SOLAR HOT WATER BUYERS GUIDE INSIDE!

ReNew

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ReNew/Conergy
subscriber offer pg 7

10 page SOLAR installation special

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Sustainable recycled homes

Issue 114 Jan-Mar 2011
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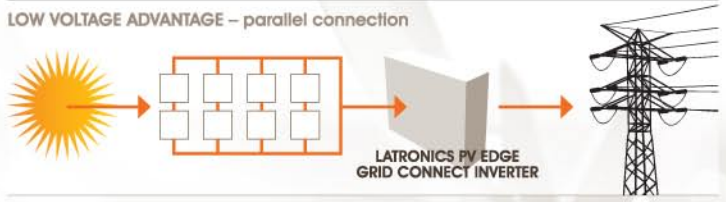

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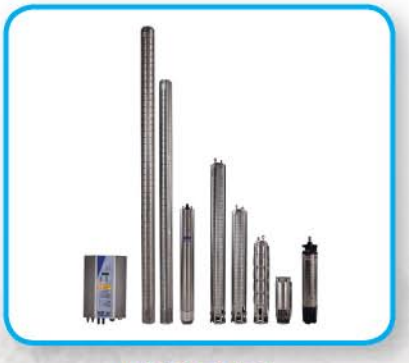

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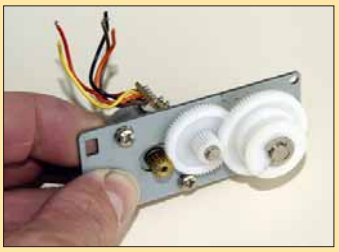

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Install tiny grid interactive solar power systems with this approved inverter. Products page 82.

From the Editor

About ReNew

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

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

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Next advertising deadlines: Booking 21 January 2011. Advertising copy 28 January 2011. Next editorial copy deadline: 21 January 2011.

Getting the best out of solar electricity

Welcome to the summer solar issue of *ReNew*. For emerging solar households, investing in solar is a different game to what it was a few years ago. Regular changes to rebates and feed-in tariff programs at a state and federal level, navigating agreements with electricity retailers and the emergence of new solar companies on the market can make it a long and difficult process.

ReNew's solar special starts with an article on what to expect from a high-quality solar installation and tips for how to monitor the connection and billing process. We hope it helps, and also prompts some robust discussion on making solar installations simpler for homeowners.

One installer we talked to for the solar special referred to the German experience when it comes to grid-connected solar. In Germany, a site analysis before installing a system is very common, after all, consumers need to know how much electricity, and therefore income, their system will generate, with feed-in tariffs helping pay for the system over a number of years.

In recent years, this installer has seen many local household solar electricity systems installed without a thorough site analysis done, raising questions as to whether new solar electricity installations are working as well as they should be. Site analyses establish the best spot for a solar electricity system, the impact of obstructions in different seasons and an estimate of how much power can be generated. Who wouldn't want this information when spending several thousand dollars on a PV system?

A uniform approach to solar installations including a well-designed national feed-in tariff, incentives for installers to carry out thorough site analyses and a push by consumers for best practice solar installations will help to improve solar standards. The recent cut to the New South Wales gross feed-in tariff, from 60 cents a kilowatt-hour to 20 cents a kilowatt-hour, needn't have been so severe and is a step in the wrong direction when it comes to promoting healthy household solar.

Green landlords have arrived

Thank you to all the entrants in *ReNew's* Green Landlords Award. It was nigh impossible to select a winner as every one of them is a leading landlord in our eyes. Meet the winner on page 22 and view more entries at www.renew.org.au

Jacinta Cleary

P.S. The promised article on the DIY recumbent pedelec has been held over until *ReNew 115*—this issue was too full!

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Up front

University bottle ban

An excessive amount of bottled water found to be sold to students at the University of Canberra has attracted calls for bottled water sales to be banned at the university altogether.

In October the University of Canberra revealed it was considering banning the sale of bottled water on campus, with 50,000 to 60,000 plastic bottles bought and consumed annually by its 8000-plus students.

The proposed university ban follows similar successful moves to eradicate plastic bottles, such as those which put the small NSW town of Bundanoon on the environmental map in 2009, and is part of a growing global backlash against bottled water.

If it goes ahead the ban would also represent another environmental win for the ACT, which has recently succeeded in passing a government imposed ban on plastic shopping bags.

The Australasian Bottled Water Institute, the industry body in the region for water bottlers such as Coca-Cola Amatil, opposes the proposed university ban as it did the Bundanoon ban last year.

In a recent media release, the institute has suggested that such a ban on bottled water sales discourages water consumption and is more likely to influence students to drink high kilojoule beverages.

Gigawatts of solar

South Africa will build the world's biggest solar power plant, with the announcement of a solar facility capable of generating 5GW (that's five billion watts or 5000 megawatts) of electricity in late 2010.

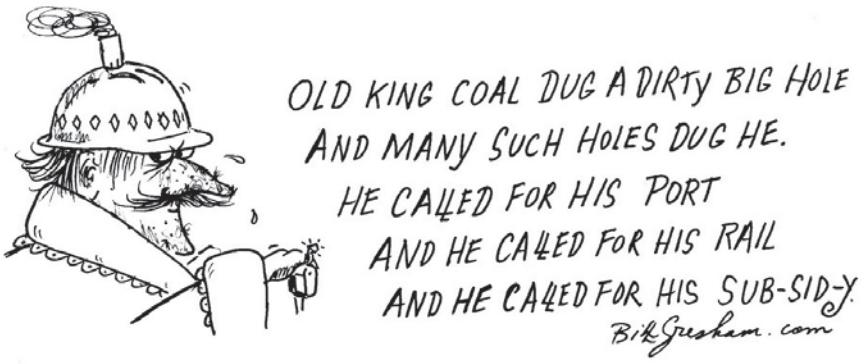
Planned for construction in South Africa's Northern Cape region, the plant is expected to be generating 1GW as early as 2012 and will be upgraded to 5GW by 2020.

According to Treehugger.com, the project's developers have set aside nearly 90 square kilometres of state-owned land in the region to cater for the solar panels required to generate this amount of electricity.

The project, which has been proposed by US-based company Fluor, is the latest in a series of new gigawatt solar projects being developed internationally, such as the 1GW Blyth Solar plant due to be completed in 2013 in California and a 2GW facility under construction in China.

Currently, the world's largest singular solar PV facility is the 80MW Sarnia solar project in Canada, while there is Solar Park Finsterwalde I-III in Germany, which boasts a total capacity of 81MW.

One gigawatt of electricity is considered enough to meet the energy needs of approximately 600,000 homes, while 5GW is thought to be enough to supply 10 per cent of South Africa's energy needs.



Calling green sages

Senior members of the community gathered in Melbourne last month to learn more about taking action on climate change.

'Climate change and older people' was the focus of the Seniors Conference 2010, an annual event hosted by the Council on the Ageing (COTA) Victoria.

The conference aimed to engage older people on climate change issues by inviting guest speakers, facilitating small discussion groups and providing opportunities to learn more about how to become a new 'Green Sage' volunteer—people who will play a leadership role in their community by talking about the impact of climate change on older people and motivating them to take action.

President of COTA Victoria, Janet Wood, welcomed people to the event with an address to the potential 'Green Sage' volunteers in the audience that sought to challenge the negative connotations often used in conjunction with older people and climate change.

Wood began by saying that older people are "burdened by being told what a big drain we are" in the climate debate, although in reality are eager to learn how they can assist in finding the solutions.

She also encouraged attendees to consider themselves as positive agents for change when it came to voting on climate matters in the Victorian state election.

A free event for people over 50, the day included an educational and interactive quiz on climate change, with questions and answers prompting discussions about climate change science and outcomes.

Guest speakers such as Environment Victoria's Josie Lee and retired physics teacher and climate change scientist Mr Keith Burrows were invited to talk on the needs of older people in a rapidly changing climate and the need for more efficient energy conservation and energy production in the future, respectively.

Another guest speaker was Anglican priest and converted climate change sceptic, Reverend Alan Colyer, who spoke of his newly "green" church in Moonee Ponds, which includes new energy efficient light bulbs and two water tanks, and will soon be fitted with $5500 worth of solar PV panels.

For those seniors who'd like to know how to become a COTA Victoria Green Sage, please contact Di Ford on (03) 9655 2139 or consumers@cotavic.org.au

Breaking ground

Installation of two wind turbines has begun near Daylesford in regional Victoria, marking a pivotal stage for Australia's first community-owned wind farm.

Construction of the Hepburn Community Wind Farm began on the Leonards Hill site following an official opening ceremony attended by 120 people in October.

The celebrated event drew members of the community, the environment movement and government ministers, including the Victorian Minister for Environment and Climate Change Gavin Jennings and federal member for Melbourne Adam Bandt.

The community-owned wind farm represents five years of planning and investment by those in the community who worked hard to get planning permits, turbine contracts and grid connections installed.

Locals in the Daylesford and Hepburn communities who are not investors can still look forward to benefitting financially from the wind farm, with an estimated $15,000 per turbine coming from the proceeds of energy sales expected to flow back into the community each year.

Another upshot of Hepburn Wind's success is the establishment of a new not-for-profit, Embark , which aims to help other communities who want to develop a renewable energy project of their own. Visit Embark's website at www.embark.com.au

The farm is expected be fully operational in the first half of 2011.

Geothermal conference

A two-day conference highlighting the benefits of geothermal energy will be held in Perth on March 21 and 22.

The West Australian Geothermal Energy Symposium (WAGES) aims to promote and expand upon the possibilities for geothermal energy application in Western Australia.

Geothermal energy can be used for large-scale electricity generation as well as smaller scale projects and is one of the most environmentally friendly, efficient and cost effective forms of clean energy.

Western Australia is thought to be an ideal geological location for developing local geothermal energy, with a number

A global solar voyage

Photo: www.planetsolar.org

Things have been fairly quiet on the solar boating front of late, but there's been at least one newsworthy story in recent weeks.

The PlanetSolar team has built a huge new vessel entirely solar powered and will soon start a voyage to sail it around the planet.

The MS TÛRANOR PlanetSolar is a multihull vessel topped by a huge array of photovoltaic solar panels. It was constructed by Knierim Yacht Club in Kiel, Germany, and was built in just 14 months.

It measures 31 metres in length, 15 metres in width, has a mere 1.55 metre draft and a sailing weight of 95 tonnes.

The solar array is also impressive. It features some movable and extendable sections and in total measures a huge 537m^2. Average efficiency is 18.8%, providing 93.5kW of solar electricity to power the boat's twin motors. Average motor electricity consumption is 20kW.

The boat requires a crew of six, but up to 40 people can sail on her at any one time.

PlanetSolar will cross the Atlantic Ocean, the Panama Canal, the Pacific Ocean, the Indian Ocean and finally the Suez Canal, to return to the Mediterranean. The aim is to cross all seven oceans and there will even be a stopover in Sydney.

For more information on the expedition and to follow the boat in real time, go to www.planetsolar.org

of geothermal exploration projects already planned for some areas.

There are also several examples of smaller urban projects which are attracting a wider interest in geothermal applications, such as the use of geothermal energy to heat five community pools and leisure centres in Perth.

Pools are particularly suited to geothermal heating, which not only benefit from a constantly available heat source, but also from significant savings in operating costs and carbon dioxide emissions due to less reliance on fossil fuel.

Aimed at scientists, technical experts, policy makers and potential end-users, the WAGES event will be supported by the West Australian Geothermal Centre of Excellence and will feature international guest speaker John Lund, who has over 30 years experience in the geothermal industry and is one of the world leaders in direct use applications and ground-sourced heat pumps. The conference will also feature technical sessions on direct use geothermal applications and ground-source heat pumps, while other sessions will seek to provide a forum on issues critical to the success of the industry.

For more information go to www.wageothermalsymposium.com.au. *ReNew* is pleased to be a supporter of this event.

Team trev in global race

Zero Race has been travelling the globe since August in a bid to make small, efficient vehicles popular. The race of four light-weight electric vehicles will be won by the team with the most efficient, reliable, usable and popular concept—it's not just about who gets over the line first.

Entrants Team Trev hail from Adelaide and includes members of ATA's Adelaide branch. *ReNew* contributor Dickson Beattie drove Trev through Russia, Kazakstan and China and will share his story in *ReNew 115*. He says Trev, a bright green three-wheeled electric vehicle, was borrowed from the University of South Australia by an independent team of enthusiasts, environmentalists and adventurers. Internally the car was stripped then equipped with a new motor, batteries, suspension and electronics designed to take it around the world. On last reports, Team Trev was headed to Cancun in Mexico for the United Nations Climate Change Conference in early December.

For more details go to www.teamtrev.com or www.zero-race.com

And the winner is...

Ian Winchcombe of Linden in New South Wales was the lucky winner in the Edwards/*ReNew* subscriber prize which closed in September, receiving an Edwards stainless steel solar hot water system valued at $7029, including a Clipsal cent-a-meter and installation for both. The household will now have greatly reduced gas or electricity bills!

At the time of going to print, the winner of the next Edwards/*ReNew* subscriber prize was unknown (closed Dec 1), but by the time you read this, someone else will have won another Edwards solar hot water system.

Never fear, the new subscriber offer is enormous, with all new and renewing ATA members, *ReNew* or *Sanctuary* subscribers going into the draw to win a solar PV system from Conergy, valued at $9956, including installation. Good luck!

Compiled by Renee Thompson

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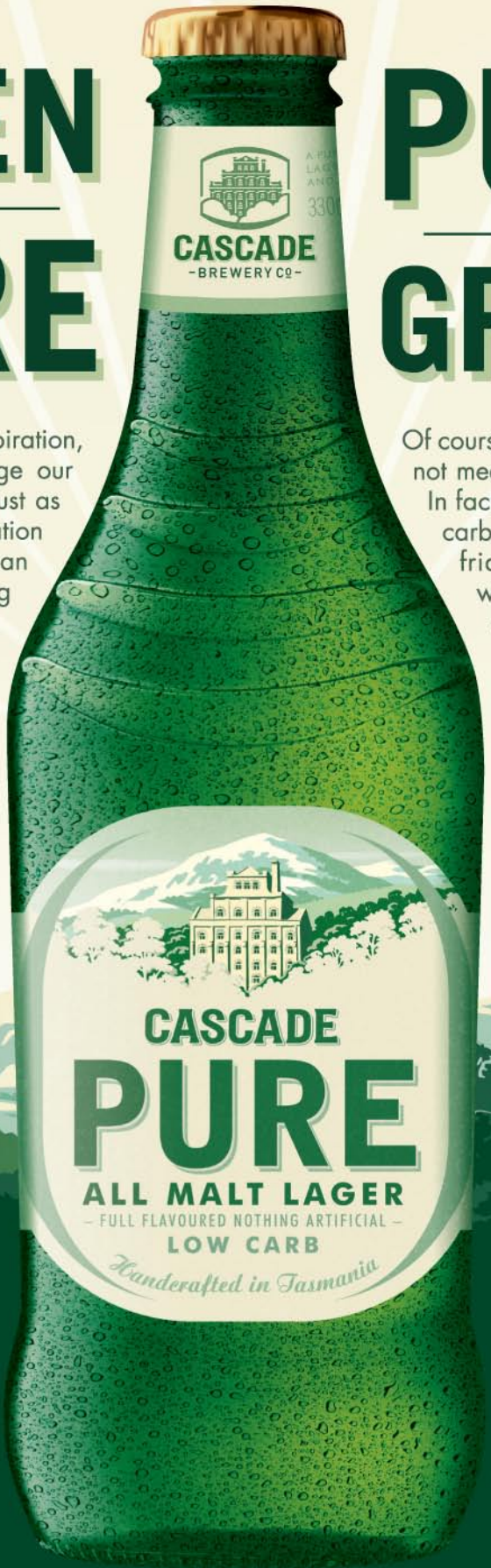

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Letters

Inverter interference

I read with interest Liz Burton's question about electromagnetic radiation from inverters in *ReNew 113* and Lance Turner's reply. I agree with what was said and would like to add additional information regarding the EMC and EMI standards that the solar power system inverters need to meet.

Several months ago I had a 1.4kW solar array fitted with an inverter that has sufficient capacity so that I can expand the number of solar panels installed later on. The inverter, whilst it converted the DC power from the panels to AC power into the mains effectively, created horrendous AM radio and shortwave radio interference. It was such that I could not enjoy listening to any radio stations.

After several months of negotiation I was able to get the offending Australian made inverter replaced with a Fronius IG20 which does not interfere with my radio reception. I believe that the SMA SB2500 inverter should also produce little or no radio interference. Both of these inverters are of German manufacture and the German Government seems much more serious about electronic equipment not interfering with other equipment and being immune to external interference sources than our government.

Whilst Australia does have various EMI and EMC standards they do not appear to be enforced. Even equipment with the C-tick may not comply as I've found equipment with such stickers completely ruining any chance of listening to radio and sometimes watching TV.

When you decide to get a solar system installed, ask for assurances (in writing) that the system will not interfere with AM or shortwave radio or TV reception. I might add my next door neighbour has a smaller version of the inverter I had and it causes interference too, and I will have to do more investigation and negotiation to get it replaced if I can.

A friend recently bought a 12 volt to 240 volt 300 watt sinewave inverter for their motorhome and it causes horrendous interference to radio and quite annoying interference on VHF TV.

I would suggest that any readers who wish to use any inverters should check whether they will cause interference before buying them and that they meet EMI and EMC standards.

I haven't had the opportunity to test all inverters by any means. I might add my profession for many years has been dealing with and, where possible, resolving radio, TV and two way radio interference to reception problems. The Australian Communications and Media Authority does have an interference advisory and investigation service too.

Rodney Champness

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 and letters published may be edited for clarity and length.

Send letters to: *ReNew*, Level 1, 39 Little Collins St, Melbourne VIC 3000, Australia,

email: renew@ata.org.au

Barking up the wrong tree!

I was recently calculating my carbon footprint on a well known internet site when I noticed that as I was a meat eater, my yearly diet was responsible for more CO_2 (2.92t) than a Toyota Prius travelling 10,000km per year (1.1t). I then began to question the carbon footprint of the family dog, that eats about three times as much meat as an adult.

A little research and sure enough a medium sized dog's carbon footprint (paw print) is twice that of a large V8 Landcruiser driven 10,000km per year, including energy to manufacture the car (*Time to Eat the Dog: The Real Guide to Sustainable Living*, by Profs. Robert and Brenda Vale, University of Victoria, Wellington NZ). And a small dog or cat has a carbon footprint equal to that of a compact car.

Some defend dogs and cats saying that the meat that goes into pet food is scrap that is unfit for human consumption, however, with over three million dogs and two million cats in Australia there is simply not enough waste products and most pet food is made from perfectly good meat and grain.

Perhaps we need star ratings for our pets…food for thought.

R Paine

Earth temperature

In reading the recent article *Heating Your Home with the Earth* by Lance Turner, it has amazed me that nobody seems to have produced any soil/depth temperature recordings in different soil types. I would have thought this would be essential in establishing the optimum depth for any efficient heat exchange system.

This research has, in a strange way, been started, recorded way back in the 1930s era by a lady called Lily Kolisko in her book *Agriculture Tomorrow*. Lily spent her life researching Rudolf Steiner's theories concerning the effect of the moon on the growing of plants.

Amazingly she did a lot of plant research down in a specially constructed research well in England. What is of great interest to me and I would think to others is that she also recorded the soil temperature every day for many many years.

Lily's research seems to indicate that the best depth for a stable temperature range of 12 to 14°C was, if I remember rightly, at 2 metres. This temperature did not vary throughout the year, summer or winter, even though there was

snow on the ground. This research was done in England and I am not suggesting that it is the same in any part of the world or in any type of soil/subsoil, however, it would not surprise me to find that it was. What would be interesting and relatively simple to carry out would be for people across the globe to put down staggered chambered temperature tubes. Electronic thermometers installed in the different chambers could be hard wired up to a multi-stationed temperature recorder and display unit.

These tubes could be made out of rainwater down-pipe sealed at both ends and installed with an insulated top to them so the direct sunlight could not influence several of the top chambers. The probes could be left in the ground for ever more, giving a constant readout for years to come.

If one really wants to get technical, one could also install moisture probes at the different levels that would then corrolate with the temperature reading and show the effect of soil moisture and soil temperature. This would also be very helpful in soil research into the effect of humus and humus-less soil conditions, affecting all usages of the land from farming to horticulture and everything in between.

Also, the effect of different soil condition could lead to a better understanding of the effect of soil temperature/moisture and growing. So I hope that your readers can see that from a single research point of view, i.e. heat exchange, a large range of knowledge could be gained.

Regrettably my lifestyle at present prevents me from furthering this idea, however I would like to see it taken up by others as long as we can all share in the information.

I would like to thank Lance for a very interesting article and look forward to reading more from him concerning the utilisation of heat pump systems, because not only has soil heat exchange got applications in the home, but also in industry, for every degree of heating costs industry millions of dollars each year.

Malcolm Henry
Caversham WA

Rainwater tank heat storage

Andrew Blair made some very pertinent points regarding the heating and cooling capacity and value of a tank of rainwater in *ReNew 113*.

In summary:

1. For every 1°C temperature change in 1000 litres there is around 1kWh of heating or cooling available.

2. An air conditioner utilising this heat storage/sink source would benefit by a power saving of 1kWh for every 1°C change in 3000 litres.

Andrew then went on to highlight the inherent dangers of mis-matching heat exchangers on a particular simple system, i.e. a 3kW compressor with only an 8000 litre rainwater tank acting as its sole heat exchange. Unfortunately the letter concluded without exploring the outcome of a properly matched system.

The energy in these storages is there for the taking but you do need a modicum of ingenuity to access it. It took decades for management within industry to acknowledge that incremental efficiency changes across the board paid the biggest dividends; the same approach is necessary in heating and cooling buildings if we are to rein in our insatiable appetite for power.

Without going into endless technical detail, there are simple cheap and dependable ways to ensure that the temperature of water entering or leaving a system is within predetermined acceptable limits.

Water returning to the rainwater tank could go via a long loop of hose buried in the ground, thus dumping some of the gained heat on its way. The atmospheric heat exchanger would remain.

The whole point of this exercise is to utilise what energy is available and reduce the need to generate more power. It is not to suggest that it is in any way capable of delivering a total solution to any heating or cooling problem.

Whether it is taking the untapped heat from our rooftops, our sun rooms, outside wall cavities or rainwater tanks, we need it all; but we do need to do it at an acceptable cost.

Fortunately modern electronics is making that possible.

Terrence Thompson
Bright VIC

Solar toilet flushing

I loved your article on the solar powered toilet flushing system in *ReNew 113*. Here are some thoughts for you:

A great supplier of brass barbed to BSP fittings for hoses to pumps etc is Preston Bearings & Oil Seals. Also, Nightingale Electrics West Melbourne have the pumps you used at a similar price to ebay and a good range, with spare parts, all cheap.

When filling a toilet from a pump, make the pump's life a lot easier by removing the restrictor on the inlet of the float valve (it looks like a rubber spiral inside the inlet tube). Also for some float valves you can get a low pressure diaphragm so it will fill with almost no effort from the pump.

Toilet float valves are set up for mains pressure so this makes the pump work hard and use unnecessary electricity.

Bruce Jeffery

Thanks for those contacts, I am sure many readers will find them useful.

Another reader also emailed about changing the cistern valve over to run at a lower pressure using the Fluidmaster valves from Haron, www.haron.com.au/fluidmaster_products.html. I thought about it but didn't want to mess with it as it's a rental home and any changes I make I have to undo when I leave, assuming I remember them! But for non renters it's a worthwhile modification and could even eliminate the need for a pump in some situations.

Lance Turner

The natural pool cleaners

Using tadpoles to keep your pool clean can provide huge savings on chemical and power use, writes John Hermans.

For the last year our family pool has been home to hundreds of tadpoles, which has benefitted our household and the local environment. Having tadpoles has helped to eliminate energy and chemical use and propagates a multitude of indigenous frogs. An article in *ReNew 110* (*Easy Swimming Pool Filtration* p37) suggests alternative ways to clean your pool with a solar Floatron, resulting in significant energy savings, but consider turning your pool into a frog pond swimming pool and you can also save lots of electricity.

Before the taddies, I used to place a large sheet of black plastic over the surface of the pool each winter to stop any light from entering the water, which then minimised algal growth. This means I don't need to use chemicals or electricity to pump and filter water. Last spring, when the plastic was removed for the start of the hot season, there were already dozens of tadpoles in the water.

John Hermans happily at home with the tadpoles in his pool.

Keep the taddies

When I asked my two children whether or not I should run the filter and add chlorine, the answer was defiantly 'no', as they knew this would kill all of the highly desirable tadpoles and the potential to have our own frog breeding pond. As algal growth is most prolific in the summer months, I wasn't sure what the outcome would be, but I knew from previous years that as summer warmth and light increases, the concentration of chlorine diminishes and the algal growth soon starts appearing on the pool walls.

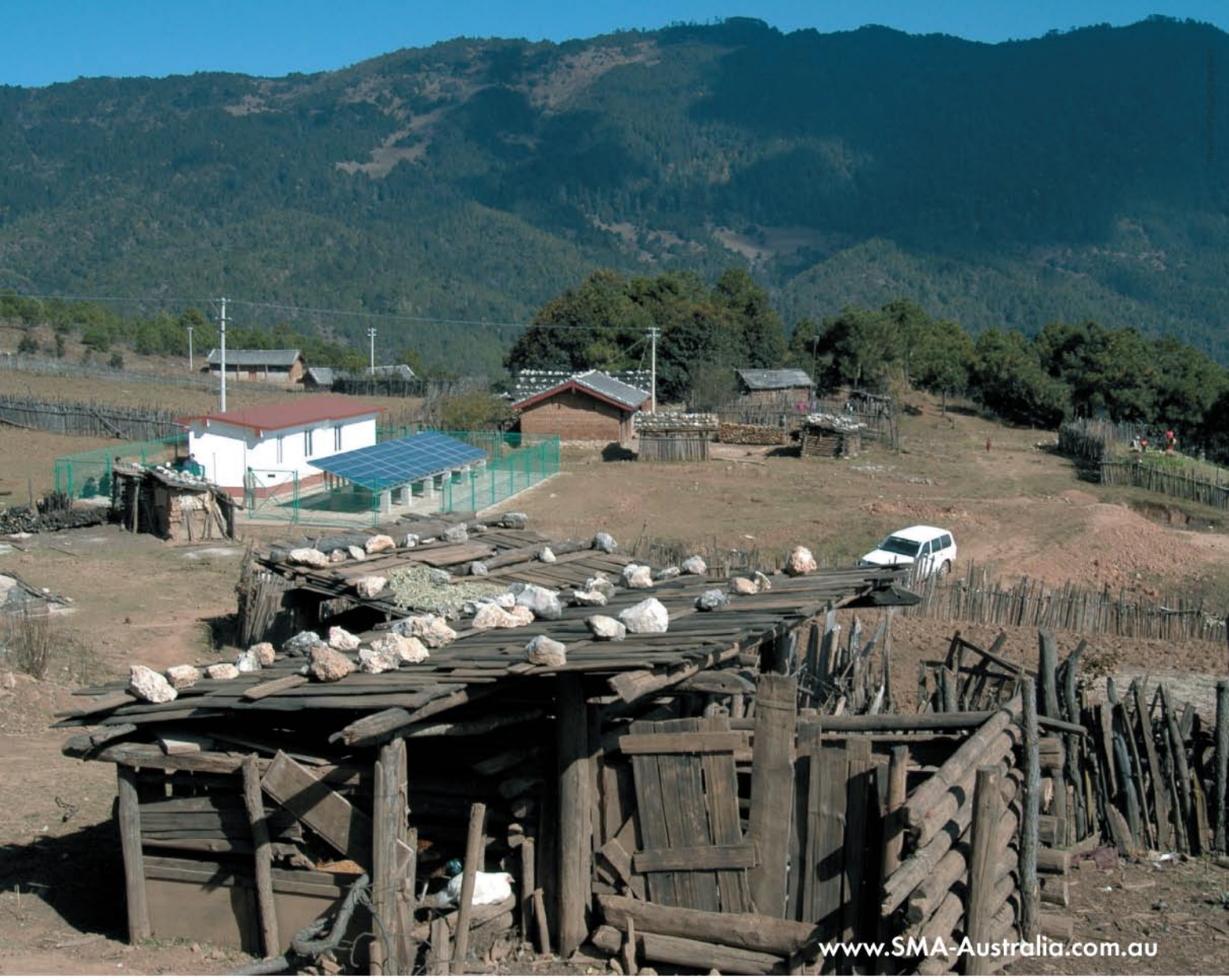
Last summer, with lots of taddies chewing away on whatever algae they could find, the water stayed crystal clear and algal growth was not easily visible. We were on an experimental adventure, using native wildlife to reduce our pool chemical and power use to zero and, as a bonus, boost the local frog population to a new high.

