice.

"If we could give one piece of advice to another council in Australia, it is that it's all possible. We managed to go through the mechanics of becoming carbon neutral in just four months and we've had great community support for it," he says.

"We're also really keen to help anyone else who wants to learn from what we've done. We've had to learn a lot while becoming carbon neutral and have developed all of the necessary expertise in-house."

Photo: Community Newspaper Group

Alex Hyndman and John East at the Fremantle Leisure Centre: the pool will be heated with renewable energy in the next few years.

"One of the great aspects of local government is that it's so cooperative—we get lots of help from other councils and are always willing to help others where we can."

So judging by these three councils, maybe carbon neutral municipalities aren't such a far-fetched idea after all. ✻

How to start a wind farm!

There's a lot to consider when planning a community wind farm. Dominic Eales guides us through a few of the vital stages.

Photo: prepared by John Cleary Planning. Copyright 2006 Hepburn Wind.

A simulation of the Leonards Hill Wind Farm near Daylesford. The two turbines will be installed later this year.

More co-operatives around Australia are looking towards community wind farms for a local and sustainable solution for their energy needs. Taking this path certainly has rewarding benefits including reinforcing community unity, although it can be a maze of challenges, both technical and regulatory. In this article we'll investigate some of these challenges and those who have sailed through them.

Best wind farm location

When looking for the right site for your community wind farm a number of different criteria need to be taken into account. For starters, you don't need a perfectly placed X on the map, but rather an area to be investigated. Although the site should be relatively windy, this is not the only thing to look out for so let's have a look at a few other factors.

Being a community project, the visual impact and proximity to homes in relation to noise and shadow flicker should be seriously considered. It is best for everyone if the location of the wind farm has the minimum negative impact possible for the people of the community, thereby maximising the benefits of your positive, community-building project.

Another important aspect is how much it will cost to connect the wind farm to the grid. Although it may seem that setting up the wind farm on the windiest hill is the best idea, if that hill is far away from the 3-phase, high-voltage power line then the cost of getting your renewable energy to an appropriate grid connection point may significantly increase the costs of the wind farm. Even if there is a power line nearby that has the right voltage and phase, it should also be checked for connection capacity before deciding it is up for the job.

Also, how easy is it to get to the site? Is there a road nearby? Large trucks carrying the wind turbine blades, tower sections and the crane will need to get to the site easily and most often an access road will need to be built. Basically, that very windy hilltop you've got in mind may just be too difficult to get to, so it might be better to have a site with lower wind speeds but easier access.

How windy is windy?

You may think that any windy site would be a good location for a wind farm, but a small difference in wind speed between two sites can have a significant impact on the energy available at each site. For example, an increase of 10% in wind speed equates to roughly 30% more energy available. For this reason it is important to have an accurate understanding of the wind resource at your site.

Once your site ticks all the boxes, the next step is on-site wind monitoring using a wind monitoring mast with a number of high quality sensors. The data should be collected over at least one year to ensure that seasonal variation are taken into account, and the system will require monitoring and maintenance over that period.

With this on-site wind data it is possible to estimate the long-term wind speeds at your site using external data collected at a reference site. This approach is standard in the wind industry and basically compares your year's worth of wind site data with the same year's worth of data collected at a reference site, often a nearby Bureau of Meteorology weather station. With this comparison, and the historical data from the reference site, it is possible to 'backcast' or estimate what the wind

would have been during the last, say, 10 years at your wind monitoring site. This technique is a good way to give you more certainty about the data you collected with your wind monitoring mast.

Turbines and energy output

With your collected wind site data, it is possible to start looking into which turbines could be used and where they might be placed on your site. This is done using specialised software that takes into account the shape of the surrounding land to estimate the wind at different positions relative to the location of the wind monitoring mast.

Using the same software, different turbine types also can be tested at different heights and the resulting energy output from each scenario can be compared. The amount of energy generated for the same wind input can differ significantly between turbine types, therefore it is important to use the turbine data that relates wind speed to power output, also known as the 'power-curve', when performing this analysis.

The offshore Middelgrunden Wind Farm in Denmark is half-owned by a co-operative.

The grid is a complex web

As mentioned, the proximity of the right type of power lines should be a factor when choosing a wind farm location, but the process of actually getting your wind farm connected to the grid entails a web of complicated technical and legal requirements. These requirements, and the intricate to-and-fro-ing of the application process, were well explained by Col Hackney from Country Energy at the recent Wind Farm Development, Design and Construction (WFDDC) conference held in Melbourne in August. To simplify something that is difficult to simplify: for grid connection, start the ball rolling early and discuss with your electricity distribution company about

getting your wind farm on their grid.

You are not alone—other successful wind farm co-operatives

There are some great success stories from around the world to encourage your community co-operative during the journey to a sustainable energy future. In Denmark the offshore Middelgrunden Wind Farm is an encouraging project that went online in 2000. It comprises twenty 2MW turbines, half of which are owned by the Copenhagen Municipal Utility and the other half owned by the Middelgrunden Turbine Co-operative. There were a number of hurdles along the way including concern about the noise from turbines. In this case, visits to other wind farms were organised for concerned residents and afterwards the project gained full community support. Up to 88% of the co-operative's 8500 members live in Copenhagen, with 40,000 shares sold in total at about $820 each.

In 1999, a group of farmers in Minnesota in the United States started looking into developing farmer-owned wind farms. Their efforts resulted in the first two Minwind projects, completed together in 2002, with seven more projects completed in 2004 with 85% owned by local farmers and 15% owned by other local community members. Developing the wind farm projects in groups meant saving on costs, for example, buying the turbines together, sharing the project management and expert advice from consultants. Specific attention was also paid to who their lender was and the terms of their loan agreements in relation to interest rates, making the projects a success and generating much interest from other farmers.

Back home, Australia's first community wind farm, the Hepburn Community Wind Park Co-operative, is quickly becoming a shining light for other communities that want to own their own energy infrastructure. At the WFDDC conference, Simon Holmes à Court, the Chairman of Hepburn Wind, discussed the benefits that the locally controlled project brings to the community, regardless of whether they are investors. "As well as creating local jobs—Hepburn Wind already employs three locals and uses local suppliers where possible—with the majority of our members living locally, a significant proportion of the project's profits will stay in our community," says Holmes à Court. "We are also setting up a Community Sustainability Fund, which will contribute over $1 million into local sustainability projects over the first 25 years of the project." Beyond the obvious environmental and local economic benefits, community energy projects bring social benefits by empowering communities to play a constructive role in the response to climate change.

All wound up and ready to go?

For more information check out the embark project, a new wiki website designed to share information about community energy projects, all with the aim of getting you going and keeping you going. The wiki articles are written by experts from many different fields and lays out in detail the different steps you need to be aware of when starting a project. Embark is an amazing project that can help you negotiate your way to community wind farm success.

www.embark.com.au

Dominic Eales is Energy Analyst with the Alternative Technology Association.


FACT #5
THE MOST COMFORTABLE THING IN THIS PICTURE ISN'T THE COUCH
And it's not the rug or the table. In fact, it's the windows. Did you know that by choosing the right performance windows you can keep your house cooler in summer and warmer in winter without sacrificing energy efficiency? For all the facts you need to know about windows visit SeeBeyondWindows.com/renew
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DO YOU REALLY KNOW WHAT WINDOWS CAN DO?
SeeBeyond™
SeeBeyondWindows.com

Difficulty rating: ★★★☆☆

Straight to the garden via one very big bucket

Margaret Hender shows off her simple greywater system that easily delivers water from the shower to the garden.

Many people keep an ordinary bucket in the shower to catch and reuse the initial flow of cold water. Some use two rectangular buckets and stand with one foot in each while they shower. Some stand on the shower alcove floor but surround themselves with a whole lot of buckets. All these methods are good, except perhaps for the inevitable trail of drips one leaves across the floor when carrying the buckets outside. I wanted to catch all the shower water, hence the idea, and the name, the Big Bucket.

How is it done?

This project is not intended for older houses that have easy access to bathroom drainage pipes either under the house or on an outside wall. There are well-known, simpler, and easier methods available. This project is designed specifically for the numerous contemporary suburban houses that have all the plumbing hidden away in the concrete slab. In these cases, gaining access to shower greywater after it goes down the drain can be a costly affair involving hiring a licensed plumber and dealing with the copious red tape associated with fee-based approvals and inspections.

Quick facts

One three-minute shower using a water-saving showerhead uses about 30 litres of water. For a family of four, that's at least 840 litres of water per week

One square metre of vegetable garden needs 28 litres per week in hot weather; 30 square metre needs 840 litres.

Shower water collects in the bucket and is pumped out to the garden. This is a Riva-Flo Model TF30 pump made by Australian company Onga and retails for around $160. It has a 1" BSPF inlet and outlet, a maximum head of 34 metres and a maximum delivery rate of 36L/min.

The Big Bucket is placed in the shower alcove only when the garden needs watering and it does not connect to the home's existing plumbing. Therefore, it comes under the health regulations for temporary manual bucketing of greywater. Check the regulations that apply in your area at www.ata.org.au/greywater-systems

The Big Bucket can also be used in rental houses since no plumbing modifications are needed and there are no changes to the existing building, provided you don't choose to use the through-wall fitting option. It is completely portable so can be taken to your next house.

I bought a round 500L poly tank for around $80 and sawed off its top, which is now part of my DIY free-range chook feeder project. The bottom part has a top diameter of 85cm which is slightly less than the width of my shower alcove, is 28cm high, and has a capacity of about 120L. This particular poly tank happens to have gradations on its inner walls, which are quite handy for measuring how much water is being delivered to the garden.

Getting water out of the house

There is no single best way to do this.




Clockwise from top left: The ring used for the outlet hole; The barbed shank assembled ready to be pushed up into the bucket. The hose with the green in-line tap connects to the pump inlet and the other short hose ends with a black tap that is normally kept closed; eight aerated concrete blocks support the bucket. They are covered in gutter silicone so they don't absorb water and grow mould; the pot scourer next to the outlet sits neatly in the hole to act as a filter, primarily for hair.

The best way will depend on your bathroom layout and its height relative to the garden. In particular, it will depend on whether you can or want to install a through-wall fitting or a through-ceiling fitting, or the type of pump you choose to use such as in-line pump, sump pump, or use gravity feed instead.

Be aware that some pumps are only rated to handle water up to 35°C, and a really hot shower is around 43°C at the point it comes out of the shower head. The cold water that falls into the bucket at the start of the shower might reduce the water temperature enough, otherwise let the water cool a bit more before pumping it out.

In-line pump setup

I use an in-line pump with my Big Bucket. My setup has evolved over time, making it progressively easier to use. In my first version I cut an outlet hole low on the side of the bucket, inserted a tap and ran a hose from the tap to the pump inlet. Since the outlet was on the side of the bucket, I had to tilt the bucket once the water level was down to about 3cm so that it could continue to be pumped out. This would be less of an issue with a narrower bucket, but since my bucket is so wide, that amount of water is quite heavy and tilting the bucket was a bit awkward. A litre or so of water would still remain, so I needed to unscrew the bucket-to-pump hose from the pump inlet and up-end the bucket to tip the remaining water down the drain in the shower alcove.

After a couple of summers the need to hold the bucket in a tilted position and bringing in and taking out the pump-to-garden hose was starting to get tiresome.

I eliminated the need to tilt the bucket by moving the outlet from the side of the bucket to the bottom. I used eco-blocks coated with silicone to raise the bucket 9cm to accommodate the outlet fitting and hose. The outlet in the bottom of the bucket has a T-fitting under

it; the outlet hose with the in-line tap going to the inlet side of the pump is off one side of the T-fitting, and the other side has a bypass tap that can be opened if the garden does not need watering to let the water run down the drain. Full details on the pump-to-garden hose can be found on my blog.

I really wanted to use a through-wall fitting to eliminate the need to bring the pump-to-garden hose in and reconnect it each time I had a shower, however, I had no suitable outside walls in my bathroom. Recently I found a good solution; the pump-to-garden hose now goes from the pump outlet up to a through-ceiling fitting, through the ceiling space, then down and out another through-ceiling fitting in the eaves outside the bathroom. This hose normally remains connected to the pump outlet, and the in-line tap just above the pump normally remains open. Closing this tap will prevent back-flow of old water if the hose needs to be disconnected from the pump for any reason. The part of the pump-to-garden hose that takes the water from the fitting under the eaves to the garden also normally remains connected.

I used a white washing machine hose for the part of the pump-to-garden hose that goes up the bathroom wall because soap scum accumulates inside hoses used with greywater, making transparent hoses look rather black and revolting after a while. Even so, I did use a short section of transparent hose adjacent to the pump outlet so that I can see whether or not water is flowing through the hose.

The filter

In my earliest Big Bucket configuration I used a rainwater tank filter over the outlet tap on the inside of the bucket to filter out hair from the shower water. Now that I've moved the outlet to the bottom of the bucket, I use a pot scourer placed in the outlet as a filter to prevent hair entering the pump.

The pump needed to be primed the first time I used this final configuration but, since the bucket outlet is higher than the pump inlet, simply opening the tap between the two and waiting for water to run into the pump took care of that. However, normally the pump does not lose its prime because water remains in the pump and the vertical part of the pump-to-garden hose between uses.

After a shower, all I need to do is to open the in-line tap between the bucket and the pump inlet and switch on the pump. When the bucket is empty, I switch off the pump and close that tap again. I then briefly open the by-pass tap under the bucket to get rid of the small amount of water that runs back towards the bucket during the few seconds between switching off the pump and closing that tap. That's it!

Watering the garden

Factors such as the type of garden, gradients, soil type, and the volume of greywater and its flow rate will determine the best method for distributing the greywater to your plants. The main options are mulch-filled trenches, or some sort of dripper hose (or ordinary hose with holes poked in it) either sub-surface or under a layer of mulch. Use sub-surface irrigation when distributing water to food that is eaten raw. Also, keep greywater away from children and pets.

What I've done

When the greywater is pumped out of the bathroom, it travels via a 19mm black poly hose to the top of a raised buffer tank (an ordinary 200L poly tank). The outlet at the bottom of the tank branches into four separate distribution hoses, each with an in-line tap. The tank outlet is higher than each of the areas being watered, so I can use gravity to do the distribution work through whichever distribution hose has its in-line tap open that day.

The distribution hoses are low-quality ribbed greywater hoses, the sort sold for use with laundry greywater. When I first began using these I used a corkboard push pin to put fine holes between the ribs adjacent to the plants I wanted to water. This worked well for some weeks, but then the holes started clogging up and needed redoing. When I start using greywater again in the warmer months, I'll be putting much larger holes in the hoses.

Storing the water

Never store greywater or let it sit for more than 24 hours. If you are not going to use it immediately, let the shower water run down the drain in the normal way.

After all the greywater has emptied out of the buffer tank, I decide which area of the garden should be watered the next day and switch the in-line taps accordingly. On days when there is a greater than usual volume of used shower water, I leave two of the inline taps open so that two areas of the garden are watered simultaneously that day. If nothing needs watering, I simply take the Big Bucket out of the shower alcove, or open the by-pass tap under the bucket, and let the shower water run straight down the bathroom drain.

My distribution hoses are 10 metres long. That length works well with the amount of water from two showers per day, and with all of one day's water going through the same distribution hose to one area of the garden. If you have a larger family, or longer showers, you can adjust for this by having longer distribution hoses over a larger area, or by having two or more in-line taps open simultaneously. ✻

This is an edited version of Margaret's original article available at www.diygreywater.blogspot.com/p/diy-shower-greywater
Visit the blog for extra details or for alternative configurations of this shower greywater system.

Murrnong: a guide for those who want to give it a go

This housing development sets new precedents in sustainable, affordable living. Fiona Negrin talks to one of the driving forces behind this unique property to find out what's involved in establishing and then running a body corporate.

ReNew's Open House Day was a resounding hit with locals and out-of-towners, nearly 400 of whom visited the open houses in Castlemaine in Central Victoria. But it was Murrnong, with its singular combination of architect-designed houses, sustainable features and co-operative living, that was arguably the scene-stealer of the day. Legend has it that the queues to get into Murrnong were so long that punters had brought picnic baskets. Carolyn Neilson, who lives at Lot 2 at Murrnong, laughs at this. "It was great to have so much interest. It really validated what we're doing. And it was wonderful for the kids to see that much enthusiasm about their home."

Bought in 2003, Murrnong—which means yam daisy in an indigenous language—is a modest housing development of four individual blocks on 10 acres of partly-cleared bushland within walking distance of Castlemaine town centre. It operates under a registered body corporate plan which provides a framework for the community to evolve, and offers useful lessons to those interested in striking out in a similar direction.

Photos: Nick Stephenson

Clockwise from top: Lot 4 at Murrnong is constructed from lime-rendered strawbale, lime-rendered concrete blockwork and colorbond sheeting. Colorbond windspray (light grey) has been used on the external walls for heat reflective qualities; Inside lot 4 clerestory windows bring in natural light; Clever use of space with loft spaces in the kids bedrooms thanks to a 4.5 metre ceiling.

