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Issue 91 April-June 2005
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All six of the ATA greywater challenge systems have been installed. We give you all the specs on the different systems and their installation. Page 39.

regulars

This 100 watt inverter is the size and shape of a drink can. To find out why, see products, page 77.

COVER PHOTO: They may look like windows, but are actually photovoltaic solar panels. For these and other options, check out the buyers' guide on page 47.

Photo courtesy of RWE SCHOTT Solar.

From the Editor

About ReNew

ReNew is published by the ATA (Alternative Technology Association), a non-profit community group concerned with the promotion and use of appropriate technology. *ReNew* features solar, wind, micro-hydro and other renewable energy sources. It provides practical information for people who already use these energy sources and demonstrates real-life applications for those who would like to.

ReNew also covers sustainable transportation and housing issues, the conservation of resources, recycling and broader environmental issues. *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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The nuclear spin

With growing scientific and public acceptance that global warming is not only a pending reality but something which is already impacting on the earth, it seems that a day doesn't go by without some reference to climate change in the media. Whether it be coral bleaching of the Great Barrier Reef or as an explanation for extreme whether events, climate change is now an accepted part of our everyday world. Scarily, in the last couple of months, a relatively new player has joined the call to halt climate change—the nuclear power industry. The amount of editorial and opinion space given in the influential mainstream press to proponents advocating nuclear power as the 'zero emissions' solution to climate change has dramatically increased. The nuclear industry is seizing on the interest in climate change to promote a power option that has a devastating environmental and human track record, is a potential terrorist risk, creates a toxic waste that lasts 200,000 years and for which there is still no secure method for storage and disposal.

Uranium mining back on the agenda

While nuclear power has never been very popular in Australia, we are not immune to the growing interest in nuclear power. The dramatic increase in the spot price for uranium has once again put Australia's uranium deposits at the top of the wish list of some of the world's largest mining companies. Switzerland-based miner Xstrata PLC's has placed a US$6.5 billion takeover bid for WMC Resources Ltd, owner and operator of the Olympic Dam uranium mine located near Roxby Downs in South Australia.

In February, the French mining company Cogema made public its interest in developing a uranium mine at Koongarra in Kakadu National Park. A five year moratorium on mining exploration imposed on Cogema by the Northern Land Council on behalf of Aboriginal traditional owners ends this year. The Koongarra uranium deposit is located near one of Kakadu's most famous tourist attractions, Nourlangie Rock, and upstream of the Woolwonga wetlands, one of the most sensitive areas of the park and listed as a wetland of international significance under the Ramsar convention.

While mining at Jabiluka, in Kakadu National Park, halted in 1999 after years of campaigning by the Mirrar traditional owners and environmentalists, the owners of the lease, ERA, would still like to reopen the mine some time in the future.

At this time, it is essential that renewable energy and energy efficiency does not get lost in the debate and that all options are rigorously analysed beyond the spin.

Donna Luckman

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Total prize value $4,642

Take out an ATA membership, become a supporter, subscribe to *ReNew*, or renew your current membership or subscription before 20 May 2005 and you could win a Selectronic SA32 sinewave inverter valued at $4,642 including GST. See the conditions below, and get your membership or subscription in today!

Conditions and how to enter

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

(2) The prize is not redeemable for cash, but winner can take other Selectronic products to the same value. Price includes GST.

(3) Selectronic Australia reserve the right to change specifications without notice.

(4) Product must be installed by a licensed electrician and all wiring must comply with the relevant standards.

(5) Paid ATA staff, members of the ATA executive committee and members of their immediate families are ineligible to enter.

(6) The competition runs from 20 November 2004 to 20 May 2005. Subscriptions/memberships must be paid by 5pm on Friday 20 May 2005 to be eligible.

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

(8) To subscribe or join the ATA, use the subscription form in this issue (or a copy of it), visit our webshop, or call the ATA on (03) 9419 2440 to pay by credit card.

(9) The competition is only open to Australian and New Zealand entries and includes delivery to the nearest freight depot.

The *ReNew*/Selectronic subscriber competition is proudly sponsored by Selectronic Australia Pty Ltd, Suite 5, 20 Fletcher Road, Mooroolbark VIC 3138, ph:(03) 9727 6600, fax:(03) 9727 6601, www.selectronic.com.au

Australia's shame internationally recognised

Australia was awarded first place of shame at the conference of the parties to the Kyoto protocol held in Buenos Aires, Argentina in late December 2004. The Fossil of the Day prize was awarded to Australia by non-government organisations attending the conference for 'trying to mislead the world about its abysmal record of rising greenhouse gas emissions.'

'Our government's massive over-statements of their efforts to address greenhouse gas pollution aren't pulling the wool over the eyes of the international community,' said Julie-Anne Richards of Climate Action Network Australia.

'An increase of 28% in pollution from transport, and 34% in pollution from stationary energy is this Government's shame for the world to see.'

Figures released at the conference showed that for the first 10 months of 2004, hurricanes, typhoons and other weather-related natural disasters cost the insurance industry just over $35 billion, up from $16 billion in 2003.

Economic losses, the majority of which were not insured, will also have cost the planet and its people dearly, with preliminary figures for January to October 2004 putting them among the highest on record—so far totaling about $90 billion, up from $65 billion in 2003.

Taskforce recommends way out of climate policy impasse

A report by the International Climate Change Taskforce, which was established by the Institute for Public Policy Research, the Centre for American Progress and the Australia Institute, has outlined a way forward for Australia and the United States to take vital steps to combat climate change outside of the Kyoto protocol. *Meeting the Climate Challenge* calls for the establishment of a G8-Plus Climate Group to provide a way for Group of Eight (G8) rich nations and other major economies to take action that would lead to large-scale reductions in emissions.

The taskforce calls on governments to agree to a long-term goal of preventing global temperatures from rising by more than 2°C above pre-industrial levels. Other key recommendations include: G8 countries adopt national targets to generate at least 25% of electricity from renewable sources by 2025; mandatory cap-and-trade schemes for emissions; and the need for a step-change in financial and technical assistance for developing countries to adapt to climate change.

'The taskforce, with its diverse membership, has been able to find common ground. Our recommendations are practical, realistic but also challenging. World leaders need to recognise that climate change is the single most important long-term issue that the planet faces and to discharge their responsibilities to the people they represent by agreeing to concerted international action to tackle climate change.' said British MP Stephen Byers, Taskforce co-chair.

While welcoming the report, Federal Environment Minister Ian Campbell told the ABC that some of the recommendations are unrealistic.

'Advocating 25% move to renewables within 20 years is technologically and economically undeliverable.'

'It's fine to have it as an aspirational sort of statement, but it's probably not deliverable unless you have a major breakthrough in storage technology.'

For a full copy of the report go to the Australia Institute website: www.tai.org.au

Scientists gather on climate change

Over 200 scientists from 30 countries met in Exeter, England, in February to discuss the latest in climate research. Convened by British Prime Minister Tony Blair, the *Avoiding Dangerous Climate Change* conference provided an opportunity to debate and encourage research into the long-term implications of climate change, what level of greenhouse gases is too high, and what options are available to stablise greenhouse gas concentrations.

While the final report from the conference refrained from defining 'dangerous', it did say the risks from global warming are more serious than previously thought and that the impacts of climate change are already being observed: 'Ecosystems are already showing the effects of climate change. Changes to polar ice and glaciers and rainfall regimes have already occurred.'

Australia is particularly vulnerable. An increase in global temperature of just 2°C would severely damage the Great Barrier Reef, Kakadu National Park's wetlands and the alpine regions of south-eastern Australia.

Mr Blair is using his chairmanship of the G8 and the European Council as an opportunity to prioritise global action on climate change, and to bring the United States back into discussions.

'If America wants the rest of the world to be part of the agenda it has set, it must be part of their agenda, too,' Mr Blair told the World Economic Forum meeting in Davos.

Computers predict bleak climate future

The world's largest ever climate change experiment has predicted that global temperatures could rise between 1.9 and 11.5°C and by an average of 3.4°C, even if carbon dioxide levels

Kyoto law at last!

After 10 years of negotiations the Kyoto Protocol came into force on 16 February. Celebrations were held across the globe to commemorate the landmark international treaty. A total of 141 counties have signed up to the treaty including 30 industralised countries, who as a whole need to reduce greenhouse gas emissions by 5.2% by 2012. The developed countries are now legally bound to document and quantify their emissions to a set percentage.

However, celebrations were a bit more subdued in Australia, being one of only four indutrialised countires refusing to sign up to the treaty. Prime Minister John Howard reiterate his stance that it was not in the 'national interest' to take part.

Opportunity lost. Subdued celebrations in Australia—one of only four industralised countries that have not signed onto the Kyoto Protocol.

'Until such time as the major polluters of the world—including the United States and China—are made part of the Kyoto regime, it is next to useless and indeed harmful for a country such as Australia to sign up', Mr Howard told Parliament.

The Kyoto go ahead also signals the beginning of international carbon credit trading which Australia cannot participate in.

'By failing to ratify the Protocol, Australian businesses will lose opportunities in the new Clean Development investment markets to be established under Kyoto,' said Australian Conservation Foundation Vice President Dr Peter Christoff.

'We are also locked out of the international carbon trading market now coming into being. This will cost Australian industry over $1 billion dollars per annum.'

in the atmosphere are limited to twice those found before the industrial revolution. Such levels are expected to be reached around the middle of this century unless deep cuts are made in greenhouse gas emissions. 'The possibility of such high responses has profound implications. If the real world response were anywhere near the upper end of our range, even today's levels of greenhouse gases could already be dangerously high,' said Dr David Frame, *climateprediction.net* Project Coordinator.

More than 95,000 people participated in the *climateprediction.net* project, which was conducted by Oxford University. The study used distributed computing, where climate models are run by individuals on their home computers rather than trying to process all the models on one supercomputer.

The programme runs through a climate scenario over the course of a few days or weeks, before automatically reporting results back to climate researchers via the internet.

This allows the project to explore a wide range of uncertainties, picking up previously unidentified high-impact possibilities.'Using the technique of distributed computing and the generous support of many thousands of individuals, we have been able to carry out an experiment which would otherwise have been impossible,' explained Dr Andrew Martin of the Oxford e-Science Centre.

www.climateprediction.net

More people living in cities

By 2007, half of the world's population will by living in urban centres according to a report from the United Nations. Growing urban populations will place further pressures on city infrastructure.

Currently 3.2 billion of the world's 6.5 billion people live in cities, and the number is expected to climb to five billion (approximately 61%) by 2030.

The 'urban agglomerations'—Toyko, Mexico City, New York, Mumbai, Sao Paulo and Delhi—each have more than 15 million residents. However, most urban dwellers live in towns of fewer than half a million people.

New CSIRO solar centre

Construction has started on the new $1.5 million National Solar Energy Technology Centre (NSETC) at the CSIRO Energy Centre cite in Newcastle, New South Wales (see *ReNew 87*). The centre will be a showcase for solar thermal technologies and have a key role in ongoing research into efficient, low-emission energy generation.

Set to open in July 2005, the NSETC will comprise of a high concentration tower solar array that uses 200 mirrors to generate more than 500kW of energy. It will be capable of achieving peak temperatures of over 1000°C; a linear concentrator solar array that generates a hot fluid at temperatures around 250°C to power a small turbine generator; and a control room facility that will house the centre's communications and control systems.

Town powered by biodiesel

Vegetable or used cooking oil will be used to power the remote community of Daly Waters in the Northern Territory. The Power and Water Corporation have converted one of the generators at Daly Waters, about 600 kilometres south of Darwin, to trial the use of biodiesel. The generator will work in conjunction with the diesel-fired generators to provide power to the township.

'While biodiesel costs the same as diesel, it is non-toxic and biodegradable and it will reduce greenhouse gas emissions,' said Trevor Horman, Power and Water's Sustainable Energy Manager.

'If the trial is a success, we will consider extending the use of biodiesel to power generators in other remote communities throughout the Territory.'

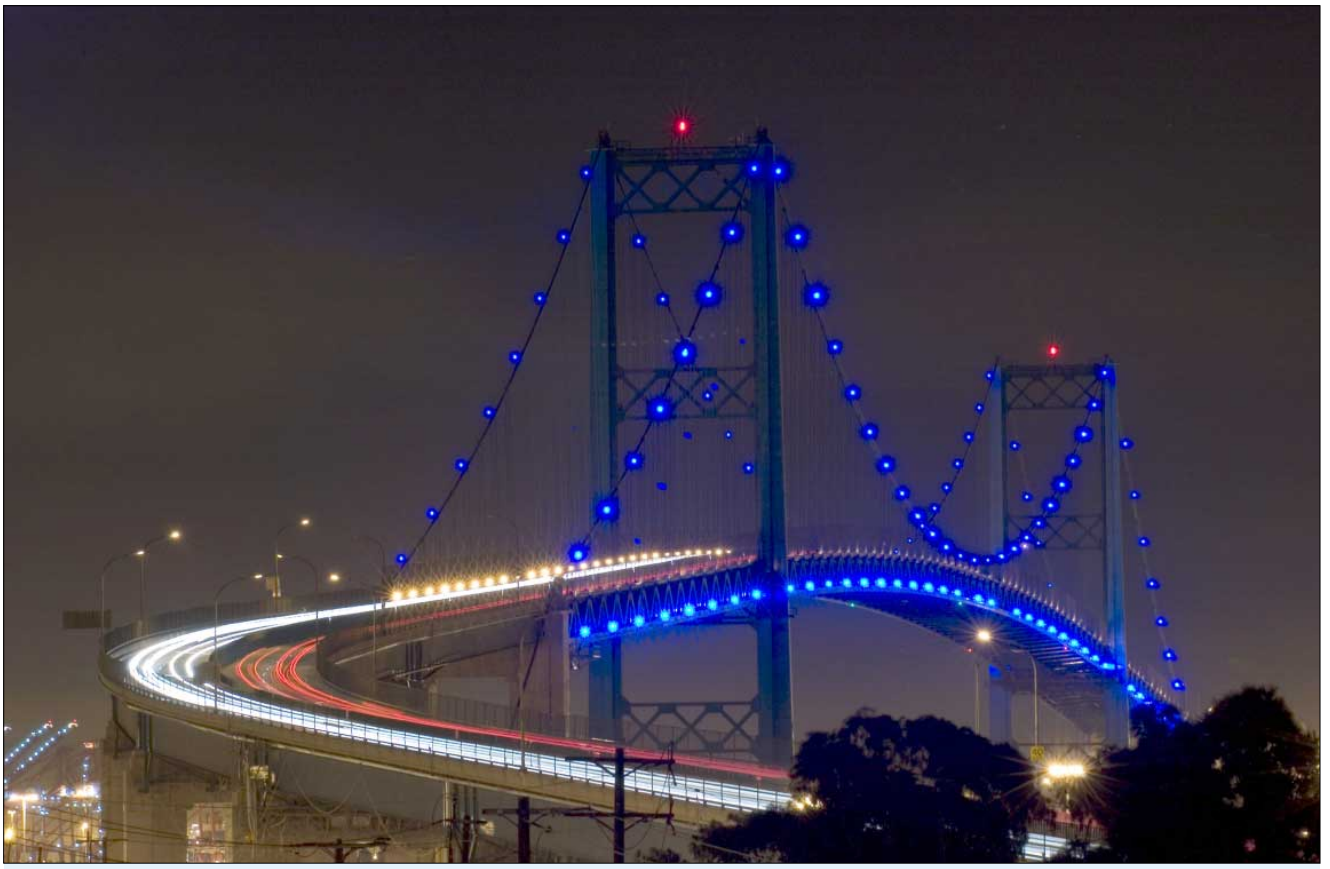
Telco goes green

Much of the electricity needs of British Telecom (BT) are to be met by renewable energy sources under what is claimed to be the world's largest green power series of contracts.

The three-year contracts, worth several hundred million pounds, will provide BT's 6500 telephone exchanges, satellite earth stations, offices and depots with environmentally friendly power. Nearly one billion kilowatt-hours of electricity will come from renewable sources and over 1.1 billion kilowatt-hours of low-carbon, fuel-efficient energy will come from combined heat and power sources.

The green power will reduce BT's carbon dioxide emissions by more than 325,000 tonnes a year.

We can only hope that here in Australia Telstra and Optus do the same.



Los Angeles bridge lights up with LEDs and solar

The welcoming bridge to California's largest city, Los Angeles, is awash with colour at night by 160 LED lighting fixtures powered by their own solar photovoltaic power (PV) system. Each LED fixture requires only 20 watts while offering a light output equivalent to one 150 watt incandescent bulb. Each bulb, a cluster of 410, 5mm LEDs, has an average lifetime of over 100,000 hours which will also help reduce the ongoing costs of maintenance.

A 4.5kW PV system powers the lights nightly from dusk to midnight only, so as to minimise unnecessary light pollution and interruption of migratory bird patterns. The use of LEDs and the PV system also overcome California's ban on decorative lighting projects.

www.renewableenergyaccess.com

Win a selection of LED products valued at over $100

We are looking for good build-it-yourself style articles, and will award a package of LEDs and/or LED products (of our choice) to the author of the best article we receive.

You don't have to be a tech-head, just have a project, simple or complex, electrical or mechanical, that has appeal to do-it-yourselfers and involves renewable energy or appropriate technology in some form. Entries must describe completed working projects.

Send your ideas to: *ReNew*, PO Box 2919, Fitzroy VIC 3065, email: renew@ata.org.au Competition closes Friday 6 May 2005.

Australian made paper from bananas and roo poo!

Two Australian paper companies are helping to turn waste into beautiful, environmentally-friendly paper products. Papyrus Australia are making paper out of the trunks of banana trees.

Banana trees have fibres that run the full length of the tree. Papyrus Australia takes advantage of this and have developed a process to harvest these long strips. The use of these long fibres produces a product that is stronger and more durable than traditional pulped paper. Preserving the natural structure of the fibre, in conjunction with the lignin bonds available in the banana tree trunk, produces a quality end product that is water repellent and greaseproof. No toxic chemicals or water is needed, and the process uses a fraction of the energy of a typical woodchip paper plant.

Another company, Creative Paper, is using a rather novel source product: kangaroo and wallaby poo. 'We came up with the idea after reading an article about how elephant dung paper was a huge tourist product in Africa and Asia,' explains Mrs Gair, Creative Paper Manager.

'I also discovered that in Scandinavia, elk poo paper is the stationary of choice in most offices. That got me thinking we should create a uniquely Tasmanian paper from roo poo.' To help create the range the company is asking for at least 100kg of roo poo donations.

For more information go to www.creativepapermill.org and www.papyrusaustralia.com.au

Prius hits the Oscars red carpet

Forget the limo, the coolest and cleanest way to get yourself to the Oscars is in a Prius hybrid. Joining the ranks of celebrities choosing to bring an environmental conscience to the Oscars, Leonardo DiCaprio, Charlize Theron, Robin Williams, Orlando Bloom, Salma Hayek, Penelope Cruz, Morgan Freeman and Tim Robbins are among those who arrived at the 2005 Academy Awards in high fuel economy, low emission Prius hybrids as part of Global Green's 3rd annual 'Red Carpet—Green Stars' campaign.

With world-wide attention focused on the awards ceremony, Global Green organises fuel-efficient transportation each year to allow celebrities the opportunity to demonstrate their support for energy independence, combating global warming and protecting the environment.

Past participants in the effort have included Harrison Ford, Calista Flockhart, Cameron Diaz, Will Ferrell, Marcia Gay Harden, Sting and Jack Black.

'Hybrid cars help us conserve natural resources and preserve the planet. Choosing a hybrid is something everyone can do today to help reduce our negative impact on the environment,' said Orlando Bloom, actor and Oscar presenter at this year's Academy Awards.

Nominate for the savewater awards

Have you made an outstanding achievement in water conservation? Well why not enter the 2005 savewater awards. The awards were established to acknowledge organisations and individuals who have demonstrated outstanding innovation and achievement in water conservation and wastewater management. Entries are open to all Victorian businesses, schools, community groups, government departments and agencies, and individuals who have helped conserve water in the past year.

For further information go to www.savewater.com.au

Tool for farmers to track emissions

The federal government has launched two new products that will enable land managers to monitor the effects of farming and forestry on greenhouse gas emissions using their own computer.

The *National Carbon Accounting Toolbox* and *Data Viewer* will help land managers make informed decisions about how to sustainably manage their properties. The *National Carbon Accounting Toolbox* will help in making these decisions by tracking greenhouse gas emissions, and indentifying less emissions-intensive land-use practices. The *Data Viewer* is a unique 30-year visual record of landscape and vegetation change in Australia since 1972 generated from satellite images.

For further information go to www.greenhouse.gov.au/ncas/index

Shale oil plant proposal withdrawn

Queensland Energy Resources has withdrawn its proposal to build Australia's first commercial-scale shale oil plant. The Queensland Department of State Development, which was assessing the proposal, announced the withdrawl on their website. It states 'On 7 December 2004, Queensland Energy Resources advised the Coordinator-General that it wished to discontinue the EIS process for the proposed Stage 2 development.'

The move comes after the closure of the controversial Stuart Shale Oil Project pilot plant near Gladstone, Queensland late last year.

'The attempt to develop a massive greenhouse-polluting shale oil industry in Australia is now back at the drawing board stage. This is in stark contrast to the optimism of just a few years ago, when shale oil was being produced at the Stuart Project and the government was formally assessing plans for the first commercial plant.' said Greenpeace Climate Campaigner Gareth Walton.

Qld energy road show

A trailer showcasing renewable energy technologies will be touring across Queensland to give local communities a hands-on experience of renewable energy. The trailer, called the *Solar Tropical,* has been fitted out with solar panels, a small wind turbine, battery banks, a solar hot water panel, solar water pumps and solar and wind monitoring tools.

For more information contact Wendy Miller on Ph: (07)3864 9126.

Heat pumps

In a reference to heat pumps on page 59 of *ReNew 86*, the writer, while speaking highly of these devices, points out that they 'unfortunately need to be operating all the time with a duty cycle of eight to 10 hours per day'. We have been using a heat pump (Quantum) for about 15 years now with good results. We are using a simple timer at the power inlet which allows the heat pump to kick in at approximately 10am. The timer is set to cut out no later than 1pm.

On most days, by that time all hot water has been replenished. In any case, this setting ensures that the heat pump is only working during the hottest (and the most efficient) time of the day. The large storage tank these systems are supplied with has meant that we have never run out of hot water.

Max O Lindegger,
Crystal Waters QLD

Freezer to fridge conversion

I was interested to see an article in *ReNew* 90 similar to my freezer-to-fridge design featured in *ReNew* 74. The Vestfrost SE255, which was the model used in the latest article, has quite impressive performance figures. I chased up the cost of this unit with a view to possibly replacing my original (still working) Fisher and Paykel freezer with a more efficient modern unit. Unfortunately I was taken aback to discover the cost of the Vestfrost.

I decided to do a bit more research and found that the site www.worthit.com.au/energylabel/ ranks freezers in order of efficiency. My research revealed:

Model	Volume (L)	Annual kWh	Star rating	Cost
Vestfrost SE255	247	237	5	$1400-$1500
Centrex CTCF200	210	290	3.5	$400-$450

That's a very large increase in cost for a 44% improvement in kilowatt-hours of energy used per litre of fridge volume. If the smaller 210 litre unit will suffice, then it's a 22% increase in energy consumption—from 0.1kWh per day to 0.122kWh per day. One thousand dollars will buy you a lot more solar panel and/or battery than needed for the extra daily 22Wh energy increase over the Vestfrost.

My conclusion: if you can afford a Vestfrost then go for it, if not, the Centrex and a tad more solar (if required) looks a better bet for the bank balance.

I'd be interested to learn what electronic thermostat was used with the Vestfrost. There is a similar looking one in the Jaycar Electronics catalogue but the description of its operation doesn't line up with what is required for a fridge. Maybe it's simply a matter of using another contact on the relay.

Ross Dannecker,
rdannecker@bigpond.com

Summer cooling

In your last issue, summer cooling was discussed. I think a couple of related issues deserve to be aired.

Firstly, the question of whether roof ventilators work very well. The key issues here are whether you have foil under your roofing material, and the colour of the roof. An unpainted steel or tile roof will radiate tens of kilowatts of heat into the roof space. To remove this heat (and so to reduce the temperature in the roof space significantly) requires an enormous flow of air—thousands of litres per second. This would require a very large capacity fan, or fairly large openings for natural air flow.

If the roof is lined with reflective foil, the radiant heat flow is dramatically reduced, so that the air flow required to remove the heat is reduced to a few hundred litres per second. A light coloured roof is not quite as effective as foil, but it certainly makes a big difference. My preference would be to use a combination of bulk blanket and downward facing foil under all roofs with plenty of openings to allow air movement. If buying a purpose-designed ventilator, I would want to know how much air it removes under a realistic range of wind speeds.

Another issue is the heat produced by halogen lights. It is quite common to install 15 watts per square metre of halogens—that's about one halogen per four square metres of ceiling. Apart from the more expensive (and rarely

used) dichroic lamps, most halogens radiate most of the heat they generate into the room. The radiant heating effect of halogen lighting is therefore around 15 watts per square metre (possibly higher if the areas of uninsulated ceiling around the lamps required for fire safety are considered). A well-insulated ceiling radiates less than 15 watts per square metre on a very hot day. So installing halogen lighting adds significantly to occupant radiant discomfort in hot weather—adding to the pressure to install and use air-conditioning. Of course, if you're standing right under a halogen, the radiant heat load can be much higher! Yet another argument for high efficiency lighting solutions!

Alan Pears,
apears@c031.aone.net.au

Water conservation

These days there is much hype in the media about the need to conserve water, and the ACTEW (the Canberra water, gas and sewerage utility) is forever talking about the need to conserve it. So, during the period of my current water bill I conducted a little experiment.

I am retired, live on my own and have a townhouse with a small garden. For my experiment the garden was hardly watered at all; I gave up using the shower, bathing instead from a plastic bowl, using no more than five litres of water; I wore my clothes for several days at a time so that I only needed to use the washing machine, a small front loader, once a fortnight and then on the water-saving option of half capacity; I only flushed the toilet once a day; I didn't run the tap while brushing my teeth; I kept a small bowl of water in the laundry for washing my hands during the day; and I only did the kitchen washing up once a day, by hand, using minimal water, washing from a plastic bowl .

I have just received my latest water and sewage disposal bill. Going to a huge amount of trouble and inconvenience, I managed to save a mere 3kL of water. Every drop counts, one might say, but was it worth it?

Definitely not! Did I save any money? The irony is that during the same period the water rate increased a little, so despite the water usage savings in my current bill, I actually paid $7 more than in the previous period. Even had there been a savings of $7, it is no incentive to go to this amount of trouble and inconvenience. Further, the fixed costs in my current bill amounted to a scandalous $121, five times more than my water usage costs of $25.

The ACTEW will no doubt say that what I am saying proves that the cost of water is far too low. That would be a convenient but wrong assumption to make. Putting up the price of water does not create more water, and only places the burden on those least able to afford it. Inevitably, more people in the community will use more water, not less, as living standards continue to increase. What is needed are significant savings for those who do save water.

We pay huge fixed costs for our water and sewage disposal. Why shouldn't these costs be used to pay for rainwater tanks and pressure pumps, greywater systems, waterless toilets and the like? Why should householders have to pay for supply and disposal systems as well as the cost of alternative systems?

What is needed is more creativity by governments, the ACTEW and other water utilities. At present there is no incentive to cut water usage, and nothing is being done to increase the amount of water captured through widespread alternative systems. I for one will be reverting to my old habits.

Barrie R D Ridgway,
Chapman ACT

I agree that there should be more incentives to save water but there should also be a lot more being done to reduce water use by the largest water users in this country: farming and industry. In fact, domestic water use is a relatively small part of total water use, and we could see far greater savings if commercial users of water were forced into making their systems more efficient. It is amazing in this day and age that many farmers still use open channel irrigation to water their crops! Most of the water used this way is simply lost to evaporation.