As each frog or tadpole species has a different food niche, finding the most suitable frog species to keep your pool clean could be hit and miss. In our case it was *Litoria Ewingi* (Southern Brown Tree Frog) that found our pool and since that first hatching of a few dozen taddies, their number has grown considerably. At times there were over 100, which is quite sustainable for a water volume of 20 cubic metres receiving filtered sunlight. This species of tree frog is the only one listed in my field guide that breeds all year round, so this is why I have had tadpoles in my pool right through the winter. In a confined vessel such as a pool, there is little to no predation of the taddies, so a high percentage end up metamorphosing into frogs. Once the frogs have formed they hop off to a new life, under leafage, singing and snapping up mosquitoes!

Instead of mechanically filtering the pool water, the taddies filter it and then drop the nutrients to the bottom. So there is still pool cleaning to do, such as vacuuming or siphoning off the organic build-up from the bottom, preferably into your garden, as we do.

When I did use chlorine (before the taddies) I only ever used a minimal amount, but chemical use is always a concern. My first swim preference is the dynamic ocean, then our local river, with its own aquatic life and compost bottom, and last of all a chlorinated pool, no matter how artificially clean it is. But now we are happy to swim with the taddies in our naturally filtered pool. ✻

For more information on natural pools read *Natural swimming pools* in Sanctuary 6, available from www.sanctuarymagazine.org.au



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The Future of Solar Technology

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The greenest street in the west

Households in this Fremantle street share a cargo bike, hold regular film nights and over 30 per cent own a photovoltaic system. Renee Thompson explains how this visionary community works.

Hulbert Street, a small cul-de-sac in South Fremantle, is fast becoming known as "Freo's sustainability street".

The green stats are impressive: 37 per cent of houses on the street are now connected to solar power and two thirds of its residents grow some of their own food.

It hosts an annual sustainability festival in September which, after only three years, attracts crowds in excess of 5000.

It's also home to popular carbon neutral bed and breakfast The Painted Fish, while monthly eco-film nights and regular street parties are held and often draw large crowds.

Even without the crowds, day-to-day life in Hulbert Street is a little different. Residents benefit from self-styled 'guerrilla' gardens; a number of inviting front verandas that double as communal gathering spaces; and a shared electric cargo bike that can be used to do the shopping.

More than anything else though, Hulbert Street is home to a community of people increasingly passionate about getting together and finding ways to live more sustainably.

Here's how the residents of this suburban street have created a more desirable place to live.

Residents with some of the first photovoltaic systems installed in Hulbert Street.

The Painted Fish

Opened in 2006, The Painted Fish has become a popular eco-tourism destination in Fremantle for holiday makers who can enjoy solar powered al fresco showers, access to organic vegetable gardens and the chance to learn more about sustainable living.

Owners Shani Graham and Tim Derby hold regular public open days at The Painted Fish on the last Sunday of each month so they can share sustainable lessons with others.

The buildings were retrofitted by Tim to be as carbon neutral as possible and include features such as a 1.12kW PV solar array, a solar hot water system and two large tanks that have the capacity to collect 14,000 litres of rainwater.

Living Smart

Hulbert Street's sustainable transformation began in late 2007 when Shani and Tim enrolled in a Living Smart course: a 10-week course that builds an awareness of sustainability issues and how to take action.

In 2008 they decided they wanted to teach the course to others in their neighbourhood and, two years later, at least half of the residents on the street have done the course themselves.

Monthly Living Smarties meetings inspire residents to bring their own ideas and discuss topics such as housing design and developing community.

Sustainability fiesta

Some ideas, such as the fiesta, gained momentum quickly.

It began almost by accident in 2007 when Shani and Tim decided to hold an open house and garden day at their house and The Painted Fish and 800 people attended.

Shani recalls that there was so much interest from people on the day, particularly questions about their grid-connected solar PV system, that it was the "first unofficial fiesta".

It was a natural progression to for-

malise the event the following year and it has grown bigger every year since, with most households in the street contributing with a street stall or two.

This year's fiesta attracted over 5500 people and involved local entertainment, artists, businesses and 60 street stalls.

But for Shani the idea isn't to increase visitor numbers—"we want people to do the same thing in their own streets."

Sustainability survey

"All it takes is one person in forty houses," is a popular saying of Shani's.

From this she means that an individual can have a positive impact on their own community and she hopes that the actions of Hulbert Street residents help communicate this to others.

This is the main reason they hired a behavioural economist to survey the motivations of attendees at the 2010 fiesta, by asking people about their motivations for going and what sort of sustainable actions they had taken.

"We wanted to make sure it was changing behaviours and we were thrilled," Shani says.

The results found that 70 per cent of attendees to the fiesta were new and, of those returning to the fiesta, 85 per cent could name something that they'd changed to become more sustainable since their last visit.

New ideas

At the end of this year's fiesta Hulbert Street pooled the money raised and purchased a pizza oven on wheels.

The portable oven will be used as a communal resource for future fiestas and events, with one resident planning to use it for a bread making class for the street.

The new Hulbert Street choir has added another event to the community calendar, the idea of a resident musician who wanted to have Christmas carols last year.

The choir was also a good opportunity for newcomer Jen, who moved into a house on Hulbert Street with her partner Damien about a year ago, to get to know people.

Top: The Painted Fish accommodation has plenty of louvres for cooling cross ventilation. Bottom: At work on one of Hulbert Street's twice-yearly planting days.

Jen says being part of the choir allowed her to share something in common with her neighbours and made it more comfortable to settle in.

"It's definitely more community focused and friendlier than any other street I've lived in."

Jen and Damien are currently building a veggie patch in their backyard that uses a new drip feed design that will be taught to other people in the street.

It seems living on Hulbert Street is encouraging Jen to do more: "the longer we are here the more we realise what we can do."

Transition Town influences

Although Hulbert Street makes no direct claim to be part of the Transition Town movement—a worldwide movement geared towards community sustainability projects—Shani cites the influence they have had and explains how Hulbert Street's achievements combine the prin-

ciples of the Living Smart course and Transition Town ideals.

"The main difference between the Transition Town movement and other sustainability movements or education is that it encourages people to think about the future in a positive way."

As an example of this, Shani wrote up and distributed a mock newspaper article for 2029, showing how Hulbert Street's accomplishments in the past had encouraged other people to make changes.

"It's about 'what sort of a future do you want?' because fear is not a motivating factor for people," she says.

Certainly for Shani and the residents of Hulbert Street, an empowering discussion about sustainability is not about providing a lot of information about how dire things are but about sharing successes and failures with others.

"Really all we are doing is sharing our journey with everyone around us." ✻

A Hulbert Street film night last summer

More info

To find out more about the Hulbert Street Fiesta go to www.thepaintedfish.com.au/hulbert-street-sustainability-fiesta-2010

If you're inspired to start a Transition Town visit www.transitiontowns.org or for the Australian perspective go to transitiontownsaustralia.blogspot.com/

To find out about the Living Smart course go to www.livingsmart.org.au

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POWER PERFORMANCE PASSION

A welcome retroblitz

The ATA is helping to make the Asylum Seeker Resource Centre water and energy smart, writes Jacinta Cleary.

Delamping a home is usually a relatively straightforward exercise involving one or two people removing unnecessary lights to save energy. Delamping a three level office building is a different story altogether, as was the case when 39 Alternative Technology Association (ATA) volunteers descended on the Asylum Seeker Resource Centre for a sustainability retroblitz.

Removing unnecessary fluorescent strip lights was just one of the activities, along with reviving the courtyard garden and the installation of water saving taps and a greywater system. The retroblitz, organised by Wendy Clarke and Kath Smalley, was part of 350.org's worldwide global work party. The group has a goal of only 350 parts per million of CO_2 in the atmosphere, so to raise awareness, and show others how it's done, over 7000 practical, energy saving community events were held around the world on the auspicious date of 10/10/10, with ATA's project just one of many inspired work parties.

First up was the difficult task of finding a suitable project for the ATA. A few options were weighed up, but the one that stood out was an energy and water saving retrofit of the Asylum Seeker Resource Centre (ASRC) building in West Melbourne. The ASRC is essentially a human rights organisation, providing aid and support to asylum seekers living in the community and in detention. Since 2001 the ASRC has helped over 7000 people seeking asylum via their advocacy work, welfare programs, medical aid or simply by giving food packages to families each week. They also serve up around 22,500 hot lunches a year to visitors to the centre.

Left: Damien Moyse reinstalls a fluorescent tube with a new reflector to improve lighting levels. Right: Simon Wilson and the new water saving tap for the kitchen.

Water smart

With such a busy kitchen onsite one of the first things to do was make it as water efficient as possible. Plumber Simon Wilson installed a WELS-rated 4 Star 'lollypop spring' water saving tap, with a flow of 7.5 litres per minute. The tap is suited to commercial uses and can easily be switched between regular flow and water saving spray mode. The ASRC kitchen staff has since given the tap the thumbs up. Simon's other jobs included fixing a water wasting urinal, potentially helping to save thousands of litres of water a year. Unfortunately all toilets in the building have a commercial-style flush system which has no accessible cistern. This means that weights can't be installed to reduce the amount of water flushed.

The aim is to reduce the ASRC's water use below 256,000 litres per billing period. It's currently higher than that, so a higher rate is charged per kilolitre.

Lights out

Meanwhile around 20 volunteers set about a major lighting efficiency project, delamping at least a hundred fluorescent boxes in the building. With the electricity turned off, volunteers firstly removed the diffuser, sending it to a diffuser washing team. Next the two fluoro tubes in each lighting unit were removed; only one tube would be placed back in the light fitting, so an all-important reflector was installed in each unit, making the single light work better and brighter by reflecting more of the light.

With so many volunteers on hand problems could be easily solved as they appeared. It turned out the reflectors were too long, so the reflector taping team—a group who had been placing double-sided tape on the back of the reflectors so they would stick within the lighting cavity—started cutting the reflectors to size instead.

The retroblitz was the same weekend as the ATA's Branch Convenors Conference, giving ATA representatives from across Australia a chance to share experiences, plan or partake in more practical matters such as lighting retrofits. ATA Melbourne Branch convenor Tim Hamer worked alongside ATA Cairns Branch convenor Daryl Douglass to form the 'test tube' team, weeding out the faulty fluorescent tubes. The tubes were all removed when the power was off, hence the need to test each one. Tim placed the fluorescent tube in the T8 portable light fitting while Daryl turned the power on at the wall, adding some speed to the process while the pile of tubes for testing grew. At least 50 tubes were found to not work, with the faulty ones recycled as part of the Detox Your Home program instead of going to landfill. CMA Ecocycle, who specialise in recycling waste containing mercury, collected the tubes from a local tip.

The duo found some triphosphor tubes in the mix, which have a much higher output than regular fluorescent tubes, so these were placed over a set of computers used by visitors to the centre.

In the afternoon all hands were on deck to dry the washed diffusers, after all, no one wanted ASRC staff to come back Monday morning to lights with no diffusers over them. Diffusers are large, flat cumbersome things that are difficult to dry with a tea towel, so volunteers combined tea towel drying with solar drying, with Daryl Douglass setting up a solar drying station on a neighbouring property with good solar access.

By the end of the day two levels of the office building were successfully delamped, hopefully cutting the lighting energy use of the ASRC building by 50 per cent. Event organiser Wendy Clarke noticed the better light quality at the end of the day: "The light was much brighter, the painted walls were brighter as well. So just cleaning the grime off the diffusers, which was probably 30 years worth, made a difference."

Garden and greywater

The ASRC has a narrow garden courtyard, the site of at least one failed vegetable garden previously. As food preparation is such a vital part of the ASRC, ATA volunteers set about rejuvenating the raised garden beds so that the kitchen could have a ready supply of herbs and salad greens. Heather led the garden group and by the end of the day the mulched beds looked healthy again with donated seedlings such as lettuces, mint, parsley, rosemary, chives, cucumber, aloe vera and lemon balm.

The foundations for a greywater irrigation system were laid, with purple greywater hose (mandatory so people know greywater is in use) delivering water subsurface to the plants. The centrepiece of the system is a nifty 24 litre barrel-like container, which is filled up with greywater from, say, washing vegetables in the ASRC kitchen, with this water then distributed to the plants via purple hose. The system is called a Direct to Root Garden Watering System and is available from Tonjac Global Hardware.

It's not over yet

The ATA will work with the Asylum Seeker Resource Centre for at least one year to make their building as sustainable as possible. Another working bee was held on December 5 to install two donated simple direct diversion greywater systems, complete the lighting retrofit and draught sealing. To get involved, or to donate, contact Wendy Clarke via wendy@ata.org.au

And thanks...

While a project like this went smoothly on the day, its success lies in the planning and the generous support of individuals and businesses.

Thank you to HAC Australia, SolaRonin, Green Makeover, EnergyLeaks, Green Electricians, Eco Master, Naturelinks Landscape, Tonjac, ecovantage, Methven and EnviroShop. There were donations of herbs, organic compost, T8 fluorescent tubes from schools that have switched to LEDs, plumbing services and all-important 350 cake on the day. Cash donations helped buy the water saving tap and one ATA member even offered his DIY double glazing services. Best of all people offered their advice, such as one ATA member who was very knowledgeable about light reflectors. ✻

Hard at work on the new garden.

Further information

For more photos of the retroblitz, including the lighting retrofit, go to www.renew.org.au
To see the ATA retroblitz on the 350.org website go to www.350.org/node/18818
Visit the Asylum Seeker Resource Centre website at www.asrc.org.au

More 10/10/10 action

Another ATA 10/10/10 event was held in Geraldton in Western Australia. Gwyn, a local ATA member, and John Knox, an ATA staff member riding around Australia to promote climate change awareness, gave away copies of *ReNew*

ReNew's green landlords

Meet the winner of our Green Landlord Award and find out what really prompts investment property owners to take action.

Tenants all wish they had one, but unfortunately there are not enough to go around. While they are not common yet, entries to our recent Green Landlords competition suggest that water saving, energy smart landlords are emerging.

Last issue we invited green investment property owners to send a description of what they've done to make their investment property more water and energy efficient for tenants.

Entries were judged on the environmental benefit of these retrofits and the initiative shown. There was no doubt that most were full of bright ideas, including the home where tenants put a sign on the garage door indicating if the solar hot water electric boost is on or not. Several indicated that being a Green Landlord doesn't stop once a house is retrofitted then leased, with one organising a Climate Smart Home Service so tenants could track their energy use and another encouraging tenants to sign up to GreenPower.

While most landlords said they were acting volutarily, making the home more energy and water smart because they believe it is the right thing to do, we want to find out what the incentives and barriers might be for the greening of Australia's rental homes in years to come. Do rebates help? Are investors receptive to improving their rental properties? And can real estate agents assist? We'll be looking at this in more detail next issue with the release of an Australian Housing and Urban Research Institute report about sustainable rental housing.

Until then, meet more green landlord entrants at **www.renew.org.au** as they share their rental retrofits.

Green Landlord winner Shane Merrick at home with his three-month-old daughter.

Green Landlord winner Shane Merrick

My wife and I are very keen to help the environment as much as possible where we can and decided to reduce the footprint of our Hampton investment property for future tenants.

Water saving

We installed a greywater system so the shower water is diverted directly onto the garden bed where it soaks into the sandy soil. This helps to keep all the plants and ferns alive, even during Melbourne's hot summers. We've also diverted the downpipe water into the front garden beds, meaning the front garden is now virtually maintenance free when

Photos: Shane Merrick

Shane's rental property retrofits (clockwise): the old and breezy non-insulated tile roof being removed to install aircell insulation and batts; bathroom walls packed with insulation; one of the downpipe diverters which waters the garden with rainwater; the roof-top SolarVenti warms and circulates air in the front of the house during winter.

it comes to watering. Native plants were planted around the house and have survived really well, with the shower and downpipe water being the only water they receive.

A dishwasher was installed to reduce water use as we found out that dishwashers actually use less water than hand washing. Some people are concerned that dishwashers use too much power, so we bought a model with an eco wash cycle that uses considerably less power than the standard cycle. Low-flow shower heads have also been installed.

Insulation

Double insulation was added to the upstairs attic room, with aircell placed under the colorbond sheets as well as polyester batts in the roof and walls. With this amount of insulation, upstairs no longer needs heating in winter, as the heat rising from downstairs is more than enough to keep the place warm. Door seals were added to reduce any drafts.

Solar hot water

A gas boosted solar hot water system was installed, so for about six or more months of the year the tenants have free hot water when the gas boosting is not used. The system uses minimal gas, so much so that the gas company thought the meter must have been faulty and came and replaced it. The meter was not faulty and the tenants continue to enjoy very low gas bills.

Solar air flow

We installed a SolarVenti unit in the lounge room to help warm the house and circulate fresh air, mainly during winter when tenants often have all the doors and windows closed.

Smart lighting

Energy efficient light bulbs have been installed throughout the house. A single light bulb hangs from the centre of the ceiling in each room with an energy efficient fitting; we can turn on all the lights in the entire home and use less than 200 watts of power. I don't know of any other house in Melbourne that can make that claim.

Another small thing we did was install a clothes line so the tenants don't need to use a clothes dryer. We stayed in the house while making it more eco friendly, so we could be sure that all the changes were easy to live with and worked properly.

Green Landlord winner Shane Merrick wins two 65 watt, 12 volt solar panels valued at $700. A special thank you to www.lowenergydevelopments.com.au for the prize.

ReNew Green Landlord Finalists

Sarah Lamshed and Sarah Burrowes' tenants receive a feed-in tariff from a household PV system

Photo: Aussie Kanck

WE OWN a delightful single-fronted brick three bedroom house in Brunswick and rent it out to three excellent tenants who share our passion for looking after the environment. Before we rented it out we changed all the incandescent light bulbs to energy saving globes plus retrofitted all the halogen downlights from 50W globes to 20W. These modifications reduced the lighting demand for the house by over 1000W.

At the same time we installed water saving shower heads in both of the bathrooms. Then most recently we installed a 5000 litre rainwater tank, diverting the majority of the roof runoff into the tank, which we had plumbed into the laundry (washing machine) plus one of the toilets. This reduces the demand on Melbourne's potable water supply and improves the water quality entering our rivers and creeks by reducing urban runoff.

At around the same time we installed a 1.4kW solar power system on the north facing roof. What's unique about our solar system is we haven't sold our RECs, as we want our system to be a positive environmental contribution over and above that of the Federal Government's target of 20 per cent solar generation by 2020. Our tenants gain most of the benefit from the solar system through selling the power they generate to their electricity retailer as a feed-in tariff.

Lastly, we also provided a hand mower instead of a petrol one for the tenants to maintain the lawn and have strongly encouraged them to buy GreenPower and Green Gas—at last check they'd done both! Taking action on climate change can't wait and we felt we needed to 'do our bit' now rather than waiting for someone else to solve the problem.

Ngaire McGaw nominated Justin Clareburt for the Green Landlord Award

HERE'S WHAT Justin has done to improve his property at Durack in Queensland

- Installed a rainwater tank and connected it to the toilet; it's also used to water the garden and other outdoor uses
- Replaced all light bulbs with CFLs
- Replaced both shower heads with 3-star water efficient shower heads
- Fitted water saving devices to all taps
- Installed a dishwasher in the home to reduce water use
- Organised (and paid for) Climate Smart Home Service so that the tenants can monitor their energy use
- Rejected several requests for air-conditioning in the home
- Ensured that the home has adequate ceiling insulation throughout
- Personally visited and advised the tenants about how to reduce energy and water consumption in the home
- Encouraged tenants to build a vegetable garden for local food production
- Passed on water bills to tenants and encouraged them to be conscious of their own water use.

Justin is hoping to install solar hot water as the next phase in the property's development but has been juggling other commitments in 2010 (such as retrofitting his own house) and dealing with his own job uncertainty associated with the collapse of the Green Loans program and the transition to the new 'Green Start' program.

On top of these efforts in his own life, Justin has done many hours of community volunteering for around four years. He was a well-loved critical member of Sustainable Jamboree's team that was one of three finalists in this year's Premier's Climate Smart Sustainability Awards. Justin led a dynamic team of volunteers to deliver The Low Carbon Diet Program to the Centenary suburbs in the West of Brisbane, which achieved 1.2 million kilograms of CO_2 reductions across more than 230 households.

Isabel Guller nominated her landlord Ms Helena Bender for the Green Landlord Award

TO IMPROVE energy efficiency my landlord has converted lights to CFL globes in both of her properties. She has also bought floor lamps that take CFLs rather than use the downlights that are spread throughout the house.

In summer she installs Renshade on the windows to minimise the solar radiation penetrating; we keep the blinds down during the day and lift them up at night and we use fans to keep the air circulating.

She had insulation (foil board) installed under the floor to reduce the heat loss in winter and reduce heat infiltration in summer.

She installed a folding clothes line so that we can sun dry our clothes rather

than use the dryer that came with the house.

She installed a solar hot water tank back in 2004, and realised this year that the electric booster to the tank can and should be turned off, unless there has been a run of overcast or rainy days. She has us using a pre-loved envelope label on the garage door handle to advise if the electric booster is on, or if we are running on solar only.

Earlier this year she converted all the flimsy light cotton curtains to roman blinds with pelmets to reduce the heat loss in winter.

She's made sure that we all have hot water bottles to keep our feet warm on cold winter nights, and although it means wearing a beanie sometimes, she keeps the electric heating panels to 17°C when we're home.

To improve water-efficiency all taps have flow regulators on them. The shower heads are flow efficient and can be easily stopped while lathering is done without losing the ideal temperature settings for when the water is turned back on.

She installed a water tank in July so that the downstairs toilet, shower and sink are now plumbed to the tank.

We collect the greywater from the laundry and have set up our own water plant filtering system before the water is used on the veggies and lemon trees.

To reduce waste my landlord has installed a worm farm that we feed regularly, reducing the amount of food waste that ends up in the bin.

We have a separate box for recyclables and she regularly salvages things from the bin to reuse, such as wine bottles that she fills with water and sits on the window sills in her room to store heat, and plastic drink bottles for making a solar hot water heating panel for her second property in Warragul.

She keeps all the paper bags and plastic bags that come into the house and gets us to use them for the bulk items we purchase at the organic grocers. We refill bottles with oil, soy sauce, honey and the like at the food cooperative rather than throw them out. She's also been encouraging us to take plastic containers to the market when we buy cheese, fish or meat, rather than getting another plastic bag.

Photo: Nick Stephenson

We have been slowly building up our own veggie garden inside and out. She's helped by purchasing or finding materials for the raised beds. ❋

Some landlords wrote to us about investment properties they have designed and built; we will feature these in *ReNew* in 2011.
View more entries at www.renew.org.au

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Once a factory, now three homes

An old factory, and the contents of building site skip bins, have been recycled into sustainable community dwellings, writes Jacinta Cleary.

"I spent $1200 on hinges, there's that many doors and windows in this place," says David Murphy. I'm surprised at the expense, as it's the first time I've heard David mention buying materials when building his house; almost everything else has been salvaged from demolition sites (with a slab of beer for the work crew), bartered, or came from the factory that used to be on site.

It does confirm there's a lot of ventilation in this house, though.

If ever there was a project that television's Grand Designs team should have followed, it would be this three house development in Newport in Melbourne's inner west. As David's partner Penny Baron puts it: "Dave just kept so much in his head," such as ideas, designs and plans for "just what to do with that piece found in a skip bin." This unique project took eight years to complete, is largely constructed with recycled materials and leads the way when it comes to low impact living.

Photos: Nick Stephenson

The front view shows all three houses benefit from a wide northern frontage.

The original factory

It all started around ten years ago, at the time Melbourne's property prices rose 30 per cent in one year. Like many, David and Penny tried to buy a house, withdrew after a failure or two, and then returned to the market with new ideas. David stumbled across a 1980s brown brick factory and was lucky to buy it at a mid-week auction. The site runs east-west with a long, sunny northern frontage.

David and Penny found two other parties (already friends of theirs) to buy into the housing development and the property was split into three titles of 25 per cent, 20 per cent and 55 per cent of the total land size. While there is no commonly-owned area, the three groups agreed that the development should encourage the sharing of resources and space. All three of the properties share a very edible front yard for instance. Underground are two 10,000 litre concrete rainwater tanks, saving precious garden space, with the water directed to all three properties for toilet flushing, laundry and watering produce.

A Memorandum of Understanding was talked about between the three parties, although they are "so like-minded" that there has been little need to pursue it or other visioning exercises. Common goals include minimal use of resources, the sharing of resources and spaces, helping each other through life cycles such as child rearing, illness and ageing, and actively engaging with the local community. They're not oblivious to changes in circumstances; down the track they recognise that one party might want to sell their home, agreeing that the two other parties can take six months to find a suitable purchaser before opening it to the market.

The house designs had to make best use of the factory site, so it was agreed to build all three dwellings against the southern back wall of the factory, providing a wide northern frontage for full solar access and healthy and abundant front yard food gardens.

From here, it was time for the housing design and planning stage, with two of the households engaging the same architect Paul Haar, along with Rohan French from Carm Constructions for the build. The third property was designed and largely built by owner David Murphy, bar some assistance with plastering, brickwork and the electrics.

Inspired recycled home

David describes himself as "a magpie by nature," scavenging and finding new uses for discarded materials. He walks to a small deck off the rear of the kitchen and throws some compost scraps down



Left: timber kitchen cabinets from an old medicine faculty; Middle: David Murphy with the worm farm made from a dishwasher; Right: Flynn with his pirate ship bed made from salvaged timbers.

a white PVC pipe that drops a few metres to a ground floor internal courtyard. At the base of the pipe is an old dishwasher; inside it's full of worms and rich compost for the garden.

David says he would lie awake at night working out what to do with pieces he had salvaged, contemplating which part of the house to use them, whether he had enough materials and importantly how to use them beautifully. "It was a constant struggle to use materials in the most efficient and aesthetic way." The dishwasher worm farm might have come from one of those late night sessions; it's novel but pragmatic at the same time, getting rid of the scraps at the source but making sure the worms are kept cool in the downstairs courtyard, rather than just putting the dishwasher on the top deck.

Before doing away with the factory completely, David worked in it for over a year prefabricating parts of the house such as the doors and windows, steelwork, staircase and the kitchen, as well as the kitchen for neighbour Kate's house. David's new workshop is an original part of the factory.

In David and Penny's house an estimate of 60 per cent of the new house was made up of recycled or reclaimed materials, with most of the roof structure of the old factory in use as joists, roof beams or structural steel. Metal cladding from the factory has been used to cover the back of the house, with David estimating it might have cost $3000 with new materials. The only visible timber that was bought for the house was some hardwood and ply for the four downstairs internal doors that David made, adding some recycled merbau packing crate as beading.

David used to live near Melbourne University, with any renovations there providing rich pickings for a man with an appreciation for fine building materials. He says the best parts come at the start of a demolition, for instance he was able to salvage whole timber cabinets from the medicine department which are now a feature in the kitchen. Over 100 metres of Kauri science benchtops from the old microbiology building have been used extensively throughout the house, especially for internal timber features, with David working around the sink holes. He also secured a lot of old cupboard doors from that department, the inside of which were silky oak—they are now inside out and on full display in this new home.

The same demolition crew were working on a high-rise legal chamber in the city and gave David a "heads up" regarding some bookcases; they turned out to be hardwood, which he used for the inside of the steel framed doors and windows.The 42 metres of sills in the home are made from teak, salvaged from a skip during building works at the Melbourne University pool.

Other sources of materials include the Ponsford Stand seating (complete with numbers) from the MCG for handrails and old plywood boxes from the Warrnambool cheese factory, which are the perfect size for kitchen cabinets. Abalone shells were mixed into the concrete slabs, making the floors a piece of art with pearly-pink highlights; the shells had been sitting abandoned in a pile at a nearby industrial site for years.

Some of the external cladding is from second-hand timber yard Yarra Timber Salvage, and is somewhat preloved with holes created by the seawater Teredo borer—needless to say the timber was sourced from an old pier. Interestingly,

David doesn't think he saved much money by searching high and low for cut price or dumped materials, due to the extra time it takes and the increased labour costs involved, although the final result would have been impossible on his budget if he had had to buy the finished timbers that he has used.

DIY double glazing

David says the windows were the most ambitious part of the house. He found some crates of toughened glass in a second-hand yard in Campbellfield. The glass couldn't be cut so he had to design the house around the glass, sending it off to be double glazed once all the decisions had been made. The windows are a highlight though, especially the high operable windows that use auto gas struts and bespoke catches to open them.

The bedrooms are cleverly positioned downstairs so they stay cool in summer, and with full winter sun streaming inside in winter the living areas heat naturally. With high levels of insulation and loads of ventilation the house can adapt to any season. While the 1kW photovoltaic system is fully operational, future projects for David include piecing together a solar hot water system, parts of which came from another Melbourne University skip.

Operable windows with the old pier external cladding in the background.

Recycled kitchen, featuring old science benches and cheese factory boxes.

Over at Cathy's

Next door, the size of Cathy Nixon and Jamie Crickmay's two-level home designed by Paul Haar is deceptive; being on the smaller block of the three it has a small footprint of roughly 10 metres by 10 metres, but with a light-filled upstairs living area which opens on to a deck and a light well that illuminates an internal courtyard on the ground level, the home feels a lot larger.

