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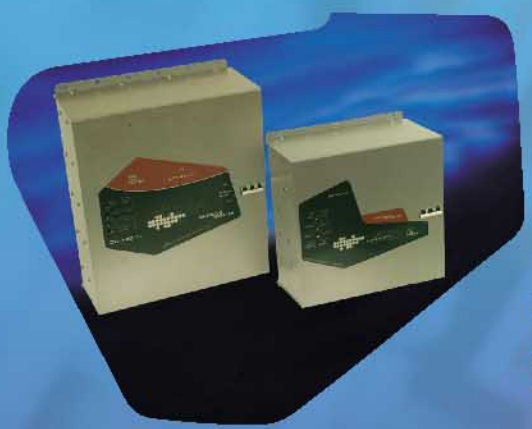

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Learn how the McQuire's home makes massive water savings. Page 25.

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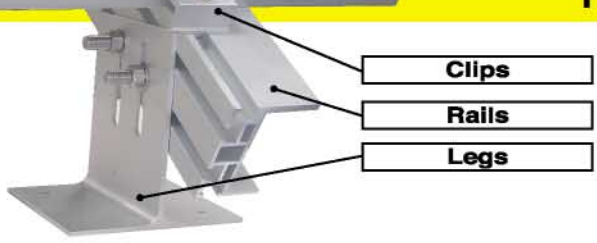

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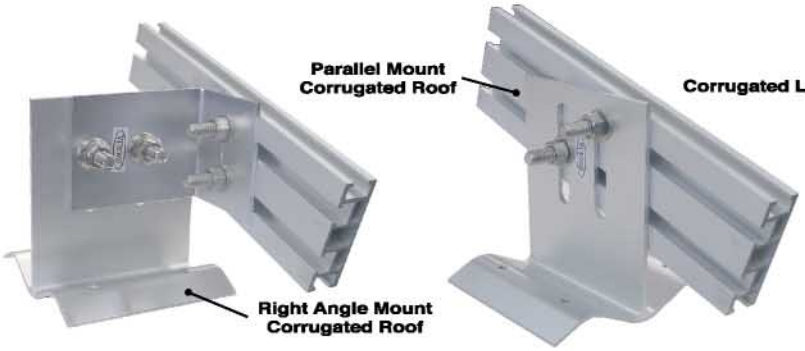

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Top 10 ways to save water around the home. Page 88.

Former *ReNew* editor, Michael Linke (right), tells us what he has been up to in Namibia. Page 53.

regulars

You don't need electricity to run these two great kitchen appliances. See Products, page 90.

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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Contacts and contributions

Send letters and contributions to:

ReNew
PO Box 2919, Fitzroy VIC 3065 AUSTRALIA
ph:(03) 9419 2440, fax:(03) 9419 2441
Email: renew@ata.org.au
Web site: www.ata.org.au
Street: Building Display Centre
Level 2, 332 Albert Street
East Melbourne VIC 3002

Contributions are welcome, guidelines available on the web: www.ata.org.au or on request.

Advertising in ReNew

Advertising is available for products and services relevant to our audience. We reserve the right to refuse, cancel and withdraw advertising at our discretion. Advertising enquiries: olivia@ata.org.au ph:(03) 9415 2106 fax:(03) 9419 2441

Next advertising booking deadlines: Booking 12 December 2005, copy due 27 January 2006. Next editorial copy deadline: 21 January 2006.

ReNew's new baby sister

Welcome to the full colour bumper summer issue of *ReNew*. We had such great articles this issue that rather than hold them back, we have extended this issue to a huge 104 pages. So we hope you enjoy some great summer reading and project ideas to fill your holidays.