Looking for land

Carolyn and Dean knew they wanted to live in some type of communal set-up when they returned to Australia after three years living in El Salvador in the '90s. "The sense of co-operatism in El Salvador was very strong and deep. It's partly cultural, and there's also a history of struggle—they went through crises together; that deepens those links and connections."

They were encouraged in their communitarian aspirations by friends near Benalla, in north-east Victoria, who had established a commune in the '70s. But Carolyn and Dean's efforts to find like-minded people in the region led nowhere, so in 2002 they packed their bags and moved west to Castlemaine, where they met some kindred spirits and began looking for land.

As a group they devised selection criteria for the land that would integrate social, cultural and geographical requirements. "We wanted to be between two and four kilometres from the town centre so we didn't need to depend on cars for travel. We wanted enough space to build for four, because we thought that was a good number, and we preferred bush that had already been partly cleared as we didn't want to disturb the land. We were after a block that would be a great place to raise children, with space to grow food. And we wanted to be part of the community, for example in terms of buying stuff, doing waged work, building relationships."

Their search took 18 months and ended quite by chance. Carolyn relishes telling this story. "One of our group just came across Murrnong on a bike ride. The owner at the time didn't have a post box, there was just a cairn at the gate. We left a letter there saying who we were, what we were looking for, and asking him to consider us if he ever wanted to sell. One month later we got a phone call from the owner, who had found our letter quite by coincidence, as it had blown away in the wind. He was a conservative, older landowner but he seemed to 'get' what we wanted to do. He could remember the Depression and a time when people had worked the land and lived together, so for him it wasn't such a strange vision. He sold us the land for less than $300, 000, which was cheaper than market value."

Making the rules

Now that the vision was taking shape, it was time to take the next step. "We started thinking, okay, now we've got land, how do we actually *do* this?" Carolyn says. "We knew each other pretty well as friends but it's interesting to go to another level of living together, sharing facilities and raising children together." Here fortune intervened. "I'd approached a lawyer to help out with the body corporate. His advice was, 'Write up a constitution that covers how you want to live together, your various recommendations and all that. But rules and guidelines are just a reference; the process you'll be engaged with more regularly is the decision-making one. So make sure you have a really sound decision-making process and conflict resolution document. And meanwhile, go away for a few weekends and talk really honestly, not just about your vision, but about your fears. Because if you don't include some way of protecting people about their fears, it will never work.'

"So we spent a couple of weekends away, really thrashing out our fears—and positive visions too—and still had a sense of excitement, passion and possibility. If you get people to talk honestly about their fears it helps them, and talking may be enough; you don't even need to mention it in the body corporate plan. So we did that, and it was amazing. If anyone wants to start something up like Murrnong, I'd recommend they have all those discussions."

The group aims to have a space for those candid, supported airings of people's issues through meetings that happen twice a month. "Living as closely as we do, sharing common infrastructure and raising our kids almost as shared

parenting, I'd be worried if there *weren't* disagreements," says Carolyn. "At Murrnong, making the time and energy to talk and communicate effectively is an important part of how we function. Group process can be challenging, it is not the conventional way of living, but there are lots of riches too." There is also the option of a facilitated Safe House meeting with a professional mediator if problems are too difficult to work out among themselves. "It's come from feedback from other communities where things imploded because they didn't have any process. Or the opposite: they did have one and never had to use it, but were glad it was there."

Alternating with community meetings are body corporate meetings which deal with nuts and bolts issues like maintenance, fire plans, working bees and so forth. It's no surprise to learn that the Murrnong body corporate document bears little in common with garden variety versions "which give a superficial reading of how people live together: 'no dogs here, park cars there'", says Carolyn. "Whereas we wanted more depth. And that is going to continue to evolve as we live together."

The nitty gritty—sharing energy and water

The rules and guidelines of the body corporate were written by the group over a two-year period (summarised by Carolyn as "frustrating at times but looking back there was no way you could write it up quickly") prior to Murrnong being built. It guarantees individual freehold title of the four quarter-acre house lots and a share of the common land, and allows inhabitants to "more easily enter and leave the community than we could in a [legal] cooperative set-up". It's also as close as Murrnong gets to prescribing how its inhabitants ought to live. Included are stipulations on building height and size "because we're strong about keeping our footprint small", restrictions on greywater discharge "because we have a limited dispersal area and we are encouraging low water consumption", details about fire plans and water-and energy-efficient appliances, and procedures for managing the shared rainwater, greywater, dam water and grid-connected solar energy systems.

Murrnong was open to the public in July as part of *ReNew's* Open House day where the residents explained the intricacies of the body corporate structure. To the right is the 3kW solar array on the shed and in the background is a 1.7kW solar array.

Murrnong has 4.7kW of grid-connected photovoltaics made up of a 1.7kW individual array on Lot 1 and a 3kW system that was collectively purchased and then installed on the north-facing roof of a commonly-owned storage shed with excellent solar gain. When the residents applied for the solar rebates, they had to prove a precedent-setting case to the Department of Climate Change, which was unaccustomed to consumers wanting individual rebates for shared panels on common title. But with the support of their electrician, and thanks to "the classic thing where someone within the authority was prepared to have an open mind", they prevailed. Carolyn celebrates this victory because "it sets a precedent for people in blocks of flats, for example, where their own individual roofs might be in shade but the shared vegie patch has solar access. This hadn't been done before but we saw that there was no reason why it couldn't be done."

Electricity bills are divided according to energy consumption, which is measured at monthly intervals on sub-meters on each house. Carolyn credits the sub-meters for improving their electricity literacy. "As a group we co-operate in minimising consumption by using a Cent-a-Meter and consuming electricity at off-peak times where possible." She adds that because the body corporate document rules were written prior to the property becoming grid-interactive, it doesn't take into account the feed-in tariff, but this will probably be included when the body corporate documents are updated.

It wasn't only during the solar install that the group came up against red tape—they faced it at nearly every step of the journey, including their installation of a common waste treatment system, which was a first in the local shire, and in acquiring their planning permit. Carolyn's attitude to dealing with bureaucracy is characteristically pragmatic and philosophical. "It's not just red tape—relationships are actually a really important part of the tapestry. You need to look at it from a more involved perspective. One of the

Top: Lot 2 at Murrnong is strawbale construction featuring a greenhouse to the northern front of the home. The greenhouse opens to the rest of the house, providing a form of passive heating on cold winter days and a place to grow produce in the cooler months. Right: This home featured in *ReNew 110* for its buried pipe cooling, or earth tubes system, and is made from double skin concrete block walls with an insulated air cavity and lime render.

planners 'got' what we wanted to do and that helped us get our permit; it's a very different conversation that you have with someone who wants to help you and someone who thinks what you're asking is impossible—but you do have to work with those people and get them onside."

Murrnong found that paying tribute to the work of tradespeople by spending time and money on their expertise paid off immensely. "We recognised that the things we wanted were out of the ordinary and we wanted to honour the effort tradespeople put into their quotes—and we needed to know if this can be done, too! So what we said was, 'Look, we know you usually don't charge for a quote, but come over, have dinner with us, have a drink with us, and we want to pay you for your time because we want you to understand this project.' That's where our electrician came on board, and the plumber too."

Maintain or barter

Included in the body corporate document is an outline of residents' broader duties. "With the setting up we allocated 'portfolios' of gas, electricity, water, waste treatment, fire plan, social (pleasure/leisure), physical infrastructure (fencing and roads), food and livestock, and that's continued. We all have particular responsibilities which we discuss at our meetings. I feel you just have to trust that the person in charge is making the best decisions they can on behalf of the group—in an evolving community like this I don't think it's

possible to have control of everything."

The body corporate also sets down rules about lot owners' obligations to the place. "It's understood we have to do a certain amount of work to maintain and sustain this place. If you don't want to do it you have other options including barter, or pay a levy, but the important thing is that there is a framework. Every year we work out what needs to be done, the budget for it, and how many hours per lot we need to do." She says this came about on the recommendations of other communities where tensions had arisen over workload, but there was nothing in writing to fall back on.

In practice, the body corporate's rules and guidelines tend to be buffered by the less-prescriptive, more negotiable community-mindedness of the place. For example, the body corporate sets out that a 'water bailiff' monitors the shared rainwater and wastewater systems, "but if people's individual water meters show that someone is consuming more than their quota (which hasn't happened), the next step would probably be to resolve the issue through a process of negotiation rather than immediately cut them off and switch them to mains water as stipulated in the body corporate plan." Similarly, although the body corporate stipulates that dwellings must not be greater than 200m^2, Carolyn explains that "although it sounds prescriptive, it was a celebration of each others' values and vision. If, say, a very large family had moved in, we would probably have been prepared to negotiate on those requirements."

Carolyn is pleased that the group chose not to have too many rules in the body corporate document, "because things can change over time." For that same reason—things changing over time—she believes they have come to a point where they need to review their rules and guidelines "because it's got to convey your living reality, and we wrote it at a time when it was still theoretical. Now it needs to reflect our new priorities and concerns."

Kid friendly

One of the most pressing of these is the question of how to raise their children. There were three kids at Murrnong when it began, but now there are eleven. Carolyn says the Murrnong residents feel that discussions about parenting should be a regular part of their community meetings. "We believe we want to help bring up each others' kids but we may have differences in either day-to-day or long-term ideas of parenting, and that's a constant dialogue. It's something we want to talk about on a regular basis, but there's nothing about that in the body corporate plan. I don't think we'd ever come to prescriptive rules about it, but there may be an acknowledgment in the preamble [which summarises Murrnong's core vision and gives the document a bit of shade and colour] that it's important to us."

Carolyn jokes that having a sense of humour should be added to the body corporate document. "My mind has certainly been expanded by this process. Although at times it's challenging, you know you're learning and growing as a person." She's reflective about the rewards and pleasures she gleans through living in Murrnong, some of which are profound in spite of their apparent modesty. "Beginning to see the woodlot and orchards grow, and watching the kids playing—these are magic moments. They sustain you." ✻

About Murrnong

Murrnong is a clustered housing development on 10 acres with four individually owned quarter acre house blocks. The households aim to work together on group projects and manage revegetation and food production using permaculture principles

Sustainable house design

All homes feature passive solar design to make best use of natural heating and cooling, with good thermal mass, wide eaves, insulation, double-glazing where possible, solar hot water, plus low-VOC paints and finishes. All houses also have water-saving composting loos and food scraps are either fed to the Murrnong chickens or composted.

Shared solar

The four dwellings at Murrnong share a single electricity meter; each house is individually submetered at the house fuse box and bills are divided on a percentage of overall usage basis. Murrnong has 4.7kW of grid-connected photovoltaics in two locations; 1.7kW of Conergy panels in a single string with a Sunnyboy inverter, and 3kW of Trina panels with a 3kW Sunnyboy inverter in two strings.

Shared greywater

The communal greywater collection system for the three new houses uses a 6m x 6m x 3m sand filter to clean the water. The greywater is gravity fed to communal orchard or to septic lines in winter.

Shared rainwater

Rainwater is collected off all house roofs and the shed to a common collection tank, then pumped to gravity feed tanks (approximately 10m+ head). Rainwater is used in houses for domestic purposes with a total capacity of 137,500 litres in five tanks (two poly tanks and three concrete).

A stormwater tank collects storm runoff from roads and rainwater overflow into two dams. The water is then pumped (petrol pump) to a 57,500 litre gravity-fed system (10m+ head) in two concrete tanks. This is used for orchard/food garden watering and as firefighting reserve. There is a stormwater connection to the house at Lot 2's laundry for clothes washing.

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Going off-grid? Your essential battery buyers guide

The battery bank is a vital part of any independent or remote area power supply system. Lance Turner takes a look at the batteries available, what to buy and how to care for them.

The battery is the heart of any independent or remote power system, but it is the one component usually overlooked simply because it is totally uninteresting and can also be a bit messy!

Experience shows that batteries are way down the list of considerations by most independent power supply (IPS, also called remote area powers supply, or RAPS) system buyers. This is sad because these people invariably have problems with their systems.

Many people believe that all batteries are the same—they are not. Batteries are designed for specific applications. For example, car batteries are designed to provide high cranking amps (they have lots of thin plates, with a large total surface area) for starting the engine. Because the alternator powers the car once it is started, the battery is not designed for providing continuous power and will quickly fail if deeply cycled more than a few times.

Over time, and with changes in technology, the energy storage requirements for domestic independent power systems have changed quite considerably. Twelve volt DC systems are mainly found in caravan and camping situations, though other small IPS systems may still run at this voltage.

Modern IPS homes usually have 24 or 48 volt or even 120 volt DC systems with sinewave inverters for converting the power to 240 volts AC, and use efficient and economical appliances. These homes have large capacity battery storage facilities to cope with the high surges required to start motors and ensure long battery life through shallow cycling of the batteries. The deeper a battery is cycled, the shorter its lifespan will be.

Battery requirements

In most systems the battery bank is made from a number of cells or batteries con-

nected together, either in series or parallel or a combination of the two. By connecting cells in series the voltage increases, while the amp-hour rating stays the same as for one cell. Connecting the cells in parallel increases the amp-hour capacity but the voltage remains the same. However, paralleling strings of cells can result in unequal charging of cells which can damage the system, so battery manufacturers generally specify the maximum number of parallel strings allowable.

IPS batteries should have the following characteristics:

- low self discharge—all batteries slowly discharge themselves over time
- long life under a continual charge/discharge regime
- ability to withstand numerous deep discharges
- low maintenance requirements
- high charging efficiency
- high performance to cost ratio
- ability to perform over a wide temperature range.

There are significant differences between batteries designed for different applications. Similarly, battery manufacturers have different specifications on the batteries they produce. For this reason, different types and sizes of batteries must never be mixed. Combining batteries of different specifications can lead only to reduced battery life.

The other big battery no-no is upgrading an existing battery bank to increase its voltage. If your power requirements mean that you will need a 48 volt system in, say, two years time, but a 24 volt system will suffice at the moment, it is better to install the 48 volt system now. New batteries added to an existing bank are soon affected by the performance of the older units, effectively wasting your investment.

Battery formats

The most common type of battery found in independent power supply systems is still the large format flooded-cell lead-acid battery. However, other formats available include small format flooded-cell, sealed lead-acid and nickel-cadmium (nicad) batteries, although the latter are rarely found in systems in Australia.

A new technology in the market that is now available in sizes suitable for home energy systems is lithium iron phosphate (LiFePO4). These have high storage and power densities, much better charge efficiency and longer lifespans than any lead-acid formats. However, they are more expensive [to purchase initially] and are yet to take much of a share of the IPS battery market, being more popular for electric vehicles, where battery weight is a primary factor.

Lithium batteries must also have an effective battery management system (BMS). This means that each cell in the battery bank is individually monitored when charging and discharging. Overcharged cells and cells discharged below the minimum voltage point can fail, so a good BMS is a must. Some batteries, like those from Lithium Batteries Australia, have a fully integrated BMS. You never see it, but it's in there nonetheless. Larger format cells like the Thunder Sky require BMS modules that mount across each cell. These are readily available from the suppliers of these batteries and are quite low cost.

Due to the longer life and higher efficiency of lithium cells, and the fact that their capacity is not affected by discharge rate like lead-acid cells (known as the Peukert effect), allowing lower capacity banks to be used compared to lead-acid, lithium batteries are already a cost effective option when all things are considered.

Large format batteries

Large format flooded lead-acid cells are usually in the form of 2-volt cells which can range in capacity from less than 100 amp-hours up to several thousand. While there are numerous brands of this type of cell, most of them are similar in what they can offer the IPS house owner. In a well designed system, these cells can provide more than 10 years of power storage.

While many flooded cells have flat plates, some have tubular positive plates, where the positive plate material is compressed inside woven polyester tubes. This is said to increase the life of the battery by eliminating 'shedding' from the positive plate, where material breaks away from the plate and falls into the bottom of the battery, thus reducing

Each battery from Lithium Batteries Australia contains numerous lithium iron phosphate cells (inset), all connected along with an inbuilt battery management system. This inbuilt management greatly increases lifespan, reliability and safety.

the usable material.

Large format sealed lead-acid cells are also available and they are usually of the gelled-electrolyte type. They have the advantage of not requiring regular checks of the electrolyte levels, but they are rather more expensive than flooded-cell units.

Small format batteries

Looking like large car batteries, these come in two basic types, the flooded-cell and sealed lead-acid. The flooded-cell small format battery is usually a six or 12 volt battery, ranging in capacities up to 300 amp-hours or so. They contain several cells connected together to provide the nominal voltage.

Small format sealed lead-acid batteries are similar in size and shape to the flooded-cell variety, but their electrolyte is either a sulphuric acid gel or a fibreglass separator soaked in liquid sulphuric acid. Both forms of electrolyte are effectively immobilised, making them the safest lead-acid choice for mobile installations such as caravans. Sealed batteries also do not require equalise charging, making them virtually maintenance free.