The homes are designed to last and to adapt to the various stages of the owners' lives. Cathy and Jamie could move to the ground level if the stairs become difficult to negotiate when older, and lease the upper level. Some downstairs walls are even non-loadbearing to al-

low for removal.

Like neighbours David and Penny, Cathy and Jamie's home includes a large amount of recycled materials. By designing and building at the same time as their neighbour Kate, they saved on the cost of these materials. Starting with what was already available on site, the concrete from the factory demolition was delivered to Alex Fraser Group in nearby Spotswood for recycling. The mix for the new concrete slabs and footings included a coarse aggregate of 30 per cent recycled crushed concrete, a fine aggregate of recycled concrete crushing dust, and cement which contains 40 per cent fly ash and/or slag from steel foundry waste. Recycled truck and batch plant wash-down water was used to mix the concrete.

Inside Cathy and Jamie's home with an array of recycled timbers on display.

Careful timber selection

As well as recycling bricks from the factory and dry-pressed red bricks from elsewhere, Cathy and Jamie's home includes many carefully selected recycled timbers. Paul Haar says that ecological impact when selecting timber was paramount, giving preference to recycled stock over salvaged tree wood, with native species plantation wood considered

Three different homes with similar sustainable features

WHILE two of the homes were designed by an accomplished sustainable architect and the third by an inspired sculptor and carpenter, there's a uniform approach to commonsense water and energy saving features.

Photo: Paul Haar

Electrically controlled double glazed louvre highlight windows with a rooftop solar water heater, and a PV array in the distance on an adjoining house.

Light and ventilation

All three homes have a considerable number of doors and double glazed windows, giving more connectivity to the outdoor spaces. "One of the most important things was to have light and a view," says Penny. Timber window framing has been used throughout, offering better insulation than aluminium frames. Looking up in all three homes are high operable windows, which assist summer ventilation.

All homes have light wells close to the long southern boundary to deliver light to the rear of the lower levels, and in turn providing internal courtyards. The Paul Haar designed homes incorporate fan-assisted ventilation shafts and some electrically controlled louvre windows.

Wall and ceiling insulation

Paul Haar says that the external brick walls were constructed thicker to allow for thicker EPS foil board cavity insulation. In the roof, 160mm thick R3.5 polyester batts were used with sisalation. The upstairs floors are fitted with R2.5 polyester batts to reduce airborne noise and heat transfer between

From Cathy and Jamie's front door is a view to an internal courtyard at the southern end, helping to brighten a potentially dark part of the house.

next, then exotic species plantation wood, with native regrowth forest wood considered last. Australian old-growth or rainforest wood as well as any tree wood harvested overseas were not an option.

Timbers used in the homes include:

- Seasoned Radiata Pine from Victorian plantation forestry for most wall and roof framing
- Green Monterey Cypress salvaged from Gippsland farm properties for balcony posts, pergola beams, weatherboards and decking
- Tempered masonite hardboard made from sawmill waste and forest thinning, and press-formed with pressure and heat only (meaning no glues were added) was used for some external claddings and eaves linings
- LOSP treated finger-jointed Hoop Pine sourced from Queensland plantations and select grade recycled Blackbutt were used for windows and external door frames
- Reclaimed Karri, Messmate and Kauri Pine were used for the floorboards
- Select grade recycled Victorian Ash was used for internal glazed doors and joinery
- Some external wall cladding, internal wall lining and cabinetry was done with Hoop Pine plywood.

At the moment Cathy and Jamie spend most of their time in the sun-drenched upstairs living area that opens on to a balcony hovering above one very healthy vegetable garden. The result is a modern sustainable home, nestled amongst other like-minded households. ✻

Thanks to Nick Stephenson for the photography

DIY hydronic heating pipes (right).

upstairs and downstairs.

In the other house there's R3 insulation in the walls and up to R5 in the roof, with David finding some recycled cotton batts made by Tontine, more commonly known for their pillows.

Thermal mass

Two of the homes have exposed concrete slab floors for thermal mass and all three have internally exposed brick walls.

Heating

High efficiency gas powered hydronic panel radiators are installed in living and sleeping areas. In David's house raised concrete platforms on the lower floor, a DIY wall-mounted system in the bathroom, along with a 50mm screed of polished concrete on top of a plywood floor upstairs are all heated hydronically.

Solar hot water and electricity

In two of the homes water is pre-heated by rooftop solar water heaters and stored ready for boosting on demand by the same instantaneous gas water heater that fuels the hydronic space heating system. One house has a 3kW grid-interactive photovoltaic system consisting of 18 Schott Poly 170 24V panels and Fronius IG30 inverter, another has all necessary rough-in wiring laid for future installation of a similar system, and another has a 1kW TXSR system with a 1100W Sunny Boy inverter. LEDs and CFLs have been used, with a focus on task lighting so that general room lighting can be minimised.

Water

The three houses share two 10,000 litre underground rainwater tanks and each household has its own greywater system in place. "In the gardens, as a general rule, residents draw from and deplete greywater supplies before rainwater supplies," says Paul Haar. Ideally they would have had one greywater system for the three homes. "The group was certainly challenged and frustrated by the technical complexities, many authority constraints and overwhelming costs associated with design and installation of a state-of-the-art collective water management system for the three dwellings," Paul comments. For further details on some of the problems involved visit www.renew.org.au

Tips for a zero emissions home—with a hothouse

In issue 112, *ReNew* visited John Morgan's high-rating 9 Star home. John shares the principles that helped him design to such a thermally-efficient standard and shows us his new space heating hothouse.

There were two levels of thinking leading to the design of Galaxy Hill. The first was simply the aim of having a low cost comfortable retirement home. Then it seemed likely that such a home would be a low energy consumption place and that it could make a real contribution to the climate change issue.

This second consideration loomed even larger as it became clear that politicians would be treating the problem as a political rather than an environmental one.

The basics of thermally efficient building design are well known; they have been listed and discussed in books for years. It seems that for some strange reason they are just not generally implemented all together or in full. Perhaps this is due to a tendency to build down to a price rather than up to a standard?

The three principles of thermally efficient building design are GMI.

Photo: Nick Stephenson

Photo: John Norgan

Top: Taken earlier in the year with the frame in place for the hothouse. Bottom: John and the completed hothouse with a small solar module that powers the hothouse fans.

G: Glazing

Windows are 'holes in the wall'; glass in the window will generally keep the rain out but heat can pass readily through. We want to keep summer heat out and winter heat in so at Galaxy Hill we have used double glazing. In addition, the windows have internal screens 'velcro-ed' across the top to seal against convection and external shutters to add to thermal insulation. We have made sure that the window and door frames actually fit tightly into the wall structure, so there are no 'leaks' through mini cracks in the wall.

M: Mass

In particular, thermal mass, where the solid material is there to lock in heat, whether it is also structural or not. Note that the external brick wall on a conventional brick veneer house is non structural. It is essentially just for show. It also allows moisture to seep into the cavity which may be undesirable.

At Galaxy Hill we have built a reverse masonry veneer house. The external wall cladding is in the form of timber laminate with very little mass. Thus it doesn't retain heat overnight in a hot summer and it keeps moisture out completely!

The internal thermal mass wall stores

thermal energy and in the process keeps the temperature stabilised to a narrow, comfortable range.

I: Insulation

The best value for money of all the 'low-tech' ideas.

1. The concrete slab is insulated around the periphery with sheets of polystyrene. There is a view that polystyrene should be seated under the edge of the slab as well; this may be a good idea but we are not yet convinced of it.

2. The external stud walls are filled with fibre insulation. There is the usual sarking on the outside of the frame, but on the inside we have reflective foil facing inwards. This is meant to reflect heat radiation from the internal wall back into the house. It is likely however, that this feature will degrade over time due to the accumulation of dust.

3. Ceiling/roof insulation. There is no roof space in this house. The ceiling and roof are separated by the width of the rafters and the battens. This space is filled with fibre insulation (R4) between the rafters and then the standard foil-backed blanket (R2) across the rafters and under the iron.

These techniques are well known, are simple to do and are known to work.

External finishing

The external cladding is painted 'April Sky', a colour almost white, with just a tinge of blue. This is designed to have a high albedo to reflect as much solar radiation as possible. The roofing iron is a 'Shale Grey' colorbond for the same reason.

The 'April Sky' is also part of the bushfire protection plan—to limit the possibility of radiation causing heat in the building skin. Also, as part of the bushfire plan, we have fitted external shutters to all windows that face the bush (there is no vegetation on the property but there is on adjacent properties). We have configured these shutters to act as thermal insulation during winter as well.

Design simplicity

We have made a point of not using any special or 'high tech' features. There is also no effort made to achieve special architectural style or effect. This is a technical exercise to ensure that we have a comfortable house for retirement and one that costs virtually nothing to run.

Sustainability considerations

It is sometimes difficult to find what is meant by sustainable architecture or sustainable living. It seems to depend on who you speak to. We have considered that the business of living involves consuming. Therefore, how and what one consumes is a significant consideration. Energy consumption is a very large factor in this equation, so we have decided to base our energy consumption on that which is provided free of charge every day from the sun. Radiant energy from the sun is external to the earth so by using it we are not extracting any of the earth's resources. Indeed we have an unlimited resource.

Thus the sun is the energy source for heating the house and for electrical power.

Three suitably-sized windows placed along the 'front' face of the house collect radiation from the sun and progressively feed it into the internal fabric of the building. This wall faces northeast so it catches the first stream of energy from the sun in winter. In summer, the sun rises in the southeast and the windows there are protected from it by the shutters.

Due to the orientation, the sun penetrates the front windows during the winter mornings but not later than that. So we have placed a hothouse on the northern corner of the house to act as a space heater as well as a greenhouse (we cannot compete with the kangaroos in a vegetable garden). The hothouse has floor-to-ceiling glazing facing northeast and partial glazing to the northwest.

A set of DC fans is fitted to the wall so that warm air from the hothouse can be directed into the house through a window. The fans are powered by a small solar module. In full sun, the fans run at rated speed, but under overcast conditions the module voltage will drop off and the fans will slow down. This sub-system is thus self regulating.

The physics of the hothouse

Most of us can probably remember from school days a couple of the basic rules of heat transfer.

1. Heat travels from a hot body to a cool body—not the other way around.
2. For a given amount of heat, the temperature change is inversely proportional to the mass of the object. That is, the more massive a thing is, the less hot it gets!

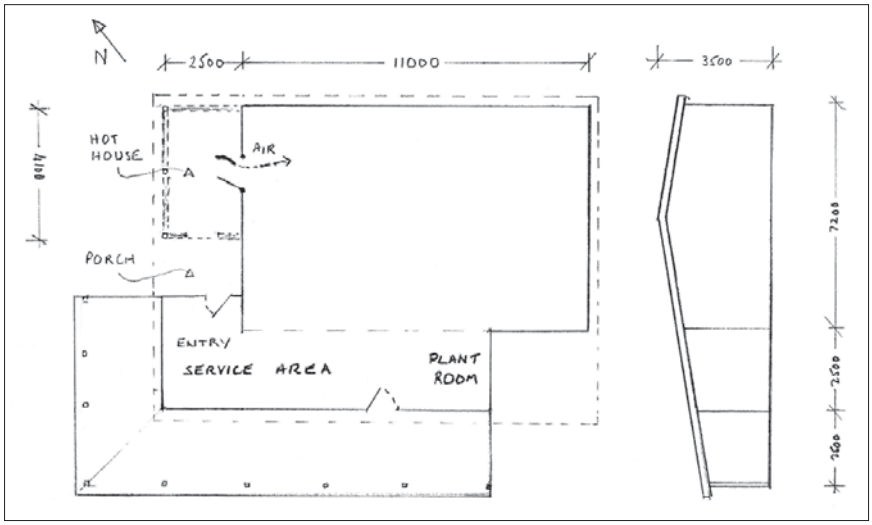
Solar radiation is surprisingly intense or powerful. For much of the day, the sun's intensity could be around 1000 watts on every square metre. So if the sun shines through, say, six square metres of hothouse, that is 6000 watts into the building. The hothouse has very little thermal mass so this energy heats up the air. Of course, a lot of this energy is lost through the glazing (by conduction) but if the warm air is moved into the house it can be put to good use. In the house, this air is much hotter than the building so it soon loses heat into the walls (rule no 1). Because the mass of the walls is so great (lots of concrete blocks) the temperature of the wall rises very little (rule no 2). In fact it would take a long time to really heat up the inside of the house. But it will happen over time.

This heating system is at its best in the autumn months just before winter with the internal fabric of the house becoming quite comfortably warm.

It is important that the warm air is 'drifted' into the house rather than 'blown' in, because air blown across the skin feels cool, even if it is warm.

During winter the hothouse is less useful but can be relied on to do a little

"We have placed a hothouse on the northern corner of the house to act as a space heater as well as a greenhouse..."



useful 'topping up' on the few good days.

Again using the dictum that radiant energy from the sun is fully sustainable, we chose to power the house using this resource.

It can even be considered as nuclear energy, where the fusion reactor is located at a safe distance of 150,000,000 kilometres. There is no nuclear waste problem and there is no charge for the resource. It is delivered free of charge every day without fail, although sometimes in lesser amounts. We expect the latter, so are prepared for it.

The energy is collected each day by an array of panels.These are arranged in two structures, some facing the front (northeast) and some the side (northwest). During the shorter days of winter the set facing the front collects energy right from the rising of the sun. The moving sun is around to the side of the house within about an hour of sunrise so for the bulk of the day in winter, the sun is active on both racks of modules.

At the end of the day, the set of modules on the side will be getting a good boost and this is in time for the 'all electric' cooking schedule. We have in effect a 'synthetic' tracker.

Current from the roof is stored in a large lead-acid battery where it is available to a suitable inverter for supply of standard 240VAC to the house. There is about a week's supply of energy in storage so, in the unlikely event of damage to the roof array, we have a week of uninterrupted supply to get things repaired.

Our average daily electrical demand is about 4kWh. In sunny conditions, we can expect at least this much and most of the time in good weather 10kWh has been regularly measured. In really dull wintry times we can make up any deficiency with a conventional generator.

Water is heated by a well-designed solar unit which has a booster powered by LPG. This is used over a few weeks each winter.

There is plenty of (free) electricity throughout the year so we have configured the domestic infrastructure to be fully electric. We have an LPG stove but rarely use it. Cooking is done with a range of appliances including microwave, electric frypan, electric skillet pan, slow cooker, electric toaster and electric kettle.

Other appliances include a dishwasher, clothes washer, iron, computer, amateur radio equipment, vacuum cleaner and electric power tools.

Domestic lighting is mostly low profile (T5) fluorescent fittings.

There are no downlights as we didn't want to penetrate the ceiling and compromise the ceiling insulation.

This energy regime results in very little emission to the atmosphere of noxious gases. Any carbon dioxide emitted is being compensated for by an extensive tree planting program as the property had no trees at all when we took possession.

Top: the plans for John's house including the hothouse; Bottom: the fans for the hothouse .

Rainwater is collected and stored in tanks of 40,000 litre capacity. There is no shortage of water and no water conservation measures are required.

Thus we have set up a household which is, in effect, a zero emissions structure and we have no ongoing bills into the bargain. Climate change mitigation here costs very little. ✻

For more details on John's previous sustainable homes and his careers as an educator and renewable energy installer, read *With ATA since the Year Dot* in *ReNew 112*. An extract is available at www.renew.org.au/sustainable-homes/with-ata-since-the-year-dot/

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Jaycar Electronics Better, More Technical

From waste to electricity

Filling an old open cut mine with Sydney's garbage is actually better for the environment than dumping it at the tip. Julian Edgar explains why.

When it comes to municipal waste, there are no easy answers. Even with householders diligently sorting their garbage for recyclables and green waste, cities still produce enormous amounts of rubbish that require disposal. The traditional approach has been landfills, where the waste is piled and compacted, over time forming unsightly mountains of dirt-covered garbage. And it's not just the visual blight that's associated with traditional landfills: there's also atmospheric methane emissions and potential toxic leachate to ground and surface waters.

But there is another way.

Photos: Julian Edgar

The containers are emptied and then bulldozers spread and compact the garbage.

Woodlawn Bioreactor

It's not perfect but it's an option that is better for the environment and can also be used to produce electricity. It's called a bioreactor and is more than just theory: a bioreactor is currently being used to dispose of 400,000 tonnes per year of Sydney's garbage.

Located near Goulburn in New South Wales, the Woodlawn Bioreactor is run by Veolia Environmental Services. Based on a disused open cut mine, the 6000 hectare site is currently being used to dispose of municipal waste and generate electricity. Aquaculture and horticulture facilities are in trial phases.

The site was originally a copper, lead and zinc mine with major open-cut and underground mine workings. The mine closed in 1998 and Veolia took over the lease for the site in 2004. In addition to the workings, the site is extensively degraded with large tailings dams and unvegetated areas that once housed crushers and other industrial facilities. The underground shafts are abandoned but the huge 25 million cubic metre open-cut pit is being used as the new rubbish repository.

But how does the garbage get to the Woodlawn site, 250 kilometres from Sydney? The major transport component is by train. The garbage is compacted into purpose-built shipping containers at Clyde Transfer Terminal in Sydney. Each container takes the equivalent of three garbage trucks of material. The containers are then placed on railway wagons—no less than 56 of them carrying 1500 tonnes of waste per train.

The train, hauled by three diesel locomotives, leaves Sydney early each week-day morning, arriving at the Crisps Creek Intermodal Transfer Station, near the hamlet of Tarago, at 6am. At the transfer station, built specifically for the bioreactor, large forklifts place the containers on trucks that transport the garbage to the bioreactor, about 10 kilometres away.

How it all works

At the bioreactor site the trucks wind their way down a road to the floor of the open-cut workings. The trucks reverse onto a tipping mechanism where

The garbage is transported by container train from Sydney to a transfer station at Crisps Creek, near the bioreactor site.

the containers are emptied. Large bulldozers spread the rubbish out into a relatively thin, compacted layer. At the end of each day earth is spread over the rubbish. After six years of operation, 2.2 million tonnes of rubbish is now piled 60 metres deep. Because the open cut pit gets larger in diameter as it gets shallower, at current rates the capacity of the pit is sufficient for about 60 years of waste disposal.

A network of wells, dug by a dedicated boring machine, is dispersed across the base of the pit. Feeding into these wells are horizontally laid pipes. The vertical wells comprise flanged pipes that collect both liquid leachate and the methane gas emitted by the decomposing garbage. As the level of garbage rises, more vertical pipes are attached at the flanges. The company claims that 90 per cent of the available methane gas is collected by this system that comprises over 30 kilometres of pipes.

The gas, the flow of which is aided by blowers that create a low pressure within the network of pipes, is fed to a treatment plant. This removes silica compounds that otherwise create coking problems in the reciprocating internal combustion engines used to power the generators.

Currently on-site are three Jenbacher 20 cylinder engine/generators. These dedicated landfill gas designs each generate 1.1MW of electricity and 1.2MW of thermal output. The electricity is fed into the national grid while the thermal output is currently used to heat the water in a small fish farm that is growing silver perch. The nutrient-rich water from the fish farm is used in a greenhouse growing lettuces. The aquaculture and horticulture activities are both small-scale trials with no commercial output, but 2.4MW of electricity is being generated on a constant basis.

Over time the decomposition of the garbage occurs at an increasingly rapid rate, so Veolia expects the electricity generation capacity to rise, with plans in place for a total of 24MW of generating capacity.

Top: Boring machines drill wells in the garbage that has now reached a thickness of 60 metres. These wells are used to recirculate leachate and collect methane gas. Below: The methane is cleaned and then burnt within three 1.1MW Jenbacher 20 cylinder engine/generators. The electricity is then fed into the national grid.

The walls of the open-cut pit are said by the company to be largely impermeable; where a fault or seam of ore occurs, the pit is lined. Leachate is recirculated to maintain a moisture level appropriate for the decomposition of the garbage. Excess leachate is treated on site and then sent to evaporation ponds.

The local environment?

The most pronounced environmental issue with local residents is odours emitted by the leachate treatment ponds. These ponds are planned to be phased out as the volume of garbage grows and as the plant's ability to handle leachate recirculation increases. Odours have also occurred through leakage from a decommissioned gas extraction system that unexpectedly became active. However, as a local resident myself, I think odours are minimal.

Extensive environmental monitoring is performed and an on-site environ-

mental scientist is employed.

The garbage is not sorted prior to being tipped: the prevention of toxic and other inappropriate substances being placed in the landfill is dependent only on the sorting done by individual householders.

No waste disposal solution is ideal (better not to generate the waste in the first place!) but the Woodlawn Bioreactor is far better than most municipal garbage disposal solutions. *

Julian Edgar's regular column *Salvage It* is on page 94.

Down on the farm

Like it or not, livestock farming continues to grow. Environmental Scientist Alisa Bryce looks at anaerobic digesters and their potential widespread use on farms in her article *More aerobic ways to farm*.

The use of this technology is becoming more popular, particularly in the United States and Europe, where below freezing temperatures cause a sizeable electricity bill. With the ability not only to produce their own heat and power, but also to sell excess power back to the electricity company, anaerobic digesters are gaining considerable favour. The only problem is that they rely on the waste created by farmed animals, a generally unsustainable process in itself!

To read Alisa's full article go to www.renew.org.au

The nutrient-laden water from the fish farm is being used in a trial horticultural greenhouse growing lettuces.

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The water saving wetlands

What began as a flood mitigation project by a South Australian city council has become an award winning, internationally recognised standard for stormwater catchment and recycling. Alan Strickland reports.

Salisbury Council in Adelaide's north east includes large areas of fairly flat land that is prone to flooding during heavy rainfall. Before European settlement the annual runoff from the Adelaide area into the sea was estimated to be 20 gigalitres which flowed out via a handful of natural streams. Most surface runoff never reached the sea but was trapped in marshes behind coastal sand hills and percolated down to feed underground aquifers.

Nowadays, due to the construction of roads, buildings and other impervious surfaces, most of the stormwater stays on the surface and is then diverted into concrete stormwater channels and flows to the sea, at an estimated rate of 150 gigalitres a year.

Stormwater flows into Gulf St Vincent at several points along the Adelaide coast and these streams of relatively fresh water have a damaging effect on local sea life. 'Fresh' refers to its low salinity and ignores the many contaminants such as oil and tyre rubber from roads. However the most damaging effects are from natural material—mainly soil, fine silt and carbon compounds from decaying vegetation. The many divers exploring this popular coastline report how the material covers and kills large areas of sea grass.

The large runoff from the Salisbury area used to be particularly damaging because it entered the Gulf towards the northern (closed) end. The lack of currents and slow rate of tidal flushing had aided the development of a rich breeding ground and nursery for many fish species in this area. However this low mixing rate also meant that the increasing runoff would pool and damage these adversely.

Clever water treatment: wetlands water is delivered to schools and sporting facilites.

To reduce this problem, and also mitigate the local flooding, the council decided to create a large artificial wetland to collect, filter and slowly release surface runoff into the sea.

It was soon realised that this idea had much greater potential and the water was not a problem but a resource. Wetlands not only clean water but their ability to store large volumes meant that water could be held for several months and was available for irrigation of council facilities during a large part of the year. Furthermore this treated water could be sold to other users.

Salisbury wetland solution

Salisbury now has over 50 wetlands covering a total area of 260 hectares.

In each catchment area, stormwater drains into a network of pipes and natural watercourses. Heavy-duty steel or plastic mesh screens known as 'trash racks' intercept leaves, rubbish and other coarse debris before flowing into the local wetland.

A wetland is a large area of shallow water in which aquatic plants grow. As the stormwater enters the broad wetland its flow spreads out and its speed slows. Solid particles that were carried by the flow now settle under gravity to form a fine, nutrient-rich silt. Although it's now visibly clearer, the water is still rich in dissolved nutrients and some pathogens.

The wetland is a mixture of deep water where particles settle and shallow areas or small islands where aquatic plants grow. Via their roots and submerged leaves these plants absorb nu-

trients, form dissolved material into clumps and break down pathogens to further cleanse the water before it flows on to the filtration stages.

Every two to three years a wetland is taken out of service during summer. It's fully drained, allowed to dry and the large volumes of nutrient-rich silt are scraped out and used as soil improver.

Filtration

The next stage of water treatment is filtration of fine particles and clumped material. Sand filters are the usual method of doing this and are installed at Salisbury's wetlands. However the council is also conducting trials of biofilters as the second stage of treatment. A biofilter uses plants and soil bacteria to absorb impurities, break down pathogens into benign forms or form them into clumps that are then filtered out.

The design varies and one example of a simple three-layer biofilter is shown below. The top layer of sandy loam is 400mm to 1000mm thick, next there's around 100mm of coarse sand and the bottom layer is fine gravel around 150mm thick.

Aquatic plants growing in the loam act in the same way as plants in the wetland to absorb nutrients. Their roots stop the loam from solidifying into impervious sedimentary layers and the passages they form allow the water to percolate through to lower layers.

Aquifer storage and recovery

Although wetlands provide a vital service by cleaning stormwater, long-term storage in shallow ponds causes significant evaporative losses, especially in hot weather. The council realised that injecting the water from wetlands into underground aquifers would permit storage with much reduced losses. As a bonus, the flow of water into aquifers would have a significant additional cleaning effect.

An aquifer is a layer of porous rock, shale or sediment with an impervious base below. Aquifers were formed millions of years ago when sea levels were high and coarse sand, coral and shells were deposited to form a permeable layer on top of hard clay or rock. As sea levels fell, fine sediment was deposited over this permeable layer and formed a semi-pervious clay seal above.

Rainwater naturally seeps into the ground and slowly sinks under gravity through the root zone and the subsoil until it reaches the aquifer. In the Adelaide area the natural process takes around 200 years for surface water to soak down to the aquifer and eventually percolate to the sea.

To speed up this process, treated stormwater from Salisbury's wetlands is pumped down injection bores drilled into existing aquifers.

Many natural aquifers in Adelaide have been severely depleted as bores have been drilled and water pumped out for irrigation and industrial cleaning. The pumping-in of water is called aquifer recharge and the process of injecting water into the ground for later recovery is called aquifer storage and recharge or ASR. Salisbury has 16 bores and uses two aquifers at depths around 160 and 200 metres.

The injected stormwater is continually monitored to ensure water quality criteria set by the Environmental Protection Authority are met. The pressure in the aquifer is monitored as over-pressure could rupture the upper confining layer of clay above the porous limestone.

Recycled stormwater is very low in salinity and when injected into natural aquifers that already contain brackish water, forms a 'fresh water plume' radiating out from the injection point. The size and shape of the plume is monitored by hydro-geologists so recycled stormwater, and not the brackish water around it, is recovered from the aquifer. Around 95 per cent of water injected is eventually pumped out—an impressive recovery rate.

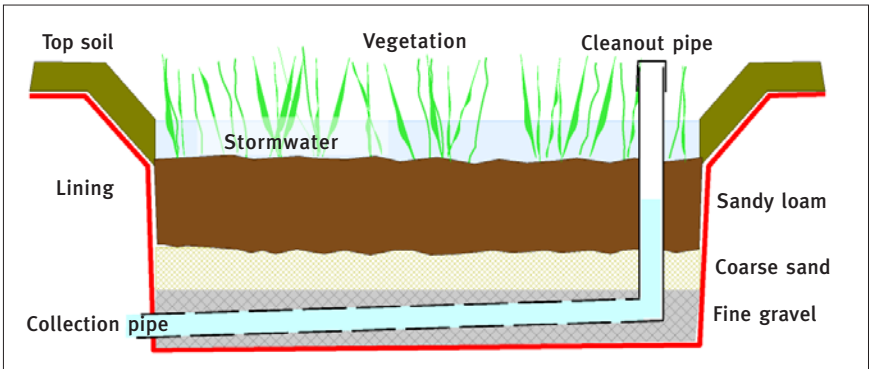
As water flows into the aquifer and through the porous rock formations, ultra-fine particles are filtered out and the water undergoes a further stage of cleaning, known as 'polishing'.

The particles that were filtered out remain trapped in the rock pores until the stored water is required for use. When pump-out starts, the initial backflow of water flushes the particles out of the rock pores and a stream of fairly dirty water flows up the injection pipe. This first flush is diverted back to a wetland for settling and cleaning.

As well as cleaning by back-flushing, the aquifer is purged with compressed air every three to four years.

Distribution to consumers

Salisbury has created a network of purple pipes to supply treated stormwater to every public school and council-owned sporting facility in the district, and to many industries and domestic consumers. Of this water recycled, 50 per cent irrigates council reserves, 41 per cent is used by industry, 5 per cent supplies domestic needs and 4 per cent feeds educational facilities.



Example of a three-layer biofilter.

Because the recycled water network doesn't fully cover the large area of Salisbury, the council must still take some irrigation water from bores that aren't part of their aquifer recharge scheme. Usually the council would have to pay for this water but instead, the volume of water they inject into one aquifer generates a 'withdrawal credit' that allows the same amount of water to be withdrawn from another at no cost.

To distribute water around a new development usually means digging large trenches to bury large pipes. To prevent this disruption and greatly reduce costs the council has used small diameter pipes installed by directional boring and a water tank at each house. The tank acts as an accumulator that can supply sudden large flow demands by the house and is slowly refilled through the small diameter pipe. It's also used to collect rainwater from the house roof.