We have been keeping ourselves busy at the ATA with the launch of ReNew's sister magazine *Sanctuary: sustainable living with style.* Over the past few years we have witnessed a growing interest in how we can lessen our impact on the earth. More people want to live in homes that not only provide them with comfort but are healthy, easy and cheap to run and also keep their ecological footprints small. Many more architects and building designers are now creating beautiful and functional homes based on passive solar design and other innovative sustainable principles. *Sanctuary* is an opportunity to showcase these wonderful homes as well as provide advice to inspire more people to live sustainably.

ReNew will continue to be the leading-edge magazine for practical information, debate on sustainable living best practice, and technological innovations. By encouraging the improvement of these technologies and practices, questioning what is possible and what is the most environmentally-friendly way to do it, we can then take this knowledge to a wider audience.

The ATA Greywater Trial is a great example of the information sharing role of the ATA. In the past few years, interest in greywater has grown dramatically, with a number of new products coming onto the market. While we all want to do the right thing and help conserve water, we also needed to test the technologies to see how they perform in peoples' households, and if they have any negative environmental side-effects. In this issue we provide you with the results and a ready reckoner to help you choose the best system for your needs.

An even better reason to subscribe

Unfortunately we have had to increase *ReNew's* cover price by 35 cents. We have not increased the cover price for four years even though production expenses have grown. But if you are a *ReNew* subcriber or ATA member there is no difference to your fees.

Donna Luckman

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Conditions and how to enter

(1) The competition is open to anyone in Australia 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. Price includes GST.

(3) Working Water (Y.B.S. P/L) reserve the right to change specifications without notice.

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

(5) The competition runs from 19 November 2005 to 19 May 2006. Subscriptions/memberships must be paid by 5pm on Friday 19 May 2006 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 entries and includes delivery and installation. This competition is not open to New Zealand or other overseas residents.

The *ReNew*/Working Water subscriber competition is proudly sponsored by YBS P/L, 398 Springfield Road, Mitcham VIC 3132, ph: 1300 366 864.

[Letters]

Alternators vs generators

Adding to the answer given in *ReNew 93* to Barry Manor's question on gensets, automotive alternators are only designed to maintain a battery, they aren't designed to recharge flat batteries. This is why a fully flat car battery should be recharged on a battery charger. It takes the car alternator days to get the battery fully charged. Four wheel drive stores carry modified alternators that have the voltage regulators set to a higher voltage so that they can be used with auxiliary batteries (which are often significantly discharged).

Alternators perform better at lower speeds, so depending what you are driving it with, an alternator is generally better than a generator.

Stephen Noolan,
steve@noolan.net

Sam Car

ReNew 84 featured the Sam electric micro car and mentioned Aussie production by the end of 2003. I have scanned each issue since but found nothing more.

With petrol prices skyrocketing and my solar array charge controller switching to float by noon—and it's only early Spring—I'm wasting heaps of power that could be charging a Sam or similar car. What's happening, please, the planet needs them! The website two years ago had a video demo and lots of information but now just has morphing shots of the car's exterior.

Brian McKenzie,
brianissolarboy@hotmail.com

According to the company developing the Sam for Australia, the car is undergoing testing and should be available some time next year.

Lance Turner

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

Electricity billing madness

I couldn't agree more with Alan Baird's comments in *ReNew 93*: a billing system based around charging for connection gives absolutely no incentive for people to reduce their electricity consumption. However I believe his assertion that 'it's been devised by people who don't have a handle on economics' is far from correct.

Unfortunately, it appears that the people making these decisions have an excellent handle on economics. It is clear that some consumers and businesses are going to start reducing consumption on environmental grounds alone (justification on the basis of cost is often difficult), therefore the electricity retailers need to ensure that they don't lose revenue, hence the 'billing madness'.

It's hard not to view this type of billing system with anything but cynicism—large companies are expected to maintain certain profit levels and reductions in consumption need to be countered with another 'income stream'. Not only that, the pay-for-connection system provides a more consistent income stream.