It should be mentioned that not all lead-acid batteries use the same plate materials. There are various metals added to the basic lead used to make the plates, including calcium and antimony. These added metals give the plates different properties and anecdotal evidence suggests that certain types, such as calcium-based plates, have a longer service life.

Other technologies

Lead-acid and lithium batteries are not the only types of large rechargeable batteries. Nickel-iron batteries are one of the oldest technologies, and also one of the most robust. They are tolerant of abuse such as overcharge, overdischarge and short-circuiting and can have very long life even when treated badly. Their main drawbacks are lower charge efficiency and higher self discharge compared to other technologies, so they have become rare but are still available. However, they do have a big advantage in that their materials are far less environmentally hazardous than lead-acid and even lithium batteries.

Another battery technology being developed is the flywheel battery. Indeed, there are flywheel units now available that are already being used in conjunction with renewable energy systems, although usually for grid-connected wind turbines and the like, where short-term energy storage is required. For an example of these, see the PowerStore system developed by powercorp in the Northern Territory (www.pcorp.com.au).

Other battery chemistries include nickel metal-hydride, which are most commonly seen in small 'torch battery' sizes but also exist as large format batteries suitable for electric vehicle and renewable energy storage, but don't seem to be readily available in Australia. Nickel-zinc cells are another interesting battery chemistry. They are not overly common in larger cells but have considerable potential (no pun intended) for power system energy storage applications. Powergenix in the USA manufacture nickel-zinc batteries, see www.powergenix.com for more information.

Capacity ratings

The unit of battery capacity is the ampere-hour, or amp-hour (Ah). Battery capacity is a measure of how much energy a specific battery has available for use over time. In IPS systems, the system designer needs to know how much energy will be required each day as, unlike a normal grid-connected house, there is only a finite amount of energy available.

For most chemistries, especially lead-acid, the actual capacity of the battery varies depending on the rate at which it is discharged. This is expressed as the

Batteries come in all sorts of enclosures and racking systems. These are the Powerstack sealed lead-acid units from Jaycar Electronics. They can be used for UPS/backup power and independent power systems.

'C' rating, for example C_{100}. In this instance, the battery is discharged over a period of 100 hours. If you were to discharge the battery in say, 10 hours, the capacity would be reduced. In the IPS industry, batteries are usually specified at the C_{100} rate, as this most closely represents the discharge rate experienced in these systems.

Lithium batteries tend to be specified at the C_1 rate. Their capacity is pretty much the same, regardless of discharge rate.

Battery life

Battery life is measured in cycles rather than in years. A cycle, in simple terms, is when the battery is discharged to a certain level and then recharged fully. The more deeply the battery is discharged, the lower the number of cycles it will last. The depth of discharge (DOD) of a battery is expressed as a percentage. A 30% DOD means that 30% of the usable power is taken from the battery before it is recharged.

Lead-acid batteries should never be

completely flattened, as this will severely reduce their life expectancy. For IPS systems, the usual DOD is between 10% and 15% per day. At this rate, most large-format batteries will give around 10 years of service.

Sizing the bank

The battery bank should be discharged only by about 10% per day, with a maximum total discharge no higher than around 50%, although the recommended rating for this varies between battery manufacturers.

A further consideration in battery sizing is the number of days of autonomy, which is the number of days the battery can sustain the system without being charged. Four or five days is usual, but this depends on each system's particular requirements.

As an example, if the house is expected to use 150 amp-hours every day and requires five day's reserve capacity, then the battery bank would need to be around 1500 amp-hours. This is calculated simply by multiplying the daily discharge required by the number of days reserve capacity required, divided by the maximum total DOD, expressed as a decimal. For our example, the calculation would be: (150 x 5)/0.5 = 1500Ah.

Battery efficiency

Nothing is perfect, so they say, and this is also true of batteries. Charging efficiencies of 90% to 95% can be expected from new lead-acid cells, however, efficiency will decrease with age with sulphation and stratification. The less-than-perfect efficiency means that you have to put more charge back into the battery than you took out, to get back to the same level. Lithium cells are more efficient chargers, with charging efficiencies of over 95%.

Sulphation in lead-acid cells occurs when the battery is discharged. During the battery's discharge phase the active materials on both plates are converted to lead sulphate ($PbSO_4$). The sulphate deposit on the positive plate is normally dissolved during recharge. However, if the battery is left for a period without being fully recharged, the lead sulphate can crystallise and become insoluble, resulting in reduced battery capacity.

Stratification occurs when flooded cells get little or no cycling. The electrolyte tends to settle into layers of different densities (with higher specific gravity at the bottom) which can reduce the life of the battery by accelerating plate corrosion. This potential problem is solved by regular boost charging (gassing) of the cells. This also helps to equalise the state of charge of the individual cells as non-uniform charging can occur due to inevitable differences in characteristics of individual cells.

Temperature has a direct bearing on the battery's state of charge. The lower the ambient temperature the more charge needed to replace that taken out. The reverse applies for higher temperatures. Battery specifications assume an ambient temperature of 25°C and battery manufacturers provide correction tables and graphs so you can determine precise specific gravity.

Maintenance

Most manufacturers supply ancillaries kits with their battery sets. These kits include such items as hydrometers, thermometers, stainless steel or brass nuts and bolts, terminal covers, terminal spray, log books, installation manuals, safety signs and more.

A home for your batteries

Batteries should be housed in a secure enclosure ventilated to the outside, which meets Australian standards.

They should not be left on concrete floors, as the cold can lead to temperature differences inside the cells, causing stratification—this will definitely void any warranty claims. Ideally, the batteries should be placed on wooden or plastic bearers to insulate them from the floor. The batteries should not be kept inside the house and should be fully protected from any sparks or flames that may accidentally occur nearby.

Safety

While battery banks are extra-low-voltage, in most cases they have the potential to cause serious, sometimes fatal accidents for the unsuspecting. Safety signs are a requirement and care should be taken at all times. The short circuit current delivered by a large battery bank (all battery banks must be fused appropriately) will be several thousand amps, more than enough to melt a metal tool, such as a spanner dropped across the terminals.

The electrolyte of lead-acid batteries is sulphuric acid, which is very corrosive to metals and will burn through skin and clothing. When batteries are being charged they release hydrogen gas which can lead to explosion and fire if ignited. Utmost care should be taken in working with batteries. Safety equipment such as rubber gloves, aprons and safety goggles should be worn. Wall charts detailing procedures and first aid are available and should be displayed in all battery rooms. Always consult an accredited installer if you need assistance.

Second-hand batteries

There is no way you can know the past history of a second-hand battery—only what the previous owner tells you.

The batteries are the heart of an independent power supply system and determine system performance. They are a major investment, often costing several thousand dollars. Remember that, with an anticipated life expectancy of 10 to 15 years or more, good quality batteries are an investment. If you can't stretch your budget to cover the entire system cost, cut back on the number of solar panels or other devices installed as they can be added at any time. Always go for the best in a battery, because everything else depends on it! ✻

Large format lead-acid batteries

Brand/supplier	Model	Voltage	Capacity (Ah)		Cycle life @ % DOD				Weight (kg)	Warranty years	RRP $	$/Ah @ 12 Volts
			C20	C100	10	25	50	80				
BAE Secura PVV Alco Battery Sales Ph 1300 883 643 solar@alcobatt.com.au www.alcobatt.com.au	6PVV660	2	576	642	8100	-	2800	1500	36.5	2	POA	POA
	6PVV900	2	821	914					50			
	8PVV1200	2	1095	1219					68			
	10 PVV1500	2	1369	1524					82			
	12 PVV 1800	2	1647	1834					97			
Energystore Exide Technologies ph:(02) 9722 5700 ph:1800 800 811 www.exide.com.au	8RP670NX	8	423	670	4500	3300	2500	1500	100	1+4	POA	POA
	6RP830NX	6	565	830					110			
	6RP1080NX		772	1080					143			
	4RP1330NX	4	950	1330					100			
	4RP1600NX		1100	1600					120			
	4RP1800NX		1213	1800					140			
	4RP1950NX		1272	1950					160			
	4RP2200NX		1435	2200					180			
	ENERSOL 130	12	108	130	3000	2300	1600	1000	35	1		
	ENERSOL 250		175	250					63			
Federal Brand Federal Batteries (Ryde Batteries Wholesale Pty Ltd) 1300 133 980 contact@federalbatteries.com.au www.federalbatteries.com.au	8KFS	12	135	150	3000	1200	400	200	37	1	POA	POA
	8C12		195	215					53			
	9C12		228	253					57.7			
	9C11	6	250	275					33.3			
	8C6V		330	366					44.3			
	8L16		370	420					51.4			
Neuton Power YHI Power ph:(03) 9588 1888 sales@yhipower.com.au www.yhipower.com.au	NF2-300	2	350	393	8000+	4800	2700	1500	24.3	3+4 pro	POA	POA
	NF2-500		585	662					36.1			
	NF2-600		750	806					44.8			
	NF2-800		1005	1075					61.3			
	NF2-1000		1260	1343					74.6			
	NF2-1200		1510	1611					92			
	NF2-1500		1865	1972					114.3			
	NS4-1350	4	1066	1350	9600	4200	2600	1500	153			
	NS4-1700		1320	1700					180			
	NS6-830	6	676	830					142			
	NS6-1000		792	1000					163			
RAYLITE Siomar Battery Engineering ph:(08) 9302 5444 fax:(08) 9302 5470 www.siomar.com	MIL 17S	6	480	600	10000	4000	2000	2200	91	2 years. Extendable subject to application	POA	POA
	MIL 21S		600	750					116			
	MIL 25S		720	900					133			
	MTL 25S	4	840	1050					97			
	MTE 21S		1104	1380					127			
	MTE 25S		1328	1660					145			
Rolls/Surrette 4000/5000 series Alco Battery Sales Ph 1300 883 643 solar@alcobatt.com.au www.alcobatt.com.au	S600	6	450	599	-	-	-	1300	55	2+5	POA	POA
	S1380	2	1050	1381	-	-	-		52	2+5		
	6CS25PS	6	820	1156	6000	5000	3400	2300	115	3+7		
	4KS21PS	4	1104	1557					121			
	4KS25PS	4	1350	1990					143			
	2KS33PS	2	1766	2491					94			
	2YS31PS	2	2430	3435					130			
Suncycle Battery Energy ph:(02) 9681 3633 info@batteryenergy.com.au www.batteryenergy.com.au	6AS190	6	129	190	>6000	4150	2500	1700	32	5 years full replacement + 5 years pro-rata	805.20	8.48
	2AS450	2	288	435					21		541.20	7.46
	2AS620		417	595					34		785.40	7.92
	2AS770		563	805					53		1040.60	7.76
	2AS920		644	960					55		1168.20	7.30
	2AS1100		787	1060					61		1348.60	7.63
US Battery Manufacturing Federal Batteries (Ryde Batteries Wholesale Pty Ltd) 1300 133 980 contact@federalbatteries.com.au www.federalbatteries.com.au	US 305	6	305	335	5000	2000	1000	500	38.55	1	POA	POA
	US 305HC		335	360					43.54			
	US 305HC DT		335	360					45			
	US L16		375	360					50.34			
	US L16 HC		415	450					53			
	US RE L16		428	441					53.9			

Nickel-iron batteries

Brand/supplier	Model	Voltage	Capacity (Ah)	Cycle life @ 80% DOD	Filled weight (kg) per cell	Warranty	RRP $ inc GST	$/Ah @ 12 volts
Ironcore Batteries Ironcore Power (03) 5962 6596 cssa@eforu.com www.ironcorebatteries.com.au	10	1.2	10	1000-1500	0.8	5 years limited	US$14	US$14
	40		40		3		US$45	US$11.25
	60		60		4.5		US$59	US$9.83
	80		80		6		US$78	US$9.75
	100		100		6.5		US$92	US$9.20
	200		200		12		US$176	US$8.80
	500		500		26		US$476	US$9.52
	600		600		45		POA	POA
	1000		1000		70		US$720	US$7.20

Small format flooded cell lead-acid batteries

Brand/supplier	Model	Voltage	Capacity (Ah)		Cycle life @ % DOD				Weight (kg)	Warranty years	RRP $	$/Ah @ 12 Volts
			C20	C100	10	25	50	80				
Alco Atlas BX Alco Battery Sales Ph 1300 883 643 solar@alcobatt.com.au www.alcobatt.com.au	XV27MF	12	85	NA	-	-	-	-	21	1	POA	POA
	XV30MF		100						23			
	XV31MF		100						25			
ENERGY Siomar Battery Industries ph:(08) 9302 5444 www.siomar.com	E12V48	12	48	54	2000	1000	500	300	13	1 year. Extendable subject to application	POA	POA
	E12V60		60	70					16			
	E12V80		80	90					20			
	E12V100		100	115					26			
	E12V180		180	200					49			
	E12V230		230	260					65			
Exide Deep Cycle Exide Technologies ph:(02) 9722 5700 ph:1800 800 811	DC6V225	6	225	-	-	-	-	-	31.2	1	POA	POA
	DC8V150	8	150						28.3			
	DC12V115	12	115						28.8			
	DC12V105	12	105						27.9			
	DC12V80	12	80						23.9			
	DC6V305	6	305						39.6			
	DC12V195	12	195						49.5			
	DC6V375	6	375						50.4			
	DC6V250	6	250						32.8			
Federal Brand Federal Batteries (Ryde Batteries Wholesale Pty Ltd) 1300 133 980 contact@federalbatteries.com.au www.federalbatteries.com.au	EVU1	12	32.5	36	3000	1200	400	200	8.7	1	POA	POA
	DC24		75	83					20.5			
	DC27		90	99					24.1			
	DC31DT		105	115					27			
Supreme Batteries Distributed by YHI Power ph:(03) 9588 1888 sales@yhipower.com.au www.yhipower.com.au	CR225	6	225	306	-	-	800-850	700-750	29.1	1	POA	POA
	CR235	6	235	NA	-	-	800-850	700-750	31.3			
	CR245	6	245	308	-	-	800-850	700-750	33.7			
	CR275	6	275	NA	-	-	700-750	600-650	34.1			
	CR305	6	305	NA	-	-	775-825	-	43.6			
	CR325	6	325	418	-	-	775-825	675-725	47.7			
	CR350	6	350	457	-	-	775-825	675-725	51.4			
	CR395	6	395	548	-	-	775-825	675-725	55.2			
	CR165	8	165	NA	-	-	-	-	29.1			
	CR190	8	190	NA	-	-	-	-	30.3			
	24DC95	12	95	137	-	-	450-500	350-400	22.3			
	27DC105	12	105	163	-	-	450-500	350-400	23.2			
	27DC115	12	115	171	-	-	425-475	375-425	26.4			
	31DC130	12	130	194	-	-	500-550	400-425	30.4			
	CR155	12	155	NA	-	-	475-525	375-425	40.1			
	CR185	12	185	NA	-	-	675-725	575-625	49.2			
	CR210	12	210	NA	-	-	675-725	575-625	59.5			
Trojan Batteries Distributed By Alco Battery Sales Ph 1300 883 643 solar@alcobatt.com.au www.alcobatt.com.au	T105	6	225	250	-	-	-	-	28	1	POA	POA
	T125	6	235	260					30			
	T145	6	244	271					33			
	T605	6	190	210					26			
	T875	8	150	167					29			
	J250P	6	250	339					33			
	J305P	6	305	372					41			
	L16P	6	360	400					51			
	L16H	6	395	420					55			
	SCS150	12	100	111					23			
	27TMX	12	105	115					25			
	27THH	12	115	130					27			
	SCS225	12	130	145					30			
	J150	12	150	168					38			
	J185P	12	195	216					51			
	J185H	12	215	239					55			
	U1MF-X	12	32	NA					8.4			
	U1RFM-X	12	32	NA					8.4			
	CV24MF	12	73	NA					19			
US Battery Manufacturing Federal Batteries (Ryde Batteries Wholesale Pty Ltd) 1300 133 980 contact@federalbatteries.com.au www.federalbatteries.com.au	US 12DCXC	12	105	115	5000	2000	1000	500	25	1	POA	POA
	31DCXC		130	143					25			
	US 12VXC		155	170					41			
	US 185		195	215					56			
	US 8DHC		240	264					63			
	US 8VGC	8	170	187					29.3			
	US 2200UT	6	232	255					28.6			
	US 2200UTL		232	255					28.6			
	US 125		242	266					30.4			
	US 145		251	275					31.75			

Sealed lead-acid batteries (continued on next page)