When the tank is full, any excess rainwater can be pumped back to wetlands. A two-way meter measures the stormwater consumption by the house and runs backward when rainwater is exported to the wetlands. This arrangement ensures the home has adequate water for non-drinking purposes independent of rainfall.

Directional boring is a method of drilling very long holes in the ground, steering the drill head around corners and is used extensively in oil and gas exploration. For water distribution, long holes are drilled horizontally from distribution nodes then the flexible pipes are pulled through. This method avoids the cost and inconvenience of digging trenches to install large diameter pipes.

Capital outlay and financial return

Although they're a fraction of Adelaide's new desalination plant, the project costs are significant and have been shared between the Federal Government ($20 million), SA State Government ($13 million) and Salisbury Council ($17 million). However, the returns are also substantial: not only does the council save on irrigation costs but the income from water sales will soon reach $3 million a year.

Recognition and advocacy

Salisbury has gained international recognition for the way it gathers urban runoff, purifies the water in wetlands and stores it underground. Water industry representatives from all over the world come to see what the council is doing. Council officers regularly make public presentations to promote their project and inspire others to do the same.

The council works cooperatively with several countries, in particular with Germany, Italy, Spain, Slovenia, Syria and the USA (Phoenix, Arizona) where projects inspired by Salisbury's work are underway. Salisbury's work attained world significance with the World Water Association Award in Beijing in 2006.

Environmental benefits and other initiatives

Wetlands form a valuable social and environmental function as a peaceful, publicly accessible oasis in the middle of suburbia. Salisbury has been particularly active in developing biodiversity by extensive plantings around the wetlands. The council nursery has developed great expertise in propagating wetland plants and sells many species throughout Australia.

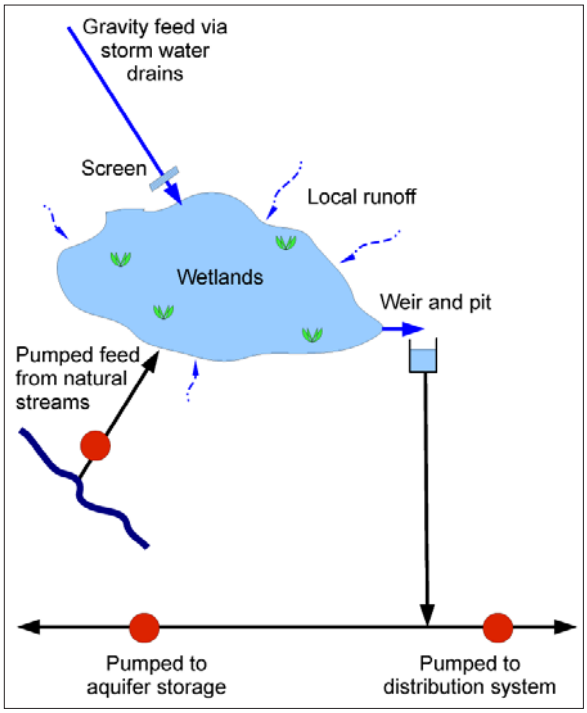
Comprehensive signage helps visitors to recognise the constantly increasing species of birds and animals that now call the area home.

A mixture of treated wastewater and stormwater is used to create picturesque lakes around local housing clusters. These also contribute to biodiversity and have a softening effect on the bitumen and concrete that characterise new developments.

GH Michell, Australia's largest wool processing facility, uses Salisbury water for scouring wool and the rinse water can be returned to the wetlands for treatment. The lack of locally available water and the ability to treat wastewater was a growing problem. If the business had been forced to relocate this would have had a major disruptive effect on the company and their local workforce.

The project currently treats and reuses 39 gigalitres which although significant is a fraction of Adelaide's 200 gigalitre annual thirst. However, the project is still developing and the initiative will soon be followed by other councils. A study has shown that if 60 per cent of Adelaide's total surface runoff was harvested it would return around 100 gigalitres a year. This is half the city's annual consumption and the same as the desalination plant's capacity.

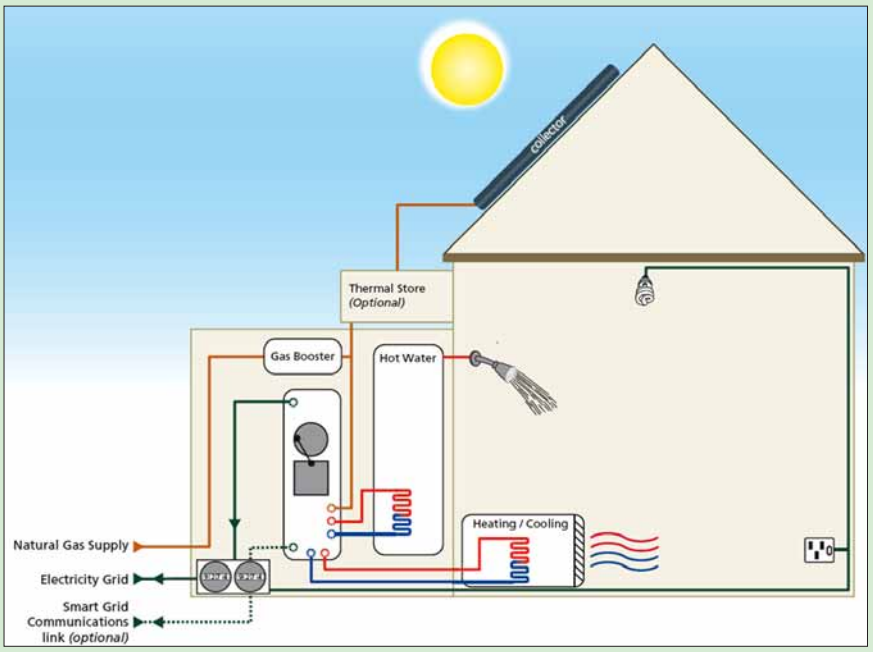
What began as a local flood mitigation scheme could one day be the major water source for the whole of Adelaide. ✻



The wetlands act as a natural prefilter.

On-site cogeneration pilot at wetlands site

The Salisbury wetlands is also home to a combined heat and power (CHP) cogeneration system being developed by Adelaide company Cogen Microsystems The system uses solar power to generate electricity and hot water on a scale suitable for domestic and small commercial applications, with a working pilot unit at Salisbury Wetlands Interpretive Centre providing electrical power, hot water and in-floor heating.



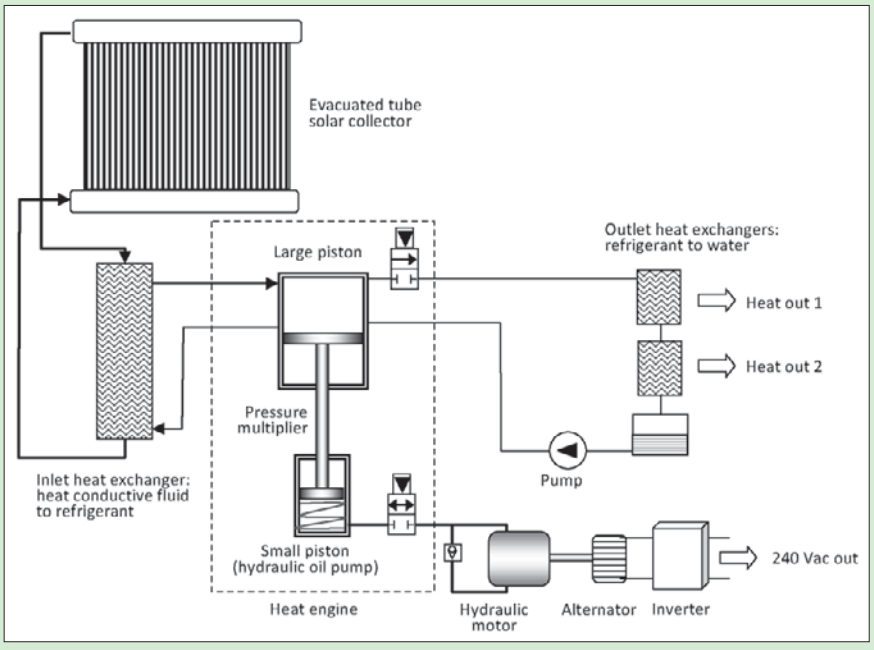
Cogeneration means the generation of two or more forms of energy from a single source. These can be electrical, mechanical, heating, cooling, chemical or even light, but most typical cogeneration systems generate electricity and heat. Another increasingly used term, 'tri-generation', usually means generating electricity, heating and cooling.

High efficiency evacuated tube collectors heat liquid to around 140°C and via a heat exchanger this is used to vaporise a phase-change refrigerant. The vapour drives a slow running heat engine to generate electricity.

The heat engine consists of a large diameter piston which is driven up and down as inlet and outlet valves alternately allow hot refrigerant vapour in and condensed refrigerant out. The large piston drives a smaller diameter piston via a common shaft to form a 7:1 pressure multiplier. This smaller piston is used to pump oil at high pressure through a hydraulic motor to drive a generator.

The liquid refrigerant exhausted by the engine is still at a fairly high temperature, and this useful heat is recovered by heat exchangers as a significant additional energy product.

From an 18m^2 solar collector the system can generate around 1kW of electricity and 7kW of useful heat. An inverter converts the electricity to 240VAC and the heat is piped off, usually as hot water, to various applications at various temperatures. Two or more outlet heat exchangers supply domestic hot water at around 70°C and water for space or swimming pool heating at around 30°C. The ratio of electricity to heat and output temperatures can be adjusted via a user interface and up to 9kW in heat-only mode is available.



The system is modular and additional modules can be added and supplemented with additional collectors for higher heat loads. The reflector-backed evacuated tube collectors can be on the roof, the ground or on a stand to create useful shade.

Future systems could incorporate supplementary gas heating for cloudy days and the addition of an absorption-chiller cooling unit. A true solar-powered home air conditioning system would then be a reality.

It is also planned to add a heat store, which will allow electricity generation at night, or postpone generation to peak electricity demand periods and the price spike—thereby maximising the economic benefit of the installation. For a complete description of the system see www.cogenmicro.com.

From wrecking yard to EV

Mechanic Graeme Manietta is shifting his business to electric car conversions, producing high-quality drive-away EVs. He explains how it's done.

Several years ago I took a great interest in DIY electric car conversions; like many, I wanted to build my own electric car and surfed the internet for ideas and inspiration. Websites such as the Electric Drag Racing Group in the US were of great interest and I priced the American electronics many times only to realise this was way out of my budget.

I'm an Alternative Technology Association member and *ReNew 109* caught my eye (*The one week EV)* with a link at the end to Eugen's website, who had imported an affordable conversion kit from China. Within a week of reading the article I was in Eugen's dining room in Gympie, chatting over a cuppa about his imports. It was great to see that Eugen's own EV was based on a 1990s Suzuki Swift/Holden Barina, as I run a Suzuki specialist workshop and spare parts company and import from many countries.

It looks like a regular Suzuki Swift from the outside.

EV plans underway

Our business includes some wrecking and we're often offered these small Swifts. Usually we decline as there are only a few components sought by our customers and workshop. The engine, starter, alternator, radiator and fuel pump are the biggest selling items when parting out these Swifts, but no one wants the bodies. An EV conversion is a perfect way to recycle something we'd usually send for scrap metal crushing!

The commercial association and friendship between Eugen and I grew. Our plan was to import several 'kits' and do a high quality EV conversion—not home builds but cars we hope to sell on with a first rate finish and details done to a high standard. We called on an engineer Eugen had used in the past for EV compliancing and used the NCOP bulletin 14 as our guide. We also joined the Australian Electric Vehicle Association (AEVA) Brisbane branch and made some new friends with similar interests. We found the other members to be a great inspiration and full of awesome ideas. I would thoroughly recommend that anyone remotely interested in EVs join this group.

We wanted to sell turn-key cars that were compliance and registered to people who would not ordinarily be able to create or convert a car themselves.

The system

The first conversion went well but needed better design work. From that car two more were built and each time we tried different designs, different wiring looms, different battery trays and restraints and looked at better ways to do things.

CNC patterns were made for waterjet cutting of components and jigs made for fabrications. All in all it took about a year of our spare time until we were happy with our final inventory of off-the-shelf components, making the conversion process quicker and cheaper, and at the same time raising the quality and final finish of the build.

The motor is a DC brushed traction style motor, rated at 96 volts DC, 8.5kW. We used the original five-speed gearbox to drive the car. The motor creates quite a lot of torque but has low rpm (around 2600rpm) so we start off in third gear and go straight to fifth. Third gear takes us briskly to 60 to 65km/h and acceleration flatlines, so I then pop it into fifth gear and the car goes briskly to 75km/h and the acceleration rate eases at 80 to 85km/h. On most cars if you hold it flat to the floor they will get to 95km/h but we advise owners that the maximum speed should be accepted as 80km/h.

The controller is a 400 amp fully programmable controller, which can be retuned for a lesser maximum amperage, slowing the acceleration slightly and

extending the range a little. We've found the factory settings work the best. We have a palm held control so we can access the program in our workshop for possible changes in the future.

The system is mounted on a heatsink with circuit breaker, fuse, main contactor and forward/reverse contactor, although we use the gearbox reverse and bypass electric reversing. The controller can be set for regenerative braking and there are kits much larger available from the same supplier that are specifically regenerative setups.

We don't use regen because we are using a gearbox without a clutch. This works great to drive—when you change gears you take your foot off the accelerator and simply shift up or down—because there's very little drag from the armature. When regen is used it can work against this because the armature has high resistance and that causes gears to crunch. The fix would be a clutch and flywheel, but that takes more costly engineering and has more parts to wear, all for small gains. Another fix is to delete the gearbox and use direct drive, however, this would limit top end speed. So it's all a compromise to get the best all round result.

We use eight 100Ah sealed deep cycle AGM batteries. We use these because lithium batteries would make the build cost much higher and our mission was to make an affordable EV. The batteries weigh 38kg each and we have since found 135Ah gel batteries at about the same weight and size. AGMs are good sound batteries, recyclable and hard to kill. The batteries we use are readily available at most battery trader outlets and are recyclable.

When creating the car a builder must watch the overall weight as it must comply with original gross weights and the placement of weight can seriously affect the handling of the car in extreme emergency braking. Our engineers said they didn't want to see a car accident with 38kg missiles leaving a car to hit people. There's a formula in the NCOP14 for calculating the extra weight a battery restraint must hold and we chose to exceed that to allow for later additions.

The 96 volt battery charger is designed to maintain the battery while charging; it electrically treats the batteries to desulphate the plates, hence extending the usable battery life. The manufacturer claims batteries should last five years when using this charger. The charger we use also has self and battery diagnostics and automatically shuts down if an error is sensed. The current draw from the mains automatically reduces until the batteries are fully charged and this saves money when a car is left on charge. We also have a trickle charger for the car's 12 volt auxilliary battery so all batteries are fully charged together. While driving we use a 96VDC to 12VDC battery charger to keep the car's 12 volt electrics at full charge all the time.

Filling up at home is both cheap and convenient.

To save energy we use LED lights for parking, turning and brake lights. The interior demister is a 200 watt 12 volt ceramic heater that demists the windscreen adequately but is not really sufficient to heat the car. Inside we also fit an emergency cut-off switch in case of accident. Emergency services people are aware of these and will look for one in case of an accident. A safety switch is fitted to the petrol flap where the 240 volt supply is plugged in for charging. This safety switch effectively cuts any power to the controller and motor so there's no chance of driving off with lead in tow.

A 12 volt vacuum pump is used to create a vacuum for the power assisted brakes via a vacuum reservoir. On latest builds we incorporate a part of the forward battery frame as a vacuum reservoir by capping the ends of a square section and putting in fittings. This gives us almost 20

The main battery box replaces the rear seat.

Under the bonnet: the yellow box on the left is the speed controller. The contactors and other gear are under the transparent cover in the middle and the auxiliary 12 volt battery is on the right. Two more batteries are at the back and the motor is underneath all of these components (right).

inches (around 67kPa) of vacuum and operates smoothly and quietly.

The car itself is given a once-over, with tyres, brakes, wheel bearings, rear springs and suspension overhauled. Most cars are painted and the outer aesthetics replaced or renewed to bring the car up to a high standard. Interiors are refurbished as needed and rear seats are replaced by a carpeted battery box. The cars are inspected and certificates issued for electrical work in 240 volt and 96 volt. The cars are further inspected and complianced for use in Queensland with a modification plate issued and attached. Finally a roadworthy inspection and certificate is issued.

Driving these cars is a lot of fun as they are reasonably zippy and it feels great driving past a service station. At our workshop we have a grid-connected 5kW solar system that supplies all of our workshop electricity, charges two electric vehicles and we get a small refund cheque each year for the electricity fed back into the grid. We can truly say we are carbon neutral. The cars travel 40km to 70km between charges depending on how much stopping and starting there is and the terrain. The best practice is to put them on charge whenever practical and not in use.

At eco shows there's always those that criticise electric cars and say they still use coal-fired power, however, I can safely say I do not. We encourage people who own our electric cars to put a solar panel on the carport at home to charge the car or feed the grid when not charging.

We are 12 months down the path to creating cheap affordable electric vehicles and have a few for sale. Our on-road price is $14,500 and our bare-bones kits for home builders start at $3000 for motor, controller, accelerator pedal and both chargers. We also offer a developers chassis, which is a car with electric motor mounted costing $3500. Home builders can use any batteries, controllers and chargers they like and can choose a 96, 120 or 144 volt DC motor. This would suit someone with different ideas and experimental applications. ✻

More photos, projects and information is available at www.suziauto.com or www.suziauto.mysite.com
AEVA website www.aeva.asn.au
Eugen's conversion parts website www.goombi2.mysite.com/index.html

Mum, what was the Great Barrier Reef like?

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Planning household solar?

ReNew magazine and the Alternative Technology Association receive many queries about grid-connected solar each year. The last twelve months have been no exception, with householders asking about connection issues, what to expect from solar companies and the frequently changing world of feed-in tariffs. Bryce Gaton explains what to do before deciding to install a photovoltaic system and what to expect from a best practice installation.

The first step to a successful grid-connect photovoltaic (PV) system that is planet and energy saving, and potentially money making, is to understand how much energy you use. By reducing your electricity consumption as much as possible first, you will maximise the system's potential to truly provide 'carbon neutral' electricity.

An energy audit involves a relatively simple three step process. First, go around your home with an energy meter (a PowerMate Lite is recommended) and add up the amount of electricity currently used. Second, work out ways to reduce that use and then implement those reduction methods. Lastly, return to step one and recalculate your energy usage to see if the reduction measures worked. In the long term, there's little point installing a PV system that will just power a rarely-used bar fridge or energy hungry halogen downlights that could be replaced with LEDs.

ReNew has published many home energy audits over the years; for recent examples see *A Top to Bottom Energy Audit* in *ReNew 105*. One participant in the ATA online forums confessed that he used 30kWh a day; others in the forum had plenty of tips on how to reduce his household electricity use—go to www.ata.org.au/forums/topic/cbd-solar

Pick an installer for a quote

When selecting potential installers, first ensure they have accreditation with the Clean Energy Council (CEC). CEC registration means the installer has met the minimum requirements to competently position, install and connect a grid-connected system. At a meeting of photovoltaic installers in October, it was unanimously agreed to set up a new Best Practice Network that installers can sign up to if they are prepared to implement a set of (yet to be finalised) Best Practice Guidelines. The following information is based on these guidelines as they apply to the stages of quoting, installing and commissioning of a grid-connected PV system.

Photo: courtesy of the Russell Family, ACT

The quotation stage

The site visit

First, and most importantly, the quotation must be based on a full personal inspection of the site and premises. The site visit is the installer's chance to assess the site and all shading issues, the strength of the proposed roof and discuss what size system will best meet your needs and give you the best return. This last point is based on the installer doing a basic energy audit and recommending what possible energy saving measures could be implemented to maximise the quoted system's returns.

If an installer tries to give you a quotation based on a certain satellite-based picture service without a site visit, strike them off your list immediately!

The site visit is also your opportunity to assess the expertise of the installer; they should explain the meaning of net or gross feed-in tariffs as they apply, the issues applying to RECs, why most grid-connected systems do not provide power during a blackout, and

more. This is also the time you should ask lots of questions to satisfy yourself that the installer is going to provide a system quotation that truly matches your intentions and usage patterns.

The written quotation

A Best Practice quotation should include as a minimum:

- A summary of the basic energy audit of the premises, with recommendations for energy reduction
- A note of what, if any, electrical issues may need to be addressed before the system can be connected. For example, a new switchboard and connection point can add $1500 or more to the cost of an installation. A full rewiring can add $5000 to $10,000! A competent electrician should note these costs up front to enable you to make an informed choice. An electrical inspector will not allow a PV system to be connected to a sub-standard household wiring system
- A detailed list of the components
- An estimate of the energy output of the system in the chosen position
- An estimate of the financial savings offered by the system
- An estimate of the CO_2 savings
- Customer references (if requested)
- How long the quotation is valid
- The date the installation will be completed
- Include all costs (this includes inspection fees, help with the connection paperwork and RECs application should you decide to sell your RECs).

Overall, a proper site analysis, energy audit and quotation is a time consuming process; some installers will charge a fee for providing a written energy audit and site analysis which is discounted off a system if you choose them to do the job. In fact, it may be worth considering splitting the process into two, paying for the audit and analysis/recommendations phase separately as research for choosing a PV installer quotation. That way, you ensure a comparison of 'apples with apples'.

The installation stage

Time of installation

On the day, those doing the installation must be 'competent persons'. This applies to the actual CEC accreditation holder and people working under the supervision of the CEC accreditation holder. Where a PV system operates over 120 volts DC (this is almost all current grid-connected systems in Australia), your installer must be a licensed electrician and electrical contractor. The CEC accreditation holder need not be an electrician, so long as they employ licensed electricians to do the job.

The inspection

In Victoria (other states will vary in detail) all PV systems for grid connection must have a 'prescribed' Certificate of Electrical Safety (COES) completed and lodged by the installing electrical contractor. A prescribed COES means that an electrical inspector has to inspect the job before it can be connected to the grid. Only when the prescribed COES has been finished by the inspector can the connection stage begin.

The connection stage

Once the prescribed COES (or equivalent in other states) has been signed off by the inspector, connection paperwork needs to be completed before the PV system can be legally connected and turned on via a new feed-in meter. This can be a difficult process, not helped by some cut-price installers saying their responsibility ends when the system has been inspected, leaving the homeowner to arrange the connection.

The process is detailed below. However, it is difficult to fully detail the steps as every electrical supply authority has differing requirements. In Victoria, this is further complicated as there are separate distributors (owners of the poles and wires) and retailers (the ones who read the meters and bill you).

What's worse is the process is still being developed, so changes often occur without notice. The best advice is to rely on your installer to guide you through the process, so ensure they have included this in their quotation!

Getting it connected: the paperwork

The section below deals with the situation in Victoria as it is the most complex. Other states will be slightly simpler, but the general stages are the same.

Photo: Chris Ogilvie

Solar PVs come in all sizes and shapes, but unless you have a good agreement with your electricity retailer, installing a system can be a nightmare.

Step one

Complete an Electrical Works Request (EWR) form and submit it to the relevant retailer. This form is commonly rejected for very simple errors or ambiguities; your installer is best placed to fill this in and submit it. A copy of the completed prescribed COES must be included with the request. It is suggested you request a copy of this paperwork from your installer, as one Victorian retailer is renowned for 'losing' around half of the original requests!

Step two

On receipt of the EWR, a Service Agreement will be sent out by the distributor for the customer to complete. This form requests details of the system and spells out the requirements of the distributor relating to grid-connected PV systems. If you are in any doubt, consult your installer. Also let your installer know if you don't receive one—it probably means the EWR has been lost by the retailer.

Step three

The retailer (or distributor, depending on their mood) will contact you to make an appointment to install your new meter and officially connect the system to the grid. In Victoria, this is not a free service and the customer will be billed for the installation of the new meter on their next bill. Another note for Victorians: even if you already have a 'smart meter' you will need a different meter for your solar system. Some smart meters are smarter than others, see *Building Better Smart Meters* in *ReNew 112* for more details. Victorians also need to note that even if there is no smart meter yet installed, a charge will still be made for installing the new meter as it is an 'elective' change-over.

Step four

Once the meter is changed over, the distributor may require an extra inspection before it can be switched on. One distributor forgot this was to be done and left the circuit breaker locked off for two weeks before the customer, who thankfully was the installer, rang to discover the job had not been allocated yet. It was done the next day.

Choosing the tariff structure

Getting the maximum return from your PV system involves choosing the appropriate tariff plan. A tariff plan is what you pay for energy use and get paid for PV generation. The tariff needs to suit your usage pattern, so the right one will vary according to your personal circumstances. In Victoria, this is very complicated and analogous to choosing a mobile phone plan. What's worse is that some householders might need to change retailer to get a particular tariff.

The energy audit will show when your greatest electrical usage occurs; for feed-in tariffs, if you can shift this to after dark, you will maximise your return at the Victorian premium feed-in tariff rate. If you cannot shift your usage pattern, then tariffs with very high day rates are not for you. Remember, for both gross and feed-in tariffs, reducing your usage is the best way to improve the cost savings and returns. This is why an energy audit as part of a full quotation process is so important.

In Victoria all off-peak hot water tariffs are being phased out with the introduction of smart meters, so electing to go early to a smart meter with a PV system means you will lose your off-peak hot water service rate. However, there is at least one retailer with a 9c/kWh off-peak rate for all electricity use at night that could be used to replace it—provided you can live with a 33c/kWh day rate!

Again, ensure your PV installer includes advice and assistance on electricity connection and tariffs in their quote. For more details on feed-in tariffs and time of use tariffs read *The latest on FiTs, ToUs and RECs* on page 55.

Watching the bill

No, not the BBC series, I mean the paper bills you receive! You will need to study these in detail as they arrive. Retailers are currently in the early stages of dealing with PV feed-in tariffs and experience shows they rarely take less than three bills to get it right. You will need to keep a copy of the tariff structure originally given to you by the retailer and compare it to the rates charged on the bill.

Some examples of errors made by retailers include:

- Simply not noticing a PV system has been installed and continuing to charge at the previous tariff, with no allowance for any PV feed-in credits
- Charging all electricity used at peak rate, with no allowance for PV feed-in credit
- Charging for electricity used at the right rates, but only paying the same rates for electricity from the PV system i.e. not the premium feed-in tariff rate.

Again, establishing a good relationship with your installer and regularly consulting them as bills come in will ensure that any errors are sorted out early. ✻

More information

A handy tool for home energy audits is the PowerMate Lite available from shop.ata.org.au

For a full list of accredited installers go to www.cleanenergycouncil.org.au/cec/accreditation/Solar-PV-accreditation/findaninstaller.html

Bryce Gaton works on CERES Green Tech projects (see his articles in *ReNew 111* and *ReNew 112*) and is also a Clean Energy Council accredited PV design/installer.

Solar PV buyers guide

Finding the right solar system for your needs requires a lot of research. Consult the *Solar panel buyers guide* in *ReNew 110* for an overview of the systems available. An extract is available at www.renew.org.au

The right type of solar home

A proper site analysis is essential when installing PVs, writes Jacinta Cleary.

Believe it or not, not every house is right for a grid-connected photovoltaic system. Common problems include shading or poor orientation that will yield low electricity returns.

To make it easier to recognise any issues, some installers or sustainability assessors use the Sun Eye, a shade analysis tool for solar site assessment. The tool computes shading and solar access percentages using a fish eye lens, and also measures roof pitch and azimuth. The Sun Eye is a big investment for any installer, costing over $2000.

Phil worked as a solar installer until late 2010 and used the Sun Eye to conduct thorough site assessments for two years. Not everyone was happy with the results of the site assessment, particularly when it was established that the property was not suited to solar panels, with some householders insisting that they still wanted to go ahead with the install. Others were delighted with the honesty and recommended Phil and his partner Francesca to others.

"On many an occasion I had to tell people not to do it…yet the jobs you turn down define who you are as an installer," he says. Of course, anyone determined to take advantage of the government's Solar Credits Scheme and install a photovoltaic system can easily find another solar company to take their money.

Phil says that most suburban properties do have good solar orientation for a photovoltaic system, finding a large majority of houses to be well suited during site inspections. However, some households are unaware of basic priorities when it comes to reducing their carbon footprint. For Phil, the first step is to improve a household's energy efficiency, then install a solar hot water system, as water heating accounts for 30 per cent of household electricity use. The next step would be to go solar. Yet some people are so determined to install a photovoltaic system that reducing CO_2 emissions becomes irrelevant.

Working as an installer for another company he's since left, Phil saw photovoltaic systems placed in the shade, or positioned on the west side of the roof, which is quite common when given the dilemma of an east-west ridgeline. Photovoltaics don't work as well in hot weather, so if an installer has to make a choice it's better to place a system on the east to collect the morning sun when the temperature is cooler, or maybe use tilt frames to gain a northern orientation. He says that some installers get this confused, because a solar hot water system works better on the west, if dealing with an east-west ridgeline.