Lance Turner

[Letters]

Heat recovery ventilation

My wife and I are retired and about to start building a house in Melbourne. I have been looking at heat recovery ventilation systems.

My mother-in-law moved into a new house two years ago and had extensive problems with allergic reactions ('new house' syndrome). She understands from advice given by medical 'specialists' that this has been mainly caused by formaldehyde. I suggested that she contact the people at Healthy House and she had them install a whole-house Venmar system. She implemented a lot of other strategies in parallel with this, plus time has passed and out-gassing would have reduced. It is hard to say how effective it has been. This system was not low-cost.

I decided that I would install a smaller system in the master bedroom of our planned house. However, after a lot of searching, I could not find any such units available in Australia. Are you aware of any?

I did eventually find a UK company that had a range of sizes of HRV systems. The bedroom-sized unit has a two-speed motor (35 watts on high speed) and two fans attached to the one motor.

I thought that it may be worth some review by a technically competent/handy person (which I am not) at ATA and an article developed to show how parts could be sourced and one could be made. When you open up the casing, the components and setup are not complex. The heat exchanger unit, while simple in concept (a series of interleaved flat plates, plastic in the case of my unit), would need some skill to make.

Garry Leach,
garry.leach@pacific.net.au

Renewables help online

Can you please let readers know about the existence of the following Yahoo! group: ARGON—Australian Renewable Grid-interactive Owners Network.

This is a forum for the exchange of information between Australians who own, or are otherwise interested in, grid-interactive renewable-energy systems; in particular, those intended to generate electricity primarily for the owner's use. These systems are typically residential rooftop photovoltaic systems with capacities of around 1.5kW, but may be as large as 10kW single phase or 30kW three-phase.

The forum is a great place if you have a problem with, or question about, any aspect of grid-connected renewables.

The group address is: http://groups.yahoo.com/group/ARGON/ or just send an empty email to: ARGON-subscribe@yahoogroups.com.

Dave Keenan,
d.keenan@bigpond.net.au

LG washer and inverters

Regarding the question from Stephen Watson about the LG 8013F washing machine running on inverters (*ReNew 90*).

We also bought an LG 8013F on *ReNew*'s recommendation when we had a water crisis and the old top loader was using 140 litres per wash. With rellies staying we were doing about 10 loads a week. That's a lot of water in a dry climate so we chose to buy a front loader to save water.

The LG will run on a Selectronic SE22 inverter (at 12 Volts). This device has a maximum continuous rating of 1200 Watts. I don't have a smaller inverter, so could not say how small you could go. I have measured most of the cycles on the LG and can advise that the 'quick 30' program uses 36 Watt-hours, with a maximum power of 685VA and a maximum current of 2.9 Amps (AC). The long cycle, set on cold, uses 135 Watt-hours, with a maximum power of 812VA and maximum current of 3 amps. Getting it to heat water to 30 degrees makes quite a difference: 259 Watt-hours, a maximum power of 2170VA and a maximum current of 9 amps! Interestingly the machine has a constantly changing power factor, ranging from unity at some points in the cycle to an awful 0.13 at others. These measurements have been made with an Energy Monitor 3000 meter.

I believe that the research into what will and won't run on inverters and what size of inverter is needed is an important area for anyone either living or wanting to live with renewable energy. It is one of the more frequent questions my clients ask me during load analysis consultations. I have started to collect and collate this information and am developing a spreadsheet that I hope to put on my website (when I get time to finish it). In the meantime if anyone would like a copy of it in its infancy they can email me at thesolarworkshop@halenet.com.au. If anyone has figures (reasonably accurate) that they would like to add to what I hope can become a public resource, please send them.

Jonathan Rihan,
The Solar Workshop,
Stanthorpe QLD

Birds and windfarms

I have been a supporter of alternative technology since before the phrase was coined. As a grandfather I am increasingly concerned for the welfare of future generations. However, I do believe that the solutions we come up with should be unflawed. I have seen no mention of bird kill (and now bat kill, in the Appalachians) from wind turbines, in *ReNew*.

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.
Send letters to: ReNew, PO Box 2919 Fitzroy VIC 3065,
email: renew@ata.org.au

This is a serious problem, threatening biodiversity and the balance of nature. Something needs to be done, now.

We all know the story of Thomas Crapper's invention, which solved the problem of public health with a sanitation system that is so badly flawed that it has broken the natural cycle of nutrients to our farmland, caused devastating pollution to waterways and the sea and used up so much drinking water that we are now faced with shortages. If at the time, attention had been paid to these flaws, we would not be in the strife we are in a century or so later. I don't think the birds or bats will survive a century of killing. Then our descendants will be faced with yet another imbalance of nature.

Is there any research being done to address the problem? I don't think the industry should be shy about owning up to problems. Far better to acknowledge and fix them.

Richard Stanford
Blackalls Park, NSW

All tall, man-made structures present a collision risk to birds and bats. Compared with vehicles, communication towers, tall buildings and transmission towers, the risk posed by wind turbines is very small. Even so, the potential impact on bird mortality rates from wind turbines is one of the best researched areas of risk to avian species.

Several wind farms built overseas before these risks were understood have caused alarm. Here in Australia, wind farm developments have benefited from what has been learnt overseas. Careful site selection, extensive bird monitoring and rigorous planning guidelines all result in much more favourable outcomes.

Bird monitoring conducted at Victorian wind farms has found very low rates of bird and bat deaths, none of which have been rare, threatened or endangered species. On average in Australia, collision rates with birds are generally around one to two per turbine per year, an impact which is insignificant compared to the chronic impact of ecological change due to climate change and rises in sea level induced by increased greenhouse gas emissions. Australia's key environmental groups are aware of these odds, which is why they support wind farms.

All wind farm developments in Australia are accountable under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC) which specifically addresses nationally threatened and migratory species.

The Australian Wind Energy Association (AusWEA) is currently developing bird impact assessment protocols with funding from the Australian Greenhouse Office. The protocols build on AusWEA's existing Best Practice Guidelines which include bird impact methodologies for wind farm developers.

The bottom line is that wind energy is a proven and reliable clean energy source that is capable of reducing the effects of the greatest threat facing birds and all other species today: global warming.

For further information download AusWEA's wind farm fact sheet from: www.auswea.com.au/WIDP/assets/8Bird&BatImpact.pdf

***Ian Lloyd-Besson**,*
President,
Australian Wind Energy Association

Turn your swimming pool into a swimming pond

ReNew looks at a unique natural filtration system that can be retrofitted to your existing swimming pool

It's 6:30 am and the rest of the family is still asleep but Dave Keenan can't stay in bed. He can hear the pipes a calling. Downpipes, drain pipes, ag pipes, electrical conduit. According to Dave, this is the stuff that energy-efficiency revolutions are made of.

Not to mention gravel, builder's plastic, geofabric and trellis mesh. Bilge pump motors with model-boat propellers, ultraviolet lamps with 12 Volt inverters, and living organisms including fish, aquatic plants, aquatic invertebrates and last but very far from least, zillions of microorganisms.

These are the components Dave uses to turn what he calls 'those fake blue toxic waste dumps' into freshwater aquatic habitats that are a joy to swim in. In other words, to retrofit standard swimming pools, above or below ground, and turn them into low-energy, biologically-filtered, chemical-free 'swimming ponds'.

The Australian Greenhouse Office (AGO) estimates that a typical unheated 50 kilolitre swimming pool (approximately 9m x 4.5m x 1.2m deep) will use 2,200 kilowatt-hours of electricity per year when operated in the recommended manner. Most will use far more, but even at 2,200kWh this will generally be the single largest user of electricity in the household, and therefore the household's single largest contributor to global warming.

The AGO estimates that there is scope to reduce the energy consumption of swimming pools by 10 to 15%, mainly by attention to the pump and its motor.

Chemical-free swimming in your own backyard.

But Dave has proved it's possible to do much more than that. His 'living' swimming pool uses about one quarter of the energy of a typical 'dead' swimming pool.

How is it possible?

'It becomes possible when you look not only at efficiency, but at efficacy, and when you pay attention to where all that energy is actually going,' explains Dave.

Engineers define energy efficiency as useful-energy-out divided by energy-in. This is an appropriate measure for a component such as a pump, which converts electrical energy to a different form of useful energy, namely that of the pressure and flow of water.

But how do you measure the energy efficiency of a whole swimming pool filtration system? You certainly put energy into it; however, the useful product of that energy is not another form of energy, but the cleanliness of a certain volume of water for a certain length of time. So perhaps we should instead speak of its efficacy in litres per watt.

A carefully operated conventional filtration system has an efficacy of around 200 litres per watt. Dave's living system currently cleans about 800 litres per watt.

So where is most of that 2,200kWh going? That's an average of 6kWh per day. Most of it is not being lost in the pump, or motor, or chlorinator. Most of it is turned into unusable low-temperature heat due to flow resistance in the filter. Why is that? 'Because the filter must have pores that are small enough to mechanically stop the particles it is intended to filter out. It has a cross-sectional area of only about one square metre and is about a metre deep. It soon clogs and has to be backwashed,' says Dave.

The filter in a living system consists

of rounded pebbles between about 5 and 7mm in diameter, so the passages between them—or the pore size—is about 1mm. This is at least 10 times larger than the pore size of a conventional pool filter, yet it can filter out single-celled algae one thousandth of a millimetre (a micrometre) in size, and effectively clear the water in a single pass. And it doesn't clog or require backwashing. How can this be?

'It has at least two things going for it,' says Dave, 'gravity and evolution.'

'It's at the bottom of the pond so the larger particles just settle there anyway, and it is colonised by microorganisms that have evolved for billions of years to grab hold of anything that goes past that looks remotely like food. You just need to give them something to attach themselves to and plenty of oxygen, and take away the carbon dioxide, nitrate and phosphate that results from the breakdown of this unwanted organic matter.'

Once you have the flow resistance of the filter reduced to negligible proportions by going biological, the pipes start calling. Flow resistance of pipework can be reduced by increasing its diameter, shortening it and reducing the number of bends. Using an extra low-voltage submersible pump means the whole system can actually be *in* the pool and the pipework can be reduced to a single short, straight, large-diameter piece going from bottom to top.

There is often a sort of multiplier or feedback effect that happens when you start on these efficiency (or efficacy) crusades. Amory Lovins' group (from Rocky Mountain Institute in the USA) found that when you lighten the body of a car and reduce its drag and rolling resistance, you not only get to have a smaller engine because you've reduced these losses, you get to have an *even smaller* engine because you've reduced the size of the *engine* (and therefore the losses due to *its* size and weight).

A similar thing happens here with the pump. Standard pool pumps are of the kind we call centrifugal. The water comes into the centre of a rotating impeller that has radial fins or vanes, and is thrown outward by centrifugal force. It is then collected and funnelled to the outlet pipe. This in itself involves a right-angle bend in the water path and enormous turbulence, but for the pressures required to overcome the filter resistance in a standard pool filtration system (typically 100kPa) these are the most efficient kind of pump.

You've already heard how reducing the filter resistance meant that Dave's pump became small enough to conveniently power it from extra low-voltage (12 or 24 Volts). This made it safe to put it *in* the pond, thereby allowing him to reduce the pipe resistance. Because these modifications drastically reduced the pressure requirement of the pump, Dave found that he could then use an entirely different kind of pump, called an axial or propeller pump, which produces two to four times the flow for the same amount of power.

An early model pump shown operating inside the fish and plant refuge.

How does the living system work?

The large surface area of the gravel provides many sites for aerobic bacteria and other useful microbes to attach themselves. By spreading the filter over the entire bottom of the pool, we can turn over the whole volume of the pool in two hours (that's twice as fast as a typical chlorinated pool), while keeping the water velocity through the gravel at less than a millimetre per second. This low velocity allows the microbes to stay attached to the gravel, and to grab their food (algae and planktonic bacteria et cetera) as it goes past.

The oxygen the microbes need is dissolved at the water surface. The pump draws the water down through the gravel via a manifold of slotted pipes underneath and returns it to the surface to lose its carbon dioxide and regain oxygen. Most of what is normally done by highly corrosive chemicals such as chlorine or ozone, the aerobic bacteria do using ordinary oxygen.

It is important for the surface to be agitated by the returning water, to get rid of the invisible film of dust, oil and microorganisms (mostly unicellular algae) that would otherwise prevent gas exchange.

The pump must run 24 hours a day to keep the good microbes alive, but its speed can be greatly reduced at night and when no one is swimming, to save energy.

What about leaves falling to the bottom of the pond? What could look more natural on a gravel bottom? And the good microbes soon decompose them. At present, Dave just removes any floating debris with a net before swimming. He's also working on a 12 Volt powered floating skimmer.

The nitrate and phosphate are removed from the water by growing plants, which must be periodically harvested and thrown on the garden. At present Dave uses a submerged, free-floating plant called Foxtail (*Ceratophyllum demersum*).

Sometimes the influx of nutrients is too rapid for these plants to keep up, such as when lightning produces nitrogen oxides which come down as nitrate in the rain. In that case, when the sun comes out again, the filamentous (stringy) algae, which normally exists as green velvet on the walls, grows rapidly until it has consumed the excess nutrients. Unlike the unicellular or planktonic algae, this filamentous algae (sometimes called blanket weed) avoids being drawn into the gravel filter by attaching itself to the walls. It is quite harmless—in fact you can eat it—but but before the streamers start to interfere with the enjoyment of swimming, brush the walls to set them adrift and remove them with a large net.

Because the water in a swimming pond is free of toxic chemicals, it is possible for mosquitoes to breed, so Dave also adds mosquito-eating fish: native Firetail Gudgeons (*Hypseleotris galii*). The fish do not need feeding at the very low stocking rates used: about 10 fish per square metre of surface. A fence made of plastic mesh holds the plants within a strip about 300mm wide along one side of the pool. The fish can swim through the mesh and this gives them a refuge when people are swimming.

A layer of the same mesh is tied down just under the surface of the gravel. Dave calls this 'boy-proofing'. It prevents active human feet from churning up the gravel and thereby destroying its microbe population and clouding the water.

Dave also employs a backup system consisting of a germicidal ultraviolet lamp. It uses a more energetic wavelength than any that reach the Earth's surface from the Sun, called UV-C. This should kill any remaining pathogens in the water, although for very resistant organisms, it may take several passes.

Maintenance

How does the amount of maintenance compare with a standard pool? Dave reckons it's probably about the same. The irregular jobs of removing filamentous algae a week or so after rain, and harvesting the plants, are offset by the absence of regular maintenance. The ultraviolet lamp and pump motor need replacing about once a year. This costs around $150, but you should save twice that on electricity and pool chemicals.

How much does it cost?

Dave's system is modular. He suggests one lift-tube, with its own independent under-gravel intake manifold, for every 15 to 20 kilolitres. The materials cost about $1000 per module. It's fairly labour intensive to build, but should be no problem for a competent do-it-yourselfer with friends and family to help out.

If you're building a new pool, you could save the cost of the standard filtration system. But be aware that a flat or stepped bottom is a *lot* easier than a sloped bottom, for building and maintaining the gravel filter.

Is it safe?

At this stage, nobody can say for sure whether a swimming pond is as safe for our health as a standard chemically treated pool, but according to Dave, 'there's no such thing as complete safety, only various compromises.'

'The pursuit of *extreme* safety, whether in health or national defence, generally results in *less* safety, not more,' he says. 'For example, both chlorine and ozone react with organic matter to form substances that are know to cause cancer.'

Waterborne diseases can be classified as bacterial (such as cholera, typhoid and dysentery), protozoan (such as giardia and cryptosporidium) or viral (such as hepatitis A and E, polio and various minor gastrointestinal diseases). Most waterborne diseases are transmitted faeco-orally, which means an infected person would have to leave some faecal matter in the water and someone else would have to swallow the water before the infectious organisms were removed or destroyed by the filtration system. Ear infections can also occur. Some people can continue to carry some of these diseases without showing any symptoms. Fortunately, for normal healthy people, these diseases are either extremely rare, not serious, or readily treated.

Chlorine takes less than an hour to kill most pathogens, but *cryptosporidium*, or 'crypto' for short, can survive for days. Crypto causes watery diarrhoea and abdominal cramps. A person with a normal, healthy immune system can expect symptoms to last for a week or two. High-dosage-rate UV-C is more effective than chlorine against crypto, because the level of chlorine needed to achieve the same kill-rate is unacceptable to humans. However, Dave estimates that the UV-C dosage rate of his current system is about as effective as standard chlorine levels. Dave is concerned that excessive use of UV-C may cause other problems, because in the words of Robert Heinlein, 'there ain't no such thing as a free lunch'.

He points out that the developed world seems to be seeing more and more health problems caused by exces-

Laying the gravel filter in the bottom of the pool.

sive hygiene: 'Polio itself was such a disease. Infection normally occurred when children were young and the symptoms mild. Immunity followed. But with sanitation, first contact started to occur later in life when the disease can have serious consequences. There is also increasing evidence that occasional mild infections of various kinds, may be beneficial in preventing your immune system from becoming overactive and turning against you, as seems to happen in the case of asthma, allergies, inflammatory bowel disease and others.'

However, swimming ponds should be avoided by pregnant women and people who have weakened immune systems, such as infants and those who are very old, malnourished, have HIV/AIDS or an inherited immune deficiency; and cancer or transplant patients taking immunosuppressive drugs. Of course people who have any disease that involves diarrhoea or vomiting should not swim, so as to avoid infecting others. If you're worried, says Dave, the simplest thing to remember is 'don't drink the water'. Public health authorities issue exactly the same warning for standard chlorinated and ozonated pools.

For those seeking further assurance, a simple test kit called 'Bacteria Check' is available from EnviroEquip for $28. It cannot tell you whether any human pathogens are present—such tests are very expensive and time consuming—but it will reveal the presence or absence of *total coliform* bacteria. These are not dangerous in themselves—they occur naturally in huge numbers in the gut of all animals, including humans—but high levels are an indicator of possible faecal contamination or filtration failure, and therefore possible risk of disease.

It is safer to swim in a bio/UV-filtered swimming pond than in most lakes, dams, rivers and creeks in which humans swim, so if you're happy to swim in these, you shouldn't have any worries about a swimming pond.

Now that we've got all that heavy stuff out of the way, we can tell you that swimming ponds are *fun*! After swimming in one, it's hard to go back. Chlorinated pools suddenly seem so offensive in the way they affect your skin, hair, nose and eyes. And they start to look so unnatural you feel they might as well be painted bright orange. Swimming in a swimming pond is like swimming in a creek—a particularly *clean* creek. The gravel under your feet feels good and there are things to see.

The Future

Dave Keenan isn't the only one thinking about swimming pool conversion. Try google searches on "swimming pond" and "natural swimming pool" (with the quotes), and you'll see there are other ways of obtaining chemical-free swimming.

However, Dave's achievement of extremely low energy consumption and the ability to retrofit existing pools appears to be unique. Others have concentrated on obtaining a natural look in a purpose-built swimming pond. There's no reason why these things can't be combined. Dave has started a 'swimming-ponds' Yahoo! group for exchanging information. These are early days for the field and there is plenty of scope for you to make a contribution. ✶

For more information contact Dave through his website: www.users.bigpond.net.au/d.keenan, or join the swimming ponds e-list by visiting www.groups.yahoo.com/group/swimming-ponds/, or sending an empty email to swimming-ponds-subscribe@yahoogroups.com

Dave would like to thank Robin Holland and Sigi Gutjahr of Mudgeeraba for getting him started on developing this system, and the following people for freely giving of their time and ideas during the development of the system: his wife Janelle, his father and brother, his friends Brendan Lee, Jan McNicol, Eddie Matejowsky, Ross Pink, Clare Rudkin and family and James Hill, Jim at Hobbyrama, Doug at Radio Active Manufacturing and John at Choice Electric Co.

The great Australian solar bbq

Solar power supplies the sizzle for an innovative barbecue for all to enjoy

Hume City Council in Melbourne has recently installed a unique energy-efficient barbecue. Situated opposite Greenvale Recreation Centre, the facility is part of a new recreational area that, according to Hume's Sustainable Energy Management Officer Stuart Nesbitt, was designed to 'promote the use of environmentally friendly renewable energy to the local community.'

The barbecue is solar powered and fitted with 'green plates', which use 50% less power than regular electric barbecue plates. It has a 1.9kW amorphous solar panel system bonded to the roof of the shelter. The energy produced is fed via a grid-connected inverter into the recreation centre's electrical system—with any excess power used to meet the area's other power requirements. Stuart calculates that 'with two hours use of the barbecue per week, the panels will more than cover the energy uses of the park,' saving the council an estimated $470 and 3.2 tonnes of greenhouse gas emissions per year.

The barbecue's Green Plates are designed by Cosmos Solar. According to the company's director, Russell Kimmins, the plates use just 1.8kW of power. Most new electric barbecues on the market use 3.6kW, with some older models using as much as 6kW. The plates use 24 volts at the element instead of 240 volts because they were originally designed to be used in conjunction with 24 volt stand-alone solar systems. They heat quickly, cook at 300°C and can be retrofitted to any existing barbecue. Based on 10 hours use per week, an average public barbecue will emit 3.12 tonnes of greenhouse gases per year. Using the Green Plates, the same barbecue will emit just 0.936.

The park is also lit by 18 watt compact fluorescent lights, and features recycled wood and plastic furniture and bollards for fencing. The council is also looking into rainwater harvesting systems for the area.

Greenvale Progress Association Members, Charlie Grech (left), Jason Carwright and Julie Andrewartha and their children, check out the new solar barbecue with Hume Council's Sustainable Energy Management Officer, Stuart Nesbitt.

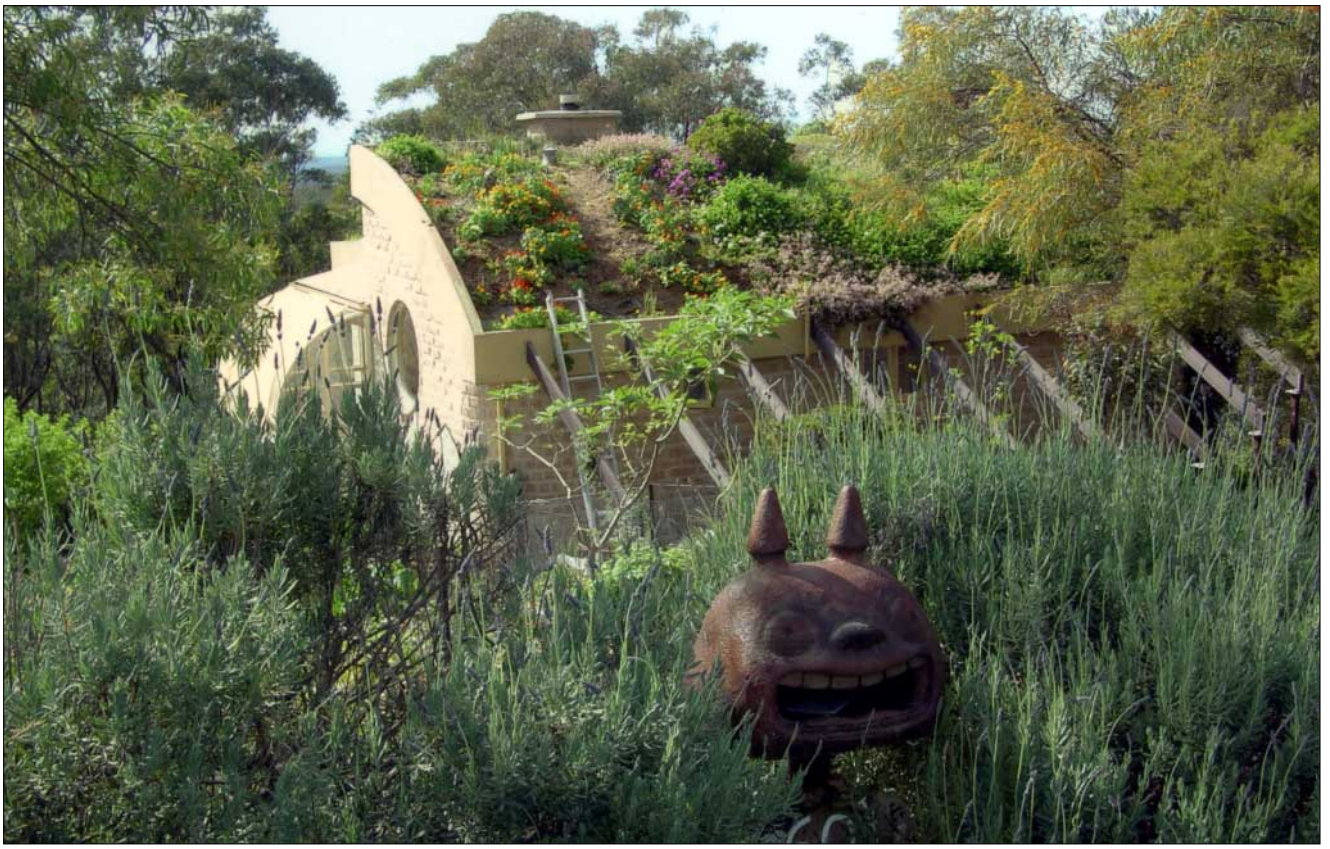
The solar panels on the roof of the shelter supply power for the bbq.

The new recreational area is part of Hume's Local Greenhouse Action Plan, which has been implemented under Cities for Climate Protection (CCP), a program to encourage local councils to reduce energy consumption and therefore their contribution to global warming.

Hume City Council became a member of the CCP program in 2000 and has committed to reducing both council and community emissions by 10% by the year 2010. So far, Hume estimates that it has saved over 200 tonnes in greenhouse gas emissions annually through such measures as the de-lamping of council administration offices, the installation of four solar hot water units, two grid-connected solar power systems and the introduction of LPG fleet vehicles.

Pioneers of the earth change

When Marilyn Pride looked to build her rural 'dream home', she wanted to be closer to the earth than the sea. Marni Cordell visits her earth-roofed home in the Blue Mountains



A large mounted pig's head is not something you expect to see in an environmentalist's house. At least, I've never come across one before visiting Marilyn Pride at her earth-roofed home in the Blue Mountains.

But Marilyn and her partner Lewis P Morley are prop makers for big-name films, and the pig's head (not real) is a memento from the film *Razorback*. Their entire house is furnished with Art Nouveau and Deco woodwork and medieval-style paraphernalia, a unique if somewhat contrary touch in a house that is, in sustainability terms, very contemporary. But of course, earth-covered houses go back a lot further than the 1970s revival in them, and the medieval touches are probably more appropriate than I think.

In 1988 Marilyn and Lewis were staying on the Gold Coast working on the TV series *Mission Impossible*. It was a boom year for building, and the view from the place they were staying was of progress in action: they would constantly see fires dotting the horizon as developers cleared more and more land for houses.

On their return to Sydney, they decided it was time to escape the urban sprawl, and began the search for a bush block on which to build their dream home: a mud brick house with an earth-covered roof.

The couple got a map of Sydney and looked at where the bushland and national parks were clustered around the city. Having spent most of their working lives in the big smoke, they wanted to remain close enough to be able to commute when work came up. With one car between them, they also needed a location that was well-serviced by public transport.

They initially looked at pieces of land around Hornsby to the north and the Royal National Park to the south. But

Marilyn's house has many unique features including round windows, medieval front door and Art Nouveau and Deco woodwork .

they soon realised that if they bought up too close to the city they might one day find themselves in the suburbs. They finally found a suitable site a little further afield—at Linden, a small town in the lower Blue Mountains.

Earth-change dream home

The block is 42 hectares of regenerated bush, on a steep slope with good northerly access. The house is split-level mudbrick, with solar hot water, rainwater tanks, in-built heating and cooling features and of course, the main attraction: an undulating earth-covered roof.