Peak summer load issues can, in part, also be traced back to ridiculous billing practices, however, this relates more to industrial users. About eight years ago there were significant charges based around end users' power factor—approximately $6.50/kVA. For a large site this was a considerable cost and quickly justified the expense of installing power factor correction equipment. While this doesn't reduce the actual energy consumption it does reduce the load on the network, effectively allowing the network to operate more efficiently.

Recently the power factor charges have dropped to around $2/kVA. It is now difficult to justify power factor correction equipment, but low power factor loads increase the strain on the network and we end up with capacity shortages in summer.

The consumption billing situation for large electricity consumers is equally ridiculous. Until recently I was the energy manager for a large manufacturing facility in Sydney. The cost of electricity, gas and water was so low that it was virtually impossible to get the company to approve projects to reduce energy consumption. The company had an environment policy that stated that it would, where practical, act in a way to reduce its environmental impact. However, at the end of the day the decision making process was driven by cold hard economics and energy reduction projects were required to have the same return on investment as a process improvement project. This is very difficult to achieve when energy is so cheap. Interestingly, the single biggest area of potential savings was in the air-conditioning systems!

I find it hard to place any credibility in a company's environmental credentials when the criteria for environmental projects is the same as for process improvements.

To put the environmental side of this company into perspective, the annual electricity consumption was approximately 30GWh, which is equivalent to approximately 3500 homes. A 20% reduction was not out of the question with a little effort and some expenditure. Unfortunately, I'm sure there are many more companies like this.

C Grout,
Canterbury UK

Service charges

I have to agree strongly and loudly with Alan Baird's letter in *ReNew 93*. If service stations charged $25 service charge plus $1 a litre the community would be outraged. They'd say it was favouring 4WDs and gas-guzzlers at the expense of people who did the right thing and drove economical vehicles. Ditto if supermarkets charged $20 to go through the checkout. Even if they cut the cost of the products on their shelves it'd be seen as what it would be, unfair to small customers.

But utility companies, private and public, can charge that way. Here in South Australia power is expensive and the average household uses $920 worth of power a year, then has $140, an additional 15%, added to that for the service charge. I do the right thing and only use about 1/5th the power of the average household, so that $140 service charge adds 70% to my bill. It should be that 15% is added to everyone's bill to pay the electricity company for providing the service. That would reward people who use less electricity. The government should assist those who need assistance—the poor and pensioners—rather than rewarding and benefiting the well off and the wasters with lower effective per unit costs.

To add injury to insult, because I do the right thing and have the greenest form of water heating (gas), I have to pay another $140 per year service charge and it triples my gas bill.

Gordon Drennan,
gordond@iinet.net.au

PV payback feedback

Michael Harris's article on energy payback of PVs in *ReNew 93* was very helpful in clarifying the value of grid-connected PV power installations. The energy payback analysis used is a good basis for considering a suburban, rooftop-mounted, grid-connected system. It seems the first 3.2 years of output will replace the energy consumed in manufacturing and connecting the panels, after which we are making an energy profit. However, it doesn't give the whole picture for a remote area power supply (RAPS) using PV panels and battery storage.

Two factors make the stand-alone RAPS system different when comparing solar and grid options.

Firstly the embodied energy in the installations. While there is considerable embodied energy in the PV/battery option, this needs to be compared with the embodied energy in building a grid connection to the same site: wires, poles, transformers, transport et cetera. Given the long distances and high money cost of many remote grid connections, I suspect that the energy investment in transmission infrastructure would often be very high.

Secondly, the RAPS exists to provide services to a home/business, rather than raw kilowatt-hours. Given the greatly increased cost per unit of electricity provided by a PV RAPS system—around ten times the cost of grid power—people tend to use it much more efficiently. On the other hand, remote grid connections often involve pricing arrangements to encourage high consumption (such as minimum bills for the first 10 years). Consequently a remote grid connected house is likely to use several times more energy per day than a home with a PV RAPS system on the same site.