He also says he was sent to install "heaps" of systems when no site assessment had been done. He notes that in Germany, where feed-in tariffs are the main incentive driving the install of photovoltaic systems, that "a pre-install yield analysis is all the rage." After all, if the system doesn't generate solar electricity, there will be no feed-in tariff paid.

From Phil's point of view, some of the industry is using best practice standards, while some start-up companies offering special deals are bringing the level down. Currently there are no incentives for a proper site analysis to be conducted, let alone the use of the Sun Eye, with Phil hoping that further training, site inspections and high-quality audits will ensure all solar installations are worthwhile and not just an opportunistic grab for rebates.

Unforeseen obstructions

It can be pretty dull thinking about the 'what ifs' in life all the time, but when investing in a PV system it's probably worthwhile. A neighbour just might decide to add a new level to their home, or plant a tree, which promptly slashes your solar access. Talk to your local council about what might happen if a neighbour proposes a second level that obstructs the solar access of your PV panels.

Some installers might use a Sun Eye site analysis tool to determine your home's solar potential.

Without a thorough site assessment the change in seasons can throw up some unexpected surprises. One user on the ATA's online forums reported his solar access was suddenly compromised in autumn and winter: a neighbour's tree in need of a good prune was shading the system. "The system output drops alarmingly (e.g. 50W/228V at midday!) We actually get about three times the daily output on cloudy days than we do on sunny days at present!" he wrote. At the time he was investigating rewiring the panels to fix the problem. ✻

For further details on the Sun Eye go to www.solarinverters.com.au

Top tips from a PV customer

Aaron Hodgson shares his advice for a successful PV purchase.

A few years ago Aaron and his wife decided to invest in enough solar panels to cover all of their power usage. They took around six months to do some intensive research into photovoltaic systems, including the brands and the industry itself. Having met with different installers, attended open house days and talked to solar panel owners they finally made a purchase and have been very happy with the results.

After experiencing large electricity price rises, Aaron's parents decided to install their own solar power system and so asked Aaron for his advice when shopping for their system. The first thing he noticed was a huge increase in solar companies compared to a few years ago, and unfortunately found that many did not bother to return his phone calls. This lack of a response helped Aaron eliminate the bad companies from the good ones.

"After shopping around for solar panels this second time I feel that I have learnt some valuable lessons from this rapidly growing industry. Unfortunately there seem to be some rogue operators popping up, after the cheap cash that some customers seem to be throwing around for possibly inferior products. However, it is not all bad news. With some research you can still find ethical operators out there who will still treat you well and offer good quality products for a reasonable price," he says.

Based on his experiences, with input from friends and family who have also shopped for solar, Aaron has put together a list of tips for prospective solar households. He has also created a list of questions for solar companies or installers; a copy is available at www.renew.org.au

Good luck!

Photo: Jenni Munguy

The installation of a PV system in north-east Victoria in 2009, which is reported to be working very well.

Aaron's advice when investing in a PV system

Home efficiency first

Before installing solar electricity the most important thing is to make your house as energy efficient as possible. When you know your minimum household usage then you can go shopping for a solar system. The system can then be smaller, cheaper and cover more of your household power usage. This is a far better strategy then paying a fortune for solar panels to cover power usage of old bad habits and unnecessary power guzzling appliances.

Customer service

If a solar panel company does not answer your questions or does not bother to ring you back then strike them off your list as this is likely to be their ongoing attitude towards you. Also, beware of fast-talking, high pressure sales people with a lot of hype and very little information.

No pressure

Never be pressured into signing a contract on the spot. Shop around and get as many quotes as possible, and ask for contact details of previous customers so you can ask them about their experience. Most people are very happy to talk to you.

Brand names

Always ask for the brand names of the main components such as the solar panels and inverter, and research the brand name history on the internet. Ask people about the solar systems and the installer at online forums such as www.ata.org.au/forums or forums.energymatters.com.au. Go to sustainable open house days or just knock on the door of a house that has installed a PV system in your area. Most people are more than happy to let you know about their positive or negative

experience with a solar installer.

Also, seek out companies and brand names that have been around a while. A manufacturer with an office in Australia is an asset due to the long 25 year warranties available. Be cautious of cheap unknown brands with little or no history.

The right price

Remember the saying 'if it sounds too good to be true then it probably is'. The quality of components, installation and after-sales service can all be sacrificed when buying cheap products. This includes solar panel systems. PV systems can be grossly overpriced as well. It is best to get as many quotes as possible to work out the average market price.

Wait until complete

Never pay the full price until the installation is complete and you are happy with what was agreed upon—including metering. If there is still work to be done you could end up on the bottom of the company's to do list.

Investigate RECs

Check for yourself how much money you will get for your RECs if you choose to sell them. A few installers have been known not to pass on the current price. Visit Green Energy Trading's website www.greenenergytrading.com.au or consult the Office of the Renewable Energy Regulator via www.orer.gov.au for pricing and a calculator.

Complaints...hopefully not

To check that a PV solar panel and inverter brand name has accreditation in Australia, or to make a complaint about an installation, contact the Clean Energy Council on (03)9929 4100, email accreditation@cleanenergycouncil.org.au, or visit www.cleanenergycouncil.org.au

Price increases

Be wary of quoted prices repeatedly increasing as you get closer to signing a contract. Don't be scared to question why or threaten to walk away if you are unhappy.

Firm date

Make sure the solar installer gives a date for installation in writing.

Fair trading

Familiarise yourself with your state's *Office of Fair Trading/Consumer Affairs Home Building Contract* for work under $25,000. This contract will explain the rights and obligations of the home owner and the installer, such as whether the deposit is within the legal limit. In New South Wales the limit should be 10 per cent for work costing $20,000 or less or five per cent for work costing more than $20,000.

Insurance

Ensure the PV system is insured; in most cases this coverage comes under building insurance. When adding the system to your insurance remember to insure the full cost of the system, meaning the price before discounts, rebates and REC sales. In some cases standard insurance may not cover lightning strikes or power surges that damage your PV system. Additional extras insurance might be needed to cover fusion and damage to electrical appliances in this scenario. Check with your insurer for more details.

Full site analysis

Ensure the installers inspect your property first as there might be issues with shade from trees and buildings, extra wiring and installation costs, space constraints or roof angles. Some installers might look at your roof via Google Maps and tell you that's good enough. This is poor customer service, lazy and may cause problems when issues are discovered on the day of installation. Bringing the installers to your house will give you a feeling as to whether or not they are running a reliable business.

The right inverter

Some solar companies might suggest installing very large inverters for small solar panel systems, saying that is a better option because you can decide to increase the size of your PV system later, without having to buy a larger inverter. This is true, however, research suggests that if you decide not to increase the size of your PV system you may lose a considerable amount of power production because your solar panels and inverter are not compatible.

Make sure the solar panels and inverter are size matched if you do not wish to upgrade at a later date. Inverters with flat efficiency curves do not have this problem.

Quality test

Looking for quality solar panels can be a difficult area to research. One recommendation is to check out the panel's negative power tolerance rating. This determines the manufacturer flaw factor, for example, if a 180 watt panel has a negative tolerance rating of 20% then the true wattage may be 144 watts instead of the 180 that is claimed. Some suggest that any negative tolerance rating over 5% is unacceptable.

Fix your roof

Before installing a system inspect your roof for leaks, cracked, damaged and shifted tiles, re-capping or rusty tin. If necessary do some roof repairs before installation as repairs later on will be very difficult and expensive if you have to remove the panels. If possible ask your installer to put at least a 30cm gap between the rows of panels for easy roof and panel maintenance, as well as cleaning access.

Roof space

Be careful if there isn't enough roof space to put all your solar panels on one side of the roof. Some installers will suggest putting some panels north and the rest either east or west and connecting both lots to the one inverter. Research suggests that this should not be done unless you have two inverters (one for each group of panels) or an inverter with two independent outputs. Otherwise a considerable amount of energy can be lost.

Correct placement of parts

Try to keep the solar panels, inverter and power box all within reasonable proximity to each other; if the panels are a long distance from the inverter and power box some loss of production can occur.

Ensure the inverter is placed in a cool, shaded and well ventilated location to prevent overheating and inefficient operation.

Rebates change

Be aware that state and federal solar panel incentives, feed-in tariffs, RECs and any other rebates can chop and change, sometimes with little notice, so it is important to find out what offers you are entitled to and how long these offers are likely to last. Consult government departments for this advice, as advice from a solar company could be inaccurate.

Do your homework

PV systems can cost a lot of money so be careful about who takes your hard earned dollars. A little research might save you a lot of headaches in the future. ✻

The latest on FiTs, ToUs and RECs

Photovoltaic owners need to keep up to date with the world of feed-in tariffs, time of use tariffs and Renewable Energy Certificates. ATA Energy Policy Manager Damien Moyse gives an update on what to expect.

In November 2010 the New South Wales government abruptly reduced the gross feed-in tariff to 20c/kWh, sending the industry and prospective PV owners into a spin. Government policy can either be a pro or con when it comes to owning a grid-connected solar system, and more changes are afoot.

Photo: Matthew Dunk

Changes to RECs

From January 2011, the national Renewable Energy Target (RET) policy is changing. Essentially, the new 'enhanced' RET will split the renewable energy market into two, with small scale technologies such as solar PV, small wind and solar water heaters operating in a separate market to large scale renewable power plants.

The new Small Renewable Energy Scheme (SRES) will fix the price of RECs for small scale technologies to $40 and will essentially be an uncapped market i.e. no fixed annual targets will apply to the amount of RECs that can be traded from small scale technologies. RECs traded from small scale technologies will be additional to the fixed annual targets set under the Large Scale Renewable Energy Target (LRET), meaning that the government's 20% renewable energy target by 2020 only includes large renewable energy projects, not the voluntary action of householders.

The Federal Government will, however, need to manage the amount of RECs to come from small scale technologies after 1 January, as this has a direct bearing on the cost of the scheme overall, with all electricity consumers contributing to the cost. Should the amount of RECs traded from small scale technologies exceed the amounts predicted in the government's modelling, then the Minister for Climate Change and Energy Efficiency may either reduce the REC price or reduce the multiplier for solar systems under 1.5kW (currently five times until mid 2012).

Feed-in tariffs

Premium feed-in tariffs are up and running in most states across the country, with each offering a different rate, metering arrangement, time frame, technology eligibility and overall policy cap size in MW.

Given their popularity, many state government's have been conducting reviews of their feed-in tariff schemes over the past six to nine months to ascertain their costs and benefits. Major changes to occur from these reviews have been:

South Australia: a 10c increase in the legislated net feed-in tariff rate to 54c/kWh. Retailers continue to offer slightly higher than this, with some offering up to 60c/kWh;

New South Wales: a 40c reduction in the legislated gross feed-in tariff rate to 20c/kWh. This decision was taken due to the massive uptake of solar and small wind in NSW in the 10 months between 1 January and the end of October 2010.

Western Australia: finally commenced their feed-in tariff in August 2010 with a legislated rate of 40c/kWh on a net basis, plus 7c/kWh provided under local REBS scheme.

For more details on the current feed-in tariffs in each state, go to ATA's feed-in tariff webpage at www.ata.org.au/projects-and-advocacy/feed-in-tariff-for-solar-systems/state-feed-in-tariffs/

Time of use tariff issue

One key issue that new solar owners need to look out for is what happens to their retail tariff for electricity consumption (i.e. the electricity that you purchase from the grid), after solar is installed. This is a problematic issue in Victoria that ATA is trying to fix, however, it may be an emerging issue in other states too.

When a household buys electricity from

the grid, besides the fixed standing charges that appear on the bill, there is also the per kilowatt-hour consumption charge. This is generally in the range of 10 to 20 cents per kilowatt-hour, depending on which state you live in and whether or not you have access to a cheaper 'off-peak' rate for water heating or other large loads on dedicated circuits.

These rates are the 'retail' rate for consumption; they are set by the retailer in accordance with their market pricing policies or as set by the energy regulator.

Included within these retail tariff rates are what's called 'network' tariffs; these are the tariffs that distribution business (the companies that own and manage the poles and wires) charge retailers for the use of their network to purchase electricity.

Retailers absorb the network tariff in their retail tariff that they offer to customers. In doing so, retailers will generally reflect what's called the tariff 'shape' i.e. whether or not the tariff is flat (one consistent price at all times) or time-based (potentially including an off-peak component).

In certain circumstances, when a household installs solar, they may be changed on to a different network tariff by the distribution business. This could be because of a change to their meter (or metering configuration), or because of a change to the load characteristics of their household brought about by the introduction of on-site micro-generation such as PV.

In Victoria and potentially other states, many new solar households are being 'reassigned' by distribution businesses from flat to time of use (ToU) network tariffs. These ToU network tariffs may be two-part (peak and off-peak) or three-part (peak, shoulder and off-peak) tariff structures. This is causing a change to solar households' retail tariffs for consumption, with their electricity retailers generally reflecting the tariff shape (i.e. the times at which the peak and off-peak components apply). Often, the peak retail rate is significantly higher than their previous peak or flat rate charge, for instance between 25c and 30c/kWh instead of 18c to 20c/kWh.

Through its advocacy work, the ATA is trying to ensure that solar customers can either stay on their flat retail tariffs or get better designed ToU tariffs for solar and other micro-generation customers, giving them opportunities to shift their times of electricity use and benefit from cheaper power prices.

Until this happens, new solar households should contact their electricity retailer before installing a system and find out what retail consumption tariffs they are going to be able to choose from once the solar system is installed. ✻

Further reading

Damien Moyse's article *RECs for Householders* in *ReNew 111* provides further detail on the Federal Government's Solar Credits scheme and RECs.

Cooling with the sun

It may seem odd, but you can use the plentiful energy from the sun to cool your home. Lance Turner shows how.

Depending on where you live, and the style, design and orientation of your home, you may need a bit more cooling on hot summer days than passive methods such as window shading and roof insulation can provide.

Active cooling usually involves using an energy source of some sort to produce the cooling, whether it just be moving hot air out of the house, or fully-active cooling such as refrigerated air conditioning. That energy source is usually in the form of electricity, but with ever increasing electricity costs, keeping your home livable in the summer months is becoming an expensive proposition.

But that energy need not come from your local electricity company. There's a number of cooling methods that can be powered from the energy of the sun. The sun's energy can be used in either the form of direct heat, or sunlight can be converted into electricity and that electricity be used to power the cooling system.

This house in Spain has a Climate Well solar air conditioner. The same system is also available in Australia.

Ventilation

The simplest cooling system is ventilation. In many cases, providing adequate ventilation to the roof cavity of the home will reduce heat flow into the living space to such a degree that no other cooling will be needed.

Passive roof vents are not usually up to the task, as you need to change all of the air in the roof space around once every 10 minutes to keep ahead of the heat. Wind-powered vents rarely move enough heat to have much effect and are often least active when needed most, such as on hot, still days.

The most easily installed sun-powered ventilation is the solar ventilator. These are manufactured by a number of companies but are all similar. They consist of a solar panel, usually in the 10 to 20 watt range, directly coupled to an electric fan inside a roof vent cap. The concept is simple—the more sun, the hotter the roof cavity, but also the faster the solar fan runs and the more hot air it extracts from the roof. This makes them very well matched to the amount of heat needing to be removed.

There are several brands of solar roof vents, including the Solar Whiz from Global Eco Solutions, the Solar Star from Solatube and the Maestro from Edmonds. Prices for these vents are generally under $1000 and in many cases you may only need one or two fans to reduce the temperature in the roof cavity by 20°C or more on a hot day, which will make a big difference to the temperature inside the home.

An important aspect of roof ventilation is the installation of vents in the eaves or in walls low down in the roof cavity. After all, you can't extract hot air efficiently if cooler air can't flow in easily to take its place. Inlet vents need to be placed so that there is as much cross flow as possible in the roof so that the entire roof cavity is ventilated.

Solar vents can do more than vent out the roof cavity. You can use ducting to allow the vent to extract hot air from the living space itself. For homes where hot air accumulates on upper floors or in cathedral ceilings, this can also considerably reduce the overall temperature. However, in this case, there must be a suitable source of cooler air that can replace the hot extracted air. This cooler air may come from under the house or even through an earth tube system. Earth tubes consist of arrays of metal, ceramic or plastic pipes buried in the ground. Air is drawn through them into the house and is cooled on its way through the pipes. An article on

earth tubes appeared in *ReNew 110*.

Solar powered vents are the simplest solar cooling available, but there are much more complex—but not necessarily more effective—systems on the market.

Solar collector systems

These broadly fall into two groups—ones that use the entire roof cavity as heat collectors, such as the HRV systems, and ones that have externally mounted solar box collector panels, such as the Solar Venti. Note that HRV the brand should not be confused with HRV the acronym, which stands for Heat Recovery Ventilation. This is where heat from the outgoing air is recovered and introduced into the cold incoming air in winter (and the reverse in summer) in order to reduce energy costs.

Both whole-of-roof-cavity and solar collector systems are used primarily as air warmers/dehumidifiers for the cooler months, but they can usually be used to exhaust hot air from living spaces during hot evenings, giving them some level of cooling ability. However, in this mode they are really just exhaust fans, and if you are considering installing one primarily for its cooling ability, you would be better off with simple exhaust fans or solar fans.

Filtration is often used on whole-of-roof-cavity systems to prevent contaminants from the cavity, such as dust and insulation glass fibres, from entering the home. External panel systems may or may not have filters—as they draw air from outside, filters may not be needed in many instances.

Effectiveness of these systems varies, but when used in a well insulated and sealed house, they can make a significant difference to the temperatures inside the home in both winter and summer—but they must be used in energy efficient homes to be effective. Energy consumption of these systems is low, as they are generally just powering fans, and in some cases, such as the Solar Venti, those fans are solar powered, so there are no running costs at all.

Air conditioning

If your house has been well insulated and sealed, appropriate shading installed and yet it still gets hot (you might live in an extreme environment such as central Australia), then you might have to resort to some form of air conditioning.

Evaporative air conditioners work well in drier climates, and because their main energy use is for the large internal fan, continuous power consumption can be only a couple of hundred watts or even less. This level of power is easily supplied in the form of solar panels. However, you would rarely attempt to drive such a system directly; normally you would install a grid-interactive system (or an independent system if you don't have mains electricity) with enough capacity to offset the air conditioner's energy use. This makes it a solar powered air conditioning system, even if it is in an indirect manner.

Calculating the solar array required is simple, but you have to decide if you want to offset the air conditioner on a daily basis (do you want to produce as much energy each day as the air conditioner uses, even though it is not used every day) or on a yearly basis (as you won't use the air conditioner in winter, you can use a smaller solar array and accumulate 'credit' towards the summer energy use). It all depends on how you want to look at it.

As an example, if your air conditioner uses an average of 200 watts for eight hours a day for 40 days a year, then you would be using 64kWh per year for your air conditioning. This means that, using an annually averaged sun-hours per day figure of 3.5 (typical for Melbourne), you would need a solar array of 64/(365 x 3.5) = 50 watts—a rather small solar power system!

However, to offset it daily, then you would need to generate 0.2 x 8 = 1.6kWh. This would mean that you need an array of 1.6/3.5 = 0.46kW, or 460 watts.

These figures are assuming no losses elsewhere in the solar power system of course, but they are a good guide.

If you prefer (or require because you live in a humid climate) a refrigerative air conditioner, then you can also offset your energy use using a solar array. These types of air conditioners use a lot more energy than evaporative systems and so will need larger solar arrays to offset them, but the methodology is the same. However, as they have a variable energy consumption rate due to compressors being turned on and off (or varying in speed with the newer inverter units) then you need to monitor the energy used by the air conditioner to get an accurate idea of energy use. You can do this with either a plug-in energy meter such as the PowerMate, or an energy meter wired into that circuit in the circuit breaker box (you need an electrician to install the latter).

You also need to make sure you buy the most efficient air conditioner avail-

This is a cut-away of the Solar Star solar vent. Solar vents are simple and effective.

able that will suit your purposes. For an easy comparison of all models currently available use the Energy Rating website at www.energyrating.gov.au

DC air conditioning

Other forms of solar air conditioning also exist. For instance, Securus of California make split system refrigerated air conditioners that run directly from 48 volt DC solar power systems, without the need for a DC to AC inverter. This eliminates one level of inefficiency that comes from running AC air conditioners from batteries in independent renewable energy systems.

The Securus systems require a minimum of 800 watts of solar panels and a 48 volt battery bank of at least 225Ah capacity.

At the time of writing, we are not aware of any similar systems in Australia. If readers know of such systems, we would love to hear about them!

Other developments

Now that we have considered the more common options for cooling, let's look at some slightly newer ideas.

One idea that has been developed and redeveloped many times over is solar thermal air conditioning—that is, air conditioning powered directly from the heat of the sun.

There are several systems in use, one of which involves the use of dessicants to produce dry air for more efficient evaporative cooling. The dessicant is then 'regenerated' (the moisture driven off) by the use of solar heat.

More active forms of solar thermal cooling have been developed and are used in commercial installations in a number of countries.

In these systems, heat is collected using high temperature, high efficiency collectors, such as double glazed flat plate collectors or evacuated tube collectors. The collected heat is used to drive adsorption or absorption cooling units.

Absorption chillers work in a similar way to compressor-based systems in that they use a refrigerant that absorbs heat as it evaporates. The refrigerant is then converted back into a liquid using only heat, and there are no moving parts. This system lends itself well to solar use as heat is so easily collected from the sun.

Because there are a number of technologies that can be used in each stage of the solar air conditioning process, it is difficult to predict which ones will become readily available in the future. To date, most solar thermal powered cooling systems have been commercial installations in Europe and the US, although a few have found their way to Australia.

One system that is currently available in Australia through Eco Kinetics is the Climate Well system, which uses solar collectors to provide heat that operates a compressorless heat pump. It can provide hot water for general use as well as heating and cooling, and includes heat (energy) storage.

Hybrid systems

Hybrid systems use regular compressor driven heat pumps which are assisted by solar heat. The only system we know of is the EEGreen which combines a Toshiba high efficiency inverter air conditioner and a solar heat collection system. The suppliers claim savings of up to 65% of energy use over a regular non-solar system, depending on the operation cycle. *

Resources

Australian Solar Cooling Interest Group: ausscig.com.au
Australian National University solar cooling page: solar-thermal.anu.edu.au/low-temperature/solar-cooling-using-ejectors
CSIRO solar cooling page: www.csiro.au/science/solar-cooling-facilities.html
Smartbreeze: www.smartbreeze.com.au
Solar Breeze: www.solarbreeze.com.au
Solar Venti and Solar Whiz: www.ges.com.au
Solar Star: www.solatube.com.au
Climate Well: www.climatewell.com and www.eco-kinetics.com/solar-airconditioning.html
EEGreen www.eegreen.com.au
Securus: www.securusair.com
Wikipedia solar air conditioning page: en.wikipedia.org/wiki/Solar_air_conditioning

Solar collector ventilators like the Solar Venti can help exhaust hot air and also work in the cooler months as air warmers.

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whatever the future holds.

Solar water heater buyers guide

If your old hot water system has given up the ghost, maybe it's time to go solar. We show you how solar water heaters and heat pumps work, what's available and how to choose the one to best suit your needs.

There are many reasons to choose a solar hot water system or heat pump over a conventional gas or electric water heater. With the rapid increase of energy prices in recent months, a solar or heat pump water heater can greatly reduce energy bills. Up to 30 per cent of household energy is used just to heat water, so anything that can reduce this energy use will save you a lot of money.

Another important benefit of such a system is that of greenhouse gas emission reduction. A solar water heater or heat pump can reduce the greenhouse emissions of an average family by as much as four tonnes of CO_2 per year—the equivalent of taking a car off the road!

Most state governments have recognised the advantages of solar and heat pump water heaters and offer incentives in the form of rebates. These vary from state to state, but can save you a great deal on the cost of a new water heater, making them more economically viable. The initial purchase price will probably still be higher than a similarly sized conventional water heater but the savings made in running costs will pay for this difference in less than 10 years—in as few as four years in some cases.

Photo: Endless Solar

Split systems make for a slimline roof installation and have become quite popular.

How does it work?

A solar hot water system usually consists of a hot water storage tank connected via pipework to solar collector panels. These collector panels are placed on a north facing roof and at an angle of no less than 15° to the horizontal. The tank can either be situated immediately above the panels on the roof (called a close coupled system), above and a small distance away from the panels within the roof cavity, or at ground level (a split system), in which case a pump and controller is required to circulate water through the panels.

As the sun shines on the collector panel(s) the water in the pipes inside the collectors becomes hot. This heated water rises through the panel and out through a pipe to the insulated storage tank. Cooler water from the bottom of the storage tank enters the panel at the bottom to replace the warmer water.

This is called the thermosyphon process, requires no pumps or other devices and is very simple and effective. However, it does require that the storage tank be situated above the collector panels. The collector panel is the driving force for the circulation, so due care must be taken with its mounting and orientation to get maximum benefit from it.

If the tank cannot be located above the collectors, a pump and a differential temperature controller must be used to provide water circulation. The controller also turns the pump on when the temperature drops to 5°C as a frost protection function.

Some systems don't heat the water directly but instead heat a fluid similar to antifreeze used in vehicle cooling systems. This fluid flows through a closed loop system (through thermosyphon or pump action) and transfers the collected heat to the water in the tank via a heat exchanger.

There are pros and cons with each system. Close coupled systems require the roof support the full weight of the tank, but they are much simpler than split systems and little maintenance is required.

Split systems have a much slimmer roof profile and are more convenient should tank maintenance be required, but the added complexity of the pump

and controller means that failures tend to be more common.

For one *ReNew* reader's take on the subject, read about her experiences in *ReNew 112*, page 75.

Heat pumps

A heat pump is a process used in refrigeration where heat is moved, or 'pumped', from one medium into another. Air conditioners and refrigerators are the most common forms of heat pumps. In a refrigerator we pump heat from the food and dump it to the air outside the fridge through the coil at the back.

Heat pump water heating systems pump heat from the air and dump it into the water storage tank. They are very efficient heaters, having a coefficient of performance (efficiency) of around three: for every unit of electricity used, they move three times this much energy into the water, although some can move considerably more than this. It is possible to put your heat pump system on a timer so that it only runs during off-peak periods, making it cheaper to run. Alternatively, it can be run only during the day if the compressor noise is a problem for you or your neighbours.

In situations where shading is a big problem for conventional solar systems and drastic tree surgery is not an option, then heat pumps deserve strong consideration.

Ground source heat pumps, normally used for space heating, can also provide hot water, and their efficiency can be even higher than a regular heat pump. If you are in the market for new water heating and new space heating systems, then a combined ground source heat pump might be worth considering. We looked at ground source heat pumps in *ReNew 112*.

Collectors

Most solar water heater collector panels consist of a collector plate to which a network of pipes is bonded. This arrangement is then placed in a metal box with insulation behind it and a glass cover on the top.

The collector plate is usually copper or aluminium, however Solahart uses mild steel for most of its models. This plate is coated with special treatments to increase the absorption of the solar heat energy.

Bonded to this plate are copper pipes, or, in the case of the Solahart, steel collectors formed into many small channels. In all cases these pipes or channels are connected at the top and bottom to header pipes which also provide the connection points to the external pipework.

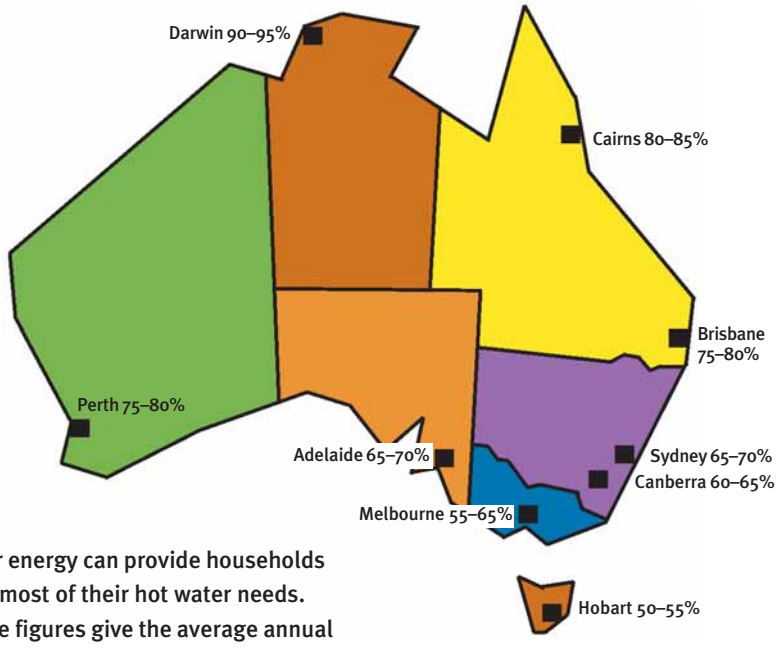
A recent entry into the market is the evacuated flat plate collector from Genersys Australia. These are similar to a regular flat plate collector except that the space between the collector surface and the glass has the air removed and replaced with krypton gas. This is said to improve cold weather performance.