Marilyn and Lewis designed the house with help from architect David Baggs and his father Sydney Baggs, who is known as the guru of underground housing. 'They were the ones who were really up on it,' says Marilyn. 'David built an underground house in Castle Hill, to try to show that it could be done in keeping with more conventional house styles.'

The couple decided to build close to the road at the top of their sloped property in order to optimise solar access. This meant that a large retaining wall needed to be constructed before the foundations could be laid, which blew their initial budget. They employed a builder and stonemason to build the house, but have added the kitchen, bathroom and most of the fittings themselves over 12 years of living there.

Building the curved roof

The roof is obviously a lot heavier than your average ColorBond one, so the bricks were machine-made with some cement in them, and are load-bearing.

The footings and part of the back of the house are fired brick, so as to avoid water damage from rain running down the hill. The house is not rendered and the couple have had some rain damage to the southern wall, which they have fixed themselves with a mix of sand, pounded brick and Bondcrete.

The roof is an elaborate curved structure, with a heavy plywood base supported by large exposed beams. Marilyn says that if she were to do it all again she would use a straightforward 'umbrella' shape, which would be 'simpler in terms of structural support'.

On top of the ply base a layer of liquid Elastoclad was applied, with fibreglass mixed into it for strength. Over that went a layer of Bidem, a kind of synthetic blanket, to stop any stones from grating into the waterproofing. 'And then you pile the dirt on,' says Marilyn. 'It's supposed to be dirt without very many stones in it, so as not to

pierce the water-proofing.' The roof is designed to carry up to 200mm of soil.

The earth didn't go on the roof until about a year after they moved in and 'I don't know if it was a particularly cold year,' says Marilyn, 'but we were freezing that winter.' Since then however, the indoor temperature has been very stable, and they use their only heating device—a Nectre slow-combustion fuel stove—rarely.

Ongoing maintenance

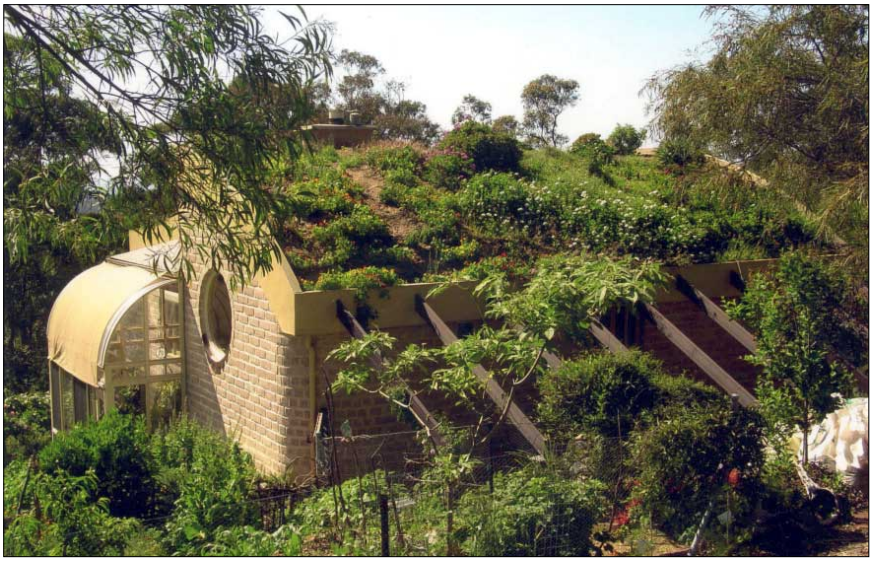
The pair have only had to make major repairs to the roof once since moving in. 'We had a leak in the bedroom that went on for years and we never got around to fixing it,' says Marilyn. 'A couple of years ago we finally did, by taking the earth off in that particular spot, cleaning the roof, laying another layer of Elastoclad on and covering it up again.'

Marilyn says that her initial idea was to build a fully underground house, but she decided against it because she was uncertain about the long-term capacity of the waterproofing techniques available.

'The actual waterproofing was done by people who do rooftop gardens in city flats et cetera, it wasn't anything that was invented especially for this, it was just applied to it. Some people use bitumen, some people use slate, there are all sorts of different methods.'

'I wouldn't like to discover a leak in a couple of years time and (if we were in a fully underground house) have to dig the back of the house up with a bulldozer. I would rather have an earth roof where I can get to the waterproofing if it springs a leak,' she explains.

The roof was expensive to install, 'mainly because the structure was more complicated than it needed to be,' but takes very little maintenance or upkeep—other than 'a whipper snip a couple of times a year'—so ongoing costs are low.



These photos show the elaborate curved structure of the earth-covered roof.

Plants chosen carefully

In order to survive on the roof, plants need to be able to last without watering, be a low fire hazard (not too much woody undergrowth or volatile oil) and not throw too many weed seeds around. 'Most native grasses are too flammable,' says Marilyn. Fire is a real fear in the Blue Mountains. The couple have experienced two fires since moving in, neither of which threatened their property directly, but one did come close—they watched the flames lick high into the sky a few kilometres away. They now do hazard reduction each Autumn. Marilyn has found a couple of native pigweeds that have been succulent enough to suit, but her mainstay is ivy geranium.

Unfortunately, a lot of ants have also made the roof home, and often traipse into the house for food. 'That's probably

the only drawback,' says Marilyn, 'I used to spray them and try to keep them out, but it doesn't really worry me anymore.'

The positives are the stable temperature, and the soundproofing. And then there's the view across the valley from the roof-top garden, which is spectacular.

Solar passive design

The house has been designed so that a flow through of cool air comes from the south through a small opening in the bricks, buffered by a courtyard. 'That as a design was a bit of a baffle,' says Marilyn, 'because you don't want to let huge amounts of wind in.' Their initial design was for the roof to reach right down to the ground on the top side of the house, but they were advised against this because of greater potential for termite damage.

A greenhouse adjoins the north side of the house, with a door that can be opened into the house to let warm air in. The greenhouse is so effective that they have had to attach shadecloth to it. This area is used as a sitting spot in winter, and to raise vegetable seedlings for Marilyn's extensive vegie garden, which includes water chestnuts, chokoes, kiwi fruit and more.

Downstairs is 'always a very even temperature,' says Marilyn, 'but upstairs can get a little hot in the middle of summer.'

'I just really like the idea of being able to grow something on the roof; that there's still the same amount of "growing space" on the earth as there was before you built the house.'

Much of the house and garden's water requirements are supplied by two 1100 litre rainwater tanks, and hot water comes from an Endless Solar 22-tube manifold hot water system with a Grundfos three-speed pump and controller, and a four-way conversion valve, mounted on the roof of the greenhouse.

Never-ending dream

Although an impressive set-up, Marilyn tells me that the house 'is never quite finished'. 'We want to get some solar power up there. At the moment it's beyond our means to get enough cells to power the whole house. We do have the space for them; it's just a financial consideration. I would like to get some bigger water tanks and a pump also.'

'When we first came up here, it was quite an unusual thing to do. We had to look around a lot to get anything sustainable. Now it's becoming a lot more common. The prices and availability are only just now making it an affordable thing to do.'

Marilyn explains that the house was mostly her 'dream'—she had always wanted a sustainable house that looked 'rustic'. 'I've always loved thatched and earth roofed houses. It's as much the look of it as the function.'

'I also felt that it would be more efficient, although later I read that earth is not that good an insulator—it's not that good compared to foam for example—but I just really like the idea of being able to grow something on the roof; that there's still the same amount of "growing space" on the earth as there was before you built the house.'

The house stays a very even temperature thanks to the insulation from the roof and shading around the house.

Zen and the art of electric car conversion

Some people get their thrills from extreme sports. Rod Dilkes gets his from extreme DIY

It's not logic that leads one to attempt to convert a perfectly good car to run on electricity stored in batteries—it's a passion, or madness! One that seems to infect relatively few people at the moment. Some may say it comes from environmental idealism, but I have the same desire for speed and power as any revhead.

Rod's converted Suzuki Mighty Boy, complete with rooftop solar panels.

The electric car: an idea whose time has come

In 1900 there were many more electric cars on the road than internal combustion (petrol/diesel) cars. They were faster, more convenient and quieter. Petrol cars of the day were noisy, dirty, smelly, difficult to start and unreliable. So what happened to all the electric cars? In a word: range. Petrol cars could go further and were quick and easy to refill, with the new resource of oil abundant and cheap. So for 100 years we have put up with noise, grime, smell and global warming for the sake of convenience! All that is about to change.

Imagine a car that gets refuelled from just being parked in your garage. It is powered from solar panels on your house rooftop, or a wind farm off the coast. Indeed it has solar panels in its roof that power the air-conditioning when it is parked and give you extra kilometres of free transport. Acceleration to 100kmh is effortless and quiet in less than five seconds, and cruising at high speed is safe and enjoyable. Instant throttle response, regenerative electric braking, high efficiency, zero emissions, silence, virtually zero maintenance, recyclable components, easy and direct use of renewable energy resources, constant four-wheel-drive with instantaneous traction control on each wheel. All these things are possible with electric cars.

At least 90% of our daily commuting is done within a distance of 50 kilometres, so a battery powered car will suffice for most people. For the other 10% of occasional driving a simple, compact and efficient microturbine generator can be installed. By turbine I mean the type used in jet planes, with appropriate silencing, coupled to a high efficiency electric generator. A turbine the size of a loaf of bread can produce enough output to easily power a car.

Even a steam turbine could be used. Turbines are simple, efficient, long lasting and will run on many different unrefined fuels including oils from fuel crops, completely renewable.

Hybrid petrol/electric cars like the Toyota Prius are coming onto the market which are a step in the right direction. It is interesting to note that the demand for hybrid cars in the USA is currently exceeding supply, even though they are significantly more expensive.

The way I see it is this: petrol cars are dinosaurs; highly evolved dinosaurs but dinosaurs nevertheless. Electric cars are furry mammals that currently coexist in very small numbers. My guess is that the coming oil shortage will see the eventual extinction of dinosaurs, except as museum pieces, and the evolution of a more effective and efficient mammalian mode of transport. This is a time of great change, something akin to the dawn of the motor car era when innovation and opportunity abounded, and it's happening right now. I personally can't wait for the car manufacturers so I'm doing it myself.

My conversion

After several years of dreaming and several months of research and collecting parts, I purchased a 1987 Suzuki Mighty

Boy with a view to converting it to run on electricity. This car was chosen because it was cheap, it is a ute, so batteries could be mounted in the tray, and it is very small and therefore relatively inexpensive to convert. The old petrol engine came out on 21 June, 2004.

The new motor is an Advanced DC 8" series wound DC model. It's 100-year-old technology, but simple and reliable for the first-timer. These motors are made in the USA especially for electric conversions. It is a fairly powerful engine for such a small car.

There is 45kW of power available at the wheels. The original petrol engine was rated at just 18kW peak! The motor needs a speed controller which connects to the accelerator pedal. A Curtis 1231C8601 500A model was chosen. These have a reliable reputation and run at 144 Volt nominal. No regeneration is available currently, but I will work on that later.

I did a lot of research on batteries with a view to using Lithium Ion or Nickel Metal Hydride (NiMH) batteries. Unfortunately, NiMH had recently doubled in price. At five times the cost of Lead Acid I would have considered it a worthwhile investment, but not at ten.

Lithium Ion batteries are very interesting but I would have needed to go to 200Ah capacity because they don't like to be drawn at high amperages and have voltage draw-down trouble when cold. They also need a complex battery management system, and are even more expensive than NiMH.

When they come down in price in the future, Lithium Ion will be the battery of choice, because they give relatively long range in a light and small battery pack. (Look for 'Thundersky' from China.) So that pretty much left only one choice: good ol' Lead Acid!

Again, 150-year-old technology, but relatively inexpensive and reliable. Trojans seem to be the popular contender and they made a smallish one to suit my

The batteries are mounted under the tray, so the cargo area is still fully useable.

Inside the engine bay. Note how small the electric motor is compared to a petrol engine.

Vital statistics

Battery voltage: 144V nominal (12 x Trojan 27TMH flooded lead acid)
Max current draw: 400A (detuned from 500A)
Max power: 400A @144V = 57kW (theoretical, 45 to 50kW more likely)
Top speed: >110kmh
Acceleration: Not yet measured but significantly faster than the petrol model.
Kerb weight: 900kg
Gears: Normal gearbox is still in place but without a clutch. For normal driving only fourth gear and reverse are required. It is like driving a very smooth automatic.

FAQS

Q. What, it doesn't use petrol?

A. Nope

Q. How fast will it go?

A. A lot faster than the speed limit, but I usually drive 70 to 90kmh. Faster than 90kmh is really scary in such a small car. Acceleration is much quicker than when it was on petrol and as quick as most modern cars.

Q. How far will it go on a charge?

A. About 40km of regular driving, more if you take it easy. Its a commuter not a grand tourer.

Q. The short range is a problem isn't it?

A. That depends how far you commute in a day. This car satisfies 90% of my driving requirements. New technology lithium ion batteries will soon all but eliminate the range issue. And for long trips an onboard generator can be added to turn it into a hybrid.

Q. How do you refuel it?

A. From the 240 Volt electricity supply. It has an inbuilt charger and a plug behind the cab. I charge it at night using off-peak electricity with a power cord hanging from the garage roof. It takes about 10 seconds to plug it in and two to three hours to recharge.

Q. How much does it cost to run?

A. About two cents per kilometre using off-peak electricity. Compare that to 10 cents per kilometre for your average petrol car.

Q. How much did it cost?

A. About the same as a new small car.

Q. Its not environmentally friendly because the energy still comes from a power station burning fossil fuel.

A. This car makes more efficient use of fossil fuel than the most efficient petrol/diesel engine car. Emissions from power stations are carefully monitored. Not so for emissions from petrol engine cars. Also, electric cars can be fuelled directly from renewable resources such as solar and wind power. The batteries are completely recyclable when discarded.

Q. How long do the batteries last?

A. Ask me in a year or two.

Q. Does it have gears?

A. Yes and no. The gears are still there but really only fourth and reverse are needed. Second and third can be used for fast acceleration. There is no clutch.

Q. Can you run a generator from the wheels to recharge the batteries as you are driving?

A. Can you stand in a bucket and lift yourself up?

Q. Could it be done cheaper?

A. This conversion was done in my shed using small volume specialist components imported and purchased at retail prices from expensive countries. I am sure car manufacturers could build electric cars for less than the cost of petrol cars. Batteries are the biggest (most expensive) hurdle but less so with modern developments.

Q. Can you charge the batteries from solar power?

A. Yes I do this already. The three solar panels give enough power for one or two kilometres per day.

requirements. At just 105Ah, the 27RV (27TMH in the USA) wouldn't give me much range, but I had serious weight constraints. The Mighty Boy only has 350kg payload capacity including two occupants. I decided to go with 12 of these batteries to give a 144 Volt (nominal) battery pack. However, the pack would weigh 312kg by itself, leaving just 38kg for the driver to keep it within the GVM for licensing. I am not quite that skinny, so I had to have the GVM (gross vehicle mass—(the total licenceable mass including occupants) legally changed to allow for the extra weight.

With all these American bits in the car, I wanted to look elsewhere for a charger. The Italian Zivan NG3 got rave reviews any time I mentioned it to other converters. All the gauges and small EV specific components I sourced from EV Parts in Washington, USA.

Other electrical bits like the kilowatt-hour meter I got from my local electrical distributor. The guy was a tad suspicious of a DIY nut buying all these high voltage bits. I think he thought I'd fry myself. Fortunately I'm still here and pretty well underdone. My local sparky did check it over though.

I had the adapter plate and coupling from the electric motor to the existing gearbox specially manufactured. I had some teething problems which took a bit of sorting. My local mechanic at Margaret River Motors did the installing.

The battery box I farmed out to my local welding expert. He makes farm gates and the like for a living. I think this was one of the strangest projects he has ever worked on. We cut bits off the little ute and welded more bits on until I had a lovely box that started just behind the front seats and went to the back of the tray. Pure art!

Wiring it all together looks pretty simple on paper, but that's where the simplicity ends. I did this myself on many late winter nights in an open carport. An

Future enhancements

- Regenerative braking.
- A small petrol generator in the tray for extending the range when required.
- Supercapacitor boosting for breathtaking acceleration whilst protecting the batteries.
- Lithium Ion batteries and battery management system for 150km+ range.
- Investigate steam or gas turbine hybrid configuration.
- A dual motor 3 phase AC drivetrain with 300kW+ output. May need a new car for this.

electric heater also had to be added to get it licensed.

The first test drive was on 21 September, 2004. It ran well, but made a godawful noise when decelerating. We pulled the engine out and made some slight modifications to the coupling, adding three grub screws to hold it tight on the motor shaft. Back in with the donk and it ran really beautifully for a week or so, until it started making a noise again. Out with the donk and some more modifications. This time it ran well.

I took it up to Perth to get licensed on 24 November, 2004. The head inspector took it for a drive and gave it a caning. The little car performed admirably and he stepped out impressed. After a whole day of consultations with licensing inspectors, an engineer and a suspension specialist, they finally signed it off just before closing time.

Since that time I have put three solar panels on the roof, and constructed a step-up (12 to 144 Volt) charger. The panels give about one 'free' kilometre for every two hours in the sun. This may not seem like much but it represents a 10% reduction in my daily energy usage. A more efficient engine and drivetrain would add significantly to this. As far as I know this is the first road-registered solar/electric hybrid car in Western Australia, if not Australia.

The car is now running very well. It is not exactly a chick-magnet, but I still prefer driving it to anything else! It's reasonably fast, reliable, quiet, non-polluting and economical. It may not go very far yet, but I have plans...

But in the meantime, back to my day job!

Thanks to Jim Lissiman for initial advice on getting started, Michael Symons, who was a trove of information on engines, controllers and batteries, Bob Fox from Witchcliffe for body modifications, Gary Madson from Margaret River Motors, Simon Dodd for the adapter plate and coupling. And finally, my partner Tova and kids, for putting up with me!

What's new in solar technology

We take a quick peek at some interesting solar advancements

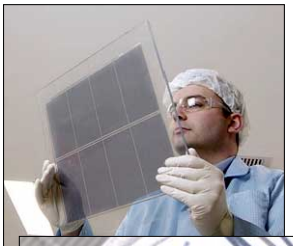
Things available now

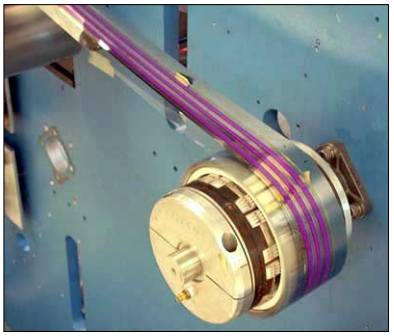
Solar technology is advancing all the time, and some new technologies promise to make solar panels a lot more common. From wearable panels to super efficient cells and even cells made from plants, the solar industry is coming up with all manner of new devices that should make our lifestyles a little more greenhouse friendly.

We looked at spherical solar cells in *ReNew* 88. At the time they were not available as a commercial product, but now, Spheral Solar has a range of products made using this technology, including their Superflex Series of flexible panels, which come in 25 watt (pictured at left), 50 watt and 75 watt models, making them the highest wattage portable solar panels we know of. See www.spheralsolar.com for more information.

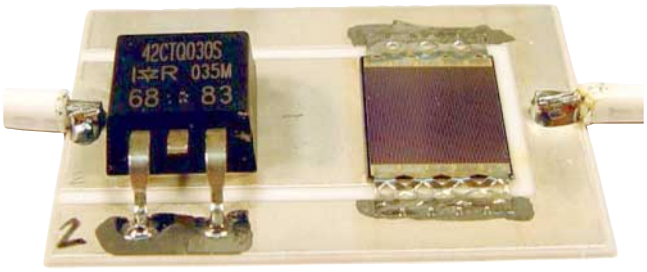
These transparent solar panels, from Sharp in Japan, combine photovoltaic cells to produce electricity by day, with high efficiency LEDs to provide light at night, all in the one sheet of glass! They are ideal for skylights, atriums or anywhere there is a large area of glass that is regularly exposed to the sun. For more information see http://sharp-world.com/corporate/news/040729.html

Australian company Origin Energy will soon be manufacturing their Sliver cell panels. These use thousands of tiny cells rather than a few much larger cells. This allows the panels to use less silicon than most other crystalline panels for the same energy produced. See www.origin.com.au for more information.





Konarka make flexible photovoltaics using a process that prints photo-reactive materials directly onto flexible substrates using roll-to-roll manufacturing, similar to printing a newspaper.
The photovoltaic materials can include a range of colours and patterns, and can be produced with varying degrees of translucency so they can be customised for use in new products.
They are working on making photovoltaic fabrics that can be used like conventional fabrics. For more information, see www.konarkatech.com



Spectrolab, manufacturers of high efficiency photovoltaic cells for satellites, makes cells for terrestrial uses too. The cell pictured above (the small square on the right) measures just 10mm square, yet can pump out over 10 watts when used with a concentrator that provides a 350 sun concentration to the cell. That means it has an efficiency of over 35% at 350 suns. Even at no concentration (1 sun), the efficiency is over 24%. See www.spectrolab.com

The Solar SCOTTeVEST is a solar version of the SCOTTeVEST jacket/vest from, yes, you guessed it, SCOTTeVEST! The removable solar panels charge a small battery, which can be used to charge and/or directly power most small USB-compatible electronic devices, such as mobile phones, PDAs, Game Boys, MP3 players, and other mobile devices, without you having to be near a computer. Typical charge times in direct sunlight range from two to three hours, but the panels will also provide some power from diffuse light. Price is US$475 for the basic jacket, or US$225 for the solar panels only. See www.scottevest.com for more information.

Things to come

Solar panels at less than $2 per watt?

Akzo-Nobel, a pharmaceutical, chemical and coatings manufacturer based in the Netherlands, is developing a flexible solar panel that is made in sheets and can be cut to the desired size. It's anticipated the price will be around • 1 (around $1.67) per watt. The company was working with Shell Solar to develop these panels, but that partnership has finished and they are looking to collaborate with others to develop them further. A test production run has already been successful. See www.azkonobel.com for more information.

From blue LEDs to solar cells

Solar panels made from the semiconductor indium gallium nitride, more commonly known for its use in blue LEDs, has the potential to make solar panels with efficiencies of 50%—if crystals of ultra pure indium gallium nitride can be produced for realistic prices, that is. The material used for blue LEDs is riddled with defects that don't affect LED operation, but would greatly reduce the efficiency of a solar cell made with that material.

Solar cells from spinach

Researchers at the Massachusetts Institute of Technology (MIT) have developed a solar cell that uses the chloroplasts of spinach leaves to produce electricity from sunlight using photosynthesis. Ironically, the initial experiment was stopped after 21 days because MIT, in order to cut electricity costs, forced most of the labs to shut down for the Christmas holidays.

This technology may have the potential to produce cheap solar cells. The prototype cell had an efficiency of around 12%, comparable with current silicon cells. See http://web.mit.edu/lms/www for more information.

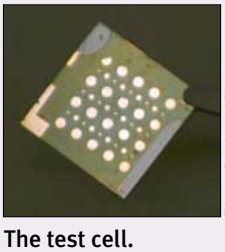
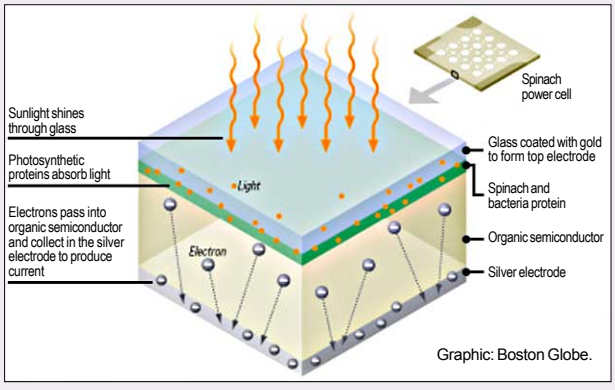


Photo: Patrick J. Kiley.

The test cell.



Build your own battery-powered lawnmower

Bruce Tonkin shows us how he converted an old petrol lawnmower into a cleaner, quieter, rechargeable electric model

After years of pondering the idea of a battery powered electric lawnmower (and prodding from my wife because she could not start the petrol one), I finally decided that it was time to turn the idea into reality. A workmate had a mower that he wanted to get rid of. Somebody else wanted the petrol motor, so I ended up with the bare shell—perfect!

I already had a 12 volt, 40Ah battery that came from some decommissioned telecommunications equipment, so the next step was to find a suitable motor. After consultation with my friendly electric vehicle expert, Randal, it was decided that a Lucas 418G starter motor would be suitable for the job, after some modifications. As far as I know, this type of starter motor came on Austin 1800s, MGs and some Triumphs. After parting with $55 at a motor wreckers that specialises in BMC vehicles, I now had a basic motor. The next problem was how to switch the thing on and off.

I figured that a starter solenoid would have a suitable contact rating, but they are only designed for a short operational cycle, so are not meant to be switched on for long periods. Ten dollars at a local wreckers secured a solenoid ready for continuous-operation modification! It's interesting to note that Ford, Holden and Mitsubishi seem to use an identical solenoid: Bosch 33C, 061-032 12V. A 12 Volt toggle switch wired in series with a key switch for security (to stop little kiddies from chopping their toes off), was selected as a convenient and safe method to turn the solenoid on and off.

Bruce's converted electric lawnmower cuts through thick wet grass without stalling.

Mower body modifications

This was the quickest part of the job. A frame was made to support and contain the battery above the rear wheels. This places the weight further back on the mower, making it easier to lift the front wheels when turning. A bracket was welded to the battery frame for the solenoid to be bolted to, and a piece of 3mm flat steel was cut with a jigsaw and turned in the lathe to fill the original hole where the petrol motor had been.

A hole was then machined in the centre of the plate to allow the new motor to sit snugly in it. Four 10mm bolts and Nyloc nuts hold the plate to the mower body. The standard cutting plate is fitted to the motor shaft with the aid of a bush, turned up from steel, which matches the shaft to the cutting plate, and also spaces it 50mm below the mounting plate on the mower, to bring it back to its original height above the ground.

Redesigning the solenoid

As mentioned earlier, the solenoid was not designed for continuous duty and needed to be modified. The solenoid body is crimped together and can be carefully prised open to expose the inner workings. I removed the original wiring off the coil and replaced it with smaller diameter wire (1368 turns of 0.5mm), calculated to give 10 ohms resistance, thus reducing the current to 1 Amp and allowing it to operate continuously without overheating. After re-

connecting the wires from the coil ends, the solenoid body was crimped back together, the operating lever shortened and an aluminium end-cap machined and fitted to keep out dirt. The internal return spring was replaced with a softer one, and an adjusting screw fitted to the cap, so the tension on the spring could be adjusted for reliable operation.

Wouldn't it be nice if all mowers were this simple to operate!