If these factors are taken into account, I suspect the PV RAPS system would compare much more favourably with grid connection than the 'eight to 11 years' energy payback figure the article suggests. By comparing the embodied energy in the respective installations and taking into account the increased efficiency which higher cost energy promotes, a more realistic and favourable comparison could be made.

Bruce Teakle,
Mount Glorious QLD

A good response

Thank you for the feature representation of my letter on pre-fabricated concrete housing in *ReNew 93*. Your magazine challenges all of us to think outside the square. I believe that it is imperative that we create and foster imagination/creativity and innovation—we cannot accept that the world is 'as good as it gets' or that we have reached the pinnacle of 'man's' existence.

I have had a good response to the letter thus far, with quite a few people wanting 'affordable' homes and some good queries about the concept and its adaptability for different circumstances.

We are now in the process of forming a company and fabricating the modular concrete wall moulds. We hope to have them finished by Christmas and do a concrete pour in January 2006 .

I will keep you informed and when we have enough modular walls and roofs to assemble a prototype home I will send you photos as well as an outline of the company and its philosophy.

Geoff Clarke,
clarkegj@ozemail.com.au

Electricity misuses

I eagerly await each edition of *ReNew* magazine and read it from cover to cover. It has had a strong influence on my attitudes towards energy usage awareness. So, first up, I'd like to thank everyone at *ReNew* for their excellent publication.

One of the strongest messages I've taken from my reading is what I call 'The Three Great Misuses Of Electricity', namely: for the heating of water; all other forms of household heating and cooling, including cooking; and for almost all the motors one can find around one's house.

Most articles in *ReNew* (and other publications) concentrate heavily on the first two areas. I suspect that electric motor great misuse is not looked at much because it is deemed too hard or not worth it. I'd like to make a few observations about this misuse, ask a few questions and propose a few ideas. I'd appreciate input from the people at *ReNew* and the readers out there as well.

When designing a renewable electricity system for one's home, the sizing of the inverter is a decision to get right first time. Of importance in this decision is both the 'normal' load (power drawn when things are up-and-running) and the 'surge' load (power drawn when things are starting up). Items that require a large surge load capability almost always involve an electric motor (such as fans, the compressor in your fridge, or the power tools in your shed). Electric motors are also pretty power-hungry even once they're up to speed. Finding an alternative to electric motors in your life could mean you are able to significantly reduce the components in your home's renewable electricity system (I think).

With all this in mind, my interest was piqued when a friend recently converted his shed over to an 'air tool' system. All his shed-based electric motors are now run from a pressurised air reservoir that is kept topped up via an electric compressor. The only surge load he now has to worry about is the compressor, which is lower than most of his tools.

Two questions sprang to mind after the conversation with my friend. Could I run an air compressor directly from a solar/wind electricity system (an air version of a direct water pumping system, if you like)? Can I convert any of my 'indoor' appliances to use an air-driven motor (my fridge would be at the top of the desired conversion list)?

My limited knowledge about all things electrical/mechanical leads me to think that it would be a struggle to run an air compressor directly from a solar panel or wind turbine. So how about with a super-capacitor in between (I want to avoid the need for any kind of battery in this system)? If this would overcome the problem, can you publish a circuit diagram and parts list that would allow me to build such a system? What about an article about converting a fridge to use a hacked-up, cheap air tool, instead of an electric motor, to run its compressor?

ReNew is better than many others because of the quality of its practical advice and the fact that many of its articles deal with things we can actually build. I'd really appreciate if it could turn its creativity to helping me solve my third Great Misuse Of Electricity.

Chris Molloy,
chris.molloy@allianz.com.au

I have to say I'm not sure why you consider electric motors as a misuse of electricity. There is simply no other motor that can produce as much power in as small a package that has as simple a connection system.

Having worked with compressed air tool systems I can say that I haven't seen a single system that didn't leak air somewhere. These leaks add up to a lot of waste, and combined with the relatively low efficiencies of air compression and storage systems in general, the result would be a system that uses a lot more energy than good quality electric appliances.