Most manufacturers are now using low-iron tempered glass in their collectors for its greater absorbency and reduced re-radiation. It is also stronger than normal glass.

The other type of collector commonly available is the evacuated tube. In simple terms they consist of two glass tubes, one inside the other, made of borosilicate glass (the same glass used to make laboratory test tubes) which are bonded to each other at one, or sometimes both ends, to form a sealed space between them. The surface of the inner tube is coated with a heat-absorbing coating, just like flat panel collectors.

The space between the two tubes has most of the gas removed from it, hence they are evacuated, which provides a high level of insulation. As solar radiation passes through the outer glass tube and heats the inner tube, it is trapped by the lack of gas, which would otherwise allow convective and conductive heat losses. As a result, the efficiency of these collectors is usually higher than flat plate collectors and evacuated tube collectors will even perform well on cloudy days.

GreenLand Systems have a different design of evacuated tube. Instead of an inner glass tube, the outer glass tube is



Solar energy can provide households with most of their hot water needs. These figures give the average annual solar contribution of a correctly sized flat-plate collector system.

bonded directly to the inner copper tube which is attached to a heat absorbing plate.

Tanks

For mains pressure systems the tank must be strong enough to hold pressures of 1000kPa and above. This means they must be made of steel. Some companies use marine-grade 316 stainless steel while others use mild steel with a coating of vitreous enamel (glass). Solahart and Rheem use glass-lined tanks.

Glass-lined tanks must have a sacrificial anode fitted (a metal rod inside the tank, usually made from magnesium or aluminium) which is designed to be eaten away by galvanic, or corrosive, action in preference to the tank material.

These anodes should be checked at regular intervals to assess wear and be replaced if required; with good quality water this replacement time may be every five to seven years. If the water quality is poor then the replacement time will be much shorter. Failure to replace the anode when required will generally result in premature failure of the tank and may void the warranty.

Sola-Kleen makes its tanks from copper and runs them at a reduced pressure using a pressure reducing valve on the inlet. This has the advantage of better supply pressure than a gravity-fed system, while still giving the corrosion resistance and extremely long life of a copper tank.

Low pressure, gravity feed and constant pressure systems are all very similar and usually use copper tanks. These tanks are placed in the roof and are open vented. Being open vented allows them to be directly connected to the heat exchanger on a wood stove. They are suitable for most water conditions and give many years of service before failure, usually due to corrosion or failed seams. A heat exchange coil can enable a low pressure tank to deliver mains pressure hot water.

Mains pressure tanks can be set up as gravity feed systems by adding a header tank. This may be desirable where there is no available roof cavity but the incorporation of a combustion stove for boosting is planned.

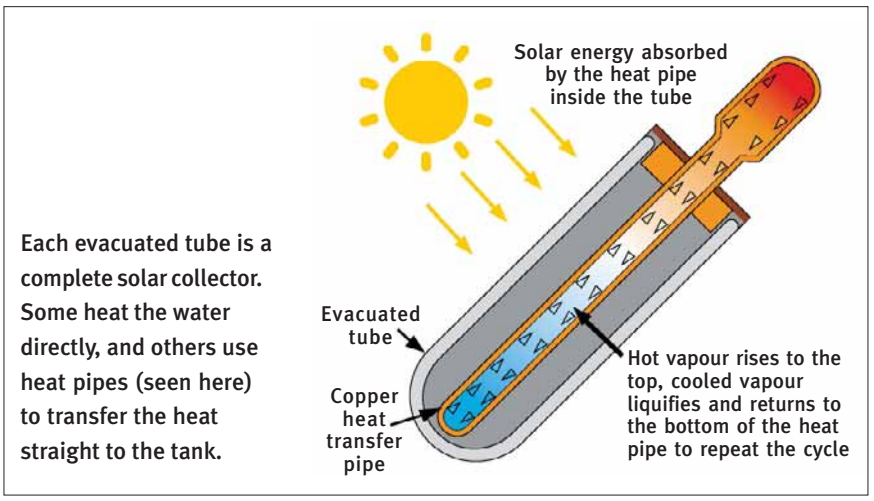


Diagram: Endless Solar

Insulation

Mains pressure tanks are usually insulated with polyurethane foam. The normal industry standard foam is CFC free. Some manufacturers build the horizontal tank such that the insulation on the top is thicker than on the bottom, which makes a lot of sense considering the hottest water is at the top of the tank.

Boosting

Virtually all heaters on the market incorporate some form of boosting for times of insufficient sunshine. People on remote area power supply (RAPS) systems usually use wood stoves or LPG for boosting. Townsfolk often have the option of natural gas or electricity.

Electric elements are the most common boosting option, as they fit in well with night rate tariffs and are a cheaper option than a gas booster. If you opt for electric boosting and plan to buy accredited GreenPower, make sure that your night rate electricity is also GreenPower.

Gas burners and control equipment cost much more than electrical elements and this is reflected in the price of the systems. Environmentally, gas is preferable to coal-fired electricity, but not all systems have the ability to override the gas during the day so that the sun, not the gas, heats the water.

A solution to this problem is an instantaneous gas booster. This type of heater can be installed between the outlet of a solar system and the rest of the hot water plumbing. It will contribute any additional heating required for the volume of water actually being used. Instantaneous heating may, however, require a higher capacity gas line as it burns a lot of gas to heat water quickly. Solar compatibility requires the booster to be able to operate with a low temperature differential between the hot water coming in from the solar system and the final hot water temperature desired at the taps. Some instantaneous heaters are now designed specifically for solar boosting, and solar water heaters come as a package with an instantaneous heater as the booster.

Frost protection

All manufacturers offer frost protection on at least some models. This is important for anywhere that a frost may occur. One older system involves dump valves which open when the temperature drops to around 4°C. As warmer water from higher in the system passes out through the valve it closes again. This process is repeated until the temperature rises.

Many systems now use a heat exchange fluid which flows through the panels and into a heat exchanger in or around the main storage tank. The fluid in this out-

er circuit contains propylene glycol, an antifreeze additive, and does not require dump valves. However, the level of fluid in this circuit must be checked regularly and replaced after an interval as recommended by the manufacturer. This fluid is more slippery than water and has been known to leak out through the panel connectors. Owners should look out for this and replace the seals and fluid before irreparable damage is done to the collector panel.

What size will I need?

Systems are usually sized the same way as off-peak electric hot water systems, as they have a similar window of access to the booster, be it the sun or off-peak electricity. The sun is most effective during the six hours in the middle of the day. Night-rate tariffs commonly run for six hours, from 1am until 7am. Check with your electricity retailer if you are not sure.

For a one- or two-bedroom house a 180 litre system is recommended. For a three-bedroom house a 300 litre system is desirable. Four to five bedroom homes should have a 440 litre system. This sizing looks at the potential maximum number of residents rather than the actual number, as the hot-water service is a fixture in the house but the residency can easily change.

We should briefly mention combined systems, which supply both potable hot water and hot water for hydronic space heating. These use much larger tanks and usually contain independent heat exchange coils for the different uses. An example of such a system can be seen in *ReNew 95*.

Temperature control

Under the plumbing code AS3500.4 it is a requirement that all water heaters connected to an uncontrolled heat source, such as solar collectors and wood stoves, must have a 'tempering' valve fitted. This valve limits the maximum temperature for hot water to the bath, shower or hand basin to a maximum of 50°C by mixing cold water with the hot water coming from the solar water heater. No solar water heater should ever be installed without a tempering valve.

Installation

The installation of any system should be carried out by appropriately qualified and experienced tradespeople. Unfortunately, too many systems have been badly installed in the past, resulting in poor performance and a loss of faith in solar water heating technology by the owners. Solar hot water systems work brilliantly if properly sized and installed. For more information on accredited installers, contact your state government energy advisory centre. You can also find a local Green Plumber by going to www.greenplumbers.com.au.

Various rebates are available for solar water heaters and heat pumps, depending on which state you live in. For comprehensive information on all solar hot water government rebates go to www.ata.org.au/rebates and for an explanation of RECs, see the article in *ReNew 111*, page 55 or go to www.orer.gov.au

Using hot water well

To optimise the performance of your system, hot water usage should occur in the morning as much as possible. This means showers in the morning and possibly putting on a load of washing, as well as the dishwasher (if you have one) before going to work. This way the sun has the first go at heating the water before the booster kicks in at night. If the sun has done its job well the booster may not be required.

For more information on getting the best from your solar water heater, see the article *How to use solar hot water well* in *ReNew 106*, page 39. ✻

A list of solar hot water systems starts on page 68.

Retrofitting existing systems

It is possible to retrofit an existing electric storage hot water system to use solar heating, provided it is in good condition (five years old or less). For a ground level mains pressure system, a special fitting can be installed on the cold water inlet. A pump circulates water from the bottom of the cylinder to the solar collectors. The hot water is injected through a small diameter pipe back into the cylinder and rises by convection to the top of the cylinder, where it is drawn off for normal use.

A controller switches the pump on whenever the solar collector(s) are hotter than the water in the bottom of the cylinder, as well as in near freezing weather to prevent the water in the collectors from freezing, which would otherwise damage the collector.

Gravity feed cylinders in the ceiling can have solar collectors connected to them, as long as the cylinder is above the collectors. If there is not a pair of unused connections available on the cylinder, an extra pair can be attached by a competent installer in about two hours. Combustion cookers used for hot water are also attached in this way, but it is not a good idea to connect a combustion cooker and solar collector pipes to the same cylinder outlets.

It is not really advisable to connect solar to gas storage hot water systems because they are designed for the gas to reheat the water as soon as some is used, so the sun can't really contribute any heat. However, the Aquamax system is designed to have solar collectors fitted if desired.

There are tank retrofit packages available that include the collectors, pump and controller such as the kits from Albury Consolidated Industries.

Run On Sun Australia Pty Ltd

"Sydney tubes"

Passive, close-coupled solar water heaters

Freeze proof by design

No pumps, no electronic controllers and no antifreeze solutions to change yearly.

A choice of frame and all the valves required are included in the price

Gas or Electric boosted models available.

Includes the top of the range 2 mm thick "Sydney tubes"

AS/NZS 2712
AS/NZS 3498

All stainless steel Construction

12 Volt DC retrofit solar conversion kits available.

Includes: Pump, 5-watt p.v panel, tank retrofit valve and collector.

12-tube collector kit $900.
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30-tube collector kit $1700.

Magnetic drive Pump, 8-24 volts.
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Make	Model	Capacity (litres)	Type	Tank material	Insulating material	Total collector area (m^2)	Number of collectors or tubes	Collector material	Glass type	Boosting	RRP	Comments	Warranty
Apricus Australia ph:1300 277 428 www.apricus.com.au	AE-250-22	250	Solar thermal evacuated tube system	Stainless steel	Polyurethane foam	3.24	22	Copper header on a steel backing	Borosilcate glass (twin glass)	Electric	$3,179	-	15 years on manifold tubes, heat pipes and frame, 10 years on tank, 1 year on pump and controller.
	AE-30-315-ESM	315				4.35	30				$3,664		
	AE-315-30	315				4.35	30				$3,664		
	AE-315-OGLB-30	315		Glass lined		4.35	30				$3,220		15 years on manifold tubes, heat pipes and frame, 5 years on tank, 1 year on pump and controller.
	AE-315-OGLM-30	315				4.35	30				$3,220		
	AE-22-250-GLE	250				3.24	22				$2,762		
	AE-22-250-GLEM	250				3.24	22				$2,762		
	AE-30-400-GLEM	400				4.35	30				$3,579		
	AE-40-400-GLE	400				5.92	40				$4,158		
	AE-40-400-GLEM	400				5.92	40				$4,158		
	AG-315-26NG-30	315		Stainless steel		4.35	30			Gas	$5,015		15 years on manifold tubes, heat pipes and frame, 10 years on tank, 1 year on pump and controller.
	AG-315-OGLG26-30	315		Glass lined		4.35	30				$4,045		15 years on manifold tubes, heat pipes and frame, 5 years on tank, 1 year on pump and controller.
	AG-40-400-26GLG	400				5.92	40				$4,894		
Aquamax Pty Ltd ph:1800 676 000 sales@aquamax.com.au www.aquamax.com.au	Aquamax failed to provide updated data for the guide. Please contact Aquamax for information on their systems.												
Chromagen Pty Ltd ph:1300 367 565 info@chromagen.com.au www.chromagen.com.au	Chromagen failed to provide updated information for the guide. For their previous information, see the guide in *ReNew 106*.												
Conergy www.conergy.com.au Ph 1300 551 303	AS250/25/O/EXX/E25BC	250	Mains pressure, open circuit, split system	Vitreous enamel lined mild steel	Polyurethane Foam	2.5	1	Copper water ways	Toughened Solar Safety glass	Electric or gas, depending on model	POA	Collectors only on roof with storage tank at ground level	Either 5 or 10 years
	AS250/4/O/EXX/E20SB	250				4	2						
	AS315/25/O/EXX/E25BC	315				2.5	1						
	AS315/4/O/EXX/E20SB	315				4	2						
	AS315/5/O/EXX/E25BC	315				5	2						
	AS315/6/O/EXX/E20SB	315				6	3						
	AS400/4/O/EXX/F20LC	400				4	2						
	AS400/5/O/EXX/V/E25BC	400				5	2						
	AS400/6/O/EXX/E20SB	400				6	3						
	AS250/25/C/EXX/E25BC	250	Mains pressure, closed circuit, split system			2.5	1						
	AS250/4/C/EXX/E20SB	250				4	2						
	AS250/6/C/EXX/F20LC	250				6	3						
	AS315/25/C/EXX/E25BC	315				2.5	1						
	AS315/4/C/EXX/E20SB	315				4	2						
	AS315/5/C/EXX/E25BC	315				5	2						
	AS315/6/C/EXX/E20BC	315				6	3						
	AS400/4/C/EXX/F20LC	400				4	2						
	AS400/5/C/EXX/V/E25BC	400				5	2						
	AS400/6/C/EXX/E20SB	400				6	3						
	TS180/2/O/V/E24/E20BC	180	Mains pressure, open circuit, roof mounted thermosyphon system			2	1					Thermosiphon system - both the tank and collectors are coupled on roof	
	TS300/25/O/E24/V/E25BC	300				2.5	1						
	TS180/2/C/V/E24/F20LC	180	Mains pressure, closed circuit, roof mounted thermosyphon system			2	1						
	TS300/25/C/E24/V/E25BC	300				2.5	1						
Douglas Solar ph:1300 302 425 david@douglassolar.com.au www.douglassolar.com.au	Douglas Solar failed to provide updated information for the guide. For their previous information, see the guide in *ReNew 106*.												
Dux Hot Water ph:1300 365 116 www.dux.com.au	D2F136W2AC D2F136T2AC	250	Split system	Vitreous enamel lined mild steel	Polyurethane	4	2	Black Chrome selective surface	4mm Low iron	Electric	POA	Open Circuit ('T' codes are sold in VIC/TAS, 'W' codes everywhere else)	5 years
	D3F136W2AC D3F136T2AC	315				4	2						
	D4F136W3AC D4F136T3AC	400				6	3						
	D2FN26W2AC D2FN26T2AC	250				4	2			Natural gas		Open Circuit ('T' codes are sold in VIC/TAS, 'W' codes everywhere else)	5 years
	D2FL26W2AC D2FL26T2AC	250				4	2			LPG			
	D3FN26W2AC D3FN26T2AC	315				4	2			Natural gas			
	D3FL26W2AC D3FL26T2AC	315				4	2			LPG			
	D4FN26W3AC D4FN26T3AC	400				6	3			Natural gas			
	D1FNP3W2AC D1FNP2TAC	170				4	2						
	D2FH00000C	259	Compact heat pump			-	-	-	-	-		-	

Make	Model	Capacity (litres)	Type	Tank material	Insulating material	Total collector area (m^2)	Number of collectors or tubes	Collector material	Glass type	Boosting	RRP	Comments	Warranty
EcoSmart Hot Water ph:133 326 www.ecosmart.com.au	E2F136W2AC, E2T136W2AC	259	Split system	Vitreous enamel lined mild steel	Polyurethane	4	2	Black Chrome selective surface	Low iron	Electric	POA	Patented HotLogic® controller constantly searches for the the cheapest available energy source resulting in greater efficiency and higher RECs values that comparable systems. Next Generation 'split system' design means no tank on the roof or expensive reinforcement required.	7 years
	E3F136W2AC, E3T136W2AC	322				4	2						
	E4F136W2AC, E4T136W2AC	415				4	3						
	E4F136W3AC, E4T136W3AC	415				4	3						
	E2FN26W2AC	259				4	2			Natural gas			5 years
	E2FL26W2AC	259				4	2			LPG			
	E3FN26W2AC	322				4	2			Natural gas			
	E3FL26W2AC	322				4	2			LPG			
	E4FN26W2AC	415				4	2			Natural gas			
	E4FL26W2AC	415				4	2						
	E1FNW2AC	170				4	2						
	E2FH18000C	259	Compact heat pump			-	-	-	-	Electric		Unique de-icing cycle automatically operates for increased energy efficiency at lower sound levels than comparable heat pumps.	
	E1F124W1CC	180	Close coupled	Stainless steel		2	1	Black Chrome selective surface	Low iron	Gas or electric		Open circuit. Stainless steel tank for lighter, safer installation.	10 years
	E3F124W2CC	330				4	2						
Edwards Solar Hot Water ph:(08) 9351 4600 www.edwards.com.au	L180-1	180	Mains pressure close coupled. Suitable for non-frost areas	Stainless steel	Polyurethane	2	1	Australis ,Australis 10 or Titan series	Low iron tempered	Electric	POA	Australis collector: aluminium with copper tubing. Titan collector: titanium coated copper with copper tubing	6 or 10 years on cylinder depending on system
	L305-2	305				4	2						
	L440-3	440				6	3						
	L180-1 GS	180				2	1			Continuous flow gas using choice of 20,24,27 LPM.			
	L305-2 GS	305				4	2						
	L440-3 GS	440				6	3						
	LX180-1	180	Mains pressure close coupled. Heat exchange frost protection			2	1			Electric		*Australis collector - aluminium with copper tubing. *Titan collector - Titanium coated copper with copper tubing.	6 or 10 years on cylinder depending on system
	LX305-2	305				4	2						
	LX440-3	440				6	3						
	LX180-1 GS	180				2	1			Continuous flow gas using choice 20,24,27 LPM.			
	LX305-2 GS	305				4	2						
	LX440-3 GS	440				6	3						
	EHP310	310	Heat pump	Vitreous enamel lined mild steel		N/A	N/A	N/A	N/A	Electric		Booster does not operate unless ambient air temp drops below 5ºC.	5 years on cylinder
	GTS270	270	Indirect split system			up to 6	up to 3	Australis or Titan Series	Low iron tempered	Gas		Drain back system, frost protected, tempering valve supplied.	
	GTD340	340	Direct split system			up to 6	up to 3			Electric		Not suitable for frost areas.	
Endless Solar ph:1300 889 585 info@endless-solar.com www.endless-solar.com	EB-160-E-10	160	Modular designed split system. High efficiency evacuated tube collector. Mains pressure, remote stainless steel storage	Marine grade stainless steel. No sacrificial anode required	Polyurethane	1.77	10 tubes	Evacuated tube with copper heat pipes and stainless steel framing	High impact resistance borosilicate glass tubes. Complies with Australian Standard 2712:2007	Electric (3.6kW standard)	POA	Frost Tolerant to -15°C. Very effective in winter and colder climates (does not require glycol) Standard package includes solar-rated tempering valve, pressure limiting valve and UV protected pipe insulation	10 years on major components
	EB-250-E-22	250				3.69	22 tubes						
	EB-315-E-30	315				4.97	30 tubes						
	EB-315-E-40	315				6.74	40 tubes						
	GB-160-17NG-10	160				1.77	10 tubes			Natural Gas (LPG option also available)			
	GB-250-21NG-22	250				3.69	22 tubes						
	GB-250-21NG-30	250				4.97	30 tubes						
	GB-315-21NG-30	315				4.97	30 tubes						
	GB-315-25NG-30	315				4.97	30 tubes						
	GB-315-25NG-40	315				6.74	40 tubes						
	Commercial Models	As Required				As required	As required			As required		Custom designed to suit the application	5 years on major components
	Industrial Models												
Generays Solar Australia Pty Ltd Distributed By EDSON PTY LTD ph:(03) 8558 8400 www.edson.com.au info@generays.com.au www.generays.com.au	1450 Vacuum Flat Plate collector	200lt upwards	Mains pressure. Closed circuit heat exchanger	Stainless steel	Glass wool/ polyurethane	1.698m² nett per panel	-	Vacuum design. Aluminum (AlMg) one piece construction, aluminum oxide highly selective surface	Safety solar ESG white glass 4mm	Gas condensing heat pump biomass	POA	High end domestic/commercial/ industrial use/swimming pools. Ten panels connected in series.	20 year on collector 20 year on stainless tank
	1000-10 collector					1.74m² nett per panel		Aluminum (AlMg) one piece construction, aluminum oxide highly selective surface				Available as horizontal (landscape) mounted panel, model 1000-10H. High end domestic/commercial use. Ten panels connected in series	
GreenLand Systems ph: (03) 9248 2900 info@greenlandsystems.com.au www.greenlandsystems.com.au	EGL7020-17(	160	Electric boosted. Evacuated tube, mains pressure split system, pump assisted. Dry heat interface (DHI). 12 volt pump and controller option available	Stainless steel	Manifold: Single piece extruded aluminum. Dual insulation: Inner: aluminium silicate fibre with black glass fibre cloth. Outer: high density polyurethane	3.6	20 x 70mm tubes	70mm or 100mm diameter evacuated tube with copper heat pipes and stainless steel framing	2.5-2.8mm AS/NZS 2712 hail resistant, high impact borosilicate glass tubes	Electric. Wood stove and kitchen wetback connections available	POA.	Single glass wall, full vacuum sealing (less than 0.001 Pa) of all active parts ensures life-long, peak performance. Stagnation-free. Hail resistant and frost protected. Stainless-steel frame, easy installation. Low thermal inertia ensures fast heat transfer. Excellent performance on overcast and rainy days. Direct Flow 100mm DF evacuated tubes also available for hydronic heating, commercial and industrial applications	14 years evacuated tubes, 15 years stainless steel mounting frame, 10 years on manifold and stainless steel cylinders
	EGL7020-26(	250				3.6	20 x 70mm tubes						
	EGL7030-32(	315				5.5	30 x 70mm tubes						
	EGL7040-32(	315				7.3	40 x 70mm tubes						
	EGL10016-26(	250				4.2	16 x 100mm tubes						
	EGL10016PT-26(	250				4.2	16 x 100mm PT tubes						
	EGL10016-32(	315				4.2	16 x 100mm tubes						
	EGL10016PT-32(	315				4.2	16 x 100mm PT tubes						
	EGL10024-32(	315				6.4	24 x 100mm tubes						
	EGL10024PT-32(	315				6.4	24 x 100mm PT tubes						
	GGL7020-17(	160	Gas boosted. Evacuated tube, mains pressure, split system, pump assisted. Dry heat interface (DHI)			3.6	20 x 70mm tubes			Gas (natural or LPG)	POA		
	GGL7020-26(	250				3.6	20 x 70mm tubes						
	GGL7030-32(	315				5.5	30 x 70mm tubes						
	GGL7040-32(	315				7.3	40 x 70mm tubes						
	GGL10016-26(	250				4.2	16 x 100mm tubes						
	GGL10016PT-26(	250				4.2	16 x 100mm PT tubes						
	GGL10016-32(	315				4.2	16 x 100mm tubes						
	GGL10016PT-32(	315				4.2	16 x 100mm PT tubes						
	GGL10024-32(	315				6.4	24 x 100mm tubes						
	GGL10024PT-32(	315				6.4	24 x 100mm PT tubes						

Make	Model	Capacity (litres)	Type	Tank material	Insulating material	Total collector area (m^2)	Number of collectors or tubes	Collector material	Glass type	Boosting	RRP	Comments	Warranty
Quantum Eco Hot Water ph:1800 383 888 www.quantumecohotwater.com.au	150-08ACW-134	150	Heat pump	Steel with vitreous enamel lining	Polyester (no ozone depletion)	N/A	N/A	N/A	N/A	N/A	$2,998	Operates in temperatures of -10˚C to +40˚C	5 years on water storage tank, 2 years on refrigeration and circuits
	270-11AC3-134	270									$3,410		
	340-11AC3-134	340									$3,713		
	340-17ACW-134	340									$5,500		
Rheem Australia Pty Ltd ph: 132 552 www.rheem.com.au	52H180K/1S-G	180	Premier Hiline Roof Mounted. Suitable for frost prone areas and areas with poorer water quality.	Stainless steel	Polyurethane	3.7	1	Mild steel	Low iron tempered	Gas	POA	Space saving design. Low maintenance, no pump required	6 Years cylinder, 5 year solar collectors, 1 year labour on cylinder. 1 year parts including labour. Applies to domestic installations only. Amended warranty may apply where a government rebate has been received. Phone 131 031 for details
	52H300K/2S-G	300				5.5	2						
	52H180/1S	180				3.7	1			Electric			
	52H300K/2S	300				5.5	2						
	52S160/1NPT-G	160	Hiline Roof Mounted	Vitreous enamel lined mild steel		2.6	1	Aluminium		Gas		Space saving design. Low maintenance, no pump required. Suitable for warmer climates	5 years cylinder, heat exchanger and solar collectors, 3 year labour on cylinder and heat exchanger, 1 year parts including labour. Applies to domestic installations only. Amended warranty may apply where a government rebate has been received for the solar water heater. Phone 131 031 for details
	52S300/2NPT-G	300				4.6	2						
	52S160/1NPT	160				2.6	1			Electric			
	52S300/2NPT	300				4.6	2						
	596270/1S	270	Premier Loline Split System. Suitable for frost prone areas and areas with poorer water quality.	Vitreous enamel		2	1	Mild steel		Gas		Split design reduces the structural load on the roof	
	596270/2S	270				4	2						
	590270/1S-G	270				2	1						
	590270/2S-G	270				4	2						
	59120/2S	270				4	2			Electric			
	591270/3S	270				6	3						
	531260/2NPT	260	Loline Split System	Vitreous enamel lined mild steel		4	2	Aluminium		Gas		Split design reduces the structural load on the roof. Suitable for warmer climates	
	511270/2NPT-G	270				4	2						
	511340/2NPT-G	325				4	2						
	511430/3NPT-G	410				6	3						
	511270/2NPT	270				4	2			Electric			
	511340/2NPT	325				4	2						
	511430/3NPT	410				6	3						
	551310	310	HDi - 310 Integrated Heat Pump	Vitreous enamel lined mild steel	Polyurethane	-	-	-	-	Electric Boosted	POA	Back up element fitted in every model	5 years cylinder warranty, 3 years labour on cylinder, 2 years on sealed system including labour. 1 year on all parts and labour. Applies to domestic installations only. Where a government rebate has been received for the heat pump water heater. Phone 131 031 for details
	551325	325	MPi-325 Integrated Heat Pump			-	-	-	-				
	551410	410	MPi-410 Integrated Heat Pump			-	-	-	-				
	561325	325	MPs-325 Split Heat Pump			-	-	-	-				
	554325	325	MPi-325 Integrated Heat Pump Rheem Plus			-	-	-	-				
Rinnai Solar ph:1300 555 545 www.rinnai.com.au	Rinnai Prestige SS180H1	180	Close coupled	Stainless steel	Polyurethane	2	1	Varies based on collector chosen	Low iron	Instantaneous gas using Rinnai Gas Boost 20 or 26 continuous flow heater	POA	All systems use high performance selective surface panels. FTC (frost tolerant collectors) available on all systems. E-Frost (warranted to -12˚C) available on all split systems. Type of collector is determined by postcode and is conditional for warranty. See rinnai.com.au or ask your dealer. An online rebate estimator is also available at rinnai.com.au	Varies from 5 to 10 years, ask your dealer
	Rinnai Prestige SS330H2	330				4	2						
	Rinnai Prestige SS250H2	250	Split system			4	2						
	Rinnai Prestige SS315H2	315				4	2						
	Rinnai Prestige SS315H3	315				6	3						
	Rinnai Prestige SS180H1	180	Close coupled			2	1			Electric			
	Rinnai Prestige SS330H2	330				4	2						
	Rinnai Prestige SS250H2	250	Split system			4	2						
	Rinnai Prestige SS315H2	315				4	2						
	Rinnai Prestige SS315H3	315				6	3						
	Rinnai Sunmaster SG1751	175	Split system	Glass lined mild steel		2	1			Instantaneous gas using Rinnai Gas Boost 20 or 26 heater			
	Rinnai Sunmaster SG2152	215				4	2						
	Rinnai Sunmaster SG2702	270				4	2						
	Rinnai Sunmaster SE2002	200				4	2			Electric			
	Rinnai Sunmaster SE3152	315				4	2						
	Rinnai Sunmaster SE3153	315				6	3						
Run On Sun Australia Pty Ltd ph:(02) 6734 6322 andrew@runonsun.com.au www.runonsun.com.au	ROSAHP150EL	150	Close coupled passive system	Stainless steel	High density 55 mm thick polyurethane	1800 x 18 heat pipes	1	AIN/AIN-SS/CU surface, "Sydney tubes" with 2mm thick glass plus copper heat pipes	2mm thick borosilicate glass	Continuous electric	$3,435	All stainless steel, including frame. Close coupled roof mount cylinder. Includes all valves required. No pumps or controllers needed. Minus 25°C freeze protection. No antifreeze needed.	5 years
	ROSAHP200EL	200				1800 x 24 heat pipes					$3,830		
	ROSAHP250EL	250				1800 x 30 heat pipes					$4,265		
	ROSAHP150G	150				1800 x 18 heat pipes				Instantaneous gas	$4,435		
	ROSAHP200G	200				1800 x 24 heat pipes					$4,830		
	ROSAHP250G	250				1800 x 30 heat pipes					$5,265		
	PV direct 12	NA	Retrofit heat pipe collector	NA	Rockwool	1800 x 12 heat pipes		Stainless steel manifold with 2 mm thick "Sydney tubes"	Borosilicate AIN/AIN-SS/CU surface	NA	$900	Full closed loop retrofit kit. Includes 12 volt, 2 watt soft start pump with pv panel	Heat pipe collector and tubes 10 years, pump & PV panel 3 years
	PV direct 18					1800 x 18 heat pipes					$1,200		
	PV direct 30					1800 x 30 heat pipes					$1,700		
Saxon Peter Sachs Industries Pty Ltd ph:(07) 3265 5133 saxon@sachs.com.au www.saxon.net.au	6410	270	Heat exchange mains pressure split system heat pump	Copper	Polyurethane	N/A	N/A	N/A	N/A	N/A	POA	Australian made, long life pure copper, no anode required, water efficient	Five years on tank, two years on refigeration components
	6420	400											
	6450	270	Storage mains pressure split system heat pump	Vitreous enamel								Australian made, viteous enamel steel tank	
	6460	340											
	6027	400	Heat exchange vented closed circuit split system solar	Copper	Polyurethane	5	2	Black chrome selective surface	Low Iron Tempered	Electric (3.6kW standard)	POA	Australian made, long life pure copper, no anode required, water efficient	Five years on tank and panels, Two years on other parts and components
	6036	400				6	3						
	6037	400				7.5	3						
Siddons Solarstream ph:(03) 9823 6272 www.siddonsolarstream.com	264SSBD	264	Split system	Marine grade stainless steel	Polymeric external casing combined with thick high density polyurethane insulation core.	N/A	N/A	N/A	N/A	N/A	$4,090	Highest quality low energy Toshiba compressor, intellegent de-ice system for subzero temp.	Domestic: 10 years on tank, four years on heat pump
	327SSAD	327									$4,490		