Motor modifications

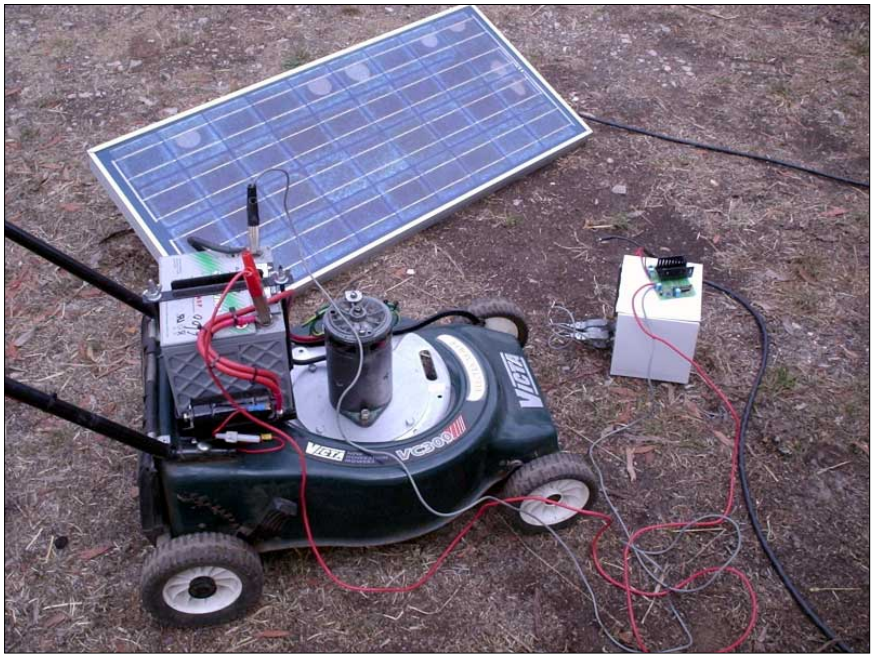
This was the most difficult part of the conversion. Because the starter motor is normally only run for short periods of time on a motor vehicle, it was decided, for longevity, to replace the bronze bushes with ball bearing races. Aluminium housings were made to take the bearings, and the shaft was machined and sleeved to get the front bearing to fit on the shaft in the right place.

The motor also rotated in the wrong direction (Murphy's Law), so the stator coil connections had to be reversed in respect to the brushes. The back plate on the motor also had to be rotated and reinstalled by drilling out the holes marked 'A' and changing the locating pin from 'C' to 'A'.

I also wanted to try two wiring combinations (series and series/parallel) and so decided to bring the coil and brush connections outside the motor to make them easier to experiment with. The motor is normally wired with two sets of two coils wired in series/parallel configuration (power mode). This gives high power but also uses more current. Alternatively, the coils can be wired in series (economy mode), giving less power but longer battery life.

Wiring

Wiring was pretty straightforward. Sixteen millimetre cable connects the motor to the battery via the solenoid. Smaller cable is wired from the battery positive through a fuse, the key switch, the on/off switch on the handle and back to the solenoid coil terminal.



No petrol or oil required, just a bit of sunshine and Bruce is ready to mow his lawn.

The test run

During the first test, which I carried out in 'power mode', the battery voltage began at 13.2 Volt (open circuit) and dropped to 11.77 Volt under load once cutting had begun. After 20 minutes, the battery voltage had dropped to 10.97 Volt. At this point there was no detectable difference in motor speed or cutting ability.

During this test I kept the motor running while emptying the catcher, so in actual fact the battery would last even longer as the motor is normally turned off at this time. In 'power mode' the mower drew 80 Amps and cut thick wet grass that would normally stall my petrol mower. This is because an electric mower develops more torque as it slows down, so it tends to keep its speed up higher, which also means that wet grass does not clog up underneath the mower.

In 'economy mode' the current dropped to 50 Amps, with a test showing that the battery voltage—which began at 13.2 Volt (open circuit)—dropped to 11.94 Volt under load once cutting had begun. 'Economy mode' would be okay for light duty lawn cutting but not

any heavy duty cutting. The mower starts slowing down after about 50 minutes in this mode, compared to about 30 minutes in power mode.

The battery is recharged with a 64 Watt solar panel feeding into a solar regulator which was built from a kit from Oatley Electronics. It takes about eight hours to recharge to the point where the regulator changes over to float charging. I normally leave it float charging between mows.

Apart from not using fossil fuels, the best things about this conversion are just flicking a switch to start the machine (no more starter cords), no excessive engine exhaust noise, and because you are not breathing exhaust fumes while cutting the lawn, you feel much better too. It is also a really good portable source of 12 Volts—just wheel it around to where it's required.

Bruce rebuilt the motor to suit the mower. Above you can see the reworked armature, while at right is the completed motor and new top bearing mount.

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What goes down your drain?

What goes in must come out, especially when it comes to greywater. Frith Kennedy looks at some of the issues householders in the ATA greywater trial are encountering as the last two systems are put in place

As most *ReNew* readers know, exactly what goes into our greywater is one of the most important issues when recycling water—especially onto your garden. The biggest risks are the levels of salts, phosphorus and nitrogen in washing powders.

ATA water guru Stuart McQuire believes the key issue is laundry detergent. He recommends the use of a liquid rather than powder, as it has a lower salt content. 'If you aren't sure about the effect your laundry detergent will have on your garden, then don't recycle that water at all,' he cautions.

'Be sure to monitor your plants' health—if they're turning yellow or suffering in some other way, either stop watering them with greywater or change the products you're using.'

Another major issue is soil pH—it shouldn't change. 'We have a simple pH probe that shows our soil stays around seven, which is neutral.'

Research Director of Planet Ark, Paul Klymenko, has spent a great deal of time investigating the effects of laundry powders on both soil and water, as the company produces two powdered products of their own.

He says although liquids do tend to keep salt down, he believes there are other consequences to consider. 'While laundry liquids do score well for greywater use, they have a number of disadvantages compared to powders.'

'They come packaged in non-renewable plastic packaging. While it is true that the type of plastic they mainly come in (HDPE) is recyclable, a significant proportion of Australians—maybe as high as one in four—do not have kerbside recycling access for it.'

What goes down the shower and bathroom sink at the Fitzroy house is then reused to flush the toilet.

'Choice magazine also found liquid detergents generally don't perform as well—so people often end up using more, which then leads to more bottles et cetera.' So make sure you use no more than recommended by the manufacturer.

Beyond salinity

Quite apart from salts, phosphorous and all those obvious chemicals, there are lots of other additives that make laundry detergents unsuitable for our gardens.

Paul Klymenko says there are other ingredients just as harmful—especially for people with chemical sensitivities. 'Variously described as optical brighteners or fluorescing agents, they are designed to attach to fibres and reflect white light. That means they're not actually doing their job if they don't stay on your clothes.'

'Fragrance is another issue. Predominantly they're synthetically derived, cheap products that mimic an "apple" or "lemon" fragrance. All these chemicals are slow to degrade and are moderately toxic to soil organisms.'

All householders involved in the ATA's SmartWater greywater trial have made sure they have a high level of awareness. The Frankston household have gone so far as to use no chemical products at all!

As we tend to use gentler products

on our bodies than on our dishes or clothes, the best-quality greywater comes from the shower and bath. However, some harsher preparations including pimple washes, anti-dandruff shampoos and even liniments can be harmful to your garden. ATA Greywater Project Manager Robin Merrick believes that the safest course of action when putting greywater on the garden is often to be over wary—'if you don't know what's in it, don't buy it'.

Another issue with shower and bath water is, of course, biological waste. For example, the Maidstone household have both a baby and a toddler and now wish they'd been able to leave the laundry sink out of their greywater loop. Because their treatment system is bacterially-based, Andrew can't use anti-bacterial products like nappy soakers, bleaches or even tile cleaners for the surrounds.

Fizzing along in Fitzroy

With 'interior-loop' systems like the one in place in the new greywater trial home in Fitzroy, one might be more relaxed about what goes into the water as it ends up in the sewer rather than on the garden. However, this situation is not so with the Wattworks system in Lisa's home.

Lisa's household came to the rescue of the ATA greywater trial when Kensington homeowner Ceridwen moved interstate. It's certainly lucky for us. The Fitzroy home is an excellent example of the small-scale urban application of greywater reuse, as well as an integrated approach to both energy and water conservation. These features have added significantly to the value of the home.

The tiny miner's cottage has no garden, so their Wattworks greywater treatment system is used for toilet flushing. The water that drains from the shower/bath is stored in a holding tank, then re-routed to the toilet cistern. This cuts the household's water usage by up to 20%.

The unit is also designed so that it self-empties every 24 hours, preventing odour build up. However, Lisa has still been very careful to monitor the system, along with exactly what goes into it. 'I don't think we're overly careful—we use natural products and soaps, but we were doing that prior to having the greywater system in anyway,' says Lisa.

'I guess when you're putting in any greywater system, you have to make sure its fits the purpose. If you're not prepared to look after a system that's going to go onto the garden, then make sure you get an interior loop system like this one.'

And although it's a permanently plumbed-in system, fitting it in was simple. 'It was easy to install, as it's just a tank under the shower. My partner and I dug the hole and all the plumber really had to do was connect it up,' Lisa says.

Highett hi-jinks

Unlike the Fitzroy house, installation at the Highett home has been a major production with a cast of thousands! The equipment alone included three tanks, two pumps, an alarm, backflow device, irrigation system and signage. That's not counting the three truckloads of material that had to be taken away as clean fill!

The family and designer were only the beginning of the consultation process. Next followed a parade of specialists—local council staff, electrician, earth-moving contractors, a plumber, a landscape designer and an irrigation specialist. Finally, the CSIRO have become involved—they are going to test the water quality of the system's output.

Of all the greywater projects, this custom-designed system has needed the most excavation. Significant earthmoving equipment was brought in, making site access a tricky business. Another surprise was the soil itself. Instead of being the expected clay, it proved to be a much sandier fill—which meant the sand filter had to be given an extra plastic surround. In fact, all round, the scale of both the system and the works was greater than expected.

'The levels for each tank were critical, as the design relies in part on being gravity fed…and that needed to be co-ordinated in with the garden design,' says Robin.

'Each of the three tanks is set at a different level, but they still have to be accessible from the surface. Also, with so many people involved, coordination became quite complex.'

However, the project was lucky enough to get some timely help from Jason at PJT Greenplumbing who took on coordinating suppliers, whilst PJT's Greenplumber Paul Talbot did almost three thousand dollars worth of work at Highett for free. In addition, Ever-

hard Industries provided pump wells, whilst Davey products pitched in by providing the pumping equipment itself. In fact, Davey donated a total of three pumps to the project and custom-built the alarm system!

'The extraordinary thing was that the council requirements for a high-grade treatment system like this are quite onerous. The system has to have public signage; an audio and visual alarm system, with a mute facility; and a backflow prevention device at the mains. That probably added another two thousand dollars to the job…yet there are no requirements like this for a simple diversion of untreated greywater,' says Robin.

Robin says her perspective has changed since she started working on the project. 'Given the complexity of treatment systems, and the energy they consume (embodied and operational), I'd like to see the simpler systems used by more homeowners. However, this requires far broader general awareness about what's in the products we use and put into our greywater diversion systems.'

The system you choose will really depend on your goals. If your main concern is for the environment rather than your garden, you need to take care that you're not trading greenhouse emissions for water.'

1. Pits are excavated for the sandfilter, pump wells and settling tank.

2. Filling sand filter—first layer.

3. Paul Talbot lays the collection pipe to the base of the sand filter.

4. Two pump wells are required. One captures the greywater and pumps it to the settling tank (top). The second well captures treated greywater from the garden, ready to be sent to the irrigation system.

5. Settling tanks gravity feed the greywater into the sand filter.

6. Pipes distribute greywater over the total area.

7. The sand filter system is complete and ready to be covered by lawn.

With all the six greywater systems in place, here is a snapshot of the systems and installation

Frankston

System Details

Greywater system: Greywater Saver/trench irrigation
System type: diversion and subsurface irrigation (trenches)
Use of water: subsurface garden irrigation
Source of greywater: bathrooms, laundry
Cost of diverter: $700
Cost to install diverter and irrigation system: $1000

Suppliers/Project Sponsors
Plumbing services: Envirosmart Plumbing (Richard Playne)
Greywater diverter: Nylex Water Solutions

Highett

System Details

Greywater system: Sand Filter Treatment System
System type: treatment system (to Class B)
Use of water: subsurface garden irrigation
Source of greywater: bathrooms, laundry
Cost of greywater system incl. design: $5800
Cost to install greywater system: $3500

Suppliers/Project Sponsors
Plumbing Services: PJT Green Plumbing (Paul Talbot)
Pumps: Davey Products
Pump wells: Everhard Industries
Surge Tank: Team Poly (distributed by TS McQuinn & Son)
Plumbing supplies: Tradelink Environmental Solutions
Irrigation system: Triangle Filtration, Toro Australia and Water Pro's Moorabbin
Electrical services: GRYB Electrical Contractors
Electrical supplies: Clipsal
Landscape Design: Gardens by Simon Watkins

North Fitzroy

System Details

Greywater system: Wattworks
System type: diversion to toilet
Use of water: toilet flushing
Source of greywater: bath/shower
Cost of greywater system: $1500
Cost to install greywater system: $800

Suppliers/Project Sponsors
Greywater system: Nylex Water Solutions
Installation: Envirosmart Plumbing (Richard Playne)

Maidstone

System Details

Greywater system: New Water System
System type: treatment to Class B
Use of water: long term water storage/garden irrigation (surface and subsurface drip irrigation)
Source of greywater: bathroom, laundry
Cost of greywater system (inground collection): $6000
Cost to install: $1600
Cost of storage bladder: $940 (installation: $500)

Suppliers/Project Sponsors
Greywater Treatment System: New Water System
Water Storage Bladder: New Water Corp.
Irrigation System: Toro Australia (distributed by Water Pro's Hoppers Crossing)
Rainwater Tank: Nylex Water Solutions
Rainwater Tank Plumbing: Aquablock Plumbing Service

East Malvern

System Details:

Greywater system: Waterwise Greywater Gardener
System type: diversion and irrigation
Use of water: drip-fed garden irrigation
Source of greywater: washing machine
Cost of greywater system (incl. installation): $2487

Suppliers/Project Sponsors:
Greywater system (supply and installation): Waterwise

Would you water your garden with salt?

To save water, many people are reusing greywater on their gardens. It is vital then that the level of salt in greywater is not too high.

But even if your laundry and kitchen wastewater goes straight down the drain it's still important to lower the level of salt in it. Sewage treatment plants are also reusing wastewater for irrigation, once it has been treated and if the salt levels are low enough.

Unfortunately though, salt is very difficult and expensive to remove from wastewater, so it makes more sense to reduce the amount we put into it! One of the main sources of salt in domestic wastewater is household detergents.

Take part in the Low Salt Cleaning Challenge and help research into this problem. For further information go to the Sustainable Living Foundation website: www.slf.org.au/cleaning

Ringwood East

System Details

Greywater system: Plasfex greywater diverter/trench irrigation
System type: diversion and subsurface irrigation (trenches)
Use of water: subsurface garden irrigation
Source of greywater: washing machine
Cost of greywater diverter: $39
Cost to install diverter and trench irrigation system: $1000

Suppliers / Project Sponsors:
Plumbing Services: Envirosmart Plumbing (Richard Playne)

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Uncertain future for PV rebate

Kane Thornton looks at the potential impact the end of the PV rebate will have on householders and the renewables industry

Get in quick, the sale is nearly over! For over four years, the cost of solar photovoltaic (PV) power systems has been subsidised by up to $8000 per system by the Federal Government. But the Photovoltaic Rebate Program (PVRP) is fast approaching its expiry date. Current funding is due to expire by May 2005 and no commitment for additional funding in the upcoming budget has yet (or is expected) to be made.

Australia needs to reduce greenhouse gas (GHG) emissions and reduce them fast. Solar PV and the clean energy it produces can clearly reduce our dependence on dirty coal for electricity generation. But Australia has no emissions trading scheme or carbon tax (of the kind that Kyoto would have bound us too), so GHG emitters have no financial incentive to reduce emissions. With such market failure, renewable energy must rely on subsidies to remain competitive. The winding up of the PVRP will leave a large hole in the industry.

Demand for electricity typically increases during hot summer days when air-conditioners fire up. During these peak periods the price of electricity on the wholesale market increases. These periods of high demand often coincide with peak generation by solar PV. However, most electricity retailers do not buy the surplus electricity from solar PV owners at the higher wholesale price. (See graph 1).

Thankfully it's not just economics that motivate people to invest in solar PV. The ATA's (Alternative Technology Association—publishers of *ReNew*) recent survey into grid-interactive solar PV revealed that the motivation for investing in PV is as much about reducing GHG emissions (85% of respondents) and showcasing new technology (70% respondents) as saving money on electricity bills.

Over 80% of survey repondents would not have bought a PV system without the financial support of the rebate.

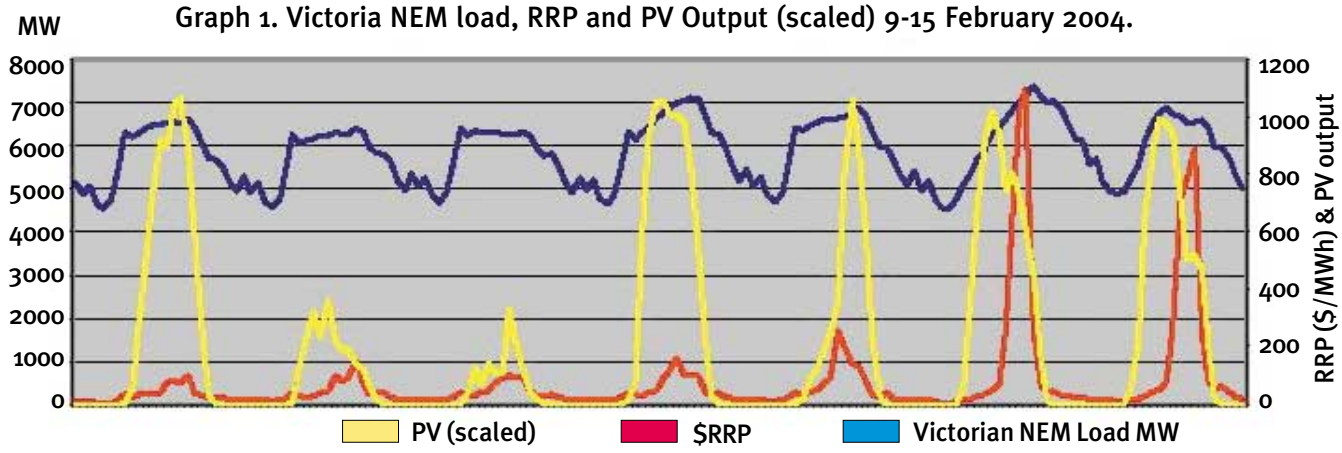
Although the ongoing costs of using solar are low, the initial upfront cost of PV is significant, averaging around $20,000. The survey also revealed that over 80% of respondents would not have purchased their systems without the rebate. Add to this the results of the Sustainable Energy Development Authority research into *Who Buys Solar Power Systems?* in NSW. Just 40.7% of respondents answered yes when asked in 2003 'Would you have invested in this system if there had been no rebate?'.

It's these high upfront costs (and the environmental benefits) of solar PV that motivated the Australian Government to launch the PVRP in 2000.

This fund directly supports the uptake of solar PV by providing rebates of up to $8000, later revised back to $4000, off the upfront cost of new PV panels. The program has been particularly effective in stimulating growth in sales of grid-interactive PV systems, which make up over half of the 10,000 systems installed across Australia.

But PVRP does not just benefit householders—solar manufacturers, retailers and installers (which collectively employ around 1100 people) also reap the

Graph 1. Victoria NEM load, RRP and PV Output (scaled) 9-15 February 2004.



On hot summer days demand for electricity on the National Electricity Market (Victorian NEM Load) peaks along with prices (RRP). This demand is driven increasingly by airconditioner usage, and often occurs at approximately the same time as sunshine maximises the output of solar PV.
Muriel Watt, Scott Partlin, Monica Oliphant, Hugh Outhred, Iain MacGill & Ted Spooner, 'Analyses of Photovoltaic System Output, Temperature, Electricity Loads and National Electricity Market Prices – Summer 2003-04', *Proceedings of Solar 2004*, Perth 1-3 Dec 2004.

rewards.

The average rebate covers up to 30% of system costs, clearly enough incentive to motivate the 5600-plus Australian households that have utilised the rebate to date.

Chris Hart from EcoSouth Solar Electricity in South Australia warns of the 'sticker-shock effect' when the rebate expires. According to Hart, Australians will 'sit back and wait' for an equivalent rebate to entice them into investing in solar PV. The result, according to the Business Council for Sustainable Energy, will be 'a loss of jobs in small businesses... and a negative economic flow-on in regional Australia where most of these businesses are based.'

So what will take the place of the PVRP, keep the solar PV industry afloat and provide that helping hand to householders considering investing in a clean energy future? The Federal Government's energy white paper, *Securing Australia's Energy Future*, released last June, announced the 'Solar Cities' program as a key initiative in driving solar PV.

The program, worth $75 million, will 'demonstrate the economic and environmental costs and benefits of the mass installation of solar energy technology, energy efficient measures and smart meters on electricity supply and demand'. This mass rollout of solar PV will be available only to those specific cities selected to participate (Adelaide and at least three other cities), leaving the rest of Australia to pay the full cost for solar PV systems. Further, 'Solar Cities' is still in its planning phase, with the solar PV industry and the lucky four cities expected to wait three years before seeing any action.

Another recommendation from the white paper was that the Mandatory Renewable Energy Target (MRET) further benefit solar PV owners. MRET requires energy retailers and large buyers of electricity to purchase Renewable Energy Certificates (REC) to proportionally contribute towards the generation of additional renewable energy. Every megawatt-hour (MWh) of energy produced by a solar system produces one REC, which is worth approximately $37 if redeemed.

System owners are currently entitled to claim these (deemed) in advance for a five year period. The white paper recommended that the deeming period be extended to 15 years—closer to the real life span of most systems. This will mean a system producing approximately 1MWh of electricity per year will be eligible to claim RECs worth some $555 ($37 x 15 years) upon installation.

But this is a far cry from the $4000 on offer from the PVRP, and meagre compensation for the thousands of dollars required for PV installation. With the PVRP due to run out by May this year the proposed mechanism will not help get solar panels on houses.

One option for householders wanting to install PV is to renegotiate their home loan to take advantage of the discounted 'green' loans which offer up to 0.5% off normal lending rates for those with environmentally-friendly housing and technology such as solar PV.

But if Australia is serious about a solar PV industry and shaking off its infamous title as the world's largest greenhouse gas polluter per capita, something more needs to be done. Feed-in tariffs, similar to those being offered in Germany, are the most effective means of fostering continued growth of solar PV. Feed-in tariffs reward solar PV system owners with higher rates for excess electricity produced during peak demand periods, and can significantly reduce the payback period for solar PV.

While the price of solar panels is coming down rapidly, just how many Australians buy PV systems after the demise of the PVRP is anyone's guess. The environment still needs you, but hurry because the price of solar PV will soon rise. ✲

Kane Thornton is the Energy Policy Manager at the ATA (Alternative Technology Association), publishers of *ReNew*.

Solar panel buyers' guide

There are many solar panels on the market, but which one is suitable for your needs? Lance Turner takes a look at the options. Table by Olivia Neville-Smith

This buyers' guide covers photovoltaic panels, which produce electricity directly from sunlight to power houses (on and off the mains grid), water pumps, and remote communications.

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

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

Many panels have glass on the front and a plastic such as Tedlar on the back to seal the panel. There are also panels that are designed to replace windows and other glass panels in architectural uses. This allows the home owner to offset some of the cost of the solar panels, as the panels themselves double as building materials. The PV Solar Energy roof tiles and some of the ASI series panels from RWE Schott Solar fall into this category.

They may look like tinted glass, but these are actually photovoltaic solar panels, part of the RWE SCHOTT Solar range.

PV applications

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

The different technologies

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

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

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

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

Flexible panels are a spinoff of amorphous technology. These are manufactured on a plastic or thin metal substrate and can be rolled up or attached to curved surfaces. They are commonly used for camping and boating, but are generally quite expensive on a dollar-per-watt basis, although larger ones designed for mounting on buildings are competitive with conventional rigid panels. See the article on new solar technologies on page 32 of this issue for more examples of thin film technology.

Panel ratings

There are a number of different ratings on solar panels.

Rated (peak) power: This is the max-

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

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

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

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

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

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

Temperature at rated power: This is the temperature that the solar panel manufacturer rates their panels at. Most panels are rated to put out their maximum power at 25°C, which is a rather unrealistic figure given that the panel temperature under typical Australian conditions can be anything up to 70°C.

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

Obviously, the most important ratings when doing calculations for a power system are the voltage and current at maximum power. A system is never calculated using panel wattage ratings, as this is a function of both the voltage and current. Some panels are rated at slightly higher or lower voltages than others, and this affects the amount of current available.

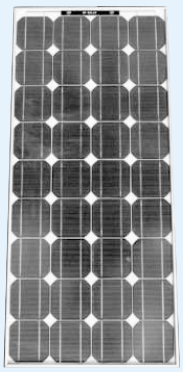
Solar panel types

There are three common technologies used in solar panels, all of which are based on the common element silicon, which makes up a large proportion of the earth. Note that the panels below are not shown to scale. The Uni-Solar is actually the largest.

Monocrystalline cells are made from a thin slice or wafer cut from a single large crystal of silicon. The cells are then doped and the fine current collecting wires printed on or in the surface of the cell.

Generally monocrystalline cells have the highest efficiency, but this comes at a price. This type of cell takes more energy to make than any other, and so has a greater energy payback period, though this is usually still within five years or so.

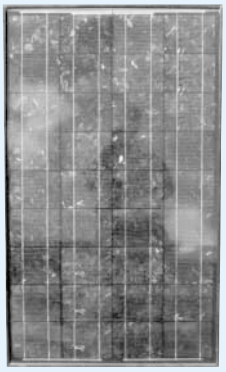
A number of manufacturers make monocrystalline panels, including BP Solar (who make high efficiency laser grooved versions), Sharp Solar, and Shell Solar.



Polycrystalline cells are made from thin wafers of silicon cut from a large cast billet. The billet is not a large single crystal, but many crystals clumped together, hence the name.

Polycrystalline cells are usually slightly less efficient than moncrystalline cells, but because they are square, can be fitted into the rectangular frame of a solar panel with high space efficiency, although polycrystalline panels are still slightly larger than monocrystalline panels of the same rating. Polycrystalline cells must also have current collecting grids printed onto them.

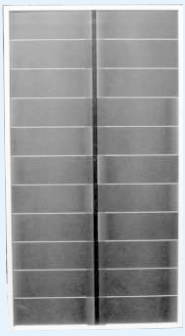
Kyocera panels use this cell technology, as do many other panels.

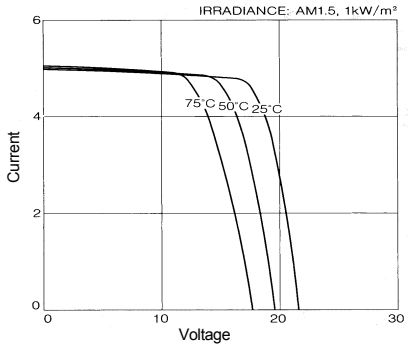


Amorphous panels involve deposition of very thin films of silicon or other materials directly onto a substrate such as glass or stainless steel. This technique produces a cell with a lower efficiency than the cut wafer varieties, but has the advantage of eliminating the need for inter-cell connections.

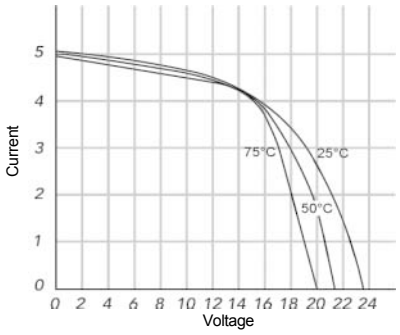
Uni-Solar makes triple-junction, nine-layer thin-film amorphous panels with a much higher efficiency than the older types. The layers of silicon are deposited directly onto a stainless steel substrate and are then coated in a flexible plastic protective layer.

There are a number of manufacturers of thin-film panels now, including Uni-Solar, Kaneka and Mitsubishi Heavy Industries.





These curves, for a typical 80 Watt polycrystalline panel, show how power output is affected by increasing temperature. This needs to be taken into account when buying panels.