Air systems also suffer from variable pressure, water in the lines, and several other problems that make them unsuitable for use in houses. The seals wear out relatively quickly, as do the brass fittings, and you can end up with connections that spontaneously disconnect, causing the hose to fly about until the compressed air in it has dissipated—not a good thing in the average home. As far as cost is concerned, air hose is more expensive than electrical cable and requires the correct tools to terminate into fittings correctly.

While some power tools and appliances have fairly high surge requirements, so do air compressor motors, so you would not be able to run a motor directly on a battery-less solar system unless you were using an air compressor made specifically for this purpose.

All in all, an air-powered system would be less efficient, more expensive, and a lot messier than an electrical system. Air-powered motors are also a lot noisier than many electric motors.

Having said all of that, if you wanted to try such a system, I would suggest using a direct drive compressor system, where the wind turbine has a compressor head rather than a generator, so you never make electricity, but rather compressed air directly. The Bowjon system is one such turbine, but I doubt whether they are available in Australia, although there is no reason you couldn't make your own. I would use a rotary automotive air conditioning compressor, as they are relatively cheap from wrecking yards, and are designed for extreme conditions. However, they do require oil, and as the system would not be a closed loop, you would need to provide an oiling system for the compressor. You would also require a large turbine to provide the necessary torque to drive the compressor.

Lance Turner

Climate change pact meeting postponed

The inaugural meeting of the Asia-Pacific Partnership on Clean Development and Climate, expected to take place in November 2005 in Adelaide, was postponed. The pact, which brings together Australia, China, India, Japan, South Korea and the United States—who collectively account for nearly half the world's greenhouse gas emissions—has been seen as an alternative to the Kyoto protocol.

Unlike Kyoto the pact does not enforce any mandatory reduction targets for greenhouse gas emissions. Instead it encourages the transfer of knowledge and technology on existing and emerging clean technologies.

Australia and the United States are the only two industrialised countries who have refused to ratify the Kyoto Protocol. Australian Foreign Minister Alexander Downer told Parliament that it would be misleading to suggest that Kyoto is going to solve the problem of climate change. 'We don't want to undercut Kyoto or try to circumvent Kyoto. I just want to make the point that Kyoto won't address climate change, I'm afraid. We may as well all face up to that.'

The inaugural meeting is now scheduled to take place in January 2006.

Climate change threat to public health

By 2100 up to 15,000 Australians could die every year from heat related illnesses, and the dengue transmission zone could reach as far south as Brisbane and Sydney if we continue to allow emissions to increase, according to a report released by the Australian Conservation Foundation (ACF) and the Australian Medical Association (AMA).

The report, written by leading world experts on climate change from Australia and New Zealand, exposes the damage already done and paints a picture of what we might expect in the future if no action is taken.

'Projected premature heat-related deaths to 2100 could be halved with strong policy action and, while the zone for potential dengue transmission is likely to move south to Rockhampton or Gympie, it would stay north of more heavily populated south-east Queensland, coastal New South Wales and metropolitan Sydney,' said AMA President Dr Haikerwal.

'Our health ultimately depends on having a healthy environment to sustain us. Climate change is one of the biggest environmental and health equity challenges of our time. Coordinated action from governments, business and the community to reduce greenhouse gas and air pollution is essential if we are to protect the health of all Australians and the wider global community,' added Dr Haikerwal.

According to the World Health Organisation, in 2000, more than 150,000 premature deaths were attributed to various climate change impacts such as spread of malaria and dengue fever and the lower yield of some crops and the salination of coastal areas.

www.acfonline.org.au

Sea level rise doubles in 150 years

Global warming is doubling the rate of sea level rise around the world according to researchers from the Rutgers University in New Jersey. Analysis of cores drilled down 500 metres showed that during the past 5000 years, sea levels rose at a rate of around 1mm every year, but in the past 150 years, data from tide gauges and satellites show sea levels are rising at 2mm a year. The rising tide is expected to make oceans 40cm higher by 2100.