Brand/supplier	Model	Voltage	Capacity (Ah)		Cycle life @ % DOD				Weight (kg)	Warranty years	RRP $	$/Ah @ 12 Volts
			C20	C100	10	25	50	80				
A600 SOLAR Exide Technologies ph:(02) 9722 5700 ph:1800 800 811 www.exide.com.au	4OPzV240	2	218	286	7000	6000	3400	2200	19	2+3	POA	POA
	5OPzV300		272	357					23			
	6OPzV360		326	429					27			
	5OPzV400		380	505					30			
	6OPzV500		456	606					35			
	7OPzV600		532	707					39			
	6OPzV720		681	829					49			
	8OPzV960		908	1105					66			
	10OPzV1200		1135	1382					80			
	12OPzV1400		1363	1658					95			
	12OPzV1700		1519	1911					117			
	16OPzV2300		2025	2547					160			
	20OPzV2900		2532	3184					198			
	24OPzV3500		3038	3821					238			
Alco Ritar deep cycle gel Alco Battery Sales Ph 1300 883 643 solar@alcobatt.com.au www.alcobatt.com.au	AC12-100HDG	12	100	115	-	-	-	850	34	1	POA	POA
	AC12-120HDG		120	138					34			
	AC12-145DG		145	166			1200		44			
	AC12-20DG		230	264			1200		67			
	AC2-500DG	2	500	575			-	-	37	3		
	AC2-600DG		600	690					44			
	AC2-800DG		800	920					58			
	AC2-1000DG		1000	1150					72			
	AC2-1500DG		1500	1725					105			
	AC2-2000DG		2000	2300					140			
	AC2-3000DG		3000	3450					215			
Concorde Sun Xtender BP Solar Refer 1800 802 762 or www.bpsolar.com.au for your nearest BP Solar Authorised Distributor	PVX - 340T	12	34	37	5200	2200	1050	550	11.4	1	POA	POA
	PVX - 690T	12	65	78					23.2			
	PVX - 890T	12	85	100					28.2			
	PVX - 1040T	12	100	118					30.0			
	PVX - 2120L	12	210	250					62.7			
	PVX - 2240T	6	220	260					30.4			
	PVX - 6480T	2	630	746					31.8			
	PVX - 9150T	2	900	1062					42.6			
	PVX - 12150HT	2	1200	1329					56.2			
Diamec Jaycar Electronics ph:1800 022 888 techstore@jaycar.com.au www.jaycar.com.au	SB1698	12	26	NA	NA	1200	500	250	8.35	1	139.00	5.35
	SB1699	12	38						13		199.00	5.24
	SB1695	12	100						31.5		499.00	4.99
	SB1696	2	200						14.5		289.00	8.67
Energystore Gel Exide Technologies ph:(02) 9722 5700 ph:1800 800 811 www.exide.com.au	6RPG700	6	620	700	5000	3200	2400	1200	100	1+4	POA	POA
	4RPG1040	4	870	1040					120			
Geltech (GEL) Federal Batteries (Ryde Batteries Wholesale Pty Ltd) 1300 133 980 contact@federalbatteries.com.au www.federalbatteries.com.au	8GU1H	12	31.6	36.4	3800	1500	650	-	11	1	POA	POA
	8G40C		40	44					14.4			
	8G22NF		50.6	56.5					17.1			
	8G34R		60	66					18.9			
	8G24		73.6	80					24.3			
	8G24M		73.6	80					24.3			
	8G24SS		73.6	80					24.3			
	8G27		86.4	98					28.7			
	8G27M		26.4	98					28.7			
	8G31DT		97.6	108					32.5			
	8G4D		183	210					59.9			
	8G8D		225	265					73			
	8G8VGC	8	140	154					33			
	8GGC2	6	180	198					32.5			
KOBE & BAE Siomar Battery Engineering ph:(08) 9302 5444 www.siomar.com	KOBE HF12-12	12	12	14	1200	800	400	200	4.3	1 year. Extendable subject to application	POA	POA
	KOBE HF17-12A		17	20	1200	800	400	200	6.4			
	KOBE HC24-12A		24	28	2400	1600	800	400	9			
	KOBE HF28-12A		28	33	1200	800	400	200	9.4			
	KOBE HC38-12A		38	45	2400	1600	800	400	15			
	KOBE HF44-12		44	52	1200	800	400	200	15			
	BAE 6PVV660	2	596	642	12000	6000	3000	1500	36.5	2 years. Extendable subject to application		
	BAE 6PVV900		794	914					50			
	BAE 8PVV1200		1022	1219					68			
	BAE 10PVV1500		1314	1524					82			
	BAE 12PVV1800		1542	1834					97			
Lifeline (AGM) Federal Batteries (Ryde Batteries Wholesale Pty Ltd) 1300 133 980 contact@federalbatteries.com.au www.federalbatteries.com.au	GPL-U1T	12	33	37	5100	1850	1000	500	11	1	POA	POA
	GPL-24T		80	96					25			
	GPL-27T		100	118					32			
	GPL-31T		105	124					33			
	GPL-30HT		150	176					43.5			
	GPL-4DA		210	250					62			
	GPL-4DL		210	250					62			
	GPL-8DA		255	300					76			
	GPL-8DL		255	300					76			
	GPL-4C	6	220	260					31			
	GPL-6C		300	354					41.3			
	GPL-L16T		400	443					54			
	GPL-4CT-2V	2	660	780					31.8			
	GPL-6CT-2V		900	1062					42.6			
	GPL-L16-2V		1200	1369					54			
Neuton Power Gel Batteries YHI Power ph:(03) 9588 1888 sales@yhipower.com.au www.yhipower.com.au	NG2-300	2	342	384	5000		2500	1500	27	3+4 Pro	POA	POA
	NG2-500		570	624					39.5			
	NG2-600		684	780					48			
	NG2-800		912	1018					64.5			
	NG2-1000		1140	1274					80			
	NG2-1200		1368	1528					94			
	NG2-1500		1710	1870					115			
	NG12-100	12	112	126	4400	2800	1500	900	45			
	NG12-150		166	189					63			
	NG12-200		221	256					82.5			
Neuton Power AGM Batteries YHI Power ph:(03) 9588 1888 sales@yhipower.com.au www.yhipower.com.au	NPD12240	12	24	-	-	-	-	600	9.2	1	POA	POA
	NPD12260		26						9.8			
	NPD12350		35						11.5			
	NPD12400		40						13.4			
	NPD12550		55						17.6			
	NPD12700		70						23.8			
	NPD12850		85						25.1			
	NPD12900		90						28.7			
	NPD121050		105						30.2			
	NPD121100		110						32.7			
	NPD121200		120						38.2			
	NPD121200B		120						38.2			
	NPD121350		135						44.3			
	NPD121500		150						45.5			
	NPD122000		200						60.5			
	NPD122400		240						75.6			
	NPD122600		260						78.2			
Powerstack Jaycar Electronics ph:1800 022 888 techstore@jaycar.com.au www.jaycar.com.au	SB1800	12	600 (C10)	686.4 (C24)	>4000	4000	2000	1200	260	2	2599.00	4.33
	SB1802	12	1350 (C10)	1543.2 (C24)					530		5799.00	4.30

Sealed lead-acid batteries (continued from previous page)

Brand/supplier	Model	Voltage	Capacity (Ah)		Cycle life @ % DOD				Weight (kg)	Warranty years	RRP $	$/Ah @ 12 Volts
			C20	C100	10	25	50	80				
Prostar Deep cycle AGM / GEL ph:(03) 9574 0257 mob:0407 094 361 www.ironhorse.net.au	PR12-40D	12	40	-	-	-	-	-	14	1	139.00	3.47
	PR12-75D		75						22		229.00	3.05
	PR12-100D		100						30		299.00	2.99
	PR12-200DG	12	200	-	-	-	-	-	61	3	549.00	2.74
	PR12-260DG		260						74		699.00	2.68
Solar Block Exide Technologies ph:(02) 9722 5700 ph:1800 800 811 www.exide.com.au	SB6/200	6	180	200	6500	5700	2500	1500	29	2+3	POA	POA
	SB6/330		280	330					47			
	SB12/60	12	56	60					19			
	SB12/75		70	75					26			
	SB12/100		90	100					36			
	SB12/130		116	130					45			
	SB12/185		165	185					62			
Sungel Battery Energy ph:(02) 9681 3633 info@batteryenergy.com.au www.batteryenergy.com.au	4SG110	4	87.00	105.70	>7000	5300	2800	1700	13.50	5 years full replacement + 5 years pro-rata	426.80	12.11
	6SG150	6	124.20	150.90					28.00		811.80	16.14
	6SG200		165.60	201.30					32.50		882.20	13.15
	2SG250	2	207.00	251.60					13.00		440.00	10.49
	4SG320	4	301.60	324.70					38.00		946.00	8.74
	2SG450	2	372.60	452.90					23.00		732.60	9.71
	2SG650		538.20	654.20					32.00		842.60	7.73
	2SG875		675.80	838.60					49.00		1320.00	9.44
	2SG1000		810.90	1006.30					54.00		1388.20	8.28
	2SG1200		946.10	1174.00					64.00		1746.80	8.93
	2SG1400		1081.30	1341.80					71.00		1837.00	8.21
	2SG1750		1351.60	1677.20					87.00		2197.80	7.86
	2SG2000		1621.90	2012.60					103.00		2453.00	7.31

Lithium batteries

Brand/supplier	Model	Voltage	Capacity (Ah)	Cycle life @ % DOD				Weight (kg)	Warranty years	RRP $ inc GST	$/Ah @ 12 Volts
				10	25	50	80				
EV Power Australia ph:(08) 9757 2998 www.ev-power.com.au	SE-40AHA	3.2	40	3000	3000	3000	2000	1.5	1	POA	POA
	SE-60AHA		60					2.2			
	SE-100AHA		100					3.3			
	SE-130AHA		130					4.4			
	SE-180AHA		180					5.6			
LiFeTech Lithium Energy (Lithium Batteries Australia) www.lifetechlithium.com info@lifetechlithium mob:0420 948 757	XPS1E-012010	12	10	18,000	10,000	5000	2000	2.3	3 years for EV applications, 5 years for approved solar, UPS and standby power applications, 10 years with GlobeTRAC worldwide battery monitoring.	RRP and $/Ah depend on level of inbuilt battery protection and computer monitoring options as requested by the customer, such as VMS, BMS or CAN.	
	XPS1E-012020	12	20					4.2			
	XPS1E-012030	12	30					6.1			
	XPS1E-012040	12	40					8			
	XPS1E-012060	12	60					12			
	XPS1E-012080	12	80					15.6			
	XPS1E-012120	12	120					23.3			
	XPS1E-024010	24	10					4.2			
	XPS1E-024020	24	20					8			
	XPS1E-024030	24	30					12.2			
	XPS1E-024040	24	40					15.6			
	XPS1E-024060	24	60					23.5			
	XPS1E-036010	36	10					6.1			
	XPS1E-036020	36	20					11.9			
	XPS1E-036030	36	30					17.7			
	XPS1E-036040	36	40					23.2			
	XPS1E-048010	48	10					7.9			
	XPS1E-048020	48	20					15.5			
	XPS1E-048030	48	30					23.2			
	XPS1E-072010	72	10					11.9			
	XPS1E-096010	96	10					15.6			
	XPS1E-108010	108	10					17.7			
	XPS1E-144010	144	10					23.2			
	XPS2E-012015	12	15					3			
	XPS2E-012030	12	30					5.5			
	XPS2E-012045	12	45					8			
	XPS2E-012060	12	60					10.4			
	XPS2E-012090	12	90					15.6			
	XPS2E-012120	12	120					20.3			
	XPS2E-012180	12	180					30.2			
	XPS2E-024015	24	15					5.5			
	XPS2E-024030	24	30					10.4			
	XPS2E-024045	24	45					15.6			
	XPS2E-024060	24	60					20.3			
	XPS2E-024090	24	90					30.2			
	XPS2E-036015	36	15					8			
	XPS2E-036030	36	30					15.6			
	XPS2E-036045	36	45					23			
	XPS2E-036060	36	60					30.1			
	XPS2E-048015	48	15					10.3			
	XPS2E-048030	48	30					20.2			
	XPS2E-048045	48	45					30.1			
	XPS2E-072015	72	72					15.6			
	XPS2E-096015	96	96					20.3			
	XPS2E-108015	108	108					23			
	XPS2E-144015	144	144					30.1			
ONYX Exide Technologies ph:(02) 9722 5700 ph:1800 800 811 www.exide.com.au	Details available on request										
Thunder Sky LiFePO4 batteries EV Works Pty Ltd ph:(08) 9353 1794 www.evworks.com.au	LFP040AHA	3.2	40 (1C rate)	10,000	5000	3500	2000	1.5	1	70.40	7 (1C rate)
	LFP060AHA		60					2.3		105.00	
	LFP090AHA		90					3		158.40	
	LFP100AHA		100					3.5		176.00	
	LFP160AHA		160					5.6		280.50	
	LFP200AHA		200					7.3		349.80	
	LFP300AHA		300					10.5		450.00	
	LFP400AHA		400					13.5		600.00	

Alexia's house—for under $35k!

Looking to save money in the long term, this dancer-turned-handy-woman built her own off-grid home. Sarah Dailey reports.

For a ballroom dancer whose only experience in construction was with Lego bricks, building her own home was no easy feat for Alexia Hicks.

After five years of planning and building, in 2003 Alexia finally completed the monstrous task of building her own home in New South Wales for a nominal cost of just $35,000. She describes herself as "handy with a hammer," so constructed the house herself, brick by tiresome brick, using nothing but her own two hands, recycled materials, and calling in unlimited favours from family, friends and the staff at the local hardware shop. The result is a spacious and sustainable family home made on the cheap, using Alexia's thrifty attitude and hard work.

A big goose plus big 600mm eaves on the north-facing side of house let winter sun in, and keep the summer sun out.

Low-cost and inspired

For Alexia, the initial incentive for building a sustainable home was cost. Way back in 1997, recently divorced and with a two-year-old daughter, a St Bernard and a horse in her care, living in an apartment was simply not an option. Neither was a sprawling mansion, a tiny block of land or continuing to live with her parents. The search was on for land in the surrounding suburbs of Wollongong, where she discovered a 37-acre bush block, with the added bonus of the nearest neighbour one kilometre away. Alexia was only interested in passive solar designs for maximum efficiency in heating, cooling and energy saving. She looked into pre-built kit homes, yurts (highly engineered tents built to withstand even the most extreme weather conditions), and countless styles of alternative homes that would suit her climate and landscape.

Due to a steadfast white-ant population in the surrounding trees, timber was ruled out, as was a metal framework due to cost, so Alexia started the laborious task of researching different kinds of brick work. She settled upon Hebel, an Australian brand of non-toxic, energy efficient autoclaved aerated cement block, made mostly of concrete with closed air pockets in them. For Alexia this meant the blocks would be light enough for her to pick up, eliminating the need for her to hire labor, but they are also fireproof, termite-proof and can be cut by a manual hand saw. The sturdy blocks offer excellent insulation and also negate the need for wall frames or additional insulation.

Happy with her well-researched choice, Alexia then whipped up the floor plans for her three-bedroom dream home and sent the submission to her council for approval. The original design included north-facing windows in the living area for maximum warmth in winter and longer 600mm eaves to inhibit the ferocious summer sun.

Determined to start making the most of her comfortable block of land, Alexia bought a caravan and parked on-site to be close to the action, and also to have somewhere to sleep and store her tools as the building progressed. Alexia obtained quotes for the slab and had it coloured and stamped to prevent the need to lay tiles or expensive floor coverings. It also ensured the floor would be warmed by the sun in winter and kept cool the rest of the year.

Bricklayer extraordinaire

When it was time to start laying the bricks, Alexia borrowed a large generator to run the cement mixer. After only one day of hard labour, Alexia had torn a ligament in her shoulder. Where most might have thrown the tools down in

defeat and hired a contractor, Alexia persevered. She had the help of a friendly construction worker for a short time, but as her self-confidence built she realised contactors weren't necessary and she could complete the project alone.

"Once he felt that I was confident enough, he just didn't turn up any more," says Alexia of that first tradesman. "I remember getting everything ready to start the days work and waiting for him. I thought he was just running late, so I started laying a few blocks myself. Towards the end of the day I realised that I did have the confidence to do it myself after all. He never came back," says Alexia. From there she began to lay around 20 blocks per day two or three days a week.

All of the windows were sourced by Alexia from local recycling yards and auctions. A working bee was planned and Alexia enlisted her supportive friends to rally together to lend a hand with the block work and installation of the windows. Gradually, she rendered the internal walls, then undercoated and painted them. Alexia made up the render mixtures herself, adding oxide rather than buying the premix, to waterproof the external walls. For three years this slow but steady construction continued, until Alexia and her daughter moved into the onsite caravan full-time to save on living and transport costs.

Once the foundations were completed three plastic water tanks were purchased. Combined they hold 42,000 litres, with one cleverly placed on top of a hill. Alexia and her family pump water into it every four weeks, which is then gravity fed into the house.

Off-grid solar

To continue on her quest for an economically efficient home, solar energy was chosen. The house is located 600 metres from mains power, meaning even if she wanted to connect to the grid, it would have been too costly. The 10 solar panels are attached to the shed, with a sloping north-facing roof of forty-five degrees. A separate room provides cross ventilation for the batteries. Used to living on minimal resources, Alexia says a house powered by eight batteries charged by 10 solar panels solar power is a luxury. Her system produces around 4kWh a day, more than enough for the family's day to day needs. "Output each day relies on how many hours of sunlight the panels receive, every day is different," says Alexia. The family has a small electric fridge but are planning on updating to gas, in line with their hot water system. "We are very happy with our solar power. It runs everything like a normal house," she says.