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

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

Self-regulating panels

There has been much debate about self-regulating panels over the years. Self-regulating panels have fewer cells, and hence less output voltage, than normal ones—typically 32 cells instead of the 36 found in most 12 volt panels. Basically, a self-regulating panel will not give the performance under all conditions that a panel with higher voltage will.

A self-regulating panel will often not have enough voltage to allow for drops in the wiring and regulator, so they rarely run at their peak power point. Also, because of their reduced voltage, performance will suffer on overcast days.

Some manufacturers claim that no regulator is required with these panels. This is wrong in most cases, as even a self-regulating panel can bring a battery voltage up to 17 volts or so, which is clearly overcharging it. The only situation where you may be able to use a self-regulating panel without a regulator is when it is attached to a large battery and is only being used to keep the battery topped up.

Heat and shading

These are two factors that can greatly affect solar panel performance. In general, solar panel performance decreases as temperature increases, and a panel rated at 25°C will not perform as well when operating at the temperatures experienced in most parts of Australia. A typical operating temperature in summer can be up to 50°C or higher.

Some companies also supply ratings for temperatures higher than 25°C, so check to see whether these are available.

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

Amorphous panels perform somewhat better, especially the multi-junction units like the triple-junction panels from Uni-Solar.

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

Embodied energy

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

What to look for

Obviously, you need to buy a panel that has the correct ratings in both voltage and current, with consideration given to their performance as determined by their IV curve. You also need to look for a few other things when buying, such as construction quality, frame type and panel shape and weight. Some panels may be more suited to your roof shape than others, especially when used on small buildings such as sheds or outdoor toilets.

Panel quality is very important. Many of the small amorphous panels manufactured in Asia are of variable quality—some last many years, others die a quick death—so be wary of these.

Manufacturer and distributor contacts (Brand: supplier)

BP Solar: BP Solar, ph:1800 802 762, www.bpsolar.com.au

GE Energy: Solar Sales P/L, ph:(08) 9258 8244, email: sales@solarsales.com.au, www.solarsales.com.au

Kaneka: The Solar Shop, ph:(08) 8362 9992, email: solar@solarshop.com.au, www.solarshop.com.au

Kyocera: Kyocera Solar P/L, ph:(02) 9870 3948, email: info@kyocera.com.au, www.kyocera.com.au

Mitsubishi Heavy Industries: EcoSouth, ph:(08) 8379 0790, email: info@ecosouth.com.au, www.ecosouth.com.au

Mitsubishi Electric: Solar Sales P/L, ph:(08) 9258 8244, email: sales@solarsales.com.au, www.solarsales.com.au

MSK: M+H Power Systems P/L, ph:1800 801 433, email: sales@mhpower.com.au, www.mhpower.com.au

PV Solar Tile: PV Solar Energy P/L, ph:(02) 9558 0512, email: info@pvsolar.com.au, wwwpvsolartiles.com

Rainbow Power Company: Rainbow Power Company, ph:(02) 6689 1430, email: sales@rpc.com.au, www.rpc.com.au

RWE Schott Solar: RWE Schott Solar, ph:(03) 9816 8345, email: solar@frankadvice.com.au, www.rweschottsolar.com; SA and NT: Sustainable Energy Enterprises P/L, ph:(08) 8267 2366, email: HeinzRechten@crestaustralia.com.au; VIC and TAS: Going Solar, ph:(03) 9348 1000, email: retail@goingsolar.com.au, www.goingsolar.com.au

Sharp: Sharp Corporation of Australia P/L, ph:1300 135 530, email: sales@sharp.net.au, www.sharp.net.au

Shell Solar: NENSYS New Energy Systems, ph:(07) 3812 0565, email: sales@nensys.com.au, www.nensys.com.au; Advanced Energy Systems (WA), ph:(08)9358 3633, email: info@aesltd.com.au, www.aesltd.com.au

SunPower: Solar Sales P/L, ph:(08) 9258 8244, email: sales@solarsales.com.au, www.solarsales.com.au

Suntech: Suntech Australia P/L, ph:(03) 5977 9489, email: sales@suntechaustralia.com.au, www.suntechaustralia.com.au; Solar Sales P/L, ph:(08) 9258 8244, email: sales@solarsales.com.au, www.solarsales.com.au

Uni-Solar: ARRID, ph:1300 663 563, email: sales@arrid.com.au, www.arrid.com.au

Webel: Solar Sales P/L, ph:(08) 9258 8244, email: sales@solarsales.com.au, www.solarsales.com.au

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

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

Another factor is whether the panels are made locally. As far as we know, BP Solar and PV Solar Energy are currently the only local solar panel manufacturers. Origin Energy is expected to start selling their new Sliver cell panels later this year, while Pacific Solar (now owned by CSG Solar) should be manufacturing by early 2006.

About this buyers guide

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

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

About the table

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

Photo: BP Solar Australia

This is what the silicon used to make crystalline cells looks like before it goes into the furnace.

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which maximum power is tested at	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP Inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
BP Solar (Hong Kong)	HX 2M	2	16	0.135	Polycrystalline		Glass, EVA, Tedlar	275 x 145 x 23	0.5	12, 2	99.00	49.50	2 to 4	25+	Envirocashback of 50 cents per watt available on all modules greater than 80W in power. Ask your BP Solar retailer for details.
	HX 5M6V	5	16.5	0.57				269 x 251 x 23	0.8		137.50	27.50			
	SX 5M	5	16.5	0.3				269 x 251 x 23	0.8		121.00	24.20			
	SX 10M	10	16.8	0.6				421 x 269 x 23	1.5		176.00	17.60			
	SX 10M6V	10	16.8	0.6				421 x 269 x 23	1.6		214.50	21.45			
	SX 20M	20	16.8	1.2				501 x 421 x 23	2.5		291.50	14.58			
	SX 20U	20	16.8	1.2				502 x 424 x 50	3		291.50	14.58			
	SX 30U	30	16.8	1.8				594 x 502 x 50	3.9		363.00	12.10			
	BP 340U	40	17.3	2.3				655 x 537 x 50	5.75	25, 12, 5	467.50	11.69			
	BP 350U	50	17.3	2.9				839 x 537 x 50	6		550.00	11.00			
BP Solar (Australia)	BP 365U	65	17.6	3.7				1111 x 502 x 50	7.2		709.50	10.92			
	BP 380U	80	17.6	4.55				1209 x 537 x 50	7.7		847.00	10.59			
	BP 485U	85	17.4	4.9	Monocrystalline			1209 x 537 x 50	7.7		910.80	10.72			
	BP 485S	85	17.4	4.9				1209 x 537 x 50	7.7		910.80	10.72			
	BP 3125U	125	17.3	7.23	Polycrystalline			1510 x 674 x 50	12		1309.00	10.47			
	BP 3125S	125	17.3	7.23				1510 x 674 x 50	12		1309.00	10.47			
	BP 3160S	160	35.1	4.6				1593 x 790 x 50	15.4		1604.90	10.03			
	BP 3160U	160	35.1	4.6				1593 x 790 x 50	15.4		1604.90	10.03			
	BP 4175S	175	35.4	4.9	Monocrystalline			1593 x 790 x 50	15.4		1766.60	10.09			
BP Solar (Spain)	BP 585U	85	18	4.72				1209 x 537 x 50	7.7		990.00	11.65			
	BP 585S	85	18	4.72				1209 x 537 x 50	7.7		990.00	11.65			
GE Energy (USA)	GEPV-110-M	110	16.7	6.6	Monocrystalline	25	Glass/Tedlar	1477 x 661 x 35	11.9	25	1155.00	10.50		40	UL-1703 and IEC-61215.
Kaneka (Japan)	GEB	60	67	0.9	Amorphous		5mm glass/Tedlar/ aluminium frame	950x960x40	13.9	25	583.00	9.72	1.6	Same as for crystalline	Rated at +10%/-5%. Better temperature coefficient than crystalline. Excellent shade tolerance.
	PLC	13	16.5	0.79				495x465x38	2.9	10	180.00	13.85			Electric fences, gates, pond pumps, automotive battery maintenance, etc.
	PLD	26	16.5	1.58				950x465x38	5.5		300.00	11.54			A good panel for telemetry and irrigation systems.
	PLE	50	16.5	3.03				952x920x38	13.5		565.00	11.30			Good for campers and boaters.
Kyocera Solar (Japan)	KC187G	187	26.1	7.17	Polycrystalline	25	Cells are encapsulated between tempered glass cover and an EVA pottant with back sheet.	1425 x 990 x 36	18.5	25	1785.00	9.55		25+	Grid Tie Module.
	KC167G	167	23.2	7.2				1290 x 990 x 36	16		1679.00	10.05			
	KC125G	125	17.4	7.2				1425 x 652 x 35.7	12.2		1257.00	10.06			
	KC120-01	120	16.9	7.1				1452 x 652 x 56	11.9		1207.00	10.06			
	KC80-01	80	16.9	4.97				1007 x 652 x 56	8.3		849.00	10.61			
	KC70	70	16.9	4.14				865 x 652 x 56	7		770.00	11.00			
	KC60	60	16.9	3.55				751 x 652 x 54	6		660.00	11.00			
	KC50	50	16.7	3				639 x 652 x 54	5		550.00	11.00			
	KC45	45	15	3				573 x 652 x 54	4.5		495.00	11.00			
	KC40	40	16.9	2.34				526 x 652 x 54			487.00	12.18			
	KC35	35	15	2.33				471 x 652 x 54	4		427.00	12.20			
Kyocera Solar (Argentina)	KS20	20	16.9	1.2				520 x 352 x 22	2.5	10	415.00	20.75		10+	
	KS10	10		0.71				304 x 352 x 22	1.9		259.00	25.90			
	KS5	5		0.42				205 x 352 x 22	1.2		183.60	36.72			
Mitsubishi Electric (Japan)	PV-MF130	130	19.2	6.79	Polycrystalline	25	Glass/Tedlar.	1248 X 803 X 46	12.5	25	1287.00	9.90		40	
Mitsubishi Heavy Industries (Japan)	MA-100	100	108	0.93	Amorphous	25	Glass, EVA, Tedlar.	1410 x 1110 x 35	21	20	785.00	7.85	2.1	30+	Four parallel fly-leads for connection. Grid connect. Stand-alone supply with suitable regulator.
MSK (Japan)	LPS125-180	180	35.6	5.05	Monocrystalline	25	Tempered glass, EVA, Tedlar, aluminium frame, MC flying leads.	1580 x 802 x 50	18	2 +25	1749.00	9.71	1.5	50	16.2% cell efficiency, 5% tolerance, three bypass diodes, sealed junction boxes.
	LPS125-135	135	26.6	5.05				1195 x 802 x 50	14		1351.90	10.01			
	MPS125-90	90	17.8	5.05				815 x 802 x 50	9		922.90	10.25			
	LPA960-60	60	67	0.9	Amorphous			960 x 990 x 40	13.7		538.82	8.98	<1		3rd generation amorphous technology.
	MST44T1010U	44	59.6	0.739			10mm standard glass with flying leads.	950 x 980 x 10	23		1650.00	37.50			See through glazing for commercial applications in grid connect systems, can also be used as a TV display when used with Video projector.
	MST44T1013U	44	59.6	0.739			13mm strengthened laminated glass with flying leads.	950 x 980 x 13	30		1850.00	42.00			

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which maximum power is tested at	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP Inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
PV Solar Tile (Australia)	PVST 180	180	35	5.5	Mono or Poly	~50	Aluminium and UV resistant plastic frame.	~1600 x 860 x 15	15	20	1460.00	8.00	2	30+	Available with a range of PV brands and sizes – see web site.
	PVST 85	85	17					~1200 x 600 x 15	8		780.00				
Rainbow Power Co (China)	SOL-Y05	5	17.1	0.29	Monocrystalline	25C	Aluminium frame, toughened glass.	255 x 235 x 20	0.81	15	$121.00	24.20		40	
RWE SCHOTT Solar (Germany)	ASE-50-ETF/17	50	17.2	2.9	Polycrystalline	50	EVA, Tedlar, aluminium frame.	975 x 452 x 34.5	6.1	10	539.00	10.78		25+	
	ASE-100-GT-FT	100	34.5				Glass, Tedlar, aluminium frame, thermoplastic cell embedding.	1282 x 644 x 35	8.5	25	1078.00	10.78	3.7		
	ASE-160-GT-FT	155	56.7	2.73		47		1282 x 1070 x 50	19.2	25	1672.00	10.78			
	ASE-160-GT-FT	160	56.9	2.81				1282 x 1070 x 50	19.2	25	1725.00	10.78			
	ASE-165-GT-FT/MC	160	35.9	4.46	Polycrystalline			1620 x 810 x 50	14	25	1725.00	10.78	4.7		
	ASE-165-GT-FT/MC	165	36	4.58				1620 x 810 x 50	14	25	1779.00	10.78			
	ASE-190-GT-FT/TF	180	36	5.01	Monocrystalline			1620 x 810 x 50	14	25	1940.00	10.78	6		
	ASE-190-GT-FT/TF	188	36	5.22				1620 x 810 x 50	14	25	2027.00	10.78			
	ASE-275-DG-FT/MC	275	59.1	4.65	Polycrystalline	45	Double-glass, aluminium frame, thermoplastic cell embedding.	1605 x 1336 x 50.8	41	25	2965.00	10.78	4.7		
	ASE-275-DG-FT/MC	285	59.7	4.77				1605 x 1336 x 50.8	41	25	3072.00	10.78			
	ASE-275-DG-UT/MC	275	59.1	4.65				1592 x 1323 x 7.6	39	25	2916.00	10.60			
	ASE-300-DG-FT (17V version)	300	17	17.7	Polycrystalline			1892 x 1283 x 50.8	47.6	25	3234.00	10.78	3.7		
	ASE-300-DG-FT	285	50.5	5.64				1892 x 1283 x 50.8	50	25	2978.00	10.45			
	ASE-300-DG-FT	300	51.2	5.9				1892 x 1283 x 50.8	50	25	3135.00	10.45			
	ASI-F 2/12	2.6/2.1	16.8	0.125	Amorphous thin film	49	Encapsulated, framed.	293 x 144 x 21	0.6	10	54.00	25.58	2.5	10+	Wp indicated is initial/stabilised.
	ASI-F 4/12	4.7/3.9		0.232				293 x 249 x 21	0.9		80.00	20.62			
	ASI-F 5/12	6.3/5.2		0.309				330 x 293 x 21	1.2		99.00	19.03			
	ASI-F 8/12	9.5/7.8		0.464				493 x 293 x 21	1.6		145.00	18.61			
	ASI-F 10/12	12.5/10.3		0.613				581 x 330 x 21	2.1		170.00	16.50			
	ASI-F 32/12	39.3/32.2		1.92				1005 x 605 x 34	6.2	20	350.00	10.86		20+	
	ASITHRU-30-SG	33/27	36	0.75			Double glass with PVB foil.	1000 x 600 x 10/22	14		770.00	28.52			Thickness of module is without/with connector button.
	ASIOPAK-30-SG	39.3/32.2		0.89				1000 x 600 x 10/22	14		688.00	21.37			
	ASIOPAK-1-L	35/29	68	0.43			Laminate.	1027 x 627 x 17	27		Used for external façade and overhead glazing.				ASI Glass is available in a range of specifications and dimensions.
	ASITHRU-1-L	31/25		0.37				1027 x 627 x 17	27						
	ASITHRU-1-IO	31/25		0.37			Double glazing overhead.	1018 x 624 x 34	29						
	ASIOPAK-2-L	71/58		0.85			Laminate.	1027 x 1204 x 17	54						
	ASITHRU-2-L	61/50		0.74				1027 x 1204 x 17	54						
	ASITHRU-2-IO	61/50		0.74			Double glazing overhead.	1018 x 1201 x 34	57						
	ASIOPAK-3-L	106/87		1.28			Laminate.	1027 x 1781 x 17	80						
	ASITHRU-3-L	92/75		1.11				1027 x 1781 x 17	80						
	ASITHRU-3-IO	92/75		1.11			Double glazing overhead.	1018 x 1777x34	84						
	ASIOPAK-4-L	141/116		1.71			Laminate.	1027 x 2358 x 17	106						
	ASITHRU-4-L	122/100		1.48				1027 x 2358 x 17	106						
	ASITHRU-4-IO	122/100		1.48			Double glazing overhead.	1018 x 2354 x 34	112						
	ASIOPAK-4x-L	140/114	72	1.59			Laminate.	1204 x 2004 x 17	105						
	ASITHRU-4x-L	117/96		1.33				1204 x 2004 x 17	105						
	ASITHRU-4x-IO	117/96		1.33			Double glazing overhead.	1195 x 2001 x 34	112						
Sharp (Japan)	NTS5E3E	185	36.2	5.11	Monocrystalline	25	Tempered glass laminate, box section aluminium frame. Lead wire with MC connectors.	1575 x 826 x 46	17	25	1590.00	8.59	2 to 3	25+	14.2% module efficiency. Lead wire with MC connector. PET backing sheet.
	NTR5E3E	175	35.4	4.95				1575 x 826 x 46			1490.00	8.51			13.5% module efficiency. Lead wire with MC connector. PET backing sheet.
	NEQ5E3E	165	34.6	4.77	Polycrystalline			1575 x 826 x 46							
	NDL3E6E	123	17.2	7.16				1499 x 662 x 46	14		1090.00	8.86			12.39% module conversion efficiency. Fitted with junction box. PET backing sheet.
	NDL3EJE	123	17.2	7.16				1499 x 662 x 46							
	NE80EJE	80	17.1	4.67			As above with junction box.	1200 x 537 x 46	9.5		720.00	9.00			12.6% module conversion efficiency. Nominal 12 Volt output. Fitted with junction box. PET backing sheet.

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which maximum power is tested at	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP Inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
Shell Solar (USA)	SM55	55	17.4	3.15	Monocrystalline		Glass/EVA/Tedlar.	1293 x 329 x 34	5.5	25	655.93	11.93	3.3 years (at 1700kWh/m^2 per year)	30	
	SQ85	85	17.2	4.95				1200 x 527 x 34	7.6		751.08	8.84			
	SM110-12	110	17.5	6.3				1316 x 660 x 40	11.5		1035.87	9.42			
	SM110-24	110	35	3.15				1316 x 660 x 40	11.5		1024.65	9.32			
	SQ175	175	35.4	4.95				1622 x 814 x 40	18.4		1517.34	8.67			With output leads.
SunPower (China)	SPR-090	90	17.7	5.1	Monocrystalline	25	Glass/Tedlar.	1038 x 527 x 46	7.4	25	924.00	10.27		40	Area efficiency of 16.5%.
	SPR-200	200	40	5				1559 x 798 x 46	16		1980.00	9.90			Area efficiency of 16.1%. All black.
	SPR-210	210	40	5.25				1559 x 798 x 46	16		2084.50	9.93			Area efficiency of 16.9%.
Suntech (China)	STA165-24	165	34.8	4.74	Monocrystalline	50	Tedlar-EVA-glass.	1580 x 808 x 50	15.5	25	1345.30	8.15	4 to 5	40	
	STA100-12	100	17.2	6.23	Polycrystalline/ monocrystalline			1315 x 661 x 50	11.5		819.50	8.19			
	STA080-12	80	17.2	4.65				1196 x 534 x 35	7.9		667.70	8.34			
	STA055-12	55	17.6	3.12				995 x 453 x 35	5.5		504.90	9.18			
	STA040-12	40	17.2	2.2				634 x 534 x 35	4.3		378.00	9.46			
	STA020-12	20	16.8	1.19	Polycrystalline			636 x 306 x 18	2.5		231.00	11.55			
	STA012-12	12	16.8	0.71				450 x 278 x 25	151		170.50	13.84			
	STA005-12	5	16.8	0.3				196 x 306 x 18	0.8		115.50	23.10			
	STA002-12	2	16.8	0.12				222 x 153 x 25	0.12		67.10	33.55			
	STP170S-24	170	35.2	4.83	Monocrystalline	25	Glass/Tedlar.	1580 x 808 x 50	15.5	25	1685.00	9.91		40	
Uni-Solar (USA)	US-5	5	16.5	0.3	Amorphous	25	Framed module.	491 x 206 x 47	1.1	10	119.00	23.80	1.5	20	Non glass construction, virtually unbreakable. Better hot weather performance compared to crystalline modules.
	US-11	10.3	16.5	0.62				491 x 383 x 47	1.6		219.00	21.26	1.5	20	Non glass construction, virtually unbreakable Bypass diodes between each cell to enhance performance in part shade. Better hot weather performance compared to crystalline modules.
	US-32	32	16.5	1.94				1366 x 383 x 47	4.8	20	359.00	11.22	1.5	40	
	US-64	64	16.5	3.88				1366 x 741 x 47	9.2		640.00	10.00	1.5	40	
	ES-62T	62	15	4.1				1258 x 793 x 39	10.9		700.00	11.29	1.5	40	
	ES-124	124	30	4.1				2459 x 793 x 32	20.5		1250.00	10.08	1.5	40	
	FLX5	5	10	0.3			Flexible Mat.	541 x 247 x 50	0.5	5	149.00	29.80	1.5	8	Non glass construction, virtually unbreakable. Better hot weather performance compared to crystalline modules.
	FLX11	10.3	16.5	0.62				541 x 424 x 50	0.9		270.00	26.21	1.5	8	Non glass construction, virtually unbreakable Bypass diodes between each cell to enhance performance in part shade. Better hot weather performance compared to crystalline modules.
	FLX32	32	16.5	1.94				1417 x 424 x 50	2.1		570.00	17.81	1.5	8	
	PVL-68	68	16.5	4.13			Adhesive laminate.	2849 x 394 x 2.5	4.1	20	700.00	10.29	1.5	40	Non glass construction, virtually unbreakable. Better hot weather performance compared to other modules. Must be applied by Uni-Solar approved installation technician.
	PVL-124	124	30	4.13				5007 x 394 x 2.5	7.5		1190.00	9.60	1.5	40	
	PVL-136	136	33	4.13				5486 x 394 x 2.5	7.7		1290.00	9.49	1.5	40	
	UNI-PAC 10 12V	10.5	17.6	0.6			Cells sewn into nylon fabric.	1168 x 495 x 2.5	0.95	5	690.00	65.71	1.5	8	Non glass construction, virtually unbreakable. Better hot weather performance compared to other modules.
	UNI-PAC 10 24V	10.5	35.2	0.3				1168 x 495 x 2.5	0.95		690.00	65.71	1.5	8	
	UNI-PAC15	15.8	17.6	0.9				1207 x 711 x 2.5	1.5		990.00	62.66	1.5	8	
	UNI-PAC 34	34	17.6	1.9				1473 x 845 x 2.5	2.1		1220.00	35.88	1.5	8	
Webel (India)	SP160	160	33.4	4.8	Monocrystalline	25	Glass/Tedlar.	1690 x 859 x 57	20	25	1584.00	9.90		40	
	SP120	120	16.7	7.18				1446 x 646 x 57	12.5		1188.00	9.90		40	
	SP80	80	16.4	4.88				1251 x 566 x 55	8.7		907.50	11.34		40	
	SP60	60	16.7	3.6				1001 x 500 x 55	6.2		660.00	11.00		40	
	SP40	40	17	2.4				973 x 436 x 34	5.7		475.00	11.88		40	

Setting up a solar water feature

We receive so many requests for information on putting together solar powered fountains, we thought we would look at what options are available for people who want to do it themselves

Most people just love the sound of running water, especially in their own garden, and it seems to have extra appeal when the flow is powered by a clean source of energy. In most cases, this means using solar power to run a pump, but unfortunately there are not many solar fountain kits available on the market here in Australia, although the range has grown considerably since we last looked at what was available back in *ReNew* 78.

Commercial kits

The solar fountain and water feature kits that we were able to find are listed in the table on page 58. They are generally based on the Oase pumps from Holland, or on small DC pumps made in China and Thailand, all of which are designed specifically for this purpose. Note that the flow rates are generally the maximum possible for the pump. Actual flow rates are likely to be less, depending on the height that the pump must push the water up to.

Some of these kits are not cheap, but if you want quality components, you have to pay for them. The cheap panels and pumps may not last nearly as long, but if you want to get your feet wet with solar technology and try a small solar water feature without the high initial outlay, then it is worth looking at the cheaper kits such as those from Creative Fountains.

With all of the kits, the part most likely to fail first is the pump, as it has moving parts which have to deal with possibly dirty pond water. Solar panels just have to sit there, so provided that they stay sealed to the weather, the panels should last at least 10 years, and probably twice that.

With almost all of the kits that we looked at, the pumps were available separately as well, so you can get a replacement if and when the pump wears out. If you can get replacement parts rather than having to replace the entire pump, then you need to consider that fact when deciding which kit to choose.

Doing it yourself?

If the kits are not what you are after (you may want more water flow than they will provide) then you will have to do it yourself. However, this is not as hard as it sounds.

A solar fountain is about the simplest solar powered device you can set up. All you need is a suitable pump, either 12 or 24 volt DC powered, and a solar panel of suitable size to run it. It is that easy. In its simplest form, the only other things needed are the appropriate cable, connectors, spray head and flexible hose. A simple diagram of a solar fountain setup can be seen in Figure 1.

While this system will work well, there will be times when it stops due to cloud cover, or late in the afternoon and early in the morning, when there is not enough sun to make the pump run. To overcome this problem, an electronic device called a maximiser can be added which matches the load of the pump to the power output of the solar panel, thus allowing the pump to run for longer each day and pump more water. These are available from many solar equipment suppliers, and can also be bought in kit form (you will need electronics and soldering experience to get them working) for less cost than pre-built units.

A solar powered water feature makes a nice addition to any garden—and they cost nothing to run.

Running at night

While the above system will run while there is adequate sunlight, it won't, of course, run at night. To achieve this you will need to add to it considerably, including energy storage in the form of a rechargeable battery, a much larger solar panel, and a suitable regulator to prevent the battery being overcharged on long sunny days. This all adds considerably to the cost as well as making the system far more complex, so we will not give examples of this type of system here.

However, there is one off-the-shelf system that is designed for use at night, and it even has LED lighting to add more interest at night. See the Solar illumina listing in the table for more information.

Table 1. Solar fountain kits that are ready to install.