Make	Model	Capacity (litres)	Type	Tank material	Insulating material	Total collector area (m^2)	Number of collectors or tubes	Collector material	Glass type	Boosting	RRP	Comments	Warranty
Solahart ph:(02) 9684 9100 www.solahart.com.au	151J Gas	150	Mains pressure close coupled. Closed circuit heat exchanger	Vitreous enamel lined mild steel	Polyurethane	2	1	Mild steel	Low iron	Gas	$4,075	Thermosiphon J series closed circuit systems shown. Also available is the thermosiphon KF closed circuit range with selective surface collectors and the thermosiphon L series open circuit range. Each thermosiphon range also available in the Free Heat series (180, 300 litre capacities). Active split systems and heat pump systems also available	For single family domestic dwellings, thermosiphon Free Heat series is 10/5/5 (10 years supply tank and collectors, 5 years labour tank and collectors, 5 years components supply and labour), standard thermosiphon series is 5/5/5. For active and heat pump warranties, ask your dealer
	181J Gas	180				2	1				$4,525		
	221J Gas	220				2	1				$4,650		
	302J Gas	300				4	2				$5,925		
	443J Gas	440				6	3				$8,000		
	151J	150				2	1			Electricity	$2,475		
	181J	180				2	1				$2,925		
	221J	220				2	1				$3,050		
	302J	300				4	2				$4,325		
	443J	440				6	3				$6,400		
Sola-Kleen ph:(08) 9271 5725 www.sola-kleen.com.au	SK-180L	180	Close coupled	Copper	Western Australian wool	2	1	Aluminium/copper	4mm toughened	Electric	$3,050	Australian made, all copper tank, no ongoing maintenance, easy to install	Standard warranty to 5 years, with extension to 10 years
	SK-240L	240				4	2				$3,855		
	SK-300L	300				4	2				$4,385		
	SK-240HX	240	Close coupled with heat exchange (fire connection)			4	2				$4,055		
	SK-300HX	300				4	2				$4,715		
Solar Lord ph:1300 133 782 www.solarlord.com.au	E270U15-O	270	Mains pressure, split system, open circuit, suitable for good quality water, antifreeze level 2	Vitreous enamel lined mild steel	Polyurethane	2100 x 15 U-tubes	1	AIN/AIN-SS/CU surface, novel sputtering treatment, U copper tubes collector	Evacuated borosilicate glass tube	Continuous/off peak electric	POA	Winner of HIA GreenSmart Award - Product of the Year 2007.	10 years on gas instantaneous booster, 10 years on collector construction and 7 years on tank and 2 years on parts
	E340U15-O	340					1						
	E450U30-O	450				2100 x 30 U-tubes	2						
	E450U45-O	450				2100 x 45 U-tubes	3						
	G270U15-O	270				2100 x 15 U-tubes	1			Instantaneous gas			
	G340U15-O	340					1						
	G450U30-O	450				2100 x 30 U-tubes	2						
	G450U45-O	450				2100 x 45 U-tubes	3						
	E180H16-O	180	Mains pressure, split system, open circuit, suitable for hard to poor quality water, antifreeze level 2			1800 x 16 heat pipes	1	AIN/AIN-SS/CU surface, novel sputtering treatment, heat pipe collector		Continuous/off peak electric		Easy and cost saving installation. Good performance in winter and on overcast and rainy days.	
	E270H24-O	270				1800 x 24 heat pipes	1						
	E340H32-O	340				1800 x 32 heat pipes	2						
	E450H40-O	450				1800 x 40 heat pipes	2						
	E450H48-O	450				1800 x 48 heat pipes	2						
	G180H16-O	180				1800 x 16 heat pipes	1			Instantaneous gas			
	G270H24-O	270				1800 x 24 heat pipes	1						
	G340H32-O	340				1800 x 32 heat pipes	2						
	G450H40-O	450				1800 x 40 heat pipes	2						
	G450H48-O	450				1800 x 48 heat pipes	2						
	E450U45-OH	450	Mains pressure, split system, open circuit, suitable for hard to poor quality water, antifreeze level 2	Vitreous enamel lined mild steel with copper coil for hydronic heating		2100 x 45 U-tubes	3	U copper tube collector		Continuous/off peak electric		Winner of HIA GreenSmart Award - Product of the Year 2007. Good performance in winter and on overcast and rainy days.	
	E450H48-OH	450				1800 x 48 heat pipes	3						
	G450U45-OH	450				2100 x 45 U-tubes	2	Heat pipe collector		Instantaneous gas			
	G450H48-OH	450				1800 x 48 heat pipes	2						
	E250U15-O	250	Mains pressure, split system, open circuit, antifreeze level 2	Stainless steel		2100 x 45 U-tubes	1	AIN/AIN-SS/CU surface, novel sputtering treatment, U copper tubes collector		Continuous/off peak electric		Good performance in winter and on overcast and rainy days.	10 years on gas instantaneous booster, 10 years on collector construction, 10 years on tank and 2 years on parts
	E315U15-O	315				2100 x 45 U-tubes	1						
	G250U15-O	250				2100 x 45 U-tubes	1			Instantaneous gas			
	G315U15-O	315				2100 x 45 U-tubes	1						
	E250H24-O	250				1800 x 24 heat pipes	1	AIN/AIN-SS/CU surface, novel sputtering treatment, heat pipe collector		Continuous/off peak electric		Easy and cost saving installation. Good performance in winter and on overcast and rainy days.	
	E315H32-O	315				1800 x 32 heat pipes	2						
	G250H24-O	250				1800 x 24 heat pipes	1			Instantaneous gas			
	G315H32-O	315				1800 x 32 heat pipes	2						
Solar-Mio Albury Consolidated Industries ph:(02) 6040 6666 www.metaldynamics.com.au	Albury Consolidated Industries failed to provide updated information for the guide. For their previous information, see the guide in *ReNew 106*.												
SolarOz ph:0411 424 322	SPZ58/1800-24	200	Integrated compact	316 stainless steel	Polyurethane	1.92	24 tubes	Evacuated tubes	2mm borosilicate	Electric	$2,640	28 RECs	5 years on tank, 10 years on tubes
	SPB58/1800-30	300	Split system			2.4	30 tubes				$3,950	32 RECs pending	
Stiebel Eltron ph:1800 153 351 info@stiebel.com.au www.stiebel.com.au	WWK300 A	303	Compact heat pump	Enamelled steel	Polyurethane	N/A	N/A	N/A	N/A	No	$3,800	Active desfrost, extrenal or internal installtion	5 years on tank, 2 years on compressor and refrigerant circuit and 1 year on electrical components
	WWK300 AH									Smart element 1.7kW	$4,000		
	WWK 300									Element 1.7kW	$4,400	Internal installtion only	
SunPlus Solar ph:1300 007652 admin@sunplussolar.com.au www.sunplussolar.com.au	CPCASE1	315	Split system	Vitreous enamel	Injected foam	3	3	Aluminium, copper and glass	Borosilicate glass	Off-peak electric boost	$4,357.10	Mid Element	5 years
	CPCASE2	315				4	4				$4,992.90		
	CPCASE3	400				4	4				$5,441.70		
	CPCASE4	400				6	6				$6,881.60		
	CPCASG5	160				2	2			Gas boosted	$4,114.00	Rinnai gas boosting	
	CPCASG2	250				2	2				$4,357.10		
	CPCASG6	250				3	3				$5,067.70		
	CPCASG3	315				3	3				$5,273.40		
	CPCASGL1	400				4	4				POA	Baxi.Luna gas hot water and hydronic boosting	
	CPCASGL2	400				6	6						
	CPCBMGL1	315		Stainless steel		4	4						10 years
	CPCBMGL2	315				5	5						
	CPCBSG1	160				2	2				$5,835.10	Bosch gas boosting	
	CPCBSG2	250				2	2				$6,451.50		
	CPCBSG3	315				2	2				$6,675.90		
	CPCBME7	250				2	2			Off-peakelectric boost	$4,936.80	Mid element (Base element available)	
	CPCBME1	250				3	3				$5,535.20		
	CPCBME4	315				3	3				$5,778.30		
Vulcan ph: 132 552 www.vulcan.com.au	511160/HBT-G	160	Split system	Vitreous enamel lined mild steel	Polyurethane	2	1	Aluminium	Low iron tempered	Gas boosted	POA	Split design reduces the structural load on the roof	5 years cylinder, collectors and electronic instantaneous heat exchanger, 3 year labour on cylinder and electronic instantaneous heat exchanger, 1 year parts including labour. Applies to domestic installations only. Where a government rebate has been received for the heat pump water heater phone 131 031 for details
	596160/1T					2	1	Mild steel					
	696160/2NPT					4	2						
	690160/1T-G					2	1						
	690160/2NPT-G					4	2						

Difficulty rating: ★★★☆☆

Danger 240 volts

A simpler fluoro light conversion

Lance Turner takes a look at how to convert fluoro fittings to use LEDs using off-the-shelf materials.

The Alternative Technology Association's office is lit with nine slimline T5 fluoro fittings, each of which contains two 28 watt T5 tubes. These fittings have been in place a few years now and the tubes were starting to fail. Rather than replace them with more fluoros, which are fragile and require special disposal, we decided to convert them all to LED fittings over a period of time.

We wrote about the first of these conversions in *ReNew 111*. In that conversion we used two T5 LED tubes and the drivers they come with to convert the fitting. However, it required the addition of insulation and the tubes were not as bright as the original fluoros.

When a couple more of the old fluoro tubes died, it was time to find a better conversion technique. I have recently been supplying a lot of LED ribbon to various people for all sorts of uses, both domestic and commercial. This material comes on a five metre roll. It is 8mm wide and around 3mm thick including the LEDs themselves. The LEDs are wired in strings of three, each string with its own current limiting resistor. The ribbon is powered by simply connecting it to a regulated 12 volt DC power supply.

LED ribbon comes in a range of colours, including warm and cool white, but not neutral white—at least not in the lower cost versions of this material, which is what we wanted to use. It also comes with several different LED types and densities. I chose to use a high density material that uses 3528-sized surface mount (SMD) LEDs and has 120 LEDs per metre, compared to the standard density of 60 LEDs per metre. LED ribbon has dropped in price in recent years to the point where it can be used for a great many projects. Prices per roll are well under $100 now, depending on LED type and density.

The new power supplies fit neatly where the old ballast used to, almost like they were made for the job! Note how the LED ribbon is mounted on square aluminium tube.

A quick note on SMD LED sizes. There are two systems in use, the imperial (inches) system, which describes the device dimensions in length by width using mils, or thousandths of inches, and the new system, which uses millimetres. With the mils system, the numbers given can be converted to millimetres by dividing each of them by four. For instance, a 1206-sized LED means the LEDs are 120 x 60 mils. Converting mils to millimetres is easy, just divide by 40. So, a 1206-sized LED is 3mm by 1.5mm, approximately.

The metric system describes them directly in tenths of millimetres. A 3528 LED is therefore 3.5 x 2.8mm in size—much simpler!

The ribbon is very flexible and comes with adhesive tape on the back, making it very easy to use. It can be cut every three LEDs, so light strips of any length that is a multiple of 25mm can be made.

The top surface of the fluoro tubes is normally a few millimetres below the diffuser. To retain that spacing with the new LED strips I decided to mount them on 20mm square aluminium tube. This is available from many hardware stores and I bought five metres for around $30. It normally comes in 1 metre and 2.4 metre lengths. I bought the former as the longer lengths were a tad too big to safely fit in the car.

The conversion

So, how was the conversion done?

Firstly, I removed the original fluoro tubes and electronic ballast. I also no longer needed the fluoro tube sockets. These are integrated into the fitting end caps but were very easy to remove, there

weren't even any screws. I cut the wires close to the sockets, pried off the plastic covers, pulled out the sockets and metal base plates and refitted the plastic covers.

In place of the electronic ballast I fitted two 12 volt switchmode power supplies. These are designed to replace the transformers used for halogen downlights when converting said downlights to LED bulbs. They were perfect for this use, as they were the ideal physical size and rating, and being fully insulated there were no electrical issues. The units I used are actually sold by ATA, but are also available from Jaycar Electronics, catalogue number MP3362.

After fitting the two power supplies I wired their mains power inputs back to the light fitting's mains terminal block using the original wire from inside the fitting, as it has the appropriate voltage ratings. I then fitted the square aluminium tube to the base of the fittings where each tube used to be. For each tube I use a full one metre length plus a shorter piece cut from the fifth length, so that the tube ran the full fitting length, from end cap to end cap. These were held in place using countersunk screws through the back of the fittings into the square tube. Only a few screws were needed—three in the long length of tube and two in the short length.

Just a couple of points here to watch out for. Firstly, make sure that the sections of tube line up fairly well. Secondly, on my fittings at least, the diffuser just clips into a flange along each edge of the fitting, so enough room has to be left between the square tube and the edge of the fitting to allow the diffuser to be fitted. Four to five millimetres was enough.

Once the square tube was fitted, the LED strips could be installed. I used a length of each cool white (5600K colour temperature) and warm white (3200K) ribbon for each tube replacement, the theory being that the two colour temperatures would give me a similar colour to the original neutral white (4100K) tubes.

To fit the ribbon, just peel the backing strip off and press the ribbon into place—easy! Just remember that, unlike through-hole LEDs which are hard moulded plastic, surface mount LEDs use a silicone gel to cover the actual LED chips (and their delicate bonding wires), so when pressing the ribbon into place, try and press between the LEDs, rather than on the LEDs themselves.

Once both lengths of ribbon are in place on each side, just wire them together. Positives and negatives are paralleled and then a single twin core figure-8 wire leads from the ribbons back to each power supply. I threaded the wire through the end caps for neatness. How you have to route the wire will depend on the fittings you use. I used some glue to hold the wires in place (the same method as the original fluoro wiring), as well as a dob to hold the ends of the ribbon in place, just in case.

So, when you are finished, you will have each power supply powering a little over two metres of ribbon in total, for a total power consumption of around 24 watts per power supply (rather convenient as they are rated at 25 watts). And that's it, the fittings are finished.

On our fittings, the centre cover needed to be sprung in slightly to get it in position between the square tubes, but this was a simple task and required no modification of the cover.

Once the fittings were installed back in the office, on went the switch. The end result was quite good, very close to the same level of brightness as the fluoros and a similar colour, if a little more toward the cooler end of the spectrum. The 120 degree beam angle was a bit narrower than the original fluoro tubes as well. For the next pair of fittings I will use a slightly different ribbon that uses thirty 5050-sized three-chip LEDs per metre, as these have a slightly wider beam angle.

This system of conversion is applicable to a wide range of fluoro and other light fittings. Indeed, any fitting with flat internal surfaces can be converted in this manner. ✻

The close-up of the ribbon shows how it is constructed. The LEDs are connected in strings of three, each with its own resistor. Note the join between the ribbon sections on the left of the photo (it's manufactured in 500mm lengths). The two ribbons here have different value resistors—it seems this manufacturer selects resistors to suit each batch of LEDs!

Tassie's wind powered radio and TV site

This remote transmission site is entirely powered by renewable energy, writes Renee Thompson.

A mountain overlooking Queenstown in Tasmania is the site of Australia's first broadcast transmission facility to be powered entirely by renewable energy.

Located on the side of Mount Owen in western Tasmania, the remote site is owned by Broadcast Australia and provides critical radio communications for local emergency services to the nearby towns of Queenstown and Zeehan along with analogue and digital radio and television services.

At 980 metres above sea level and a mountainous landscape dominated by strong winds, Mount Owen was assessed by Broadcast Australia to be an ideal location for switching its transmission site to full onsite solar and wind turbine power.

Broadcast Australia's Energy Systems Engineer, Gary Cafe, says that renewable energy generation was also considered more cost effective for the remote site than upgrading the existing infrastructure.

"Usually renewables are uneconomic due to the large consumptions required or easy access to mains. This was a good combination of 2.5km mains run over rocky ground, an end-of-life mains cable, good wind resource and manageable power demand," he said.

Transmission begins

In July the Mount Owen site began to harness enough wind and solar energy generated onsite to reliably meet the site's 8kW power needs up to 90 per cent of the time.

With a 15 metre high wind turbine capable of producing 15kW of power and 36 square metres of monocrys-talline solar PV panels adding an extra 5kW, the excess electricity generated from the Mount Owen facility is stored and later used to supplement the power supply if onsite generation drops below 8kW.

While remote telecom sites that are powered by wind and solar hybrid systems do exist in other parts of the world, such as one on Duncan Mountain in Idaho, US, that has been run since the mid-1980s (and several more recent examples in the US, Canada and northern Europe), they tend to present unique challenges.

Cafe explains that the difficult location of the onsite facility at Mount Owen and embarking on a project unprecedented for a transmission site in Australia required a high level of expertise.

"The access to the site is very restricted, especially when around eight tonnes of equipment was required on site. The diesel generator container alone was four tonnes and the turbine head one tonne so specialist equipment was required to transport the plant up to site. The weather conditions are extremely harsh on site, with heavy rains, sleet, ice, snow and near cyclonic wind speeds. The remote nature and access means that this essential service must have a number of levels of redundancy to keep operating until a serviceman can get there, especially if it is snowed in."

Potential problems

As an Australian first, Broadcast Australia knows that there will be hiccups at the transmission site at Mount Owen along the way and Cafe is just as upfront about its teething issues as he is about its potential.

"It has had one failure due to a supporting system not reporting a certain running condition. In general I am stepping back and learning lessons from this one with the view to building a nationwide renewable energy strategy to ensure we're investing in the right technologies in the most efficient way," he said.

There are no current plans to shift Broadcast Australia's other transmission sites to renewable energy just yet, however, trials are underway for energy efficient cooling systems and improved battery systems. ✻

The national picture

The federal government's recent energy efficiency report shows some potential but still offers nothing definite, writes Alan Pears.

The Energy Efficiency Task Group report originally commissioned by former Prime Minister Kevin Rudd has now been released (available at www.climatechange.gov.au under 'consultations'). It acknowledges Australia's poor past energy efficiency performance relative to many other developed countries. It also flags a lot of exciting ideas, such as an 'aspirational' target to improve primary energy efficiency (measured as energy/unit of GDP) by 30% by 2020, along with many new measures and the strengthening of existing ones.

But you have to read the fine print to find many of the potentially most powerful proposals, including a national energy agency to coordinate and fund energy efficiency and a single Ministerial Council to coordinate energy efficiency. The report recommends a national energy efficiency scheme, probably a certificate trading scheme, that would deliver net benefits of up to $6.6 billion over 30 years and cut household annual energy bills by up to $180. Surely that's good news for governments under attack over rising energy prices!

Innovative funding mechanisms via local government are proposed, similar to the trial scheme just begun by City of Melbourne with Victorian government support. By loaning money for energy efficiency improvements to buildings through councils and repaying via a levy on rates, interest costs are reduced and the beneficiaries of the investments repay the loan.

Some of the language in the report is a bit of a worry, though, especially in the early parts where discussion of the potential benefits uses tentative language like 'may'. And it assumes that energy growth will continue. All the recommendations are politely offered 'for consideration'.

What is an 'aspirational target' that relates specifically to 'primary energy efficiency'? It means improvements in efficiency of the energy supply system will count towards it, including renewable electricity production. Each unit of renewable electricity replaces three or more units of primary energy from coal or gas because of a quirk in the way statistics are calculated in Australia. So the actual rate of improvement of end-use energy efficiency under this target may be much lower than many readers might expect, and renewable energy will be 'double counted' under the Renewable Energy Target and energy efficiency. Tricky.

I must admit that finding a way to frame an energy efficiency target is challenging. By targeting end-use efficiency improvement you might encourage replacement of efficient local gas use and cogeneration (with conversion losses on the customer side of the meter) with grid electricity (much bigger losses at the power station), which would be perverse. But using primary energy as the indicator is too broad. Maybe we need separate efficiency targets for each energy source!

The report's modelling of the target shows that around half of it will be achieved by measures already in place. So why don't we call it a 15% primary energy efficiency target?

Modelling of the energy efficiency scheme proposal assumes that only household measures with up to three year paybacks and industry measures with up to five year payback periods will be implemented (p.222). Investment in centralised fossil-fuel based energy supply infrastructure typically has much longer payback periods, so the modelling accepts that we will continue to over-invest in energy supply capacity at the expense of more cost-effective energy efficiency. Why should energy efficiency policy makers propose that Australian society should continue to waste money?

The proposed national energy efficiency scheme is described as 'transitional'. That seems to be code for shutting it down when emissions trading is introduced: the report proposes phasing it out when a 'mature' carbon price is operating. This seems to reflect the government position that all programs must 'complement' an emissions trading scheme. Unfortunately the government still doesn't seem to understand that an emissions trading scheme needs to complement other programs as well.

The report also carefully avoids linking energy efficiency improvement to greenhouse gas abatement beyond the 2020 government emission target. This reflects the government's reluctance to recognise and credit voluntary abatement action as 'additional' and its belief that a carbon price will be the main policy driver. So saving energy will reduce the cost of meeting the Kyoto target and the government's 2020 abatement target, but it won't reduce our emissions further. This blocks the most powerful motivator for many Australians to save energy. See www.vcma.org.au for more information of voluntary abatement.

Electrifying issues for electric cars

The electric car is coming close to 'silver bullet' status for low emissions transport. But we need to be careful, as most claims about vehicle range on full charge are based on relatively slow urban driving. As speed increases, aerodynamic drag rapidly increases so that, cruising at 100km/h, an electric car may have less than half the range claimed under urban conditions.

In the United States, General Motors have changed their claims for the Volt's range from 40 miles on electric only to 25 to 50 miles after criticism from motor magazines. So even driving on urban freeways and arterial roads seriously cuts the range. Many see battery replacement stations as the answer, but it may be difficult to establish enough of them, and the hassle of frequent stops is an issue.

One promising solution, based on my modelling, is installation of a small 15-20kW engine-powered generator instead of some of the batteries. If this is started when starting a long trip rather than waiting until the battery is drained, it can extend range dramatically. It also offers a limp-home speed of 60 to 70km/h and a useful backup generator for home.

The trick is to predict when the car may be used for a long trip, so the generator starts early to maximise range. One option could be for the driver to be prompted to select the range extension mode manually at the start of a long trip. Another could use GPS destination data and/or monitoring of driving style to predict a long trip or high speeds. In this mode, the electric car is really a 'smart' plug-in hybrid with a very small engine-generator.

National Greenhouse Gas Inventory distorts policy

For many years I wondered why government policy staff focused so little attention on the roles of the residential and commercial energy efficiency in greenhouse gas abatement. Finally I realised that the NGGI, which shaped their thinking, allocated only direct on-site emissions to these sectors. Since 85% to 90% of their emissions result from the use of fossil fuel sourced electricity, the NGGI incorrectly made them look trivial. NGGI attributes all electricity emissions to the 'electricity' sector! Even the NGGI allocation to economic sectors leaves all electricity emissions out of the commercial and residential sectors. Likewise, most advocates of emissions trading look at the NGGI and conclude that they've got stationary energy 'covered' by including power stations. They don't seem to grasp that it is end users (and suppliers of appliances and buildings) that create the 'need' to run the power stations.

Because the NGGI only looks at flows of emissions from points of emission, it also ignores existing carbon stocks and potential resources that would avoid emissions. For example, the waste industry has estimated that over 40 million tonnes of emissions each year could be avoided if we recovered and reprocessed 'waste' materials to recover the embodied emissions in them. But the NGGI only shows emissions from decay of organic wastes. Likewise, ignoring the stocks of stored carbon in forests undervalues the importance of maintaining that enormous store.

It's fascinating how the way we present information can distort understanding and lead to strange policies! *

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.

www.youtube.com/greenpowerscience and www.greenpowerscience.com

We don't normally look at commercial websites, but Green Power Science has some really good information on using big scary lenses and mirrors to collect solar energy, so we thought we would make an exception.

Green Power Science is a small business in the US that sells large fresnel lenses of various sizes and shapes in both framed and unframed format. However, most of their website is devoted to explaining just how useful these lenses can be in solar power projects.

This is done through over 200 videos that cover all manner of solar projects, from running Stirling engines from a large solar lens, to cooking with solar, making parabolic trough collectors, how to use solar power regulators, using Peltier devices, simple solar water heaters and many other subjects.

You can view all of these videos, many of them in high definition, by going to the Green Power Science YouTube channel (the first URL listed above).

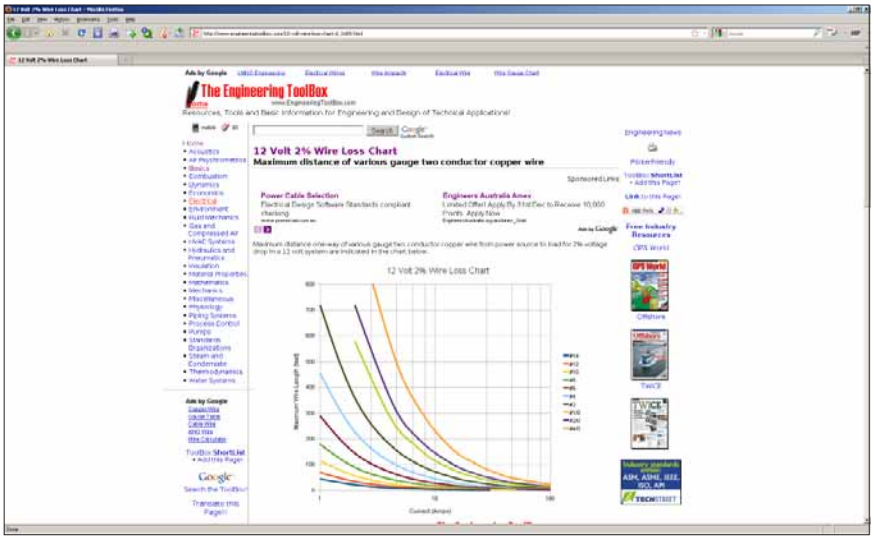
Watch water being boiled in minutes flat or find out how to cook bread using sunshine.

While it might not be realistic to have such large lenses shipped from the US, the videos alone will keep you busy for hours, and there's a lot more information than just the videos. So if you have a keen interest in DIY solar projects, you must check out this site.

www.engineeringtoolbox.com

Anyone interested in the DIY aspect of renewable energy and sustainable living will need to convert from one type of unit to another at some stage. There are quite a few online conversion sites and calculators, but being able to find most conversions in one place is a bonus.

Engineering Toolbox is exactly that. The site has many pages on all manner of technical units, from length, volume and pressure, to electrical units and even drag co-efficients.