'We can say the increase we're seeing is much higher than we've seen in the immediate past and it is due to humans,' said Professor Kenneth Miller who led the study.

The principle cause of the rising sea levels could be Antarctica according to researchers from the University of Cambridge. The edges of the Antarctic ice sheets are crumbling at an unprecedented rate, with the Pine Island and Thwaites glaciers losing more than 110 cubic kilometres of ice each year. The two glaciers are discharging ice three times as fast as a decade ago, and if they disappeared completely they could raise sea levels worldwide by more than a metre on their own.

www.newscientist.com

Federal ministers wrong on nuclear power

A coalition of environment and public health groups recently released a report challenging the argument put forward by some Australian ministers that nuclear power is 'clean' and a potential fix to climate change.

The report, *Nuclear energy: No solution to climate change*, states that nuclear power poses unacceptable proliferation and security risks, is not clean, is not cheap, and there is no solution to the intractable problem of nuclear waste.

'A doubling of global nuclear power output by 2050 would reduce greenhouse gas emissions by just 5%—less than one tenth of the reduction required. Nuclear plants are potential bomb factories. Four or five countries have developed arsenals of nuclear weapons using their "peaceful" nuclear facilities,' said Dr Jim Green, author of the report.

The report shows that energy efficiency measures and renewable energy sources can deliver the large reductions in greenhouse gases required without the dangers associated with nuclear power.

A copy of the report can be downloaded from www.foe.org.au

Australia's foremost sustainable living event is on again next year from the 17-19 February 2006. The Festival is a three-day event in the heart of the City of Melbourne. The event draws together a wide variety of exhibits, talks, workshops, artworks, films and performances to inspire a sustainable culture.

sustainablelivingfestival

17-19 february 2006 federation square, melbourne

If you are building, designing, renovating, or just wish to live in an improved home environment, come and explore the Festival's program. Get practical ideas for putting your home on track to a sustainable future. Meet some of Melbourne's leading building and design consultants in our Sustainable Home Hub on site.

Sustainable homes are cheaper to run, more comfortable, and healthier to live in, so bring your house plans along to workshop ideas on how to improve your home (existing or proposed). Themes covered will include:

- passive solar design
- renewable energy
- garden design
- water management
- indoor environment quality
- waste systems

Come and explore other festival activities, which will encompass many aspects of sustainable living including:

- organic food
- transport
- health & healing
- family fun
- community action
- future thinking

www.slf.org.au/**festival**

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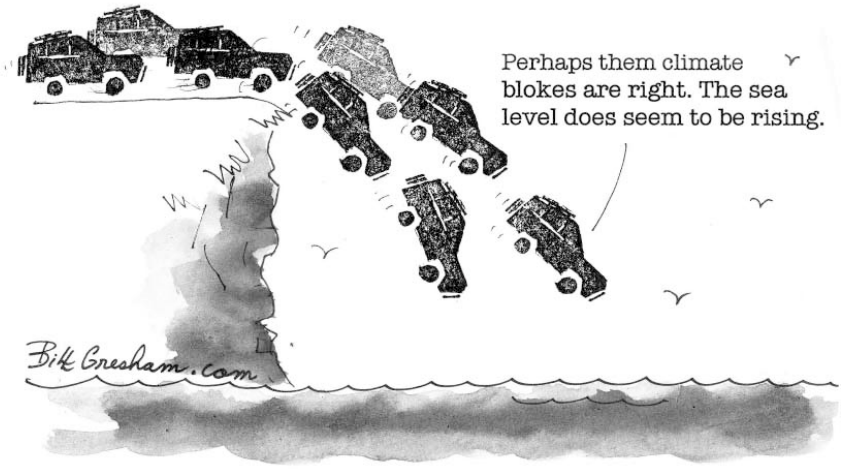


Nature tells us climate is changing

Australian animals and plants are already changing their behaviour to adapt to climate change and the development of a new database will help us understand the impact of climate change.