Supplier	Model/kit #	Pump	Panel	Other equipment	Maximum head	Maximum flow	Cost
Creative Fountains ph:(08) 8377 4748 sales@creativepumps.com.au www.creativefountains.com.au	Mini	Solar Trend Mini	Pump only		200mm	210 litres/hour	$28
	Midi	Solar Trend Midi			750mm	290 litres/hour	$38
	Lugamo	Solar Trend Lugano			1.95 metres	440 litres/hour	$47
	Aquasolar 700	Aquasolar 700			2 metres	700 litres/hour	$198
	Aquasolar 1500	Aquasolar 1500			3 metres	1500 litres/hour	$345
	Seerose 4200	Seerose 4200			3.9 metres	4200 litres/hour	$959
	Mini	Solar Trend Mini	0.7 watt	5 metre cord, 3 fountain heads	200mm	210 litres/hour	$88
	Pond Island	Complete floating pump/panel combo			200mm	210 litres/hour	$99
	Midi	Solar Trend Midi	1.4 watt	5 metre cord	750mm	290 litres/hour	$137
	Hawaii	Wagner Hawaii	1.5 watt	Battery and 5 metre cord	1.15 metres	280 litres/hour	$209
	Lugano	Solar Trend Lugano	5 watt	3 fountain heads and 5 metre cord	1.95 metres	440 litres/hour	$249
	Aquasolar 700	Aquasolar 700	Uni-Solar 11 watt	5 metre cord	2 metres	700 litres/hour	$427
	Aquasolar 1500	Aquasolar 1500	Uni-Solar 21 watt	5 metre cord	3 metres	1500 litres/hour	$654
	Seerose 4200	Seerose 4200	Uni-Solar 64 watt	10 metre cable	3.9 metres	4200 litres/hour	$1598
Going Solar ph:(03) 9348 1000 retail@goingsolar.com.au www.goingsolar.com.au	2 Metre kit	12 Volt Oase Aquasolar 700 7 Watt pump	RWE Schott ASI-F 10 watt amorphous	Includes all connections and cables	2 metres	720 litres/hour	$360
	3 Metre kit	12 Volt Oase Aquasolar 1500 17 Watt pump	2 x RWE Schott ASI-F 10 watt amorphous	Includes all connections and cables	3 metres	900 litres/hour	$595
	Rule Bilge Pump	Rule Submersible	RWE Schott ASI-F 32 watt amorphous	Battery, fusing, regulator, cables, electronic timer	—	1360 litres/hour	From $550
Innovations ph:1300 303 303, www.innovations.com.au	CASF cascade fountain kit	Separate panel on 5 metre cable		—	—	—	$249
Solar charge ph:(03) 9596 1974 www.solarcharge.com.au	Fish pond pump kit	Rule bilge pump	20 watt BP Solar	Maximiser included	1.2 metres	600 litres/hour	$395
Solar Trend ph:(03) 9512 0680 www.solartrend.com.au	Toskana mini solar fountain		0.7 watt	3 fountain heads and 5 metre cable	250mm	150 litres/hour	Available through distributors in each state. Contact Solar Trend or check out their website for distributor details.
	Solar pond island	Integral floating pump and panel system	1.13 watt	3 fountain heads	450mm	210 litres/hour	
	Solar illumina	Integral floating pump and panel with battery and LED night lighting	2.3 watt	3 fountain heads	750mm	290 litres/hour	
	Solar splash	Pulsing type fountain	1.7 watt	5 metre cable	Adjustable height and frequency		
	Solar fish fountain	Ceramic fish and bowl fountain with 6 volt, 120mA pump	1.5 watt	5 metre cable	—	290 litres/hour	
	Solar Lugano	12 Volt, 200mA	5 watt	3 fountain heads 5 metre cable	1.2 metres	500 litres/hour	
	Solar birdbath fountain	6 Volt, 120mA	1.1 Watt	Include pedestal birdbath	—	210 litres/hour	
	Solar dove	4.8 Volt, 100mA	0.8 watt	Glazed ceramic bowl and dove water feature	—	210 litres/hour	
	Rustic cascade	6 Volt, 120mA	1.5 watt	Complete 4-tier terracotta water feature	—	290 litres/hour	
	Dual cascade	6 Volt, 120mA	1.5 watt	Complete 4-tier terracotta water feature	—	290 litres/hour	
	Solar Cairo	6 Volt, 120mA	1.5 watt	Complete terracotta water feature	—	290 litres/hour	
	Ocean cascade	6 Volt, 120mA	1.5 watt	Complete terracotta water feature	—	290 litres/hour	
Solaris Technology ph:(08) 8359 1900 www.solaris.com.au sales@solaris.com.au	SFA/SFS	Aquasolar 700	10 watt	Cascade adaptor and sprayhead option (SFS) kit. 9 metre cable	1.2 metres	Up to 240 litres/hour	$476/$502
	SFR	Aquasolar 1500	20 watt	9 metre cable	1.8 metres	Up to 450 litres/hour	$757

The Solar illumina kit has a battery and LED lights for running at night.

A few helpful hints

There are a few things to look out for when setting up a solar fountain. Doing it right the first time will result in a long-lasting water display, but cutting corners will often result in disappointment and added maintenance.

First, you will need your pump. Bilge pumps are very cheap, but don't last long when run continuously. You can generally expect to get only a year or so of running time out of them, although we have heard of cases of them lasting up to five years. Higher quality pumps like the Davies Craig EBP (see www.daviescraig.com.au for more information) or the Oase Aquasolar models are more efficient, will last much

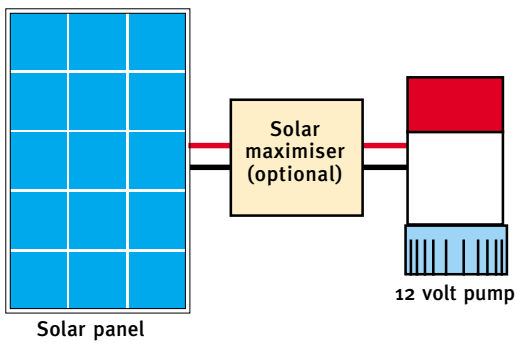


Figure 1. Setting up a solar fountain is pretty simple—a solar panel and pump are the only basic requirements.

longer, and will do a better job with smaller solar panels.

It is possible to make a bilge pump last longer by running it from a 6 volt solar panel, rather than a 12 volt one. This means it runs slower and so has less flow and will pump to a lower height, but it should increase the life of the pump considerably.

Most pumps will deliver a higher total water volume each day when used with a maximiser, as this device allows the pump to make best use of all available power from the solar panel. There are not many maximisers on the market, and most of them are quite expensive.

The Alternative Technology Association has its own version of this kit, which is supplied with a larger, easier to solder circuit board and all parts, except a suitable case.

The solar panel is a very important part of the system, so don't cut corners here. It is best to buy a brand name panel rather than the cheaper Chinese panels, as these have a habit of failing early due to poor weather sealing and faulty inter-cell connections.

It is also important that the solar panel is located in a position where it will be able to receive the maximum amount of sunlight each day. This may be on a garden shed or even the house roof, or on top of a pole elsewhere in the garden. Obviously, it will work best when faced north and is unshaded for most of the day.

Make sure it is well secured, as a panel coming loose in high winds can be dangerous and destructive to the panel itself. There is also the possibility of theft—they are expensive items, and some do get stolen.

The connections between the panel and the pump are also important. Use a good quality wire of adequate size. Extra-low-voltage garden lighting wire is ideal for cable runs up to 10 metres or so, and is readily available. Also, make sure wire joins are watertight, as water can corrode the wires, causing them to eventually fail. One of the best ways to seal them is to solder the join and then coat them in vaseline and wrap in 'self amalgamating' tape. Unlike insulation tape, this tape has no sticky side, but is made from a stretchy rubber that fuses to itself in a day or so, making a completely watertight, solid sheath over the joint. It is available from electronics hobbyist stores. Alternatively, use glue-lined heatshrink tubing, available from Jaycar Electronics and some other suppliers.

Well, that is about all there is to setting up a simple solar fountain. So, why not get to it and make yourself a relaxing cascade of water—a great addition to any garden. ✲

The national picture

ReNew's regular policy columnist Alan Pears looks at the good, the bad and the ugly in energy policy

December last year saw a flurry of activity at the state level on energy issues. New South Wales published an *Energy Directions Green Paper* (www.deus.nsw.gov.au) while the Victorian Government published its *Greenhouse Challenge for Energy Position Paper* (www.greenhouse.vic.gov.au).

The NSW paper dismisses energy efficiency in a couple of paragraphs, stating: '... Even if the full estimates of cost-effective demand-management potential in the immediate future are achieved, its effect will be to defer the need for new supply by a year or two, rather than eliminate it.' It is difficult to understand how an agency whose recently appointed head has an outstanding record in US demand-side management could dismiss demand-side action so bluntly—and incorrectly. Public comment was due late February, making it difficult for many community groups to engage.

The Victorian paper is a fascinating mix of good intentions and disturbing mindsets. While, on one hand, the government's first objective is to 'facilitate Victoria's transition to a carbon-constrained future', another objective is to 'ensure the Latrobe Valley's long-term future'. The second objective appears to mean finding ways to continue to use brown coal to provide energy. The paper goes on to advocate the kind of energy policy objectives that I thought were antiquated in the 1980s: it proposes to 'protect Victoria's economic interests by maintaining a secure, reliable and affordable supply of energy'. As Amory Lovins and others have been pointing out since the 1970s, people (and businesses) don't want energy, they want the services that energy helps to provide. The Victorian Government makes some positive commitments: it wants emissions trading; an expansion of the Mandatory Renewable Energy Target; it supports innovation (although much of it is related to making brown coal viable in a carbon-constrained future); and it is developing renewable energy and energy efficiency strategies. The paper is full of good intentions, but not many serious and tangible sustainable energy commitments.

Both papers reflect the dilemmas governments are facing. Climate change science suggests that Australia needs to cut its greenhouse gas emissions by 60 to 100% by 2050. But governments are desperate to limit increases in electricity prices in the short term. They also believe an increase in energy consumption is unavoidable. More coal-fired plants are the obvious 'short-term' answer, but this would place long-term emission reduction at risk, and investors would risk being left with stranded assets—they are looking for government guarantees to protect their investments.

The reality is that we can actually cut energy (and electricity) consumption. If we can improve energy efficiency, total energy costs will decline, even as prices increase.

Victoria's brown coal future

The inquiry into planning permission for the Hazelwood power station to access more coal has continued. The inquiry reconvened to consider climate change aspects of the project. This process has put climate change issues on the agenda of Australia's electricity industry. I was asked by the Environment Defender's Office to give expert evidence on the potential for energy efficiency to contribute to the Victorian economy. My submission identified the equivalent of at least two and a half Hazelwood power stations in cost-effective energy efficient potential.

Before the inquiry I spent over two hours answering questions from Hazelwood and electricity industry representatives. The usual attempts to dismiss energy efficiency were made: the 'rebound effect' was invoked (that is, people who save energy will use the money saved to buy more energy, reducing net savings). The argument that if energy efficiency existed, more of it would have happened, was also thrown around.

The impact of using alternatives on the wholesale price of electricity was presented as a '30% increase in electricity prices'. In reality the impact would be much smaller, because much of the customer price for electricity is due to transmission, distribution and retailing costs. Few electricity industry representatives seemed keen to acknowledge that if we used less electricity, total electricity costs for customers could decline, even if prices went up a bit.

Building Code progress

An outline of the Australian Building Codes Board's proposed energy requirements for non-residential buildings, as well as a second round of more stringent proposals for residential buildings, are also available for public comment at www.abcb.gov.au. Comments are due in April. The residential requirements are a response to criticisms of the first round of regulations, enacted in early 2003. Many state governments believed the 2003 requirements were too weak, and proceeded to introduce schemes such as the Victorian 5-Star regulations and the NSW BASIX scheme.

The non-residential requirements are fairly modest in terms of their stringency, but they are the first ever regulations in this area, and we can expect them to be tightened over time. The good news is that they cover all types of non-residential buildings, not just office buildings. But we will still need to keep pushing for more effective regulation.

New technology drives energy efficiency

In its energy white paper of June 2004, the Commonwealth Government concluded that Australia was not an innovator in energy efficiency, but was a 'fast follower'. This position provides a convenient justification for not funding much energy efficiency research and development.

But energy efficiency research is going on in Australia, often disguised behind other titles. For example, a recent Commonwealth Government publication describes Australia's research in the trendy field of nanotechnology. Surprise, surprise, we are developing special roof coatings and paints that reflect and re-radiate heat, cutting cooling energy use. New coatings for food containers are extending shelf life (reducing spoilage and its associated energy waste). Nanotechnology underpins development of super capacitors, which will play a key role in hybrid cars, and potentially support renewable energy technology. Nanotechnology is also supporting development of improved filtration systems, stronger materials, micro-electronics, et cetera, all of which will contribute to energy efficiency improvement.

Another Commonwealth Government report, *Innovation Australia: Backing Australia's Ability*, published in 2004, summarises a wide range of innovative research activities. Again, many of these activities will contribute to energy efficiency improvement. Examples include development of high-capacity optical communication fibres, micro filtration systems, e-health systems, distance education systems, fleet and freight management systems, traffic management systems, intelligent vehicle technologies, truck braking energy recovery systems, lightweight plastic fuel tanks and other vehicle components, increased yield of wine from grapes, and so on. Many of our cooperative research centres are contributing to energy efficiency improvement through improved materials, information and communications technology and industrial process efficiency improvement.

We need someone to draw together information on how Australia is already contributing, and could contribute a greater extent, to energy efficiency improvement, both at home and abroad. And governments need to focus more attention on accelerating activity in energy efficiency research, development and demonstration. We could be world leaders in this field, and capture export income instead of—yet again—becoming importers of products and services in an emerging growth area. ✻

Noel's Treasures from Trash

This vintage 'Noel's Treasure' shows you how to make a simple but clever toy

To make your own Cartesian diver you will need:

- a long glass bottle with a wide mouth
- a large balloon to fit over the top of the jar
- a couple of strong rubber bands
- some paper clips
- a small plastic bottle—a film canister is ideal
- some small weights—nuts and washers work well
- a balance or set of scales
- a pair of pliers

This toy is simple to make and enjoy, and you can learn a lot of physics explaining it.

To make the cartesian diver you will need a set of scales. If you don't have these, you can make a simple balance by suspending a wooden ruler by a hole drilled exactly in its centre, then hanging a tin or other suitable container from each end.

The small plastic film canister will become the body of your diver, so you need to know how much water it displaces (in grams). To do this, fill it full to the brim with water and pour this into one side of your scales. Then put the empty canister in the other side and add small weights until the scales balance.

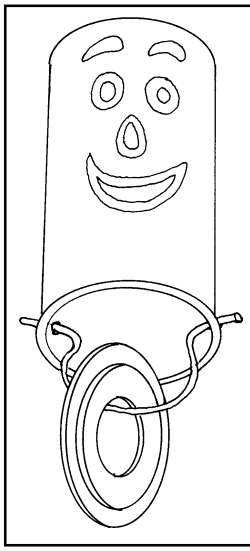


Figure 1. Making your diver is quite simple. Here you can see how the bent paperclip is used to hold the various weights.

What we are aiming for is a diver that just floats. Archimedes, a Greek scientist, showed that the weight of water displaced by an object equals the weight of that floating object.

We also need to allow for the water displaced by the weights (nuts and washers) so add a small amount of extra water to the scales, and another weight or two until it balances.

Making the diver

Now poke a hole through each side of the plastic film canister, very close to the mouth of the canister. Straighten out a paperclip and bend it to shape as in figure 1. Pass one end through one of the holes in the canister from the inside of the canister mouth, place all of your weights from the scale over the paperclip and pass the other end through the other hole in the canister. When you have finished, your weights should be hanging from the paperclip underneath your canister when it is turned upside-down.

Now you have to test your diver. Place it in a container of water so that air is trapped in the upside-down film canister. It should just float on the surface of the water. If it sinks, remove a small weight, but if it floats too high, add some extra weight—a paperclip or two will probably do it.

Fill your large glass jar with water, leaving about 30mm of air at the top. Place your diver into the jar, making sure the air is trapped underneath.

Stretch the balloon across the mouth of the jar, and hold it in place with a strong rubber band or two. You may need an assistant for this.

Your diver should be now ready to go. Just press on the balloon, and the diver should sink. Release the balloon, and it should rise again.

How your diver works

When the diver is floating, its weight is slightly less than the water it is displacing—just like a ship. When you press on the balloon, you increase the air pressure inside the jar, but as water is virtually incompressible, it pushes on the air inside the diver. This causes the air in the diver to compress, so it takes up less space and therefore displaces less water, making the diver too heavy for the water it now displaces. This is why it sinks.

When you release the balloon, the air pressure decreases, causing the air in the diver to expand again. This allows it to displace more water, and so the diver now floats again.

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SolarVenti is ideal for holiday homes, cabins, granny flats, museums, campervans, boats, garages and basements. ***SolarVenti*** can be fitted in a few hours by a handyman, or can be professionally installed.

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The benefits of ***SolarVenti*** include preventing mould on clothing, linen and other fabrics while reducing rust on metal or instruments (pianos, guitars etc). The unit may also be used to reduce problems with rotting stumps and floorboards. And the best part is that there are no ongoing costs accociated with running ***SolarVenti***.

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Testimonial *'After buying a SolarVenti 14 for our 60m² summer cottage, we have got a nice supplement to the heating of the house, especially in spring and autumn. It's also great in winter partly heating the house, while circulating fresh natural air. ...It is an ingenious product which absolutely fulfils what it promises, and we highly recommend it.'*

Best regards, Kurt & Lone Rise

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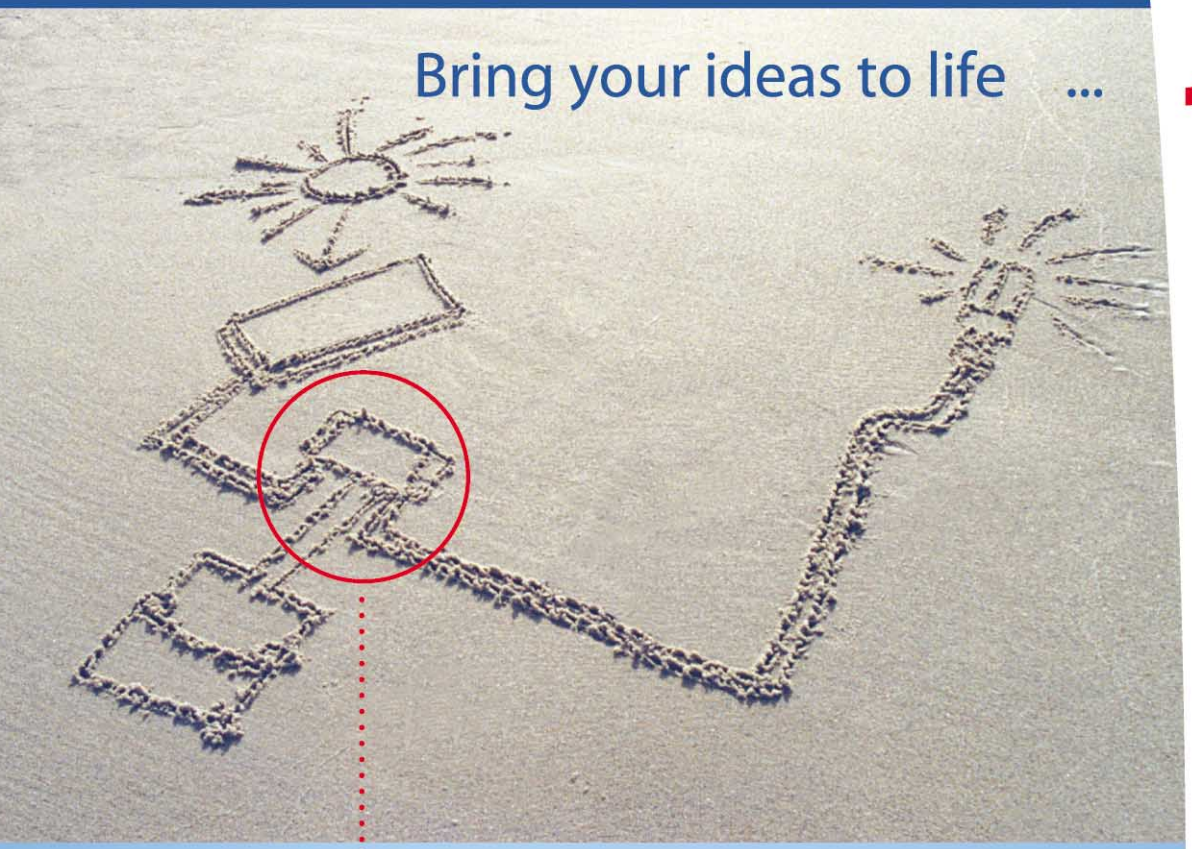

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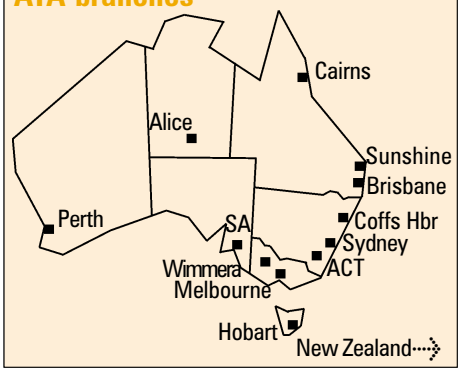

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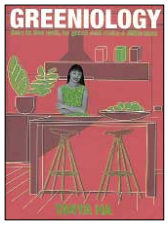
Contains over 60 fact sheets on sustainable solutions for designing and building your home. *Item code: YHTM*



Greeniology

Author: Tanya Ha

Price: $29.95, Paperback

Greeniology shows you practical ways to reduce your impact on the Earth. Covers all aspects of the average home, including kitchen, loungeroom, laundry, bedroom and garage, as well as a green office guide, building and renovating, shopping, personal care and green baby care. *Item code: GREENIOLOGY*

Windpower Workshop

Author: Hugh Piggott

Price $30.80, Paperback, 160pp

The ultimate resource for anyone who has ever wanted to build their own wind turbine. Provides practical advice on how to design and build a machine up to five metres in diameter. *Item code: WPW*

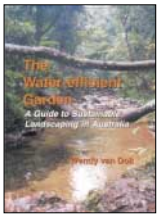
The Water-efficient Garden

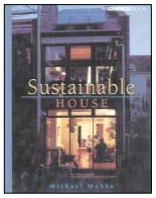
Author: Wendy van Dok

Price: $25, As reviewed in *ReNew* issue 81

Practical and detailed information on planning and design of a water-efficient garden, including use of greywater on the garden.

Item code: WEG





Sustainable House

Author: Michael Mobbs

Price: $38.50, Paperback, 188pp

The sustainable house in Sydney provides all of its own power and waste water recycling on-site. Contains many great ideas on how to make your house less of a burden on the planet.

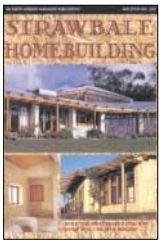
Item code: SHB

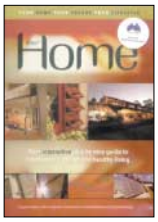
Strawbale Homebuilding

Price: $19.95, Paperback, 156 pp

This book details practical strawbale building practices you can use to build anything from a small cabin in the bush to a mansion in the city. A great book that details many homes that have been built around Australia.

Item Code: SBH



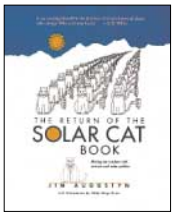


Your Home Technical Manual DVD

Price: $27.50

This DVD allows you to virtually visit some of the most beautiful, innovative and low-maintenance houses in the country. Be inspired as you take a visual tour of some of Australia's most comfortable and stylish homes, created by leading architects and designers.

Item code: YHTMDVD

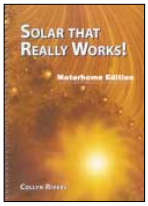


Solar Cat book

Price: $32.95 ($31.95 for ATA members).

Learn about renewable energy in a simple and light-hearted way with the solar cat book.

Item code: SCB



Solar that really works

Price: $35 ($33 for ATA members)

Running caravan or motorhome electrics from solar energy is neither difficult nor complicated. Planning is relatively simple, and anyone comfortable with basic tools can do it. This book is a down-to-earth guide to getting it right first time, and is available in both Caravan and Motorhome editions.

Item code: STRW-CARAVAN and STRW-MH

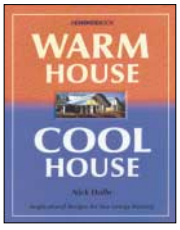
Sustainable Living - a Practical Guide for Australians

Author: Frank Burton B.Sc, Ph.D

Price $25 ($22 for ATA members),

A4 ringbound paperback, 104pp

This book covers the everyday actions that we can all take in the quest for sustainability. Item code: SL



Warm House, Cool House

Author: Nick Hollo

Price: $33.00, Paperback, 172pp

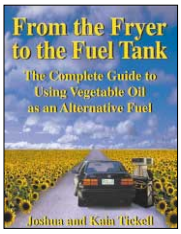
An easy-to-read introduction to the principles of energy-efficient housing design. Covers a broad range of topics and contains an abundance of drawings, plans and photographs. *Item code: WHCH*

From the Fryer to the Fuel Tank

Author: Joshua Tickell

Price: $34.95, Paperback, 160pp

A great book that shows the reader how to make a clean-burning renewable fuel from waste vegetable oil. Includes detailed instructions on making and using the fuel in a standard diesel vehicle. *Item code: FFTFT*

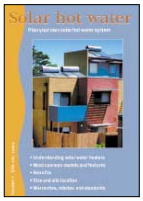


Renewable energy and energy efficiency in detail

Brisbane Institute of TAFE has published a range of renewable technology resource books.

Introduction to Renewable Energy Technologies	$78.95	Item code: IRET
Solar Water Heating Systems Resource Book	$89.95	Item code: SWHSRB
Photovoltaic Power Systems Resource Book	$87.95	Item code: PVPSRB
Energy Efficient Building Design Resource Book	$67.95	Item code: EEBD
Wind Energy Conversion Systems	$93.95	Item code: WECS
Hybrid Energy Systems	$74.95	Item code: HES

Solar hot water



ATA Booklets series: Solar Hot Water

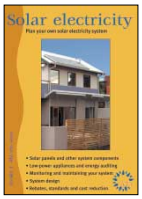
Price $10 each inc postage ($9 for ATA members)

Solar hot water is possibly the best way to get started with renewable energy. This booklet outlines all of the different system types and which one will best suit your needs.

The Lorax book and tape

Price: Book only: $8.95 ($8.00 for ATA members);
Book and tape: $14.95 ($13.95 for ATA members).
This Dr Zeuss classic is a great story teaching kids about the need to care for the environment.
Available as the book only, or both book and cassette tape. The tape is read by Rik Mayall.

Solar electricity



ATA Booklets series: Solar Electricity

Price $10 each inc postage ($9 for ATA members)

Covers all the basics you need to know when designing a solar power system.

ATA Booklets series: Wind Power

Price $10 each inc postage ($9 for ATA members)

This is our new wind power booklet. In it you will find all the information you need to get an understanding of wind power electrical and water pumping systems, how to size and install them correctly, how to look after them, safety requirements and a great deal of other information.

Kits, LEDs and energy efficient lighting

Dynamo torch

Price: $29.95 ($28 for ATA members).

This is a super-bright LED wind-up torch that will provide light anywhere, anytime, without requiring batteries or an external power source.

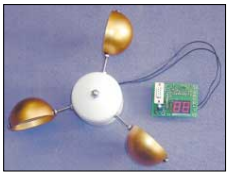
One minute of winding provides light for up to 30 minutes, and you can switch between one or all three LEDs. Ideal for emergency use. *Item code: TORCH_DYNAMO*

Weather monitoring kits

Price: $160 ($150 for ATA members)

The 1-wire weather station connects to a PC to measure wind speed, wind direction and temperature. Use it to monitor the weather, or log a possible site for wind turbine suitability. Price: $200

The anemometer and pre-built datalogger kit from Fascinating Electronics/James Jarvis lets you measure wind speed and log the data without a PC. Download the data only when you need to—the datalogger stores up to 32k samples, and also displays windspeed on an LED display. Anemometer requires assembly but datalogger is pre-assembled and ready to log. Note: does not record wind direction.



Aluminium 4 LED torch

Price: $15 ($12 for ATA members).

This machined black finished aluminium torch uses 3 AA-cell batteries (supplied) to drive four 5mm LEDs. Never be stuck with a blown bulb again! The torch is water resistant and very robust. What's more, a set of alkaline batteries should give at least 24 hours of usable light.

LED halogen replacement globes

Price: $25 ($20.00 for ATA members)

These 5mm LED lamps have 21 narrow angle (25 degree) LEDs and are suitable for highlighting, task lighting and general illumination. They will run from either AC or DC and so can be plugged straight into existing halogen fittings. Note that the rounded shape of the 5mm bulbs might prevent them being used in some fittings. **To prevent damaging these bulbs with excessive voltage, we strongly recommend you replace your halogen lamp transformers with the 1 amp plugpack below.**

12 volt, 1 amp switchmode plugpack

Price: $25 ($23 for ATA members)

This plugpack is ideal for running our LED halogen bulbs or LED halogen replacement kit. Use it to replace the inefficient transformer supplied with most halogen fittings, or wherever you need an efficient 12 volt plugpack.