Ten 100 watt solar panels on the roof of the shed. Inside the shed are eight batteries, inverter and back up generators, plus tools, of course.

Sunroom

A unique feature of the house is the four metre by five metre sunroom. Centrally located, the sunroom acts as a heater to warm up the entire home, buffered by extra thick roof insulation batts and bifold doors to block the heat out in summer. On particularly chilly winter evenings the home is heated by a slow combustion stove. Large French windows were fitted for maximum light, as were 3.5 metre ceilings for ventilation. The glass-brick sky-

The sunroom warms the whole house in winter.

lights in the kitchen, bathroom and hallway let in plenty of light and delay switching on the overhead lights until sunset. The light fittings throughout the home are LEDs. But Alexia took standard council issue globes one step further to get even more light from them. "I bought the cheapest plastic light covering/lamp shade from the hardware store. I sprayed the inside of it with metallic silver paint to reflect the light back from the plastic covering, and sprayed the upper side of the covering with a speckled feature spray. It worked out to cost $5 a lamp-shade and looked stylish when I hung them up," says Alexia.

Recycled materials

Despite the hired plumber, both the bathroom and kitchen were an exercise in savvy shopping. The entire kitchen cost only $300. Alexia used recycled timber for the benchtops and again called upon her trusty Hebel bricks to build the kitchen frame. The cooktop and stove were pre-loved from a recycling yard. This is where Alexia says potential builders have the most opportunity to save money and be sustainable.

"Recycling yards were my greatest friends. I bought things such as the internal doors, stove, windows, external doors, a lot of different timbers, roofing for the shed and walls, roofing for the pergola, all sorts of different fittings as well as the laundry sink."

Secondhand and foraged fittings were used in the bathroom too, including the vanity and bath her mother found discarded on the street, waiting for the council hard rubbish pick-up. Alexia salvaged all the tiles she would need from a recycling garbage tip and received a 15-minute telephone crash course from a friend on how to tile.

"The skirting boards were the bargain of the year," says Alexia on her extraordinary $30 purchase. "When I had finished putting them around every room in the house I still had plenty left. I made a picture frame and used them around the windows and doors."

The three rainwater tanks have a combined 42,000 litre capacity.

Another of Alexia's proud purchases are her doors. "I bought two sets of 120-year-old French doors, from the Sydney newspaper," says Alexia. "The owner had started stripping the paint away, not knowing how many coats of paint were really there. I bought them cheaper for that reason. It took me months to remove the seven layers of different colored paint. However, looking at them now nobody would ever know how much work was actually involved."

Jill of all trades

Even though most of the bathroom fittings were secondhand, the hot water system is new. The Rinnai Infinity system is run by 9kg gas bottles. The system is activated by a touch screen in the bathroom where water temperature can be digitally selected. The water only starts heating up when the hot tap is turned on, minimising gas wastage and unnecessary water use.

By the time that system was installed, Alexia was a seasoned tradie. She battled the septic tank installation by herself also, calling into practice all the years of research and library books she read to familiarise herself with home building. "I read the instructions and installed it myself, as well as connecting all the pipes and installing the 60 metre rubber trench. It took all my energy to bury the trench with 50 tonnes of rock and gravel." The fitting took her two weeks, before a plumber and the council came to approve her dirty work.

Overall the project took Alexia five years, a broken foot and an injured shoulder to complete, and demonstrates how cheaply a home can be made, for both your wallet and the environment. Even when it came to furnishing Alexia continued her philosophy of recycling. The home was completed with some reupholstered furniture and carpet remnants and is now a very comfortable pre-loved family home. Her family has since expanded, with two extra daughters, and she has now added an extra large bedroom, a study and a pergola. Although with these extensions she did have a little more help. "This time I had my own apprentice—my husband, and I was the bricklayer." ✻

Alexia and her green electricity supply.

Difficulty rating: ★★★★★

Making a BMW better

Wendy French shows us how she converted a BMW to electric for some robust country driving.

For the past few years we have been almost obsessive in reducing our household energy, and it's paid off with a 50% reduction in power consumption. So, where to from here? Solar panels perhaps? Well, we're already on 100% GreenPower. What about transport?

I realised my daily commute to work caused the most greenhouse gas emissions in my life. Converting the car to run on gas would give a 30% reduction in greenhouse gases, while car pooling would ease it by 50%. There's no public transport out here, so I decided to aim for zero emissions and build an electric car, charged on 100% GreenPower.

Which car?

With the decision made there were a few criteria to establish. The car is primarily for my commute to work, a 40 kilometre round trip between two country towns and I wanted to be able to sit on 100km/h. Light small cars and kangaroos are not a good mix! Lasers and Pulsars, the next size up, are nearly there, however I already owned a 1986 318i BMW with a sick engine. It fitted all the criteria other than being a bit heavy, although still only marginally heavier than a Laser, and possibly a bit boxy, i.e. not aerodynamic.

Design criteria—batteries

The next decision was to do with the electric components.

Should I use lead-acid or lithium ion batteries? I wanted to be able to travel over 40 kilometres at a reasonable speed, so it had to be the more expensive lithium ion batteries.

Next, the motor: AC or DC? AC motors have the advantage of regenerative charging. As I was doing country miles I wouldn't be using the brakes very often so I chose the cheaper DC option.

I was advised to use at least a 120 volt system for country driving. The decision was also helped by the fact that I had purchased a second-hand DC motor and controller which were suitable for 120 volts. The preferred lithium ion batteries for electric cars is the Thunder Sky brand which are 3.2 volts. To get 120 volts I would need 38 batteries.

But what capacity should the batteries have? Thunder Sky make cells in a wide range of sizes. Some simple maths gave me the answer. I was advised that the car would do four kilometres per kilowatt-hour of energy used.

Calculations for the 160Ah batteries are as follows:

160Ah x 3.2 volts x 38 cells = 19kWh of total energy storage. Multiplying this by the kilometres per kilowatt-hour (four) gives a 76 kilometre range.

This range was about right, so 160Ah cells it was. Recent actual measurements reveal that the four kilometre per kilowatt-hour expectation was conservative. I actually manage around 4.5.

Weight

Another consideration was the final weight of the car. I was advised the car would, when converted, weigh roughly the same as the original car plus the weight of the batteries. This turned out to be a very rough estimation—with the final weight of 1250kg being 110kg less than predicted. Not knowing the final weight at the design stage, the decision was made to reduce the car from a five seater to a two seater. This would leave plenty of margin for error in calculations and make the back seat available for batteries.

Location

I gave a lot of thought to where all the batteries, motor and controller would mount. I had a self-imposed design rule that I would not disturb the original structure of the car, which would ensure fewer problems when getting the

The batteries were weighed in packs to make sure that the weight distribution would be correct. This pack weighs just 40kg.

engineer's certificate. The electric motor runs longitudinally, directly replacing the petrol motor.

One bank of seven batteries is in a box above the motor, another seven are in front of the motor and 24 are where the back seat used to be. I chose the back seat area rather than the boot to keep the weight more central. The controller sits up the front left of the engine bay and the battery charger in the boot. The weighbridge revealed that the front and back are both 50 kilograms heavier; so the distribution must be right!

Construction

The first stage was to remove the petrol engine and associated parts. The pile just kept getting bigger with the engine, radiator, exhaust etc.

With the gearbox out I started on the electric motor adaptor plate. The first bit was easy, I just needed a circle of 12mm thick steel. The challenging bit was getting both sets of holes—motor and gearbox—in the correct place. In the end I got a bell housing from an automatic car and gave it to my 'friendly' milling machine operator to use as a pattern. From this he picked up the centre and bolt hole locations and then replicated them onto the adaptor plate.

Next was the drive coupling to go on the motor shaft. This was turned from steel and designed to have the original clutch plate bolted onto it. Although there is no clutch action, it retains the torque damping springs and the original spline to accept the gearbox input shaft. These two tasks proved to be the most technically challenging and definitely required outsourcing.

With the motor and gearbox united, they were installed. I fabricated a cross member to use the original rubber engine mounts to support the new motor. To take the torque from the motor I used the tapped hole for the eye bolt lifting point.

Battery boxes and auxiliaries

Throughout the above I was building battery boxes and their mounts. The boxes were constructed from sheet steel made into an open-top box. The mounts are rectangular section steel tubing running across the engine bay. This involved designing, purchasing, cutting, welding, painting and bolting.

Other items to be mounted were the motor controller and heat sink, brake vacuum pump, circuit breakers and main fuse. All these bits and pieces went in and out many times before the final fit!

The 38 batteries were clamped into packs of seven or eight batteries. The battery boxes were lined with packing material, hold-down bolts were arranged and in went the batteries. Again, they went in and out quite a few times—part of my fitness regime!

Electrics

With the bits of metal over and done with, it was finally time to start guiding the electrons around. The first job was to engage my brother to advise on cable sizes, plugs and sockets and mounting options. This pointed me in the right direction and so averted possible future errors.

Armed with a length of high voltage cable and a bag full of lugs, I made up

Inside the engine bay. Note the battery management units on the battery cells.

the nine required cables. These were encased in split flexible conduit and clamped into place. The main pair run along the tailshaft tunnel, up into the boot and then into the battery box in the rear seat. The battery charger was mounted in the boot with a 240 volt power socket where the original petrol cap was. A pair of cables run to the front of the car to connect into the battery circuit.

Extra-low voltage (12 volts) is needed to run high voltage cutouts, the brake vacuum pump, battery box cooling fans, charger shutdown circuit and volt/amp gauges. My circuit diagram on paper morphed into a maze of wires going in every direction, then mysteriously appearing with relays and fuses back at a central point! This wiring has required ongoing fine tuning mainly due to repeated failures of the DC to DC converter black box.

D-day

Nine months later it was ready to drive! Several hours were spent carefully charging the batteries for the first time to ensure all batteries got up to the same voltage. I pushed it out of the shed (just in case), turned the key, put it in gear and it went—hallelujah!

Project management

Having never done a project of this scale I quickly realised I needed to manage the project timelines and materials. By Sunday afternoons I needed a shopping list for the week to ensure sufficient materials for the following weekend.

I also quickly realised I needed to have multiple tasks running in parallel to make sure I had work to go on with if a bottleneck arose. A simple example was needing four lengths of steel and only having enough for three lengths. When I needed six 20mm bolts the only place that sold metric bolts locally closed at lunchtime! It was these simple things that caused bottlenecks.

This is what can happen if you don't check your cable connections.

Driving

Test driving has revealed a quiet and surprisingly smooth car. Acceleration and top speed are less than with the petrol engine, but that's fine. It will happily sit on 95 to 100km/h and does the required 40 kilometre country road commute with plenty to spare. The actual driving is simpler and more like driving an automatic, with no clutch, and I leave it in gear when stationary. The gears work well; I take off in second or third and change up to fourth at 40km/h and just need to feel in the clutchless gear changes. As there is no regenerative braking I have to watch downhill runs to make sure the car doesn't get away.

Legalities

Any conversion needs to conform to Australian design rules. So, to get it right from the start, I met with a VicRoads certified engineer to discuss my plans. The inspection and discussion went well and I got the green light to start the project.

Before I could drive it I needed a weighbridge certificate, a roadworthy certificate and an engineer's certificate. Then, a final visit to VicRoads rounded out the legalities.

Energy consumption

Our household energy consumption had plateaued to around 7kWh a day, whilst charging the car overnight uses 11kWh. This is a powerful reminder of how much energy is used driving, and that to reduce your footprint you need to look at every aspect of your energy use.

Driving costs compared to the petrol engine on my 40 kilometre commute are as follows:

In its electric incarnation, 40km/4km per kWh = 10kWh. Round this up to 12 for losses in the charger etc. We pay 21 cents per kWh, so this means we pay 12kWh x 21 cents = $2.50 per 40km.

On petrol, at 10 litres/100km, we would use four litres. At $1.30 a litre that's $5.20.

Postscript

The car had been my trouble-free daily transport for 18 months until the embarrassing day that it simply stopped and had to be brought home on a tow truck. The culprit turned out to be a meltdown caused by a nut working loose on one of the cable connections to the motor. An important reminder of how much energy is involved and the care and respect it commands. ✻

The Zivan battery charger lives in the boot, for charging on the go.

Difficulty rating: ★★★☆☆

DIY solar hot water cover

Richard Stanford explains how he curbed the troublesome behaviours of his hot water system with simple DIY covers over his solar panels.

Our solar hot water system has a habit of making loud explosive sounds. This happens in the storage tank when you turn off the hot water, particularly during summer in the middle of the day. The plumber was unable to offer a reason why this was happening so I contacted the supplier who suggested removing six of the tubes. The wholesaler was not interested in helping, except to offer the unlikely suggestion that it was the cold water hitting the hot sides of the tank as the hot water was drawn off.

The best solution was suggested by Lance Turner at the ATA. He explained how a radiator connected to the collector on the roof with a heat-actuated valve would bring the radiator into the circuit when the water reaches a certain temperature, thus alleviating the explosive sounds.

The cover reduces the output of the solar collector in summer to prevent the system overheating.

The pipes are bolted to a length of timber for easy and safe cutting.

As this would need development as well as hiring a plumber, I deemed his solution to be too expensive. Unable to admit defeat, I devised my own method of getting the system back under control.

DIY option

I have adopted a very cheap and fairly effective solution which has resulted in my hot water tank now making an occasional low rumbling noise, instead of the series of loud and disruptive explosions.

I have made a pair of covers that will not be affected by wind, as would a blind. There are two covers so that each is lightweight enough to install and carry up a ladder when I put them in place at the spring equinox and remove them at the autumn equinox.

To make the covers, I bought three lengths of 60mm PVC pipe, each at 3m long. I cut these into three 1790mm long pieces, with two off-cuts joined together, also cut to 1790mm, giving me four lengths of pipe.

The pipes were then cut into halves longitudinally with a band saw. To do this safely and accurately, it is necessary to bolt each pipe in turn to a square sectioned piece of timber, with a hole at each end, at exactly half the external diameter of the pipe from the bottom. With the pipe and timber on a flat bench, drill through the hole in the timber, into the pipe at one end and bolt it. Then drill the other end and bolt that in the same way. The bolts need to be short enough not to damage the band saw blade. Adjust the fence and cut the pipe in half, as in the photograph. The joined length needs spacer washers between it and the timber, to the thickness of the joiner.

I used a galvanised steel bar, 50 x 4mm, to join the pipes together. This is overkill strength-wise but it means it is heavy enough to stop the wind from dislodging the cover.

I had the merchant cut the steel into 6

pieces 280mm long, giving me a substantial leftover for the 'useful bits bin'. I drilled the steel as shown in the photograph, with the pairs of holes at exactly the same spacing as the tubes. I cut a length of foam rubber channel into 60mm lengths and punched holes in them at the same spacing as the holes in the steel. The rubber rests on the glass tubes without damaging them.

Then I assembled the two covers, using 19mm x 5mm stainless steel round head metal threads, with flat washers under the heads, passing through the rubber, the PVC tube from the inside and then the steel plates. To stop the covers from sliding downwards, I bought a couple of SS 'eye beckets' from a yacht chandler. With these bolted to the centres of the bottom steel plates, a piece of nylon cord can be used to lash the bottoms of the covers to the frame of the solar collector.

The plates are drilled and then used as a template to drill the pipes.

Even with the covers we still have piping hot water in the summer. With hindsight I think we could have bought a 22 tube hot water system which might have prevented the problem of overheating and the subsequent exploding sounds. But the extra six tubes are worthwhile for the winter, especially as the roof slopes only 20 degrees. This cover gives us the best of both worlds, with a gentle low murmuring to accompany our water heating in summer, and piping hot water year round. Best of all there were minimal costs involved. ✻

Pieces of U-channel foam are cut and punched and then bolted into the PVC half-section pipes. This prevents damage to the evacuated tubes when the cover is added or removed, or if it moves around in the wind.

10 years of DIY solar-powered hydronic floor heating

As winter departs it's a good time to evaluate how well the heating's been working. Bruce Gill updates us on his DIY solar heating system installed a decade ago, spiders and all.

With DIY projects, reliability is often a major issue, so solving problems as they emerge and keeping the systems running, and even improving them, is part of the adventure.

In 2001, I put together four 0.9 by 2.8 metre-long polycarbonate-covered black poly solar water heating panels to heat the bathroom floors in my home in Central Victoria. My DIY article outlining the system was published in *ReNew* 77. Here are some of the things I have learnt over the last nine years.

The house today still has the four solar hot water panels which are attached at the start of winter. Below: The house as it appeared in ReNew 77.