'Change to plant and animal behaviour is nature's own yardstick,' says Dr Lynda Chambers of the Bureau of Meteorology Research Centre.

'The Sleepy Lizard is now mating earlier due to the warmer and drier winters. And the Purple-crowned Lorikeet is one of more than 20 bird species whose migration patterns have changed. Along the semi-arid coastline of western Australia, the lorikeets are now arriving more than a month earlier than they did in the 1980s.'

While we have some knowledge of the changes occurring in nature, there is a need to collate this information and to look at these changes over a longer period of time.

'By encouraging people to look for climate change signals, we will be in a good position to understand observed and potential impacts of climate change over a wide range of species, ecosystems and regions. This will allow us to better manage our natural resources,' says Dr Chambers.

For more information go to www.bom.gov.au/bmrc/clfor/cfstaff/lec/NEMD.htm

Green Power customers up by over 40%

The number of people who have chosen to buy non-polluting Green Power from their energy retailer has increased by 43%. The Green Power Annual audit for 2004 sales increased to the current level of 480GWh per year.

Green Power is a voluntary scheme that lets all Australians drive an increase in the development and investment in new renewable energy generation. The electricity is sourced from wind, solar, low-impact hydro power, and biomass from landfill or waste products from agricultural processes, such as bagasse from sugar mills.

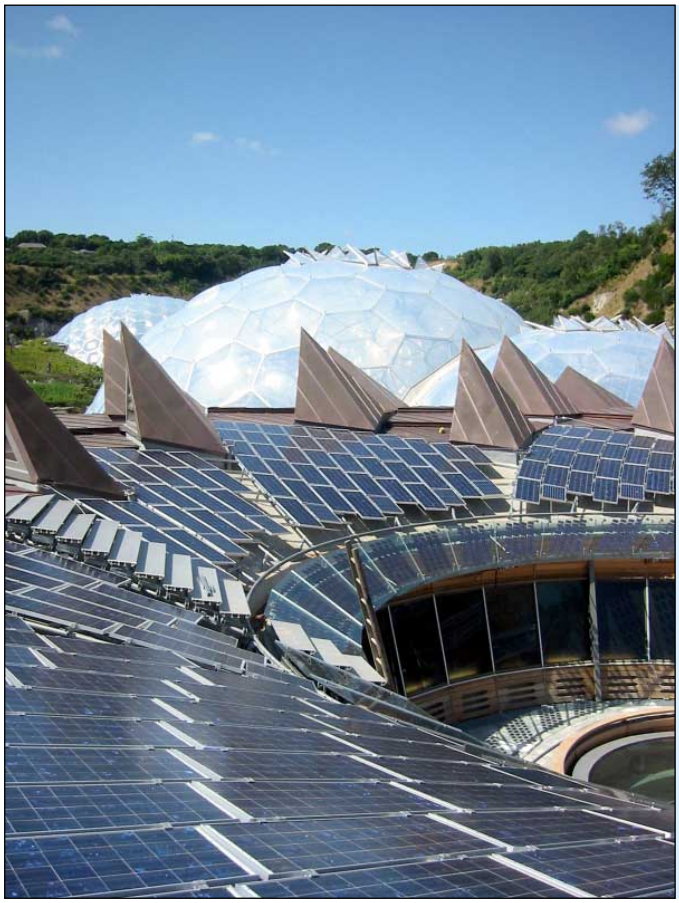
In 2004, 12 energy retailers together offered 18 accredited Green Power products across Australia, making Green Power available to all domestic and commercial energy consumers in Australia.

For more information on Green Power go to www.greenpower.gov.au or check out the Green Power Buyers' Guide in *ReNew 93*.