Item code: SMPLUGPACK

Solar powered flasher

Price: $24.95 ($23 for ATA members).

This multi-purpose solar-powered warning light has six high brightness red LEDs. Ideal for bicycle lights, emergency warning lights or personal emergency lights for walking or hiking. Comes with a magnetic stand, belt clip, elastic strap and clip and a bicycle mounting bracket. *Item code: SOLAR_FLASHER*

Aluminium 9 LED torch

($25 for ATA members).

This is a machined aluminium torch that uses 3 D-cell batteries to drive nine 5mm LEDs. Never be stuck with a blown bulb again! The torch is water resistant and very robust (we have drop tested it onto concrete!). What's more, a set of alkaline batteries should give at least 48 hours of usable light. Price: $30 **Note: Actual stock is silver in colour.**

Nightstar kinetic torch

Price: $70 ($65 for ATA members)

This amazing torch uses no batteries and no incandescent globes, yet will provide light when you want it with total reliability. The Nightstar uses a high power rare-earth magnet passing through a wire coil to provide the electricity to charge a super capacitor that drives the white LED lamp. Around 30 to 60 seconds of gentle shaking gives 5 minutes of full light and a steadily reducing level for another 15 minutes.

More cool products

Greywater Diverter

Price: $33.00 plus $8 postage

Don't send that water down the drain, use it to water your garden! Fits standard 50mm pipes, or other sizes with appropriate adaptors.
Item code: DIVERTER

Hexagonal lens holder assemblies for Luxeon LEDs

Price: $6

These assemblies consist of a 20mm diameter lens in a hexagonal holder which is designed to fit directly over 3 and 5 watt Luxeon star LEDs (we tried them on the 1 watters and they worked just fine!).
We are currently stocking four different lenses—6 degrees, 15 degrees, 25 degrees and the 4 x 25 degree line optic. *Item code: LED_OP6DEG, LED_OP15DEG, LED_OP25DEG, LED_OPLINE.*

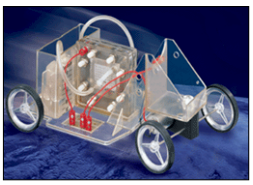
Low-power 12 volt spiral compact fluoro

Price: $14.95

This is a neat little bulb, made by Nelson, which is designed to plug into a standard G4 bi-pin fitting, like those used for halogen desklamps.
It is powered from a nominal 12 volt AC or DC (in the range of 11 to 13 volt AC od DC), making it ideal for small solar power systems, garden lighting and the like. Power consumption of the lamp is 5 watts.
Item code: SPIRALFLUORO

Fuel cell car kit

Price: $290 ($280 for ATA members)



The Fuel Cell Car and Experiment Kit provides an introduction to the technology of fuel cells. With this unique kit, you can build your own experimental reversible fuel cell car to learn more about this energy source. With more than 30 experiments and demonstrations, users will learn how a reversible fuel cell works to perform electrolysis as well as to create energy. The electricity required to activate electrolysis is created by a solar panel included with the kit.
The 96-page, full colour Experiment Manual offers over 30 experiments, including: how to build a solar-powered car, effects of direct and indirect radiation, characteristics of a solar module, electrolysis and its effect on water, oxy-hydrogen test, how to construct and load a reversible fuel cell, decomposition of water in the fuel cell, qualitative and quantitative analysis of gas in a fuel cell, how efficient is electrolysis?, how light influences electrolysis, solar electrolysis, and making a fuel cell-powered car. *Item code: FUELCELLCAR*

Windup radio torch

Price: $33.90 ($32.90 for ATA members)

This is an AM/FM radio which is compact, portable, splash proof and best of all it can operate without batteries! The radio can be powered three ways: built-in lithium battery (wind it up for 90 seconds for 20 minutes of use); two AAA batteries; or an optional DC adaptor
The unit also features an LED torch. The unit's casing is water resistant so it is ideal for use outdoors as well as in.
Item code: DYNAMORADIO

2005 Sustainability Info Diary

Price $13.95 ($12.95 for ATA members)

Get daily hints on how to live sustainably and remember all your important dates with the little things: 2005 sustainability info diary. Printed on 100% recycled paper, hard cover, spiral bound the diary makes a perfect christmas gift. *Item code: TLTD*

Shake-powered calculator

Price: $14.90 ($13.90 for ATA members)

You will no longer have to buy replacement batteries for your calculator or put up with fading calculator screens. The battery free calculator is powered by shaking the calculator side to side.
Electricity is generated by a magnet passing through a coil of wire. If the screen starts to fade, just shake it again for power.
The calculator features an eight-digit screen and a clear plastic body so you can see the workings.
Item code: CALCULATOR

Power House kit

Price: $290 ($280 for ATA members)

Make a renewable energy powered model home!
The kit focuses on the heat and light energy from the sun, the energy from the wind, as well as with electrochemical and plant energy.
With the Power House kit you can build a model house complete with solar panels, windturbine, greenhouse and desalination system. You can build and operate an electric train, windmill, solar cooker, solar hot water tank, hygrometer, electric motor, power hoist, sail car, and more! Plant watercress, prepare sauerkraut, and make chewing gum. Learn how plants convert sunlight into energy for your body and your engines.
Over 20 different building projects in one kit, including Power House, wind-powered generator, solar collector, solar oven, solar power station, greenhouse, current indicator, oil press, sail car, hygrometer, refrigerator, thumbtack scale, electric motor, electric crane, electric train, lemon Battery, oil lamp, light telescope, rice cooker, electric switch experiments.
Includes a 96-page full colour manual. *Item code: POWERHOUSE*

Power Mate power energy meter

Price: 10 amp version is $380 ($360 for ATA members); 15 amp version is $480 ($460 for ATA members)

We have been selling the German-made SparOmeter energy meter for some time, but while it does a good job, we have been looking for a locally produced equivalent or better meter for general household use, and finally we have found it!
The Power Mate has all the functions of the SparOmeter, as well as quite a few extras. The unit consists of a hand-held meter which can be connected to the appliance it is measuring via a simple piggyback plug and socket set. The meter features an LED display for easy reading and high visibility at all times.
The meter can tell you a variety of measurements including: power in watts, voltage and current. The meter can tell you the minimum, maximum as well as instantaneous readings.
The meter can also tell you: cost of running the appliance, how much energy the appliance used in kilowatt-hours and how many kilograms of greenhouse gas emissions it produced. All in hourly, yearly, quarterly and accumulated figures. *Item code: POWERMATE*
We also have a PowerMate for hire for $50 a week!

1 watt and 5 watt Luxeon LEDs

Each 1 watt Luxeon LED is equivalent to a dozen or more high-brightness 5mm LEDs in light output.
With over twice the current draw and twice the voltage of a 1 watt LED, each single 5 watt LED is equivalent to up to 50 or more high-brightness 5mm LEDs in light output. Available in blue, green, cyan and white (**Note: the 5 watt white LED has a rated life of 1000 hours**). For more information, prices and to order, go to the ATA's website at www.ata.org.au or call the ATA on (03)9419 2440.
Now available: 3 watt LEDs and 1 watt warm white LEDs! See our webshop for details.

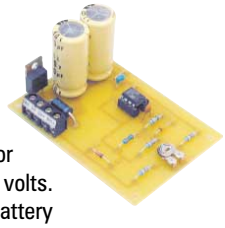
Luxeon optical collimators

Price: $10 each
This 25mm optic with holder solves the problem of how to attach the optics to the LEDs! Available in wide, medium and narrow versions.

Simple 1 amp rectifier kit

This very simple kit allows you to build a rectifier for use with our polarised LED halogen lamps or for polarity protection of electronic equipment. Uses four Schottky diodes to reduce voltage drop and includes a 1 amp fuse. $5.
Item code: RECKIT

Mini-maximiser kit



Our popular mini-maximiser kit will handle pumps up to 6 amps. The kit allows you to build the unit for use on either 12 or 24 volts. Note: not suitable for battery charging use! Price: $40 ($35 for ATA members). *Item code: MINIMAX*

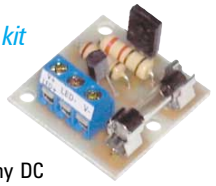
30 amp speed controller kit

Price: $45 ($40 for ATA members)
This controller allows you to vary the speed of 12 or 24 volt DC motors from 0 to 100%. It is also ideal for controlling loads such as incandescent/halogen lamps and heating elements. It is ideal for use on small electric vehicle projects, such as electrically assisted bikes and go-carts.
We have tested it to over 30 amps without problems.
Item code: SPEEDCON

LED halogen conversion kit

Price: $22.00 each without LEDs ($20 for ATA members), or $60 including three white Luxeon Stars ($55 for members)
This kit uses three of the 1 watt Luxeon Star LEDs, and includes a rectifier and constant current circuit to drive the LEDs at the correct current.
Note that the light output won't be equivalent to a 50 watt halogen lamp, but then, the kit only uses 4 watts! Also note that you may need to replace your halogen transformers, as they often need a minimum load of 20 watts.
Item code: LEDHALKIT.
To prevent possibly damaging these bulb kits with excessive voltage, we strongly recommend you replace your halogen lamp transformers with our 1 amp switchmode plugpack.

Constant current circuit kit



Price: $8
This short form kit allows you to build a simple constant current circuit for driving LEDs from almost any DC voltage. It is available in four sizes, 20mA, 50mA (for the Superflux LEDs), 300mA (for the 1 watt Luxeon LEDs) and 650mA (for the 5 watt Luxeon LEDs).
Please specify which current rating you need when ordering.
Item code: CCBOARDxxx where xxx is the current rating in mA (020, 050, 300 or 650).

Superflux LEDs

Price: Red and amber: $2 each, green, blue and cyan: $3 each
The Superflux LEDs are about the best value for money available in LEDs today. Each 8mm square Superflux LED has the equivalent light output of several of the best 5mm LEDs, for the same or less cost as a single 5mm device! Available in red, green, cyan, blue and amber.

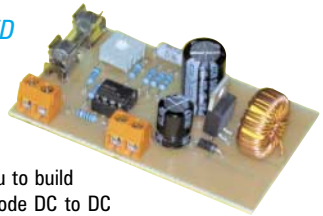
Chinese Superflux LEDs

Price: Red and amber: $0.50 each, white, green, blue and cyan: $1 each
These are a cheaper Asian-sourced Superflux LED which are the same size and shape as the Lumileds Superflux, but not as expensive. Although they probably won't last as long as the Lumileds LEDs, they should be great for most uses.

Maxi-maximiser kit

Price: 12 amp: $70 ($65 for ATA members), 20 amp: $80 ($75 for ATA members)
A larger version of the mini-maximiser which is available in 12 and 20 amp versions. The kit allows you to build the unit for use on either 12 or 24 volts. You must specify current rating when ordering. Note: not suitable for battery charging use!
Item code: MAXIMAX

Switchmode LED driver kit



Price: $30 ($25 for ATA members)
This kit allows you to build a simple switchmode DC to DC converter with either voltage limiting (for powering small DC appliances from up to 30 volts DC) or current limiting (for driving LEDs directly from up to 30 volts DC). The voltage or current is fully adjustable, allowing the one design to be used for a huge number of appliances or LED types, including the 1 watt and 5 watt Luxeon LEDs. Efficiency is typically over 70% on most input voltages.
Kit includes circuit board, all components and instructions. No case is provided.
Item code: SWITCHMODE.

Expand your *ReNew* collection

All available back issues up to issue *ReNew* 76 $7.50 inc. postage within Australia. *ReNew* issue 78 onwards $8.50 inc. postage. For a listing of what is in each issue, see the ATA's web site at www.ata.org.au.

Issues available are: *Soft Technology* issues 46, 47, 48, 49, 50, 51, 52, 53, 54, 55 and 56. *ReNew* issues 57, 58, 61, 62, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89 and 90.

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91/05

Build a simple expanded scale voltmeter

Measuring a solar power system's battery voltage on a normal analogue meter is difficult, as the meter is designed to read from 0 volts while the system varies between two limits near the top end of the scale. Darren Mitchell describes his expanded scale voltmeter that solves this problem

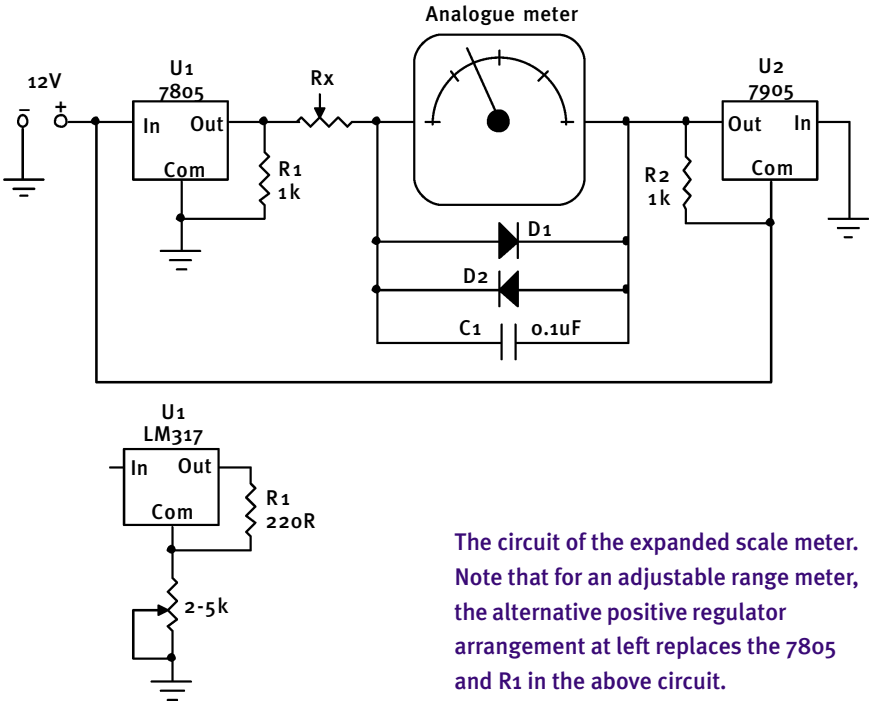
This circuit lets you change an ordinary 0-15 Volt meter into a meter that displays a five Volt range over its entire movement, thus improving accuracy and resolution by a factor of three.

The two regulators cancel their total voltage (10 volts in total for the two fixed-voltage regulators) so that the meter will only display a forward reading above the regulator's voltage, which means the meter will only display a reading when the battery voltage is in the range of 10 to 15 volts.

The positive regulator can be replaced with a variable type, such as the LM317, to set the minimum reading volts of the meter. You adjust the resistor value in series with the meter (Rx) to set the maximum voltage reading.

The meter reads in a linear fashion—just over a smaller range. The one minor drawback with the circuit is that if the battery falls below the minimum Volt setting, the meter will go backwards to the stop (this will not harm the meter). The idle current of the circuit will be about 15mA. To reduce battery drain for small systems, a pushbutton switch in the supply line could be used.

An expanded scale meter solves the problem of low resolution when using analogue meters in solar and other battery power systems.



The circuit of the expanded scale meter. Note that for an adjustable range meter, the alternative positive regulator arrangement at left replaces the 7805 and R1 in the above circuit.

Select resistor Rx to suit the meter type and the range required. Start with a 1k variable resistor and a 220R resistor in series to limit current through meter. If adjustment is too sharp near the low end, try reducing the value of the variable resistor to 500R or even 200R.

There will be a bit of trial and error due to different types of meters and the range required. Also, make sure you fit the diodes D1 and D2—any type of silicon diode will do—across the meter for overload protection.

You may have noticed that the 7905 negative regulator is connected in an unconventional way! It is correct however, and functions normally, but in this circuit it is subtracting the regulation voltage from the positive battery supply. The two 1k resistors, R1 and R2, provide a small load on the regulators for stability.

The Story of Oil: Crude

Sonia Shah
RRP: $24.95
Published by Allen & Unwin
ISBN: 1 74114 597X

The story of oil begins with tiny phytoplankton. After feeding on sun and carbon dioxide, they die and fall to the bottom of the sea, along with other creatures and organic matter. The seabed is lined at a rate of 0.1 millimetres a year with sediment, which slowly becomes pressurised and heated. Millions of years later it bakes into shale and finally liquid oil, capturing the vast majority of the planet's carbon.

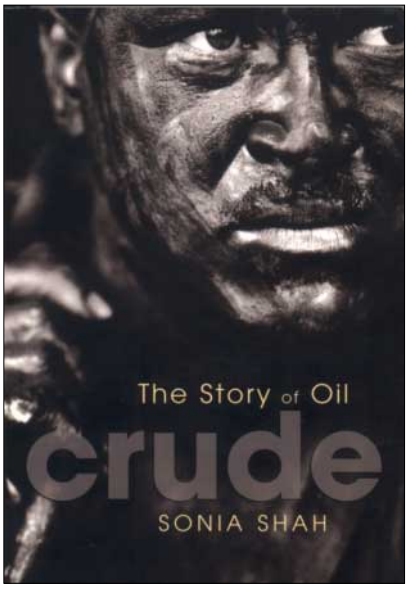
But the problems begin with the discovery of this abundant and accessible resource, and the manufacturing of uses for the hydrocarbon. It's now released back into the atmosphere at staggering rates.

This book explores the role of both governments and financial institutions in opening the way for multinational conglomerates to satisfy the demands of this new gas-guzzling society.

It's an intriguing read, that offers little joy as Shah recounts the stories of environmentalists and human rights activists fighting to protect the developing and natural worlds against the impacts of oil extraction. Ken Saro-Wiwa and the Ogoni people of the Niger Delta's futile attempts to protect their liberty and lands against a Shell-backed Nigerian military is poignantly detailed.

But Shah's wrath for the oil industry doesn't end there. Exon's handling of the Valdez disaster, and the oil industry's lengthy campaigns to discredit human-induced climate change and block efforts such as the United Nations Framework Convention on Climate Change, are also exposed.

This book is far from a rant, with over 30 pages of references to support first-hand accounts and expert opinions. It makes for a timely read as the reality of



Kyoto and a carbon-constrained future threaten oil consumption.

It's hard to know what Shah fears most: the geopolitical crisis as rising appetites for oil result in growing desperation in the name of energy security, or the environmental catastrophe of human-induced global warming if the oil industry continues to win out.

Review by Kane Thornton

Car Wars

Graeme Davison
RRP: $29.95
Published by Allen & Unwin
ISBN: 1 74114 207 5

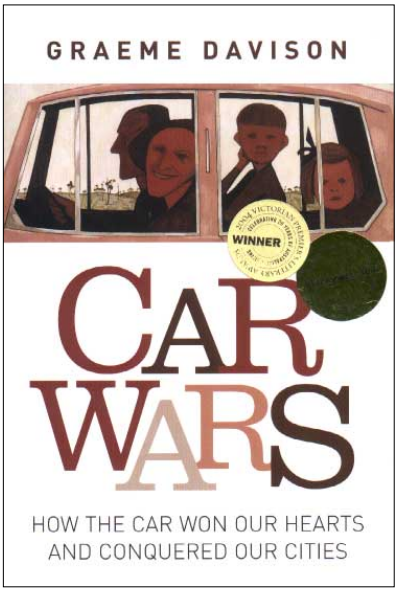
Graeme Davison's *Car Wars* is at once a wonderful short history of Melbourne, and an extraordinary story about the motorcar's rise to power since its arrival in Australia just 60 years ago. Despite its daunting weight, this book's clarity, flow, humour and fascinating content keep you reading.

Davison traces the gradual infiltration of the car into Melbourne society, portraying the car both as liberator—offering commuters 'emancipation from the perspiration of the crowd' and young men new prospects of sexual conquest— and as a destructive force, ending young lives and ruining Victoria's natural environment.

As the story unfolds we meet the diverse people and places that illuminate Melbourne's automobile history: Prime Minister Ben Chifley, motor racing driver Bob Jane, Fitzroy and Collingwood's protesting Mayors, Jeff Kennett's Citilink, Cyril Lewis' Oakleigh Motel, drive-in shopping at Chadstone (the beginning of the end of the shopping strip), and the now-ubiquitous Melbourne cul-de-sac.

The historical recounts in *Car Wars* demonstrate with simple clarity that the same technology that has allowed us to access the beauties of our country is responsible for destroying them. Whether you are pro- or anti-car, this book will force you to concede that the car, and its history, is as marvellous as it is terrifying.

Davison concludes that Melbourne's car wars are far from over. If he is right,



this book is a must read for those opposed to further automobilisation, because 'glancing in the rear-view mirror…. may help us navigate the road ahead'.

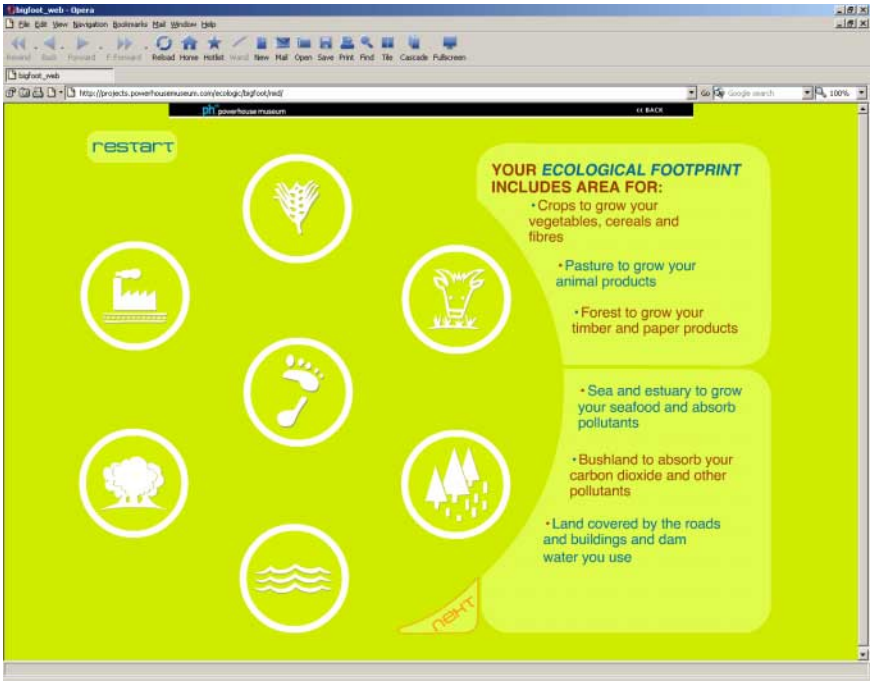
Review by Robin Merrick

projects.powerhousemuseum.com/ecologic/bigfoot/mid/

Find out what impact you are making on the planet by calculating your 'ecological footprint'. This website estimates your individual environmental impact based on the kind of food you eat, the house you live in, how you get around and your use of resources. According to the site, the average Australian has a footprint of 10 hectares—far above the world average of 2.5.

Go through and answer all 14 questions. Once you're done, the site takes a minute to calculate your footprint—it might surprise you how big it is!

Note that in some sections you can select more then one answer, so make sure you select all items that relate to you. Once you have answered each question, move to the next question by clicking the 'lock in' button. The site is quite large in size, so is best viewed with a broadband connection.

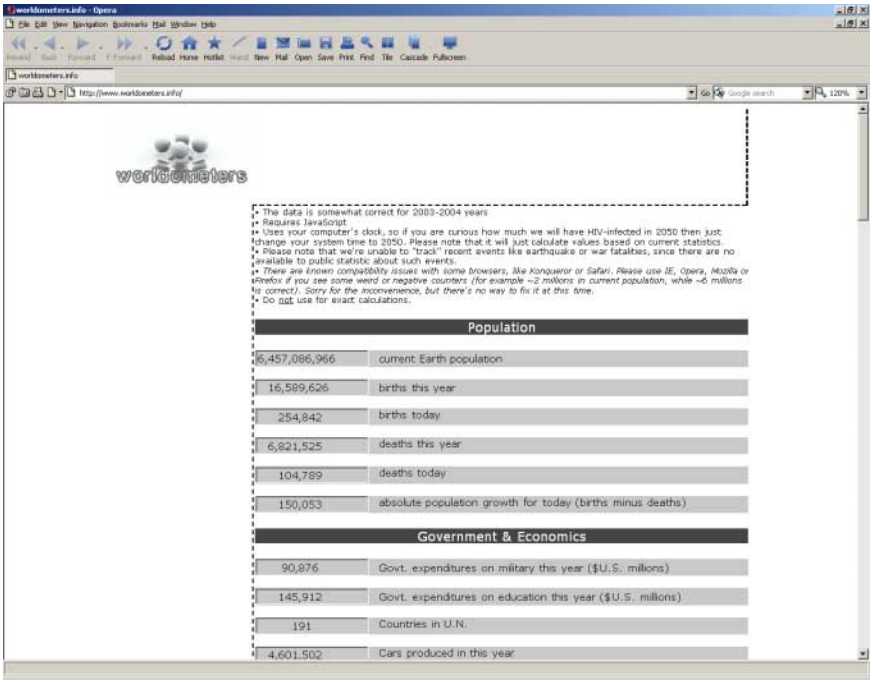


www.worldometers.info

If you visited the ecological footprint site above and thought that was scary, wait until you see the worldometers site!

This site lists a heap of interesting figures pertaining to the planet and the people on it, which update in real time.

Figures include births this year, deaths this year, the current population (watch how fast it increments!), government spending on military versus education, the number of cars, bikes and computers sold. There are also some interesting environmental statistics, such as the area of forests cleared this year, land lost to erosion and topsoil loss, CO_2 emissions, tonnes of food produced and consumed, and the number of underweight and hungry people.



Some of the most interesting figures are those for energy—the amount of solar radiation hitting the earth vastly outweighs all of the other energy figures, such as energy produced and consumed, and oil production and use.

The figures on this site are generated using current statistics and your computer's clock, so if you want to see what the figures will be for next year or any subsequent year, change your computer's clock and the figures will change accordingly.

New LED products from ATA!

We have two new products that we feel are tops in quality compared to many LED products around at the moment.
The first is an aluminium torch that has a 5 watt Luxeon LED as it's light source, and includes a 2000mAh nickel-metal hydride rechargeable battery pack, charger and holster. The torch features three power levels that give run times of 1.5 hours, 3 hours and 6 hours. There is also a flash mode for emergency use. Torch weight is just under 600 gms with batteries, and it measures 227mm long x 37mm diameter.
Price: $159 ($149 for ATA members).

These LED bulbs contain 18 superbright white LEDs in a strong plastic housing, and run directly from 240 volts, so can be used in place of standard bulbs where a bright white colour of light is needed. Total light output is around the same as a 15 watt incandescent, making them suitable for beside lamps, nightlights etc. **Price $20.**

**Available from ATA,
ph:(03) 9419 2440,
email: orders@ata.org.au or
go to www.ata.org.au**

Investing in the sun

Michael Walsh, editor of *Ethical Investor*, looks at the choices when investing in solar energy companies

So you've bought a solar hot water system. Solar electricity panels are also on the cards. It's a growing industry. Governments across Australia are making it easier/compulsory for new properties to use some form of solar energy. Developing countries are more likely to use solar energy in remote areas, rather than incur the cost of extending the (coal or gas fired) electricity grid.

All this sounds like good progress towards renewable energy sources. It also sounds like a good idea to invest in companies whose business will benefit from this shift. But as always, a good investment idea is not always so simple to implement.

The solar sector is a very small component of the energy industry, so any Australian company that is solely dedicated to solar energy is likely to be small. Solar energy development is more likely to occur within large companies that are currently reliant on fossil fuels to generate profits.

From an ethical investing point of view you might prefer to invest in the small company. But this is risky. Many small companies, particularly those developing new technology, are less profitable, their share price is more volatile and face the risk of running out of capital.