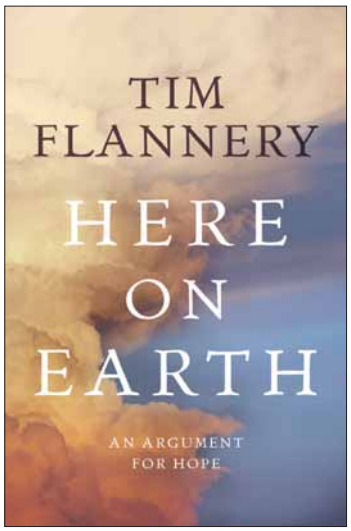


The site is categorised by broad technical areas, such as electrical, environment, hydraulics, process control, thermodynamics, mathematics, basic conversions and many others.

Clicking a category gives you a page of subcategories presented in a list format, with each sub category having a title and brief description to help you find what you're looking for.

The only annoying thing about this site is that the pages are broken up with 'sponsored links' (i.e. advertisements), but it is a free service and has to be paid for somehow. The adverts themselves are quite targeted and some look like they might even be useful!

Overall, if you need to know how many psi in a kPa or need to convert AWG to mm² then Engineering Toolbox is the one-stop place to look.



Here on Earth
Professor Tim Flannery

Published by Text Publishing. $34.95 paperback, $49.95 hardback

This new major work by Professor Tim Flannery is a companion book to his book *The Weather Makers*, which provided an urgent scientific and practical path to a more sustainable future.

This time Flannery goes back to the origins of modern science and the work of Charles Darwin. He asks the tantalising question of what kind of world we could have inherited had we followed the works of Alfred Russel Wallace more than Charles Darwin? Wallace was a self-taught naturalist and scientist who came to his theory of natural selection while he was living in the East Indies and Indonesia.

Wallace posted his findings to Darwin back in England and stirred Darwin into publishing his very influential *On the Origin of Species*. The book explained evolution by concentrating on changes to species over time, but was also taken up by 'social Darwinists' and proponents of 'the selfish gene'.

In contrast Wallace preached 'interdependency' and the inter-relatedness of all living things. In other words he was an early environmentalist who could have steered the world on a different course which valued the Earth's ecosystems. His book, *Man's Place in Nature,* is praised by Flannery for its study of astronomy, the earth's atmosphere and biodiversity.

Here on Earth is full of insights on how the natural world works, ancient Aboriginal fire stick farming as an excellent means of maintaining biodiversity, mass human migrations, limits to growth, the overuse of chemicals and how we can transform the process of degradation by using renewable energies and changing our way of life.

The book was launched in Sydney by Cate Blanchett under the Sydney Theatre Company's solar panel roof. At a public lecture for Gleebooks, Tim Flannery told a large audience that he was still optimistic that we can transform our relationship with planet earth, if we confront the dangers ahead.

Reviewed by Margaret Smith

Products

Monitor electricity, gas, everything!

There's been a proliferation of energy meters aimed at the domestic market in recent years, but most just monitor electricity use.

The EM20 meter from Synctek not only monitors electricity use but can monitor gas consumption, water use and other consumption parameters and send all this data over one of several optional interfaces for use elsewhere. Interfaces include the Clipsal C-Bus, Modbus RTU, wired and wireless ethernet networks.

The EM20 has too many features to list but includes real-time analysis and reporting (it can even email weekly and monthly reports to you), up to three phase electricity metering to 200 amps per phase with 1 watt resolution, programmable monitoring and alarms for various parameters, programmable 4-20mA analogue outputs for voltage, current, power and energy and there's even ten programmable digital outputs.

The metering system comes in two main parts—the EM20 and a 7 inch colour touchscreen which connects to the EM20 via an RS485 link.

RRP: $1850 for the package that includes the EM20, a 7 inch touchscreen, three 100 amp current transformers and power supplies for the EM20 and screen. Synctek is offering a special price for *ReNew* readers of 10% off, so $1665 for the package if you mention the ATA while ordering.

For more information contact Synctek Pty Ltd, 57 Northern Rd, West Heidelberg VIC 3081, ph:(03) 9458 2911, info@synctek.com.au, www.synctek.com.au

Simple battery status monitor

When's the last time your batteries received a full charge? What's the state of charge of your batteries?

The MidNite battery monitor from Zylux uses a simple LED status display to show you the answers to these questions, which should enable you to keep your batteries alive longer.

The monitor is auto-sensing for 12, 24, 36 and 48 volt batteries, so there's nothing to adjust. It displays the state of charge, as well as whether your batteries have been fully charged recently, whether it's been a week since the last full charge or whether it's been more than two weeks.

By allowing you to have a better understanding of your battery's charging regime without having to keep notes, the monitor should allow you to prevent your batteries from sulphating due to lack of charge.

The MidNite monitor is suitable for all gel, AGM and flooded cell lead-acid batteries.

RRP: $135. Contact Zylux for trade pricing.

For further information contact Zylux, ph:(03) 9482 2203, www.zylux.com.au

Give a worm a home

Worms are great for turning scraps and organic waste into rich fertiliser, but your worms need a good home or they won't last long.

The Wormie Bin from CERES is their latest incarnation of their popular worm farms. Made from recycled wheelie bins, they are simple and robust and make a great home for your composting worms.

The Wormie Bin is available in two sizes—120 and 240 litre capacity. They are vermin proof, have an external tap to collect worm juice, and are designed and made on the CERES site.

RRP: $190 for the 120 litre, $225 for the 240 litre unit. 1000 worms costs $49.

For more information contact the CERES nursery, Lee St East Brunswick 3057, ph:(03)9389 0111, ceres@ceres.org.au, www.ceres.org.au

An approved microinverter

Some time back we looked at the SWEA GTI250W 250 watt grid-interactive inverter for micro systems. At the time it was undergoing approvals and it now has Australian Standards approval (AS4777). In the process, it was totally redesigned and is in effect a completely new inverter.

The inverter accepts up to 280 watts of solar panels (but can also be used with wind turbines) to produce up to 250 watts of power into the grid. Input range is 20-54 volts. We had a chance to test one and found that the inverter didn't draw much current from the power source until the input voltage exceeded 30 volts, so we would recommend using this with panels at the higher end of the voltage input range. A quick test showed efficiency to be around 95% at 100 watts, so the inverter doesn't waste much, especially for such a small unit.

The inverter has all the usual safety features including fusing, anti-islanding and isolation switches and is housed in a very robust steel enclosure. Various options are available and larger systems can be installed that consist of multiple GTI250W inverters working together.

For more information, contact Ladder Technologies, 294 Palmyra Ave, Shanes Park NSW 2747, info@laddertech.com.au, www.laddertech.com.au

A big inverter with the lot

If you are setting up a large renewable energy system then you will need a large inverter, preferably one that can integrate with the rest of the system and automate much of the power control.

The Victron Quattro 10000 is a combined inverter/charger with two AC inputs, one for mains power and one for a generator (or you can use two generators). It handles all of the power flow from all energy sources, so AC changeover switches are not needed.

The main output has no-break functionality, so in the event of a grid failure or generator power being disconnected, the Quattro takes over the supply to the connected loads. This happens in less than 20 milliseconds, so computers and other electronic equipment will continue to operate without disruption.

The unit also has a second AC output, which is live only when AC is available on one of the inputs of the Quattro. Loads that should not discharge the battery, such as air conditioning or a water heater, can be connected to this output.

Another feature is called PowerAssist, where peak power is partially provided by the inverter from the batteries to increase the total peak power available to the loads when generator output is insufficient. When the load reduces, the spare power is used to recharge the battery.

RRP: POA

For more information contact Victron Energy on ph:(02)9863 1052, mleeftink@victronenergy.com, www.victronenergy.com/inverters-chargers/quattro

Disposable nappies you can feel less guilty about

If you have kids in nappies, then odds are you use disposables. While reusable nappies are the more eco friendly option, there are better disposable options now.

Little Takas from EcoQuest are disposable nappies that are designed to biodegrade by over 90% in six months. We should point out that this is in aerobic (aerated) conditions, while most landfills are anaerobic. They come in a range of sizes, from newborn to toddler.

RRP: $19.95 a pack of nappies. The number per pack varies depending on size.

For more information contact EcoQuest Ltd, 1/66 Mill Point Rd, South Perth WA 6151, ph:(08) 9277 7476. To buy online go to www.littletakas.com

Products

A tree of many uses

We don't often review living things in the Products section, but paulownia trees are so versatile we thought it was time to look at them.

Paulownia is a medium to tall, large-leafed, fast growing deciduous tree, originally from Eastern Asia. They were introduced into Australia in the 80s and after a rocky start, a few growers evolved the stock to be a very useful and versatile tree for Australian conditions.

Paulownia trees are very fast growing and can grow more than three metres a year. Because they are deciduous, they can provide rapid shade for new homes with bare gardens. They also produce copious quantities of purple flowers and their foliage can be trimmed and used as livestock fodder.

Toad Gully Growers provide paulownia trees in two forms—plugs, which are small plantlets in cell trays, and headstarters, small bare-rooted trees with trimmed trunks, which are ready to plant and are ideal for small plantations and home gardeners.

But the most common reason for growing these plants is the beautiful wood they produce. Because of the fine grain and the tree's ability to produce flamed timber, paulownia can be used to replace a number of other woods, including ash, birch, maple and walnut. Their fast growing nature and hardiness make them suitable for plantation cultivation throughout much of Australia, especially tropical areas.

RRP: $60 for five paulownia trees (of your chosen variety), $90 for 10 and $600 for 100.

For more information, contact Toad Gully Growers, 361 Stumpy Gully Rd, Balnarring VIC 3926, ph:(03) 5983 5688, info@toadgully.com.au, www.toadgully.com.au

Ditch the plastic keyboard

You might be stuck at a computer all day but you don't have to be completely surrounded by synthetic materials.

The USB keyboard and mouse set from Brando are predominantly made from bamboo, although the keyboard keys are still plastic, just bamboo coloured. However, the mouse is almost entirely bamboo, except for the electronic components of course.

The items are available separately, or as a set for a reduced price, and shipping is just US$3 on all orders worldwide. Note that availability varies, sometimes either or both items can be out of stock.

RRP: US$19 for the mouse, US$39 for the keyboard and US$52 for the set.

Available online at http://usb.brando.com/usb-bamboo-keyboard-mouse_p1179c34d15.html

And a wireless unit that needs no batteries

Everything is going wireless these days, and there's no doubt that wireless devices can be more convenient, but the big problem is that wireless devices need batteries to operate. Even the best wireless devices need their batteries recharged every couple of months.

The Logitech K750 wireless solar keyboard solves this problem. Like a solar powered calculator, it collects light and uses it to charge an internal battery. The keyboard has comparatively quite large solar panels, so can run on normal indoor light levels as well as direct sunlight. Once fully charged, the keyboard will stay charged for up to three months without additional light.

Other features include PVC-free construction, a slimline design (around 8mm thick) and the inclusion of a PC application that can tell you battery power remaining, as well as how much power the solar panels are generating!

RRP: US$80

For more information and to preorder, go to www.logitech.com or check out your local computer store.

Low cost EV motors

If you are planning an electric vehicle conversion, then you will need a suitable motor. For larger vehicles that need to do highway speeds, you will have to pay a few thousand dollars. But what if you just want a low speed, lightweight urban run-about or want to convert a small vehicle such as a motorbike?

The Mars motors from EV Works range in output power from 5kW to 15kW, which is enough for most smaller EVs. There are three models, two rated for 48 volts DC (one brushed and one brushless) and a larger brushed 72 volt model.

The motors are designed to run up to 5000rpm and they are compact and light-weight, ranging from just 11kg to 18kg. Suitable Alltrax controllers are also available.

RRP: From $515 to $625 including GST, depending on model. Controllers are as low as $465.

For more information, contact EV Works Pty Ltd, ph:0407 152 552, www.evworks.com.au

Integrated LED downlight

Until recently, replacing halogen downlights in domestic situations meant using LED bulbs, which generally have lower outputs than a 50 watt halogen, or changing fittings to use fluorescent lamps. But recently there's been a flood of high quality complete LED downlight solutions aimed at the MR16 replacement market.

The Powerlux fittings from LED Lighting is a complete customisable system which includes the LED light engine and a choice of four different fascias and three different drivers, including two fully dimmable versions using the two most common dimming systems (standard wall dimmers and the 0-10 volt system).

The fittings use Osram LEDs and are available in either warm white (3000K) or neutral white (4000K) colour temperatures, with beam angles of either 30 or 60 degrees. Power consumption is 15 watts maximum and light output is 700-750 lumens, making them very close to equivalent to a 50 watt halogen.

RRP: $126.50 inc GST for a complete set of light engine, one fascia and dimmable driver.

Available from LED Lighting, Unit 44-46, 55-59 Norman St, Peakhurst NSW, ph:(02) 9534 4404, www.ledlighting.com.au

LED bulbs getting cheaper!

As more companies have increased production of their LED bulbs, prices have continued to drop to the point where they are comparable to compact fluoro lamps, at least for the cheaper Chinese sourced LED bulbs.

Viribright produces a range of LED bulbs in 5 watt and 11 watt sizes. They come in both warm and cool white with a number of base options, including ES26/27, E14 (5 watt model only) and BC22. Rated lumens for these bulbs are 270/300 lumens for the warm and cool 5 watt units respectively and 400/430 lumens for the 11 watters. Having tested both sizes in warm white, we feel the 11 watt output rating is probably a bit conservative, as a single 11 watter will illuminate a small bedroom quite well.

The only issues we had with these bulbs is that they produce a slightly pinkish light, but after a few minutes of use you no longer notice this. It might just have been the batch we received, and we haven't tested the cool white model for light colour quality yet. Also, they can run quite warm, so should only be used in well ventilated light fittings.

The bulbs are manufactured to meet Australian Standards AS/NZS 60968:2001, although as far as we know they have not been tested here in Oz for Electrical Authority Approval. They are readily available from numerous overseas sources via auction sites like eBay, but make sure you buy the 220-240 volt model!

RRP: Around US$10 for the 5 watt bulb and US$15 for the 11 watt model, plus postage.

For more information go to www.viribright.com and to buy check out www.ebay.com and search for viribright.

Q&A

Pressure tanks and filtering

I have recently had a water tank installed, with a Davey RainBank MKII pump to automatically pump water to the laundry and toilet. This unit automatically switches to mains water if the tank level is low.

The problem is that the pump seems to operate at a very low flow rate, and switches on three times each time we flush the toilet. It switches on while the toilet cistern fills, switches off when the water into the cistern slows to a trickle, then on twice more briefly as the last small amount of water flows into the cistern. Davey say the pump triggers are not adjustable.

Following the article by Lance Turner in *ReNew 113* I was wondering if it is feasible to fit a pressure vessel to this system and if this would solve the problem of multiple switching on without causing problems with potential backflow into the mains supply?

Also is it advisable to fit a first-flush device if the water is only being used for toilet and laundry?

Peter Barker

There might be a couple of issues. The first is that while the Rainbank incorporates a backflow prevention valve, you might have to fit one anyway to meet plumbing requirements. This is mentioned in the Rainbank installation instructions. If you don't have them you can download them at www.davey.com.au/ApplicationandProducts/RainBank_2_mains_water_backup.aspx

I can't see an issue with fitting a pressure tank, but you might want to contact Davey on the best place to fit it, either after the pump/Rainbank, or between them.

The Rainbank instructions also state that you must fit a first flush device as well as a strainer between the filter and pump or pump and Rainbank in order to prevent particulates entering the Rainbank and blocking the valves from operating correctly. The plumber who installed it should have done this.

Lance Turner

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

Heat pump or solar hot water?

I am in the process of purchasing a new hot water system and would like to check my understanding on the following:

I thought that a solar hot water system uses less electricity on an annual basis compared to (more recent) heat pumps (with electric boost), however www.yourhome.gov.au/technical/fs65.html shows medium to large households emit more CO_2 (so use more electricity) using a solar hot water system.

As I have read in *ReNew* and other sources that many heat pumps are quite noisy (ours would be next to our outdoor eating area), what other benefits do heat-pumps have over solar hot water?

Marnix Vunderink

It actually depends on your location. If you are up north then a solar system will use less energy for boosting than a heat pump system. In many cases, in warm areas solar systems require no boosting for a large part of the year. In cooler places like Melbourne, an electrically boosted solar system will use more energy than a good heat pump.

But, a heat pump always has to have electricity available to produce hot water, a close coupled (thermosyphon) solar system doesn't (split solar systems using pumps do need electricity to work at all). So, if you have regular blackouts then a solar unit might be a better option, if your supply is stable then a heat pump might be better.

Bear in mind, heat pump efficiency is affected by the installation location. A heat pump will have a lower running efficiency in colder weather or if placed in the shadow of a house. It will be more efficient if placed on the sunny side of the property.

Lance Turner

Effective roof ventilation

I am about to have two whirlie ventilators installed in the roof of my two story terrace. The roof is tiled and although I have insulation and ceiling fans the top floor is still very hot in the summer. I was hoping that these ventilators would be effective in sucking the hot air out of the roof and therefore lowering the temperature of the top floor.

Would you be able to advise me as to whether they are effective and if so what I need to look for with this product.

Jan Woodcock

I'm not a fan of these things as they don't move anywhere near enough air to have any real effect. You have to replace all the air in the roof cavity every 5-10 mins to keep ahead of the heat, and wind powered units don't come close to that level of extraction. Further, when you need them most, they are often barely working, as many hot days have little wind, so they do nothing on days like that.

The most ideal vent is a solar powered unit—when you need them most they are working hardest. There's a few on the market, like the Solar Star (www.solatube.com.au/homeowner/solarstar.php) and the Solar Whiz (www.ges.com.au). Also remember that you have to fit eave vents so that air can easily flow in to replace the air you are sucking out, otherwise the fan will be restricted to moving whatever air can leak in via gaps in the tiles.

Lance Turner

A backup for power failures

With grid-connect systems, for safety, a fault in either the solar system or the reticulated power system means a complete loss of supply to the premises. We have a 2.2kW petrol generator, but this is only a stop-gap, with a petrol refill needed every 13 hours.

Due to our age and health we have a dependency on power to operate pumps

and respirators every night, and a petrol generator running all night would certainly not be appreciated by neighbors!

Is there any legal or other reason why we should not be able to install an additional off-grid system using batteries, which would service separate wiring for some lights and power points, with a standby mains (or generator) battery charger? This could be operated as a trickle charger at off peak rates, and this would allow operation of the second system at any time.

Would you know whether we could receive rebates and/or government subsidies for this alternate set-up, and if so, to whom would we make an application?

Bruce Plowman

If you are talking about establishing a new system (as opposed to getting credited for an existing system), then off-grid installations now qualify for additional RECs under the newly expanded Renewable Energy Target. Under the new scheme, for off-grid solar installations you can create and trade five times the normal amount of RECs for systems up to 20kW in size. The solar supplier will do this for you at the point of sale, but it's worth knowing as it could (depending on location) provide about a 50% discount on the capital cost of the system.

As an example, say you want to install an off-grid solar system of 4.5kW capacity in Victoria (i.e. solar insolation Zone 4). The number of RECs that can be created and sold for this installation is:

Zone 4 capacity factor (MWh/kW/year) x 15 years (max. SGU generation can be deemed) = 1.185MWh x 4.5kW x 15 years = 79 RECs. You then apply the multiplier and get 395 RECs.

If, say, the REC price is $40 per REC, the value of your RECs is $15,800.

Assuming a cost of $6 per watt fully installed, 4.5kW of solar may cost in the order of $27,000. So, after RECs rebate, you only pay $11,200.

Damien Moyse

There's no reason why you can't install a separate off-grid system at all, in fact I've just done one at my house for a small water pumping system (see ReNew 113). For simplicity, you would just have an extension lead that plugged into the inverter and ran to the equipment you needed to power in an emergency. You could have it wired to the house, either all or some of the circuits, using a changeover switch, but that's more expensive and some electricians wouldn't be sure how to do it safely anyway, you would have to make sure you used someone familiar with such systems. My preference for this sort of thing is to always go with the simplest option, i.e. a completely separate system.

The other option is to have battery back-up on your grid interactive system. This means changing the inverter to one that has this capability, which would be a considerable added expense and probably wouldn't be worth it if you only need the system to run a few small devices and lights on an occassional basis.

As far as I know, there wouldn't be rebates for this if you plan to trickle charge it from the mains instead of solar or whatever, as it isn't a renewable energy setup.

Really, for such a system, all you need is a suitably sized battery bank, inverter and battery charger, plus wiring and safety gear (circuit breakers and switches). Depending on the capacity required, you could do it for under $1000; the system I just installed cost around that, although I am a pretty good online bargain hunter.

Lance Turner

Notes and errata: Issue 113

Battery buyers guide: In the guide, Siomar were incorrectly listed as the source for Raylite and BAE battery products. Alco Battery Sales Pty Ltd are the sole Australasian Distributor of the Raylite battery range and BAE Solar Battery products.

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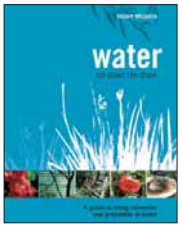

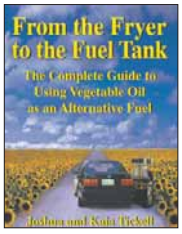

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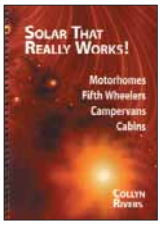

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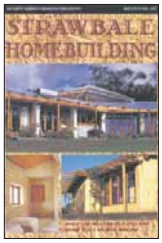

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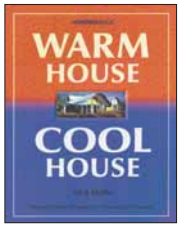

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Kits, LEDs and energy-efficient devices

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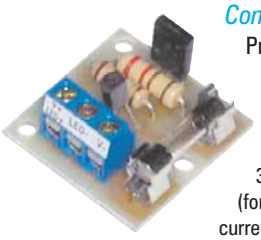

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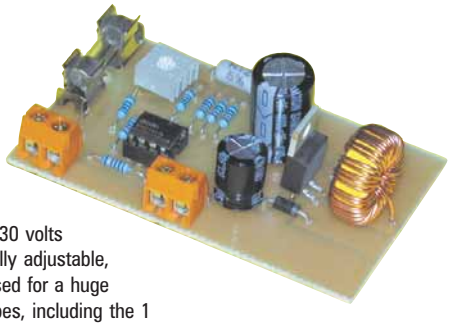

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Good parts from old computer scanners

What use can be made of the parts inside old flatbed scanners? Despite first appearances, a lot, writes Julian Edgar.

It's not hard to obtain a computer flatbed scanner for nothing—they're a frequent discard that can be found at garage sales, kerbside hard rubbish collections and the tip.

Pulling the scanner apart is easy: most models just clip together and can be separated by the judicious use of a screwdriver. Inside you'll find a moving carriage on which the cold cathode fluorescent lamp (CCFL), focusing lens and image sensor are mounted. In addition, the carriage contains two or three mirrors to reflect the image to the lens. The carriage is moved by a geared-down stepper motor that operates a toothed belt to which the carriage is attached. All of these components are easily removed, but take care when extracting the CCFL—it is fragile.

So getting the bits out is easy, but what uses can you put them to?

Seed germinating

The front of the scanner consists of a flat sheet of high quality glass mounted in a plastic housing. And that's it. Most times, the electronics, carriage and motor are all in the bottom half of the scanner. So what use is this top half? If the housing is placed over a shallow tray that's been filled with soil, it is ideal for seed germinating.

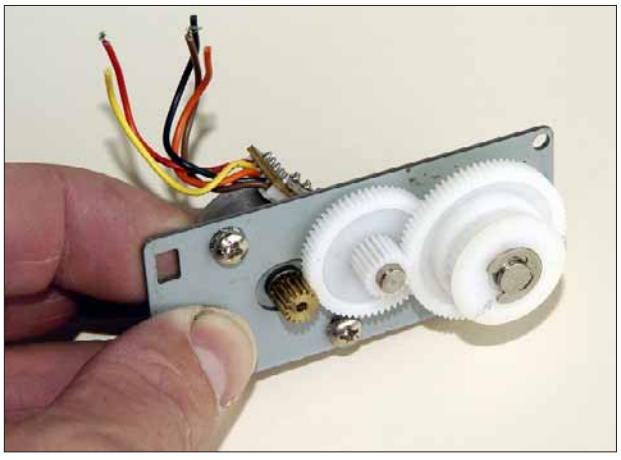
Want some other uses? The front housing can also be used to provide a layer of protection for solar cells that aren't already under glass, or you can make a picture frame that matches the glass size. When I was a kid, I made a solar pie warmer that used a front glass sheet very similar in size to a typical flatbed scanner's glass panel, so there's another use.

In short, wherever you need a pre-cut, zero cost small sheet of good quality glass, here it is! Why on earth would you throw it away?

Stepper motor/generator

Scanners use stepper motors that are attached to compact reduction gears. Unlike many discarded consumer goods from which you can obtain steppers, the scanner stepper and its gear-train often comprise a standalone, easily removable assembly. So wherever you want a small stepper (they're typically 25mm to 35mm in diameter) that's integrated with around a 16:1 reduction drive and forms an assembly that's only about 70 x 50 x 40mm, reach for the nearest discarded scanner.

One of the best uses for a geared stepper motor of this sort is to turn it into a tiny hand-cranked generator. The 16:1 reduction ratio then becomes a 16:1 step-up ratio. By adding a crank handle to the output cog (this is easy because this cog originally needed clearance to drive the belt and so always stands proud), you can take advantage of the gear train to turn the stepper motor at an easily achievable 1500 rpm!



The power produced is enough to run a high intensity white LED.

Despite producing AC (alternating current), you can connect the stepper motor/generator directly to the LED—it will light every half-cycle. If you put two LEDs back to back (wire the anode of each one to the cathode of the other), the LEDs will take it in turns at lighting and will protect each other from excess reverse voltage. If you turn the generator only fast enough to brightly light the LED, you won't even need any current limiting resistor. (If you turn it faster and faster, you may blow the LED.)

Free miniature fluoro light

The cold cathode fluorescent lamp (CCFL) is like a 225mm long version of a household fluorescent tube. It's run by its own high voltage (HV) power supply. The power supply generates a voltage high enough to give you a shock or burn your skin, so never touch it when power is applied!

Salvaging this part of the system is very easy—in most scanners, the HV power supply is mounted close to the CCFL on the carriage, or alternatively, is mounted remotely and is connected to the CCFL via HV wires. The HV power supply is a separate circuit board, often identifiable by its 'High Voltage' warning.

Making the light operate is quite easy. The HV power supply is fed by either two or three wires. When there is only a pair of wires (which is most common), you'll normally find the wires are red and black—red for positive, black for negative.

Observing the polarity, connect a variable voltage DC power supply to these wires and slowly wind up the voltage. The CCFL will first light at anywhere from 4.5 to 21 volts. If the original input voltage is unknown, go up only 1 volt over the 'light-up' voltage of the CCFL. So for example, if the CCFL first lights at 4 volts, run the light on 5 volts.

A car phone cigarette lighter adaptor can easily be used to provide a regulated 5 volts, and other output voltages are also available. With these adaptors, input voltage can be anything from 12 to 24 volts. Car phone cigarette lighter adaptors are available free wherever phones are thrown away!

In the case of three-wire HV power supplies, in addition to the red and black wires, there'll be a 'control' input. With power connected via the red and black wires, supplying this control input with a small voltage (eg 1 volt) will cause the CCFL to light.

CCFLs have some major advantages over other low voltage lighting sources. First, they provide a diffuse light, usually with good colour rendition. Secondly, they are quite bright. And finally, they are free.

However, you must remember that the tubes are also fragile. Where possible, they should be supported in the same way as they were in the scanner carriage and you cannot expect them to be anywhere near as rugged as LEDs. Also remember that the power supply must be well insulated away from probing fingers.

Ex-scanner CCFLs are ideal for lighting the inside of cupboards, illuminating control panels and for automotive use. For example, I have used one very successfully as a car boot light. Scanner CCFLs have power consumptions of two to four watts.

Hand lens

I nearly forgot one of the gems—the final focusing lens. Scanners contain a variety of pre-focusing lenses and curved mirrors but it's the lens closest to the image sensor that's the good one. Often only about 8mm diameter by 10mm long, these very short focal length lenses (e.g. a focal length of 15mm) make for extremely effective close-up hand lenses. They're not super bright but they're ultra-sharp and provide huge magnification.

And...

Also, don't forget the other bits and pieces inside the scanner. I always salvage the chrome-plated steel bar on which the carriage rides. These bars are typically 8mm in diameter and, if you have a metal turning lathe and/or a set of thread-cutting dies, make an excellent raw material for all sorts of projects. You'll also find assorted hardware and many salvaged scanners come with a low voltage plugpack that can be used to power other equipment.

When not doing DIY projects Julian Edgar is a trainer, editor and journalist. For more details visit www.julianedgar.com

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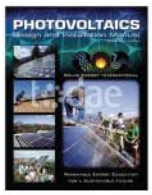

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