Problems solved

After the first winter there were a number of problems that I had to solve. A thermostat set at 25°C turned the circulation pump on as the sun heated the panels during the early part of the day. However, because the roof stayed warm for an hour or so after the sun went off the panels, the pump continued operating. This meant that for an hour or two, some of the warmth that had been collected during the day was lost. I solved this problem by putting a 24 hour timer on the power supply to limit the pump operation to between10am and 4pm.

Another major reliability problem in the first year was the day-night temperature cycle which caused the pipes to swell when they warmed and contract when cold. This happened especially when a frost occurred overnight, with the expanding water escaping out of the relief system. Some persistent small leaks also posed a problem due to the many joins in the poly pipe fittings, so I had to manually refil the small header tank each morning, which I sometimes forgot. This problem was solved by connecting a dripping tap via a 4mm poly pipe to the header tank, keeping the system topped up all the time. While a small amount of water might be wasted doing this (it overflows into our stormwater capture lake), it has proved to be a reliable fix over the years.

The other major problem that occurred in the first year was due to the water not circulating sometimes, usually due to some sort of failure. Without water circulating, the panels got quite hot and the black polyethylene sheeting behind the poly pipes contracted by season's end. This pulled the sides of the panels in and severely distorted them. While this demonstrated

how much heat can be captured under clear corrugated polycarbonate sheeting, even in winter, it meant the panels were not in a fit state to be put up again the following year. On rebuilding the panels, I added a full length and width of black aluminium fly-wire between the black poly sheeting and the water pipes. I figured that this would help conduct the heat better, limit the temperature of the black plastic and increase the surface area in the collector. It might have helped warm the air better in the polycarbonate corrugation housing each collector pipe, too. However it works, though, it solved the problem and the panels have remained flat ever since.

Another problem was with thermosyphoning. At night, the panels got very cold and started a reverse convection flow that meant very cold water made the cold winter floors even colder! To fix it I put a marble in a copper wire cage in some suitably sized poly plumbing fittings at the inlet to the panels. This solved the problem, and the rattle of the marble when the pump is running gives an audible sign that the system is working.

Put them up, take them down

Each season when I put the panels up and take them down I replace the original poly pipe over barbed poly fittings connections with rubber sealed screw fittings, which has made the job of assembly and disassembly much easier.

Look out for critters

Another more bizarre problem concerned storing the panels in the shed in summer. Because they are made from plastics, the summer sun would be too much for them, especially without water circulating to keep them cool. However, after setting them up in the second or third year, I noticed that the non-return valve wasn't working, so I took the valve off and gave it a suck to see if it was operating, only to find the soggy remains of a large huntsman spider in my mouth! It then occurred to me that critters found the open pipes an inviting place to live over summer, so this problem was solved by making sure I plugged each opening while in storage.

The final problem concerned air getting stuck in the circulation pump. When I originally put the pump in, it was installed on the heated water return pipe in a horizontal orientation. Every now and then the pump got air trapped in it somehow, which stopped it from working. This problem was solved by moving the pump to a vertical orientation on the floor return (cold side) where any slugs of air are now helped though the pump by gravity.

Will I get another 10 years out of the panels? So far, despite the panels just sitting on the roof, winds have not caused any problems. The styro-foam insulation is holding up reasonably well and the poly-carbonate still comes up shining after a clean. However, the UV and weather is taking its toll on a few parts, even though they are up for only about four months a year. I think I might get another 10 years from them, provided I keep maintaining them.

You have to be pretty dedicated to run such a system, with its annual ritual of installing, getting them running, fixing the odd problem, taking them down again and having to store them away from the spiders! I doubt that anyone but the more dedicated Alternative Technology Association member could be bothered. However, it's all worth it when I come home after a sunny winter's day to a warm bathroom floor and the warm glow of satisfaction I get knowing that for the running cost of a 40 watt pump and less than a day's work each year, I can capture several kilowatt-hours of free energy.

Quick facts

- The house was built in the summer of 1998.
- The house is in Central Victoria where the system benefits from a number of cloud-free winter days.
- At the time of building the cost of materials was $170 for the laserlight and $150 for the poly pipe, fittings and plastic sheet. The collectors cost approximately $40 per square metre.

An extract of Bruce's original DIY article published in *ReNew* 77 way back in 2001 can be found at www.renew.org.au

www.gogreentube.com

Anyone who uses the internet regularly will know about video websites, such as YouTube. Here, people post videos on just about anything. While there's lots of variety, it does make it difficult to find videos worth watching.

Gogreentube.com is like a YouTube for the environment conscious web user. It works in much the same way that other video sites do. On the front page it has several categories where the most popular and newest videos are displayed, making it easy to find what other people are finding most interesting.

Because the site has a green bent, the majority of the videos are actually worth taking a look at. Topics vary from cooking to making your own clothes, green roofs, making your own custom bike lights and a huge range of other ideas.

Indeed, if it's possible to take a video of it, and if it has an environmental theme, then odds are you will find it on this site.

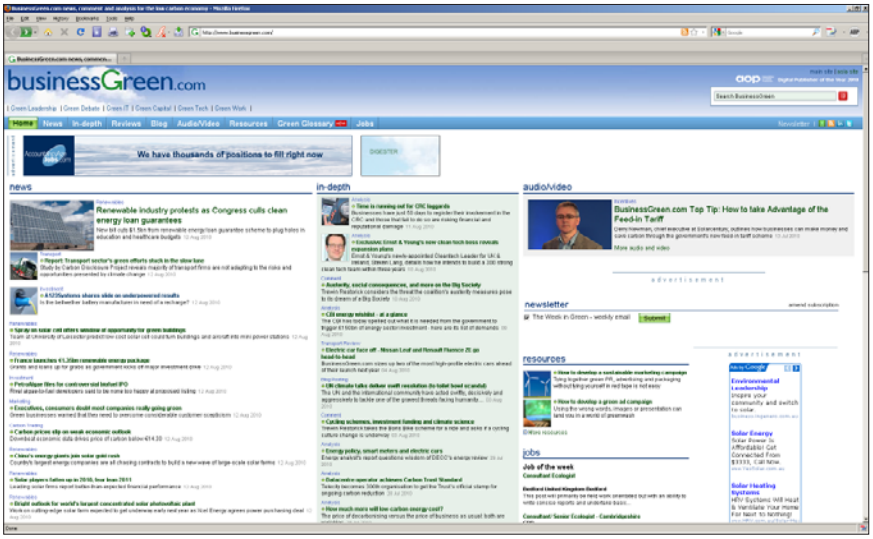
Like many other free video sites, it also features advertising, but it's not too in-your-face and it is tailored to the target audience, so the ads themselves are actually of interest.

Many of the videos also show how we affect the planet and other species. One video on swimming with manatees (what an experience that would be!) clearly shows one manatee with multiple boat propellor slices in its tail—evidence of just how our recreational practices can affect endangered species.

www.businessgreen.com

As you can probably guess from the URL, this site has something to do with green businesses. Or more accurately, how businesses can become more green.

Basically, businessgreen.com is a news site with a green leaning—all of the articles have some aspect associated with greener practices or environmental issues in relation to running a business.



While a fairly US-centric site, there's plenty of info to keep anyone interested in green issues reading for quite a while.

As well as news items there are slightly more in-depth pieces of social commentary, technical reviews, from energy meters to hybrid cars, 'top tip' video clips (they are a little staid, but there's useful info in there), a basic green glossary, and 'how to' articles aimed at businesses, such as how to undertake a climate risk assessment.

To make finding articles a little simpler there's a row of category titles you can click on, such as Green Leadership, Green Debate, Green IT, Green Capital, Green Tech and Green Work. Each of these brings up articles more relevant to the particular category.

Many of these articles are a little on the light side but they are a good place to start for the average business owner or CEO who is new to all this 'green stuff'. And if you get bored, you can always check out the green blogs section.

Going solar big time and fast

The shift to 100% renewable energy by 2020 could be a reality according to a new report, writes Fiona Armstrong.

If the politicians are to be believed, switching to clean and renewable energy in Australia is something that will take decades. We currently don't have any major incentives for industries to make a transition away from fossil fuels, and only minor policies are so far in place to encourage fuel switching.

But is it all as hard as the coal and oil lobbyists and parliamentarians would have us believe? What about our abundant solar and wind resources in Australia? How fast can they be developed? Pretty quickly, according to a new report from Beyond Zero Emissions (BZE) and Melbourne University's Energy Institute. In fact, it is possible for Australia to make a transition to 100% renewable energy in Australia in just ten years.

Launched last month the Zero Carbon Australia 2020 Plan (ZCA2020) has attracted some serious attention. Endorsements range from the International Energy Agency to former Chief Scientist Robin Batterham and Nobel Laureate Peter Doherty.

Beyond Zero Emissions Director Matthew Wright says the endorsements reveal the unique nature of the report and the failure of governments to undertake vital planning on Australia's inevitable transition to a renewable energy supply system.

"The overwhelming support for this plan from industry and experts is due to its science-based approach and the fact that it is not about half measures. It is about directly addressing the problem which is that a rapid transition to a zero carbon economy is needed if we are to avoid further and even more dangerous climate change," said Mr Wright.

Photo: www.esolar.com

Solar thermal could play a big part in Australia's renewable energy future. See 'Solar is Scaling Up!' in *ReNew* 110 for more on solar thermal such as this 245MW solar thermal power station by eSolar in California's Antelope Valley.

Which renewables?

The plan outlines a pathway for Australia to make a complete switch to renewable energy for stationary energy by the end of this decade, using a mix of solar thermal with storage and wind power. The two technologies were chosen on the basis of their commercial availability and proven effectiveness. Wind is already an established energy source, with over 50 wind farms currently operating in Australia. Solar power is yet to be properly exploited in Australia despite the abundant natural resource, and the capacity of the technology to provide reliable and affordable power generation.

ZCA2020 proposes the construction of twelve solar thermal plants each with 3500MW installed capacity located in resource rich sites across Australia, along with 48,000MW of wind power installed at 23 geographically diverse locations to offset regional variability. The plan includes upgrades to existing transmission infrastructure to create a national energy transmission system, as well as provision for backup power generation from biomass and hydroelectricity in the event of unexpected demand.

Wright says the report dispels the myth that renewables can't provide baseload or 'dispatchable' power.

"Our report shows you can run a modern economy on renewables. The two technologies we've chosen are proven off-the-shelf technologies; wind power is already well established here, and substantial solar thermal with storage is being installed in Spain where

it provides energy security as it can deliver baseload power 24 hours a day."

World-wide renewables

The report represents a paradigm shift from any other produced to date in Australia, although there are international precedents, such as the plan by researchers at Stanford University (USA) for 100% renewable energy for the entire world by 2030. Wright says this makes the Zero Carbon Australia Plan look modest by comparison.

"Mark Jacobson's plan (from Stanford) looks at the entire planet's energy supply needs—ours is just for Australia which is a much smaller task."

In fact the report reveals the available energy supply from this plan would exceed demand, if energy efficiency measures were introduced simultaneously. This surplus could be used to deliver additional industrial energy capacity, for example, for minerals processing or potentially for export.

Another recent Melbourne University report, *Australian Sustainable Energy—By the numbers*, supports the findings of ZCA2020 in terms of capability of renewable energy technologies and costs. In fact the costings are remarkably similar: Peter Seligman's *By the numbers* suggests it would cost $320 billion for Australia to shift to 100% renewable energy (over an unspecified timeframe); while the cost of the BZE plan is $370 billion over ten years.

Wright says this is affordable, given that it represents an investment of 3% of GDP over the ten-year timeframe. If funded through electricity prices, the impact could be as little as $8 per household per week. And it is attractive from the point of view of employment, energy security, and Australia's future economic growth.

"It's not just affordable; it actually offers Australia energy security as well as the environmental outcome. In a $1200 billion dollar a year economy, this is a relatively small investment."

Photo by Richard Pocknee, Project Manager, Cathedral Rocks Wind Farm, SA.

Large-scale wind power is already an established energy source in Australia.

How could it be achieved? The critical thing is political will, says Wright.

"We just need to make a decision to do it. Wind is already cost competitive with fossil fuels but investment in solar thermal will need some incentives through policy to bring the costs down to allow it to compete with cheap coal. There are a range of mechanisms that have been demonstrated to be effective in the roll-out of solar thermal in Spain, including a gross feed-in tariff which was specifically designed to encourage large-scale solar. But in a way, the actual mechanisms are less important than the decision to implement the plan—if there is a real committment to delivering it, the right policy tools can be found."

More jobs

At the peak of implementation, the ZCA2020 plan would provide employment for 80,000 construction workers and ongoing employment for 45,000 people in operations and maintenance.

Wright says the jobs would provide important opportunities for workers in fossil fuel industries to transition to the renewable sector as many of their skills would overlap with the plan's requirements, such as pouring concrete, manufacturing turbines and towers and building transmission lines. More jobs would be created than lost in the fossil fuel sector.

"The concentrating solar thermal and wind sectors provide more jobs per unit of energy produced than fossil fuels and the renewables industry is safer, with fewer health risks, and lower workplace injuries and deaths," said Wright.

Will it be built? Wright says that's a decision for Australia, and Australians, to make.

"We see this plan as the Snowy Hydro of solar for the 21st century. It would enable Australia to become a renewable energy superpower. It's achievable and it's affordable. And it can be built quickly—there are renewable energy companies who are ready to start work right now." ✻

A copy of the Zero Carbon Australia 2020 Plan is available at http://media.beyondzeroemissions.org/ZCA2020_Stationary_Energy_Report_v1.pdf

Fiona Armstrong is a Melbourne based freelance writer and policy analyst.

The national picture

Alan Pears asks why energy efficiency is under-rated in a low-carbon future and discusses whether natural gas could help wean us off coal power.

RECENT studies such as the ClimateWorks-McKinsey strategy, and statements from the leader of the IPCC mitigation taskgroup have highlighted the enormous potential of energy efficiency improvement to deliver multiple benefits, including cutting greenhouse gas emissions.

Yet the underlying culture in Australia is focused on growing large-scale energy supply capacity, not driving efficiency. The Prime Minister's Energy Efficiency working group has accepted energy growth as a fait accompli, according to their issues paper in April this year. Grant King, head of Origin Energy, argued in his recent Deakin Lecture that, despite impressive improvements in energy efficiency, electricity use by households had continued to grow in recent years, so we can't rely on energy efficiency and must focus on increasing supply. (This lecture can be viewed at www.slowtv.com.au)

All acknowledge the importance of energy efficiency and factor in more than has been achieved in the past, but energy efficiency is not central to most approaches. This is a serious problem that will cost us money, hurt the environment and support over-investment in energy supply capacity, with serious risk of stranded assets.

Past failure to deliver easily visible reductions in energy use reflects weak and piecemeal policy, not failure of the few effective policies we have implemented. In the few areas we have seriously addressed, we have achieved results.

In the residential sector, improvements in efficiency of products subject to energy labelling and minimum performance standards have stabilised and begun to reduce overall consumption of fridges, dishwashers and clothes washers, as well as improving the thermal performance of new buildings. But these policies have been underfunded and standards have been weak. For example the best European fridges are much more efficient than our best. Our most efficient air conditioners are twice as efficient as our minimum standards.

Explosive growth in halogen lighting, inefficient flat screen TVs (now rapidly improving after belated introduction of energy labels), larger houses, widespread installation of central heating and inefficient air conditioners in thermally-appalling existing buildings have driven demand growth that has overwhelmed our successes. All of these could have been managed by effective policy.

In industry, recent programs such as Energy Efficiency Opportunities, Victoria's EREP and NSW's E&WSAP have shown that large cost-effective savings have been ignored for decades. In the commercial sector, the first ever building energy requirements were introduced in late 2006, so we are just beginning to see their effects. The recent increase in stringency will take some years to flow through.

Investment in energy supply infrastructure typically has a 'payback period' of eight to 15 years, while investments in emerging energy supply options have much longer payback periods. Yet most businesses and households will not invest in an energy efficiency measure with more than a two year payback. As a society, we are seriously under-investing in energy efficiency. This is costing our economy billions, and driving up greenhouse gas emissions and energy costs.

We must confront a fundamental question: why do we persist in failing to invest in measures that save a lot of money, cut emissions, and improve quality of life and productivity? We need dramatic institutional and cultural change.

As someone who has benefitted from improved comfort and low energy bills, and has helped many organisations to save money and improve productivity, I still struggle to understand why it is so hard to make energy efficiency a central pillar of our society.

The great gas debate

I've raised the issue of whether we should still be treating natural gas as a transition energy source in previous columns; the case for gas has been weakening as the rate and scale of necessary change has increased due to inaction on climate change.

This issue has become a focus in Victoria, with Environment Victoria proposing some extra gas generation as part of its strategy for the rapid closure of Hazelwood power station. On the other hand, Beyond Zero Emissions (BZE) has argued for an entirely renewable solution. BZE has also used US data to suggest that the greenhouse impact of natural gas is much greater than is generally recognised—although Australian data suggests our gas industry's emissions are significantly lower.

Both groups make some important points. But there is room for both if we are smart.