On the other hand a large energy company is likely to be more profitable and stable, so it can afford to incubate new energy technologies until they have proven themselves. But of course, the dollar will still rule.

Three examples illustrate this point: Solco is a small Australian Stock Exchange-listed company based in Perth. It develops, manufactures, markets and distributes solar water pumps, solar hot water and power generation systems in Australia, Europe, East Timor, the Maldives and China. Its market capitalisation is about $30 million and recent acquisitions in the solar hot water systems business are now expected to see next year's revenue grow to $16 million.

But to date the company has not been profitable and it has not paid a dividend. Last month ethical fund manager AMP took a 10% stake, a vote of confidence in its ambitious growth plans. But for a 'mum and dad' investor the absence of a track record spells risk. Since the company listed in 2001 (as Solar Energy Systems) its share price has drifted from 25 cents to only 5 cents in early 2003, before its ascent to 39 cents at the time of writing.

Origin Energy is a different story. Its market capitalisation is $4.6 billion and it earned $186 million in profits last year, paying consistent, fully franked dividends. The company maintains a high rating for its environmental management and is investing more in solar energy than Solco—in a way that will not materially detract from its current profitability. For example, it is constructing a $20 million solar photovoltaic (PV) cell manufacturing plant in Adelaide that will produce solar panels to demonstrate Origin's new 'Sliver' solar cell technology, which has been developed with the Australian National University's Centre for Sustainable Energy Systems. Designed initially to produce up to 5MW of PV modules per year, the plant will be readily expandible to 25MW per year if it meets all design objectives and proves Sliver technology can be applied on a mass-produced scale.

Then there is the global energy giant BP. At an Energy Users Association conference in Brisbane late last year, Colin Gomm, Environment Director Asia Pacific for BP, argued the case for investing in fuel companies that are making the transition to sustainable energy, rather than in pure alternative energy companies. Gomm said that fuel-based companies tended to produce higher returns on capital, whereas the profit streams from renewable energy were more akin to that from utilities. He also said a large company like BP had the scale to make patient investment in new energy technologies. Part of BP's 'beyond petroleum' strategy is encompassed in a separate division, BP Solar, which is one of the major solar energy players in Australia. Gomm said that BP Solar only became profitable last year, 20 years on from its inception.

Overall, it's a trade-off between a purely ethical approach to investing and one that is also concerned with risk. Different people will make different choices in line with their values and their concerns for protecting their capital. And that's the way it should be!

***Ethical Investor* is not licensed to give financial advice and recommends that potential investors obtain professional investment advice before making any investment decisions in relation to information provided in this article.**
www.ethicalinvestor.com.au

Make your bike easier to ride

If you ride a long distance each day, or have to deal with hills regularly, having electric assistance on your bike can be helpful.

Brett White, who makes and sells parabolic solar cookers, now also has available low cost hub motor kits that can be fitted to most bikes. The 200 Watt continuous rated (360 Watt peak) brushed hub motors are available to suit 20, 24 and 26 inch wheels, and both front and rear motors are available.

The kit includes the motor and spokes, a two-speed control unit (which uses pulse-width modulation for speed control), and a twist-grip throttle that is simply fitted onto the handle-bars.

RRP: Inside Australia AU$250, outside Australia US$260. Both prices include shipping directly from the factory in Asia.

Available from Brett White, mobile:0413 238 109, solarbbq@hotmail.com, www.users.bigpond.com/solarbbq/

Eight channel datalogger

The dataTaker DT8 is a battery operated datalogger capable of sampling, processing and displaying measurements without connecting to a computer. The DT8 is a compact and stand-alone datalogging system that can be used in a wide variety of applications.

The graphical display and analysis functions allow the user to view data collected from voltage, current, temperature and user defined inputs. On-screen text editing allows users to add additional information to the collected data. Data can be viewed as measured values, graphs, meters or tables.

The logger has eight 16-bit logging channels, can display real-time or logged measurements, can be set up via either the keypad or by connecting it to a PC, can log up to 4000 samples per second, with 512kb of data storage, has a rechargeable battery, and even has built-in help and user notes.

Note that the DT8 is only available to the Australasian region.

RRP: $1,865 inc GST

Available from Datataker Pty Ltd, 7 Seismic Court, Rowville VIC 3178, ph:(03) 9764 8600, fax:(03) 9764 8997, email: sales@datataker.com.au, www.datataker.com/products/dt8.html

Got a big family? Get a big washer!

Many people think that you need to buy a water-hungry top-loading washing machine to do really big loads, but not so! The LG WD-1019BD is a frontloader with a massive 10kg wash load capacity, making it the largest domestic frontloader, and one of the largest domestic machines, available in Australia.

However, while the machine is large, it isn't wasteful, with an AAAA water rating and a 4-star energy rating. It also features a direct drive motor, a porcelain top plate, stainless steel drum, a huge 400mm door that opens 170 degrees, a variable spin speed up to 1000rpm, variable water temperature, including cold water wash, and a digital display.

The unit measures 686mm wide x 1086 high x 750mm deep and weighs 86kg.

RRP: $2,124, although LG products are usually considerably cheaper in the stores.

Manufactured by LG Australia, ph:1800 725 375, www.lge.com.au and available through LG dealers.

[Products]

Organic cotton undies

Cotton production is one of the most chemical intensive farming practices on earth, and many of the chemicals stay trapped in the fibre to some degree, even after processing.

Blessed Earth have a range of organic cotton underwear and other items that contain no chemical residues at all. According to Blessed Earth, all of the cotton they use has been certified to be chemical free, Demeter-certified Egyptian cotton which is pre-shrunk. All dyes are non-toxic and biodegradable.

The range includes womens briefs, camisoles/singlets and bras, mens briefs and singlets, and childrens undies and singlets. Other items include socks, bags, hats and menstrual pads.

RRP: Womens briefs range from $15 to $19, mens from $17 to $24, triple-packs of socks are $29 to $30.

For more information, contact Blessed Earth, PO Box 550, Warburton VIC 3799, ph:(03) 5966 9388, fax:(03) 5966 9388, email: info@blessedearth.com.au, www.blessedearth.com.au

A real Par38 alternative

The common Par38 lamp is really an environmental nightmare. Drawing between 120 and 150 Watts of power continuously, these lamps are one of the most common outdoor lamps in use, and are often left running all night long.

While we have looked at a few compact fluorescent lamps that were an approximate replacement, none have really fitted the bill, until now. Solar Charge have a new range of compact fluoro fittings and bulbs, and one of those is a direct replacement for a Par38 lamp. The fluoro version has a 20 Watt tube and is the same size and shape as a standard Par38 lamp, and is even waterproof, so can be used in all outdoor fittings.

We bought one of these lamps and can say that they are very close to the brightness of a Par38 incandescent lamp, and are able to light large areas well. While the price is relatively high compared to other compact fluoros, these lamps will still pay back their cost in well under a year if used 10 hours per night.

RRP: $45

Available from Solar Charge, 115 Martin Street, Brighton VIC 3186, ph:(03) 9596 1974, fax:(03) 9596 1389, mail@solarcharge.com.au, www.solarcharge.com.au

Strength without weight (or forest timber usage!)

To get rigid doors and building panels, many people still think you must use high density materials like hardwoods or MDF, but Eco-core cross-laminated block boards are a more environmentally sound alternative.

The board is suitable for a range of applications including sliding doors (where high rigidity is often required), benchtops, tables and other applications where strength and stiffness but not weight is desired.

Eco-core is made up of three cross-laminated layers of FSC-certified plantation poplar blocks (grown in Italy and southern France). This structure means that there is much more solid timber than in MDF or particleboard, resulting in less glue use. In addition, a low formaldehyde-emitting glue is used and the products are tested to conform to the EU E1 standard, with emissions of less than 3.5mg of formaldehyde per hour per square metre. Eco-core is available in thicknesses from 15 to 75mm and in panel sizes from 1840 x 2730 to 1840 x 5150mm.

A paint-finish face can be supplied by either a 3mm thick MDF face or a 2.6mm poplar veneer. Only the Poplar is 100% FSC certified as the MDF is a combination of FSC poplar and non-FSC certified Spruce.

Available from Global Ventures Australia, 1431 Old Northern Rd, Glenorie NSW 2157, ph:(02) 9652 0187, fax:(02) 9652 0187, email: enquiries@globalventures.com.au

Evacuated tube collectors

Sunplus CPC Solar's range of solar water heating systems use evacuated tube solar collectors with the common 'twin-glass tube' construction, which is chosen for its reliability, performance and low manufacturing cost.

Each solar tube consists of two glass tubes made from strong borosilicate glass. The outer tube is transparent, allowing light to pass through with minimal reflection. The inner tube is coated with a selective coating, which has a high rate of solar radiation absorption and minimal reflection. The tops of the two tubes are fused together and the air contained in the space between the two layers of glass is pumped out while exposing the tube to high temperatures. This 'evacuation' of the gases forms a vacuum, which is an important factor in the performance of the evacuated tubes. The insulating properties of the resulting vacuum are so good that the inside of the tube may be 150°C while the outer tube is cold to the touch, which means the tubes retain the collected heat even when the outside air temperture is low.

RRP: Depends on system specifications.

Sunplus CPC Solar, Factory 24, 7 Dunstans Crt, Reservoir VIC 3073, ph:(03) 9462 1427 or (03) 9857 0279, email: info@sunpluscpc.com.au, www.sunpluscpc.com.au or call for your local dealer 1300 653 872.

Recycled paper pencils

Most pencils are made from wood from dubious sources, ranging from bordering on sustainable right through to very ecologically damaging. But why do pencils need to be made from virgin timber at all? Ecopaper has a range of environmentally responsible pens and pencils, including a pencil made entirely from recycled office paper! They look and feel like conventional pencils, except that instead of wood, the pencil body is a white compressed paper composite.

The pencils sharpen just like any other pencils, and have erasers attached. Also available are plantation timber pencils, recycled paper pens and pens made from cornstarch plastic.

RRP: 22 cents each plus GST for 100 quantities.

Available from Ecopaper, PO Box 46, Berry NSW 2535, ph:(02) 4234 1212, fax:(02) 4234 1818, email: ecopaper@shoal.net.au

Self-cleaning surfaces

Wouldn't it be great to have surfaces that cleaned themselves when it rained, so that you never had to waste water washing them down? Well, that's possible thanks to Nanotec.

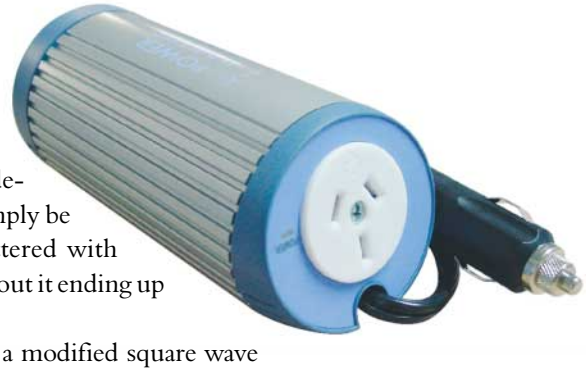
They make a range of treatments that can be sprayed onto surfaces such as glass, concrete, stone, wood, and even fabrics. The treatments contain nanoparticles that bind with the surface they are applied to, modifying it so that neither dirt or water will stick. So, when it rains, any dirt accumulation is washed away.

The coatings are transparent, so you can't tell the surface has been treated. According to Nanotec, the treated surface is guarded against new contamination from dirt, dust and atmospheric pollution. Dirt cannot penetrate into the structure of the surface, moss and algae cannot develop and red wine and urine can't penetrate and leave stains. The treatment is resistant to friction, is UV and temperature stable. It can't be removed by water, normal cleaning agents or with high pressure cleaning equipment (maximum pressure of 60 bar).

All in all, these coatings have the potential to save a hell of a lot of water! Note how the water in the photo beads—and this is on the normally very porous lightweight concrete.

Manufactured by Nanotec, ph:(02) 9905 8111, email: nanotec@nanotec.com.au, www.nanotec.com.au

Can-sized inverter



Using an inverter in the car can be a pain as there is usually nowhere safe and convenient you can place it while on the move, but Waeco have a possible solution in their new MOBITRONIC CanSize inverter. It is designed to have the exact same outer dimensions as a drink can, so it can simply be placed in one of the many drink holders that new cars seem to be littered with nowadays. This means you can have your inverter on board all the time without it ending up on the floor or other places it shouldn't.

The inverter has a rated input voltage of 12 volts (10 to 15 volt range), a modified square wave output of 240 volt AC, a no-load current input of 0.25 amps, and a continuous power rating of 100 watts with a 200 watt surge rating. It is also designed to run in ambient temperatures up to 50°C, so you shouldn't have to let it cool off before use after it has been sitting in a hot car. The inverter weighs 450 grams and measures 66 x 173mm. Safety features include thermal overload protection, electronic short circuit protection, acoustic alarm signal if the battery voltage drops below 10.7 Volts, and has automatic low battery voltage shutdown.

RRP:$59.95

WAECO Pacific Pty Ltd, ph:(07) 5507 6000, www.waeco.com.au

Solar powered ventilation

If you have a need for a flow of warm, dry air through your home or other buildings, then the SolarVenti system may be the ideal solution.

One or more solar collector panels warm and filter the air, which is then ducted into the home by solar-powered fans. This reduces moisture and condensation buildup, reducing mildew damage, and can improve the quality of air in your home.

The standard collector panel is called the SV30, and is a 3m^2 panel that can produce up to 2kW of heat energy. The warm air is ducted into the home by a 7 watt, 125mm fan powered by a 12 volt, 12 watt solar panel. A cooling kit is also available.

The collector is made from aluminium with a polycarbonate clear panel, making it pretty much smashproof. The system can be scaled to suit almost any building.

RRP: Depends on application.

Available from Global Export Solutions Pty Ltd, ph:(03) 9830 2161, fax:(03) 9830 3164, email: arne.hachmann@ges.com.au, www.solarventi.com

Flat as a pancake (well, almost)

Need an energy efficient light in an alcove or over a benchtop? It isn't always easy to fit lights in these places, as many light fittings need to be recessed into surfaces. Neco now has a complete 'GX53' light fitting and globe combination that can solve many of these problems.

These 9 Watt units have a 108 degree beam angle, so give a much wider spread of light than a halogen downlight, with a 280 lumen output from the flat compact fluorescent tube. The units are not recessed and come with fixing screws to screw the unit directly onto shelving or ceiling. The fittings are available in white, chrome or silver, and the 15,000 hour rated fluorescent tube is available in either warm white (2700K) or cool white (4000K).

RRP: $49.90

Available from NECO, PO Box 3413, Sydney NSW 2001, ph:1300 882 640, email: mail@neco.com.au, www.neco.com.au

Low-fume finishes

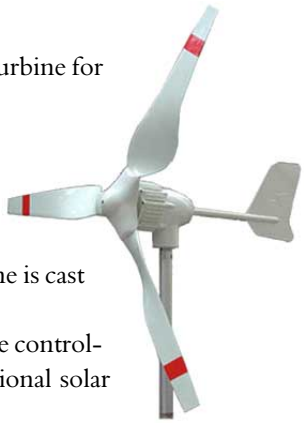
The smell of house paint is often enough to keep you out of the house, or at least some rooms, for days after painting. Some people react badly to the formaldehyde and other toxic chemicals that paint off-gases even after it is dry.

Wattyl has released a new range of low VOC (volatile organic chemical) paints and varnishes for use all over the house. The paints are said to have virtually no smell, are 99.7% free of VOCs, have reduced toxic emissions and so give improved indoor air quality compared to traditional paints, have minimum impact on the environment due to the use of low-toxicity materials, and have excellent stain resistance and washability.

The range includes: 100% acrylic matt, low sheen, satin and gloss finishes for interior walls; enamels in satin or gloss finishes for use on trims, doors and furniture; ceiling white, primer and primer sealer; and specialty finishes, such as pearl finish, copper pearl, stone effect, colour wash and decorative effects.

Available from all Wattyl paint suppliers. For more information, ph:132 101 (local call cost) or go to www.wattyl.com.au

400 watt wind turbine



Oatley Electronics have added to their wind turbine range (doubled it in fact!) with a new 400 watt turbine for small to medium independent power supply systems.

The turbine features injection moulded blades designed to have a consistent aerodynamic outline and mass distribution to reduce noise and vibration. It has a start-up speed of 2.4m/s, a cut-in speed of 3m/s, will produce its rated 400 watts at 12.5m/s and has a wind speed survival rating of 60m/s.

The turbine uses a permanent magnet alternator, and the windings and shaft are designed to reduce start-up torque, allowing the unit to generate at very low wind speeds. The body of the turbine is cast aluminium. Rotor diameter is 1.4 metres and the alternator output is a nominal 12 volt AC.

The generator is supplied with a controller unit which regulates the output to the battery bank. The controller can also have up to 300 watt of solar panels connected, thus eliminating the need for an additional solar regulator in smaller systems.

RRP: $1050

Available from Oatley Electronics, PO Box 89, Oatley NSW 2223, ph:(02) 9584 3563, fax:(02) 9584 3561, email: sales@oatleyelectronics.com, www.oatleyelectronics.com

Itty bitty compact fluoro

Just when we thought we had seen everything in compact fluoros, along came this little bulb from Nelson Lighting. Designed to be used in light fittings that use G4 bi-pin fittings, like those used for halogen desklamps, the lamp uses a tiny spiral cold cathode fluoro tube.

It is powered from a nominal 12 volt AC or DC (in the range of 11 to 13 volt AC od DC), making it ideal for small solar power systems, garden lighting and the like. Power consumption of the lamp is 5 watts.

RRP: $14.95

Available from ATA, PO Box 2919, Fitzroy VIC 3065, ph:(03) 9419 2440, fax:(03) 9419 2441, email: orders@ata.org.au, www.ata.org.au

Solar electric fence

I have an electric fence unit that is powered by electricity from the power point in my house. I am interested in using solar as the power source. Can you please advise me what I need to purchase to do this?

Rachel Preddey,
rachel@ectarc.com.au

Running an electric fence unit from solar should not be too hard. Off-the-shelf solar electric fence energisers have been around for many years. This website will show you one range: www.pakton.com.au/PTESB2.html

The first thing you need to know about your existing system is how much energy it uses (look at the compliance label and find out the wattage). If the wattage is not shown but the current and voltage are, then just multiply the two together to get the wattage. Multiply the wattage by the number of hours you run the unit for each day, and that will give you the daily watt-hours. For example if your unit uses 2 Watts and runs for 24 hours a day then you would need 48 watt-hours of energy to run it.

To run your existing unit on solar you have two options. One is to run it from 240 Volts by using an inverter, battery and solar panel. If the energy consumption that you have worked out (as above) is very low (similar to the above), then while this would work it would be very inefficient due to the likely inverter losses. It would also be relatively expensive. It would probably be cheaper just to buy a new solar electric fence energiser.

The other option is to check the voltage your unit actually runs off. The chances are you have an extra-low voltage unit with a transformer and rectifier added. If that is the case you may be able to simply disconnect the transformer and run it directly from a battery which in turn is charged by a solar panel with a small regulator. To check the voltage your unit is running from you need to use a multimeter.

If you don't have one or don't feel confident probing around near 240 Volt wiring, get a suitably qualified person to check for you. If the energy consumption is similar to the example above, a panel with an output around 25 Watts would be adequate in conjunction with a deep cycle battery with a capacity of around 40 amp-hours.

But once again, check the price of a new solar unit. It may end up easier and cheaper.

Michael Harris

Savonius rotor monitoring

Do you know of anyone who has a Savonius rotor setup that is in use, and has proven satisfactory over, say, five years? The concept has been written up several times, and I know that the test rig at CERES has not performed as well as had been hoped for.

I believe the main drawback is its high torque and the cost of a substantial gantry to mount it on.

I'm wondering if making the rotor bigger in circumference, but with smaller 'paddles' would be more efficient? The longer radius would theoretically improve the start-up in light winds, and the smaller paddle would reduce 'push-over' wind resistance. Is my reasoning sound? Or am I 'up-the-creek?'

My site is on top of a hill, 450 metres elevation, with tall trees around. I am hoping the Savonius will be more appropriate than the horizontal axis machines.

I would be glad to hear your opinions on this.

Alan Marshall,
anakial@hotmail.com

I don't know of anyone who has monitored a Savonius for that period of time, though I know we have written about people's turbines that have been around for that long. The thing with a Savonius, as with other wind turbines, is that as the diameter increases, so does torque, but rotational speed decreases, so for electricity generation you don't want to make them too large. The ones I have built have always started in very low winds, but as there is little energy in wind below three metres per second, then start-up speeds below that usually aren't an issue anyway.

The unit at CERES was not that well designed, it was built by volunteers with no wind turbine experience, so as you would expect, it had problems... It is also surrounded by trees and doesn't get much wind.

If your turbine location is surrounded by trees and you can't locate the turbine at least twice the height of the trees, then you would be better off with a vertical axis machine like the Savonius, as a horizontal axis machine will get too much turbulence. It would certainly be worthwhile doing a Savonius as they are cheap to make and robust if you design them correctly, and can have multiple uses.

Lance Turner

Practical solar vehicles

Do you guys know offhand if anyone is working on a solar vehicle for day-to-day use? I have searched the net but all you find is a lot of universities working on low-slung single-seat racing cars, which are nice but not much use in the suburbs.

I'm aware that the race across Australia has a class for such vehicles, but couldn't find details of anyone entering that class.

Michael Karas,
mkaras@idx.com.au

The problem is that conventional cars are too heavy and bulky to power from solar panels. When you do the maths on mass, carrying capacity and performance, you find that cannot get enough power from the available surface area of the average car. You can use solar panels to slightly extend the range of a conventional electric vehicle. For an example of this, see the article on an electric ute elsewhere in this issue.

As a result the more innovative vehicles out there tend to be hybrids such as the Toyota Prius. You can find out more on these vehicles from this

website http://zebu.uoregon.edu/2001/ph162/toy.html

Solar panels may be supplied as an option to trickle charge electric hybrids in the future, but not as the main power source.

Michael Harris

Landfill gas

Last week I was up at Taree on the NSW Mid North Coast visiting NSW Agriculture's office there. I was talking to one of the technical guys and he was telling me that he is on the local volunteer bush fire brigade and they are always being called to put out fires at the old Taree tip. These fires apparently spontaneously ignite, and I immediately thought that methane gas is being generated by the breakdown of the waste and this is what is starting the fires.

I remembered that there is an organisation in Victoria that is running a very successful business tapping into the gas from urban landfills and using it for cogeneration, but couldn't remember which organisation it was.

Could you please tell me if you know who they are? If the local council can contact this 'gas to energy' crowd, there may be a great opportunity to generate power from this tip. Taree has been there for about 170 years and is a pretty substantial city, so I imagine that there is a lot of garbage in the landfill there.

Chris Taylor,
chrisatrolyatservices@bigpond.com.au

The breakdown of organic matter of the right composition can cause the generation of heat resulting in tip fires. However, this a different process to the one that causes the production of methane gas. For combustion to take place air must be present. This means the breakdown process is aerobic, (takes place in the presence of oxygen). Methane production takes place in an anaerobic environment (in the absence of oxygen). So although fires are taking place in the Taree tip, there may well be no methane present.

This does not necessarily mean there is no potential for future methane production. Much of the power from landfill gas that I am aware of is bought by AGL. One of the major companies involved in developing these projects is Energy Developments P/L. They currently have 19 projects operating, generating 79MW of power. Their website is www.edl.com.au/mainpage.asp

A government report on landfill gas is available at www.greenhouse.gov.au/markets/mret/pubs/9_munic.pdf

Michael Harris

Ride-on mower conversion

My problem (opportunity?) is that hydrostatic transaxles on my ride-on mowers ($5000 to $6000 range) are failing, and reconditioning is not lasting. I have a Toro 17/44HXL which I may have to retire after 300 hours. The hydrostatic pump and motor in the transaxle was reconditioned at 200 hours for $700 and has just about had it at 300 hours. The estimated replacement cost is $1500 (which I don't readily have and am reluctant to spend this way if I did). I gather that quite a few machines must be having this problem.

I don't like the petrol motor pollution, let alone the noise, and I have read about 25-year-old GE Electrak mowers about this size still in service in the US (for those interested, do a Google search for 'electric tractor').

I'm sure Lance Turner's electric go-cart technology (as outlined in issue 66 of *ReNew*) could be redesigned to drive these machines, but although I could probably assemble it, I don't know how to design or where to get parts (particularly the motors).

Of course, the application has some significant differences: the mower deck needs to be driven too and the machine travels much slower than a go-cart but needs pulling power. Maybe the petrol engine could drive a generator?

I don't expect you to do anything for me so much as I wonder if this situation presents an opportunity—ie a much more cost effective solution to failed hydrostatic replacement. Or, you might just suggest folks replace the turf with something that doesn't need mowing!

John Abel,
john_abel@bigpond.com

I have always wondered why no-one makes an electric version of these things, after all, electric mowers, the few that exist, work well. I owned a Stealth rechargeable mower for a while and it was the quietest, cleanest and best performing mower I had used. I have seen the Electrak mowers, it seems there is a bit of a cult following around them, and from what I have seen they are a pretty well-built machine.

There is no reason why you couldn't just replace the petrol drive system with a battery bank and suitable electric motors where they are needed.

Unfortunately though, the motors won't be cheap, as you need to use good quality permanent-magnet or series-wound motors, like the Advanced DC units which are made for us in electric cars et cetera. They come in several sizes, from quite small through to the '9 inch' motor which has a great deal of push.

For the main mower drive motor, a shunt wound motor might be the go. They have the properties of producing very high torque and run at a low, fairly constant speed—just right for a mower. It isn't so easy to vary their speed though, so maybe stick with the other types, as they respond well to pulse-width-modulation speed control. And after all, the mower must already have a gearbox to couple the output of the petrol motor to the wheels, or are they hydraulic motors too?

Anyway, you could contact the Australian Electric Vehicle Association to see if they have any members in your area who might be interested in the project. Go to www.aeva.asn.au

Lance Turner

Classifieds/ Suppliers Directory

When selecting an installer get 2 or 3 quotes and check accreditation/references. § = ATA Member discounter.

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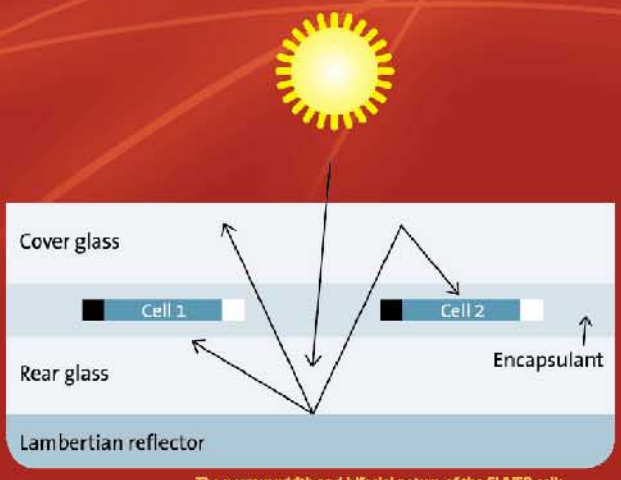

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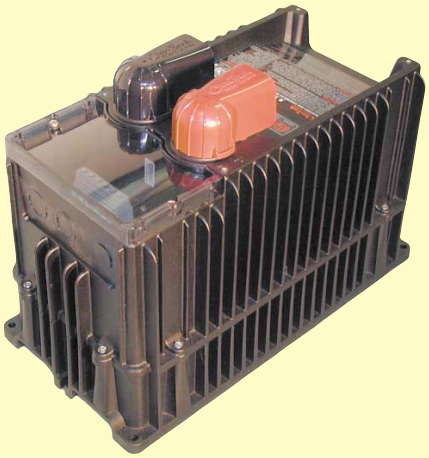

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