To date, the gas industry has complacently sat back, arguing that gas is great

because its emissions intensity is a lot lower than competing energy sources. But that is no longer enough to justify the use of gas. The big long-term issue for the gas industry is to prove to Australians that it can move towards zero emissions gas supply over time, using biogas and maybe biomass pyrolysis and hydrogen. The community would then be more likely to accept wider use of gas.

In my view, our approach to gas will need to vary with circumstances. For example, small, energy-efficient households simply can't justify the cost of being connected to both gas and electricity because the fixed supply charges are so high, and increasing. They need to look at either all electric/renewable energy, or renewable/gas (e.g. fuel cells) and energy storage to provide onsite electricity without connecting to the electricity grid.

The situation is complicated by the rapidly improving efficiency of some electric technologies, such as the best reverse-cycle air conditioners which have lower emissions and are cheaper to run than gas heaters, even using brown coal-fired electricity!

In industry, a combination of improved process efficiency and cogeneration could deliver all needed electricity and heat services without increasing gas use, and probably reducing it.

In the commercial sector, gas and electricity are both typically used at very low efficiencies. For example, central hot water systems lose enormous amounts of energy as the hot water is pumped around buildings in poorly insulated pipes. Around three-quarters of all the greenhouse gas emissions from commercial buildings are generated by efforts to keep people comfortable and provide light. We know the potential for saving energy is enormous.

So I'm inclined to think that some investment in gas-fired power generation makes sense as part of a strategy for the rapid closure of dirty power stations, and as a longer-term backup for renewables. But it must be linked to aggressive energy efficiency improvement and a funded strategy to move gas to zero emissions over the next couple of decades.

Vale Peter Szental

Peter Szental played a pivotal role in the development of the energy efficiency sector in Australia. Sadly, he passed away in July at age 60. I met Peter in the 1980s when his fledging energy efficiency business, Energy Conservation Systems, was bidding for work with the Victorian government. He built this business over time, developed the 40 Albert Road green building and played key roles in the Business Council for Sustainable Energy.

Peter was outspoken and controversial. But he always stood up for the broader public interest and put his own money on the line many times. We have lost a deeply committed friend.

No comment on election policies?

I have chosen not to review election policies on energy and climate change in this column because any comment would be outdated by the time you read this. And neither of the major national party policy positions really addresses the fundamental issues anyway. The Victorian government's recent announcements, however, provide room for some optimism. ✻

Alan Pears has worked in the energy efficiency field for over twenty years as an engineer and educator. He is Adjunct Professor at RMIT University and is co-director of environmental consultancy Sustainable Solutions.

Products

Getting smart with energy monitoring

There's been quite a few whole-of-house energy monitors released lately, but one of the most interesting is the Envi from Current Cost.

The Envi can monitor single- or three-phase power connections using a transmitter mounted in the meter box to send the energy use data to the transmitter located in the home. The data is displayed, as well as logged for later use. The meter can store up to seven years of data and it can be downloaded via the built-in USB connection for later viewing.

The Envi data is also compatible with Google's Powermeter software, so you can record and display your data to the world via your Google account, which is ideal if you need to monitor a remote site for energy usage.

The great thing about the Envi is that it can monitor data from up to 10 transmitters, so you can monitor energy consumption data from the main meter, as well as individual branch circuits and even individual appliances. You can even monitor the output of your grid-interactive solar power system. Even better, you can have as many displays as you like all receiving data from the same transmitter(s), with displays in several rooms if needs be.

There's a number of buying options, including a standard single-phase package, extra sensors and extra transmitters. There's even a 'solar pack' aimed at PV owners.

RRP: $139.95 for the Envi pack, $39.95 for the three-phase kit, $69.95 for extra transmitters and $219.85 for the solar pack.

Available from SmartNow, 97 Graham St, Port Melbourne VIC 3205, admin@smartnow.com.au, www.smartnow.com.au

New solar panels

There's a great many solar panels on the market nowadays, and the choice just got even more complex with a new range of monocrystalline panels from Victron Energy.

Called Bluesolar, they are said to have a low voltage-temperature coefficient to enhance high-temperature operation, and good low-light performance and high sensitivity to light across the entire solar spectrum. They come in a range of sizes from 30 to 280 watts.

Features include waterproof junction boxes, bypass diodes to minimise the power drop caused by panel shading and an EVA encapsulation system with triple-layer back sheet to meet the most stringent safety requirements for high-voltage operation (1000V maximum system voltage rated).

They also have anodised aluminium frames, high-transmission tempered glass and a pre-wired quick-connect system with PV-ST01 connectors.

The panels come with a 25-year limited warranty on power output and performance and a two-year limited warranty on materials and workmanship.

RRP: 30W: $209, 50W: $345, 80W: $554, 130W: $898, 180W: $1243, 280W: $1935, all ex GST.

Available from a number of Victron Energy dealers. For more information contact Victron Energy, ph:(02) 9863 1052, mleeftink@victronenergy.com, www.victronenergy.com

Large capacity heat pump hot water system

Heat pump hot water systems have been around for quite a few years now, but most are in the 200 to 400 litre class. The Stiebel Eltron WWK300 can deliver 540 litres of mixed draw-off with 80% at 60°C.

Other features of the system include a coefficient of performance (COP) of up to 4.5 at 30°C ambient air temperature and active defrost, which uses hot refrigerant to de-ice the evaporator (rather than a separate electric element), allowing it to operate in cold environments.

The unit is designed to require no on-going maintenance and has a 15-year design life.

RRP: $3900.

For more information, contact Stiebel Eltron, 1800 153 351, info@stiebel.com.au, www.stiebel.com.au

Beefy inverter/chargers

The new MS-E series of inverters from MagnaSine are designed and produced in the USA. There are two models available—the 2.7kW, 12 volt (with 125 amp charger) MS-2712E and 4.1kW, 24 volt (with 105A charger) MS-4124E.

The inverters are true sinewave units and DC charging levels can be preselected to suit the specific requirements of the battery system. This ensures the longest possible service life from your battery system. The inverters also feature power factor correction on the charger and an oversized toroidal transformer which helps provide high surge capacity. The MS-E inverters are supplied as standard with a fully functional remote control panel.

Optional accessories include an automatic generator start module, battery monitor kit and a battery combiner, which enables charge current from the MS-E single output charger to be diverted to a secondary battery start bank. The inverters come with a two-year warranty.

RRP: $3600 for the MS-2712E, $4000 for the MS-4124E.

Available from Enerdrive, Unit 11/1029 Manly Rd, Tingalpa QLD 4173, ph:1300 851 535, sales@enerdrive.com.au, www.enerdrive.com.au

Bikes made from bamboo!

Well, partly at least. Organic Bikes has released its first bike made partly from bamboo. The 'Dylan' is made from natural laid-up bamboo tubes and 100% recycled alloy lugs and chainstay tubing.

It is designed as a flat-bar road bike or fitness bike, ideal for the morning commute or a ride down the bike path.

The Dylan is designed to offer a more eco-friendly choice for biking enthusiasts, with the alloy bike frame tubing being replaced by bamboo, one of the strongest and most renewable materials available. The result, according to Organic Bikes, is a bike that is lighter, stronger and more comfortable than standard frames, with a much smaller ecological footprint.

The bikes are available in small, medium and large sizes and use a single speed drive system, so they are probably not great if you live in a hilly area.

RRP: $990 including delivery anywhere in Australia.

Available from Ecolifestyle, ph:1300 889 470, info@ecolifestyle.com.au, www.ecolifestyle.com.au

Solar PV and solar hot water panels that match

One gripe that many people have about their solar electricity and solar hot water system is that the panels detract from the look of the home.

The SolarCombi is a combined PV and solar hot water system which uses photovoltaic panels and solar water heating collectors that have very similar appearance and size. This allows the systems to look like one large integrated panel that looks far better than two separate systems.

There are two versions available, the Classic, which has 2 x 1 metre Solon PV panels that are colour matched to the solar collectors, and the Premium, which has 1 x 1 metre frameless QSE PVs. The systems come complete with a Power-One Aurora 2kW inverter and a 315 litre hot water cylinder with a five-year warranty.

RRP: Premium with electric boost $11,999, Premium with gas boost $12,999, Classic with electric boost $7,999, Classic with gas boost $8,999.

Available from BrightGeneration, ph:(08) 6311 2836, contactus@brightgeneration.com.au, www.brightgeneration.com.au

Products

An easier way to save shower water

We all want to save water, and one area where a lot of water is wasted is in the shower while waiting for the water to run hot. Collecting this water with traditional buckets and tubs can be hard work, especially for the elderly or those with bad backs.

The Joeycan is a two-in-one watering can and shower water collector. You lie it flat in the shower and it collects the run-through water, which flows down the front face and into the can through the hole in the side. After the shower is warm, just pick it up like a watering can and set it aside for later use. It can then be carried and used like a regular watering can.

The Joeycan is made in Australia. It measures 300 x 450 x 80mm and is available in blue and green.

RRP: $20 plus postage.

Available From Joeycan, mob:0402 032 198, denis@joeycan.com.au, www.joeycan.com.au

Low cost flow sensors

If you want to monitor how much water you are using in the house or garden or if you are on tank water, then these little flow sensors could solve the problem.

Available in three sensing ranges, they can measure water flows of as little as 0.8 litres per minute right up to 25 litres per minute. The two lower flow sensors are for cold water only, while the higher flow unit can handle hot water up to 80°C.

The sensors are ideal for irrigation systems, rainwater storage systems, recycling systems and anywhere water flows need to be measured. They operate from any DC supply of 2.4 to 26 volts and have open collector outputs (i.e. the output connects to -ve for each pulse). Pulse rate is one pulse per 4mL.

RRP: $10.24 for the two smaller sensors, $12.54 for the larger unit.

Available from Futurlec, 2/136 Broadmeadow Rd, Broadmeadow NSW 2292, sales@futurlec.com.au, www.futurlec.com.au

And water monitoring too!

It's not just electricity that you can monitor at home in real time, but water use as well.

The AquaMonitor consists of a display unit that each minute receives information from tank and/or mains sensors via low-power wireless data transfer. The LCD displays total water consumption or consumption from individual supplies.

The display has illuminated buttons for data navigation and access to menus. The buttons show the overall status of consumption and indicate if an alarm is present.

The consumption information and statistics includes 24 hourly, daily, weekly and quarterly totals, as well as average daily consumption.

When used with a water tank, the display shows the amount of water in the tank in litres, water inflows in litres and the anticipated time remaining before the tank will run dry. Data displayed for water meters includes consumption and flow rate in litres.

Up to three tank sensors and one mains sensor can be used with each display unit. The battery-powered sensors are easy to install on virtually any type of tank and on commonly available water meters with a reed switch facility.

RRP: Display and tank sensor or display and mains sensor packages: $299. Additional tank sensors: $149, mains sensors: $149.

Available from AquaMonitor Pty Ltd, mail@microelectronics.com.au, www.aquamonitor.com.au

An even better LED bulb

A while ago we looked at the EarthLED Zetalux LED bulbs from AdvancedLumonics in the USA. Well they have now released the new version, the Zetalux 2, which is even better than the original.

Available in 'Standard' and 'Pro' versions, the Zetalux 2 can produce up to 550 lumens in cool white (5000K) or 450 lumens in warm white (2800K) from the CREE MX-6 LEDs, depending on the model.

The bulbs draw six and seven watts for the Standard and Pro versions respectively and are available in 120 and 240 volt versions but only in an Edison Screw (ES27) base. Adaptors are readily available elsewhere.

The bulbs have a rated lifespan of 25,000 hours @ 30% degradation, meaning they will have lost 30% of their light output after 25,000 hours. They measure 60mm diameter by 107mm long, making them the same size as a regular incandescent. The bulbs come with a three-year warranty.

RRP: US$34.99 for the Pro, US$24.99 for the Standard, plus shipping.

Available from AdvancedLumonics, earthledsales@earthled.com, www.earthled.com

Build your own rainwater tanks

It seems that modern building blocks just keep getting smaller, while homes keep getting bigger. As a result, there's less and less room for important infrastructure like water tanks. Modtank make two modular rainwater tanks designed to fill just about every possible need.

The flat-sided Modtank is a stackable module tank that can be arranged into almost any configuration. Each polyethylene module stores 77 litres and measures around 300 x 550 x 600mm. You can arrange them against walls, under decks, under the house or even into large cube tanks.

The Modtank Pod is a vertical 600mm diameter x 1860mm high 500 litre tank. They can also be arranged into various configurations to form elongated tanks to be placed against walls and fences.

RRP: $60 for the Modtank, $350 for the Modtank Pod.

For more information, contact Modtank, 3/2 Cawkwell Street, Malvern VIC 3144, ph: 0409 704 397, www.modtank.com.au

A turbine with a difference

While most urban locations are not suitable for wind power generation, there are some sites that are well suited, such as the top of tall buildings in CBDs and on high bridges and other structures. Conventional horizontal axis wind turbines are not suited to many of these locations as they don't cope well with the turbulence and can be too noisy.

Windpods have been designed to make use of the wind in such places. They are basically a vertical axis wind turbine mounted horizontally, although they can be mounted vertically if required. They look a lot like Savonius rotors, but in fact have aerofoil profile blades and so use lift instead of drag to harvest energy, making them more efficient than a Savonius so they can produce more power for the same size of turbine.

The standard module, the G1, measures 667mm high x 2530mm in length and weighs around 35kg. It can produce up to 500 watts at 12.5m/s wind speed.

They feature electronic braking in extreme wind speeds and are compatible with a number of grid-interactive inverters, such as the SMA Windyboy.

RRP: $4500 for a 1kW (two x G1 module) package.

Available from TEI Australia, ph:(02) 8898 9735, info@windpods.com, www.windpods.com

Q&A

Solar panel reflectors

I was wondering if I can improve the performance of my 1.5kW solar system by putting stainless steel reflectors of about 30cm high along the back edge of the panels without damaging the cells? Or would white be better?

Ray van Lieshout

You can do that but there are several negatives. The first is that concentrating the sun increases the heating effect and so the output is not boosted by as much as you might expect. The hotter a panel, the less efficient it is.

The second is that it may well void the panel warranty.

My personal preference is to simply add some extra panels, if you have space.

Lance Turner

Evaporative coolers and water use

I have a query about evaporative coolers for household use.

We have a strawbale house which is set up to get all cross-flow breezes and only has ceiling fans, except for an underground cooling system which we set up ourselves. It has pipes set 2m underground coming into the house via openings at floor level (although this is not working 100% efficiently yet).

In the hot weather we close up the house early in the morning and pull down blinds until the temperature drops at night when we open it all up. The main area that we need to cool is the lounge/dining/kitchen area that faces north and is 80m^2 in area.

With this setup we find that internal temperatures are about 12°C lower than outside, where we often get temperatures of 44°C for days at a time. We find this is very comfortable except when we don't get any cooling breezes at night or when the overnight temperature doesn't drop below 30°C, so we start off the next day at this temperature. We were thinking about getting an evaporative cooler for such times.

We are on a 3.6kW stand-alone solar power system which gives us about 20kWh a day in the summer. We thought that an evaporative cooler would be best for us, but we have had conflicting advice concerning the amount of water they use (we are also on rainwater only). Some people say that the water they use is minimal and most of it is recycled back into the unit anyway, but others say that they use about 15 litres an hour and as you have to have an evaporative cooler on all day to get the cooling effect, that uses a lot of water.

One retailer told us that a couple living in the country had to have the unit removed as they ran out of water during the hot summers we've had in the last few years!

Could you please advise us of the facts regarding power use and water use with evaporative systems?

Eileen Russell
Southern Flinders Ranges SA

I had a quick look around and there's a fair bit of info out there if you google it. Yarra Valley Water have a report dated 2005 at www.yvw.com.au/NR/rdonlyres/823F5570-98A1-442E-BB67-63781C813576/0/EACReport.pdf that gives water use figures, although they could be a little out of date (the average use is listed as 1.5L/min or 90L/hr, pretty scary actually).

The water use will depend on lots of factors though, including the size of the unit, how often it is run and the relative humidity of the air.

Generally, evaporative coolers use 20-25% of the energy of a refrigerated system, but they are only really effective in climates with relatively dry air. In humid climes and days of high humidity elsewhere they don't work.

One solution would be to have a separate small rainwater tank that is reserved for the cooler. When it runs out of water you can't use the cooler further. This would give you an idea of the water use without risking your main supply.

Lance Turner

LED lights

In *ReNew 111* there was a very interesting article on LED lights. The house we are moving into has 125 mm diameter 100 watt soft glow lights. These lights fit snugly into the existing fittings but they put a large amount of light into the roof space.

Is it possible to fit LED bulbs in place of these lights or will this require different fittings and to have existing holes in ceilings blanked and new holes cut?

If replacement is possible, what is recommended and are these carried by most retailers? We would be looking in Forster on the NSW mid-north coast where choice is often limited. Any advice would be much appreciated.

Val Heath

Assuming they are standard bases like ES27 or similar you shouldn't have too many problems using ES-based LED bulbs. Just make sure you buy ones suitable for 240 volt supplies, there are a lot of 120 volt ones around for the US market. Many newer bulbs are universal voltage now and can run on any mains voltage. A few places to start are www.earthled.com, www.dealextreme.com/products.dx/category.907 and stores.ebay.com/LEDBulb-Bizz

Lance Turner

Inverters and EM fields

I'm writing to ask if you have any information on solar inverters and radiation/electromagnetic emissions. I plan to install a 2kW solar power system and have been looking at the SMA SB2500 inverter.

However, I understand that there are different inverter technologies and I'm not sure which would have the lower

Write to us!

We welcome questions 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 questions to 200 words.
Send letters to: *ReNew*, Level 1, 39 Little Collins St, Melbourne VIC 3000, renew@ata.org.au

radiation and whether there are any comparative tables. I know that with mobile phones the radiation emissions are measured in SARs and you can get this information from their technical manuals. However, I don't know how it is measured with inverters.

I would appreciate any information you may have on this and look forward to hearing from you.

Liz Burton

Any device sold in Australia has to comply with RF emissions requirements to get C-tick approval, but this doesn't include magnetic fields as far as I know. Generally, this isn't an issue unless you are close to the device. Fields decrease with the cube of the distance, so they drop off rapidly.

I haven't seen any comparisons on the levels of RF and EM fields from inverters, as most are mounted away from living areas, often outside, so it generally isn't an issue. Also, most have fully enclosed metal cases or internal shielding, so the fields produced are going to be low I would expect.

Mobile phones are different as they are designed to emit RF radiation, they are transceivers after all.

Lance Turner

Advice on sustainable living

I am extending/renovating my half house in Bentleigh. It has three rooms off an L-shaped passage and an extension (in progress) to the kitchen/family area at the back. The extension includes a narrow laundry and powder room on the side. The house runs east-west and is approximately 20 metres long with an area of approx 112m², is solid brick and has a pitched roof (32°).

The family room has a wall of windows facing north and west. I have put Comfort Plus clear glass in these windows, have shade cloth for summer, will have a Mitsubishi split air conditioning heating system and am considing honeycomb blinds. The floor in the extension kitchen and passage is being insulated as it is re-laid. I live on my own and have visitors intermittently.

I need help computing the amount of water it is possible to collect before I make the decision about which rain water collection system to use.

I can fit in two slimline 2500 litre tanks on the south side of the building on the side fence west of the laundry, near both toilets. At the moment it is only possible for me to collect about half the rainwater off my roof (from the south face of the house). Currently the plumber has put on the downpipes to exclude the north and east face and is telling me I do not need the water from there. Is this true? My builder has said that it is possible to adjust the spouting to capture this water.

I also have two very different quotes for the installation of the water tanks. One says the tanks can be on sand; the other says a concrete slab is necessary. One wants to put in a leaf eater, a first flush diverter, a pump cover over a Davey RainBank and a water level gauge and the other does not. Can you comment on this? Both plan to use plastic tanks. Is this all right or is metal better? I know there are issues about length of life and recyclability, but I am also concerned about any toxins such as plasticisers that may leach out.

Will there be enough rainwater to plumb both toilets and to irrigate the garden, which does not take a lot of water? I had a greywater system put in five years ago. I am not going to reinstall it but will continue to use the drip irrigation system. Are these good ideas?

Also, I am going to replace my 1998, 135 litre gas hot water service and am considering instantaneous gas. Would solar with gas booster be better? What brand would be best?

Lastly, should I consider installing photovoltaic solar panels?

Jill McGregor

The rule of thumb for the amount of water you can collect is that for each square meter of roof you have, you will collect 1 litre of water for each millimetre of rain you receive. Melbourne's average rainfall is around 600mm per annum. So a roof area of 10m x 10m (100m²) would in theory give you 60,000 litres per annum. However, you have to take a bit off for first flush diversion, evaporation, wetting down, etc.

When people ask what size tanks or how much roof area, I always say as much as possible. Country homes often have tanks of 100,000 litres or more. However, this is generally not possible in the city so I tend to tell people just fit in as much as you can.

Toilet flushing can easily use 100 litres a day so 5000 litres of water storage would only last 50 days. So more is better. Plumbers will tend to want to do what is easy for them so you need to push them to connect as much of the roof as possible.

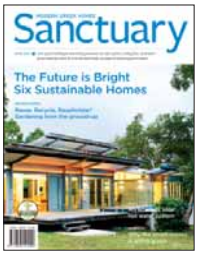
Slimline tanks should be on a concrete base. Otherwise, if the ground is unstable they could tilt. Also, it's better to have a leaf eater and first flush diverter. A pump cover is not essential but a good idea to reduce noise. Plastic tanks are okay, especially if you are not planning to drink the water.

Regarding solar hot water and solar PV, there is a range of issues to consider. Have a look at the Your Home Technical Manual which has heaps of good information, it is available online at www.yourhome.gov.au/technical/index.html

Mick Harris

Welcome to the ATA shop

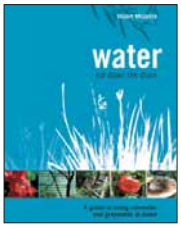
These are just some of the products available in the ATA Shop. To browse the full range, or to place an order, go to shop.ata.org.au. Or simply fill in the order form on page 96!

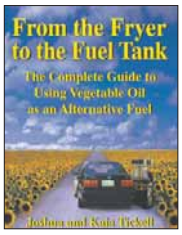


Sanctuary magazine: modern green homes
Price: $9.95 plus $2.50 postage
Or subscribe 12 months (4 issues) $36 or 24 months (8 issues) $70

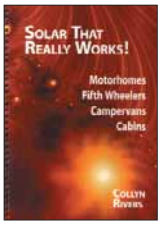
Issue 12
Australia's green building codes, Gardening from the ground up, Six sustainable homes, Reuse, Recycle, Reupholster! Sanctuary 6, 7, 8, 9, 10 and 11 are also available.

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*

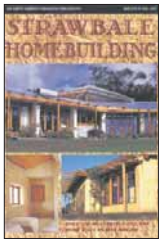




From the Fryer to the Fuel Tank
Author: Joshua Tickell
Price: $34.95 plus $8 postage
Paperback, 160pp
A great book that shows the reader how to make a clean-burning renewable fuel from waste vegetable oil. Includes detailed instructions on making and using the fuel in a standard diesel vehicle. *Item code: FFTFT*

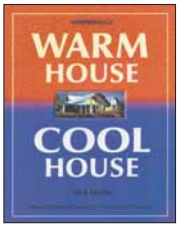


Solar That Really Works!
Author: Collyn Rivers
Price: $42.50 plus $8 postage, 82pp
Whether for motor homes, fifth wheelers, caravans or cabins, solar energy is silent, clean and increasingly affordable. This book is a down-to-earth guide to getting it right the first time.
Item code: STRW



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 describes many homes that have been built around Australia.
Item Code: SBH

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*



ATA Booklets series: Solar Electricity, Solar Hot Water and Wind Power
Price: $10 each plus $2.50 postage
These booklets are essential if planning a renewable energy system at home. Covers all the basics you need to know when designing a solar power system, solar hot water system or wind power system.

Longer descriptions of all products can be found at shop.ata.org.au

Renewables on CD ROM

ReNewROM
Price: $65 plus $2.50 postage
The second CD ROM of the series, covers issues 41 to 70 of *Soft Technology* and *ReNew*. 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, covers issues 71 to 89 of *ReNew*, 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, covers issues 90 to 99 of *ReNew*, 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

LED Replacement Bulb: cool white and neutral white

Price: $29.95

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 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.

Available in 38 and 60 degree beam angles.

Item code: LEDHAL_5WMR16_XXYYCLR — replace XX with CW (Cool White) or NW (Neutral White). YY is the beam angle (38 or 60)

Mains Outlet - Foot Operated Switch

Price: $28

Easily access your power outlet with this convenient foot switch. It can also be used on a bench to avoid those inconvenient foot-tapping mistakes! Simply connect any mains operated device to the GPO and turn it on or off remotely from up to 2.8m away. Ideal for the elderly or disabled and to turn off those hard-to-get-at phantom loads. *Item code: FOOT_SWITCH*

12 amp maximiser kit

Price: $70

Drive pumps and other motor-driven devices directly from a solar panel or panels without the need for batteries.

Item code: MAXIMISER_12AMP_KIT

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)

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.

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. 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.

Item code: METER_LUX_50K

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!

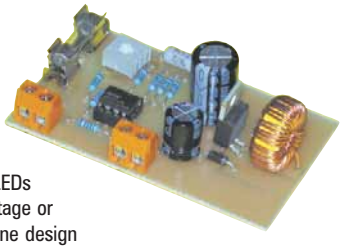
Item code: MAXIMISER_6AMP_KIT

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 incandescant/halogen lamps and heating elements or for use on small electric vehicle projects, such as electrically assisted bikes and go-carts. Item code: SPEEDCONKIT

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. Item code: SWITCHMODEKIT

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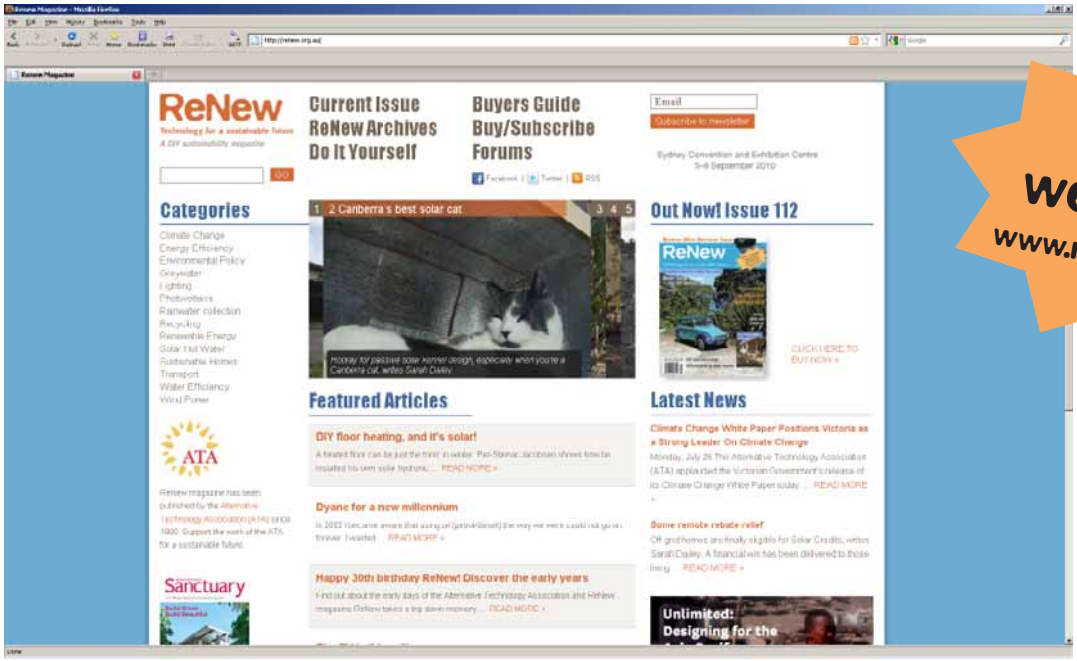

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Using the lenses from car headlights

Just because a car headlight is smashed in an accident doesn't mean that the whole light is junk. There could still be usable parts in there, writes Julian Edgar.

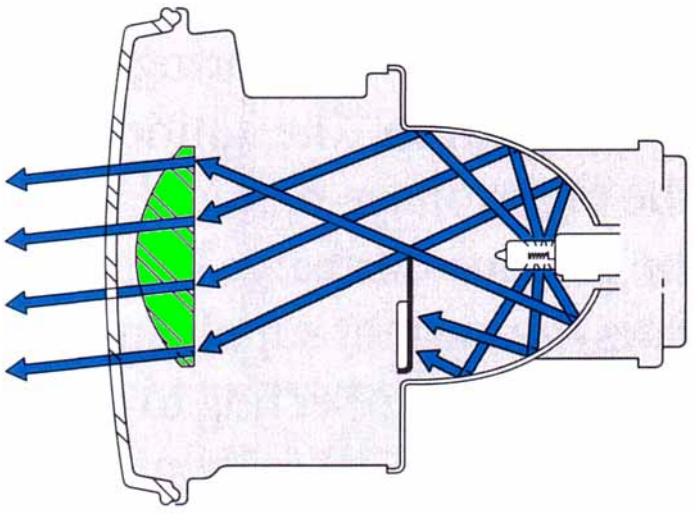
When you watch cars go by at night you can see a variety of headlight designs on display. Old cars use sealed beams, often rather yellow in appearance. Then there are the whiter designs with replaceable halogen bulbs, while more luxury recent cars feature high intensity discharge lights, most easily picked because of their brilliant blue/white colour.

But there's another bunch of lights that when viewed at an angle, have red or blue beams grading to white as the car is seen face-on. These cars have an abrupt beam cut-off and a very even spread of light within the beam. These headlights are called 'projector' and use a simple reflector teamed with a large plano-convex glass lens.

And you want to know something? That large glass lens can be obtained for nearly nothing from broken headlights at car wreckers. And you want to know something else? They make excellent lenses for use in bike lights, torches and handheld spotlights!

A projector car headlight can be seen in the picture at left. These solid lenses (pictured above) have a great many uses. If the low beam convex glass lens is intact but any of the other parts of the headlight are broken, the convex lens can be bought for nearly nothing.

This diagram shows a typical projector car headlight. From the front, there's a cover plate of glass or plastic. Behind that is the plano-convex glass lens (normally used on only the low beam) followed by the bulb and then a simple reflector. To avoid blinding oncoming drivers, the bulb is masked so the upper part of the beam is abruptly cut off. The single headlight assembly also contains a high beam, which usually comprises a conventional halogen lamp and reflector.



For example, at a wrecking yard I found and salvaged three convex lenses and took them to the front counter. I made the point that I didn't break any headlights to obtain the lenses and asked for a price. The counterman was puzzled: what on earth did I want these lenses for? I told the truth—I was making a bicycle headlight—and he charged me $10 for all three. On another occasion, when I was buying some other car bits, the convex lens didn't cost me anything extra.

If you are salvaging the lens from a headlight with a broken cover glass, be very careful. It is extremely easy to cut yourself on the shards of glass, especially if you slip while wielding a screwdriver.

Incidentally, smaller lenses of a similar shape can also be salvaged from old slide projectors.

Using the lens

So you have a bunch of high quality, large, plano-convex glass lenses that you've obtained for nearly nothing. Now what? I could get all theoretical and talk about focal lengths and beam angles and point sources, but forget all that. The easiest way of coming up with the best design for your particular application is to simply play around with the light source and the different lenses.

For example, a Luxeon or Cree LED makes an excellent light source as it is small, very bright and has high efficacy. Power-up the LED (if it's a 3W or 5W design, do this after mounting it on a suitable heatsink and make sure you use the right power supply or dropping resistor) and hold the lens in front of it. View the beam pattern on a wall or the ceiling. By altering the distance between the lens and the LED, it's possible to change the beam from a broad diffuse beam to a narrow spot. In the case of the high power LEDs, you can also try matching the glass lens with the various collimators available for these LEDs.

The lenses can also be used with conventional incandescent bulbs and reflectors. Incidentally, lots of working torches are thrown away each day, and nope, I don't know why. Again, it's a case of trying different combinations and looking at the results.

If the lens is placed very close to the light source, it's possible to get an extremely broad beam. To put this another way, the visibility to others of the light is greatly enhanced; it's just the thing for a flashing warning light or bicycle tail light.

Building a compact broad beam light

I used a plano-convex lens from a car headlight to make a very bright, broad beam bike tail light.

A stainless steel drinking cup was shortened in length using a hacksaw and file. This gave a housing with an opening that matched the diameter of the lens. A 1W red Luxeon LED and narrow beam collimator were installed on a small block of aluminium (a 1W Luxeon doesn't need a heatsink but having one doesn't hurt!) and then the block was mounted in the base of the cup.

A U-PVC plastic pipe cap to suit the diameter of the lens was obtained and its inner diameter cut out with a hole-saw, creating a flange that fitted over the end of the cup, holding the lens in place. Silicone was used to secure the cap in place and to weatherproof the opening. In this application, the best results were gained by reversing the lens over its normal car orientation; that is, the convex part of the lens faced the LED.

The LED was powered by a 1W LED power supply—these are now available quite cheaply.

So why go to all this bother when LED tail lights are cheaply available? Well, you've simply never seen a tail light like this. It is intensely bright; from directly behind, it's able to be seen at distances of 500 metres or more. The convex lens creates a broader beam than would otherwise occur, allowing the light to be visible at a much wider angle than would be achieved with conventional high intensity LEDs. This effect is enhanced by reflections from the internal walls of the stainless steel cup.

Conclusion

In addition to making lights, the large convex lenses are also great in optical experiments (kids love them), as magnifying glasses and as solar concentrators. They're worth picking up! ✻

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