Dutch solar car wins three in a row

A team from the Netherlands won the World Solar Challenge for the third year in a row, with the Nuna III. The Nuna III took 29 hours and 11 minutes to travel 3021km from Darwin to Adelaide. With an average speed of 102.75km/h the team bettered its previous world record set in 2003 by almost two hours.

An Australian car, the Aurora, came in second with an average speed of 92.03km/h.



Unique solar building open at the Eden Project

One of the most unusual sustainable buildings in the world, designed on nature's architecture and generating energy from daylight, has opened at the Eden project in Cornwall, UK. True to the Eden Project's principles, the new education and research facility, named the Core, is a unique example of building using photovoltaics.

Described by Tim Smit, Project Eden CEO, as 'the finest modern building in the world,' The Core's architecture follows the Fibonacci series—a unique pattern at the heart of nature that generate, for example, the spirals in snails' shells or the pattern of seeds in the head of a sunflower.

Each petal of the flower uses a combination of sharp 80W watt panels and Kyocera 40 watt panels, arranged in descending row length, extending from the center of the building. Since connection to the grid in mid-August 2005, the PV system has generated more than 5000kWh of energy.

'It is a very green building and one conducive to learning for both adults and children. If every building was designed like this, the world would be a better place,' says Sir Nicholas Grimshaw, the project's architect.

The Core took two years to build and cost just under AU$35 million.

www.renewableenergyaccess.com

Private solar farm in WA

One of Australia's largest privately owned and operated solar installations is up and running in Carnarvon, Western Australia. The 16 kilowatt solar farm consists of one hundred and forty four 110 watt solar panels on fixed array frames and three 5 kilowatt grid-connected inverters.

Lex Fullerton had been investigating the benefits of solar energy for more than three years. After installing a pilot plant at his home nearly two years ago and proving that it would deliver to expectation, he has now constructed a larger 'solar farm'.

'When I got the land I wondered what I'd farm on such a sun-scorched piece of arid desert. Then I thought, that's it, I'll farm the sun,' said Lex.

'The results so far have been far better than expected. The plant is producing over 100kWh on a daily basis, added Lex.

The farm is designed to benefit the wider community as the generated power is fed back into the grid.

The farm cost a total of around $190,000 to build with funding of $104,00 provided by the Remote Area Power Supply Program.

World Sustainable Buildings Conference to be held in Australia

Melbourne has won the bid to host the next World Sustainable Buildings Conference to be held in 2008. It will be the first time that the conference will be held in the Southern Hemisphere.

SB08 Melbourne will bring together leaders in the sustainable built environment to discuss sustainable urban regeneration, future technologies, sustainability for rapidly population cities, and healthy buildings and cities.

Solar-powered hospital in a box

For many people in remote areas the nearest hospital could be hundreds of kilometres away. An ingenious new invention—a solar-powered hospital in a box—brings the hospital to the patient.

Developed by doctors and technicians from the UK's National Health Service, the system comprises of two small boxes that unfold to provide an operating table, equipment holder, lighting, anaesthesia and monitors, plus a plastic tent to provide a clean environment for surgery. The two boxes can fit onto the back of a Land Rover.

'We're confident that with this system and a minimum of three properly trained staff, it is possible to offer general surgery to the standard you would expect in any European hospital,' says Alexander Bushell, a surgical technician who helped design the system.

'All you need to run it is a truck battery, and that can be charged up by the solar panel. And in many parts of Africa, for example, sun is one thing that is not in short supply.'

The solar panel should capture enough electricity in one day to provide power for five days' worth of surgery.

The system was launched at the British Invention Show in London, where it won World Invention of the Year.

www.newscientist.com

ReNew prize winner

Congratulations to Mark Herbert from Hurstville, New South Wales, the lucky winner of the Sunplus CPC Solar evacuated tube solar water heater retrofit kit valued at $2995. Mark will put it to good use in the building of his new sustainable home.

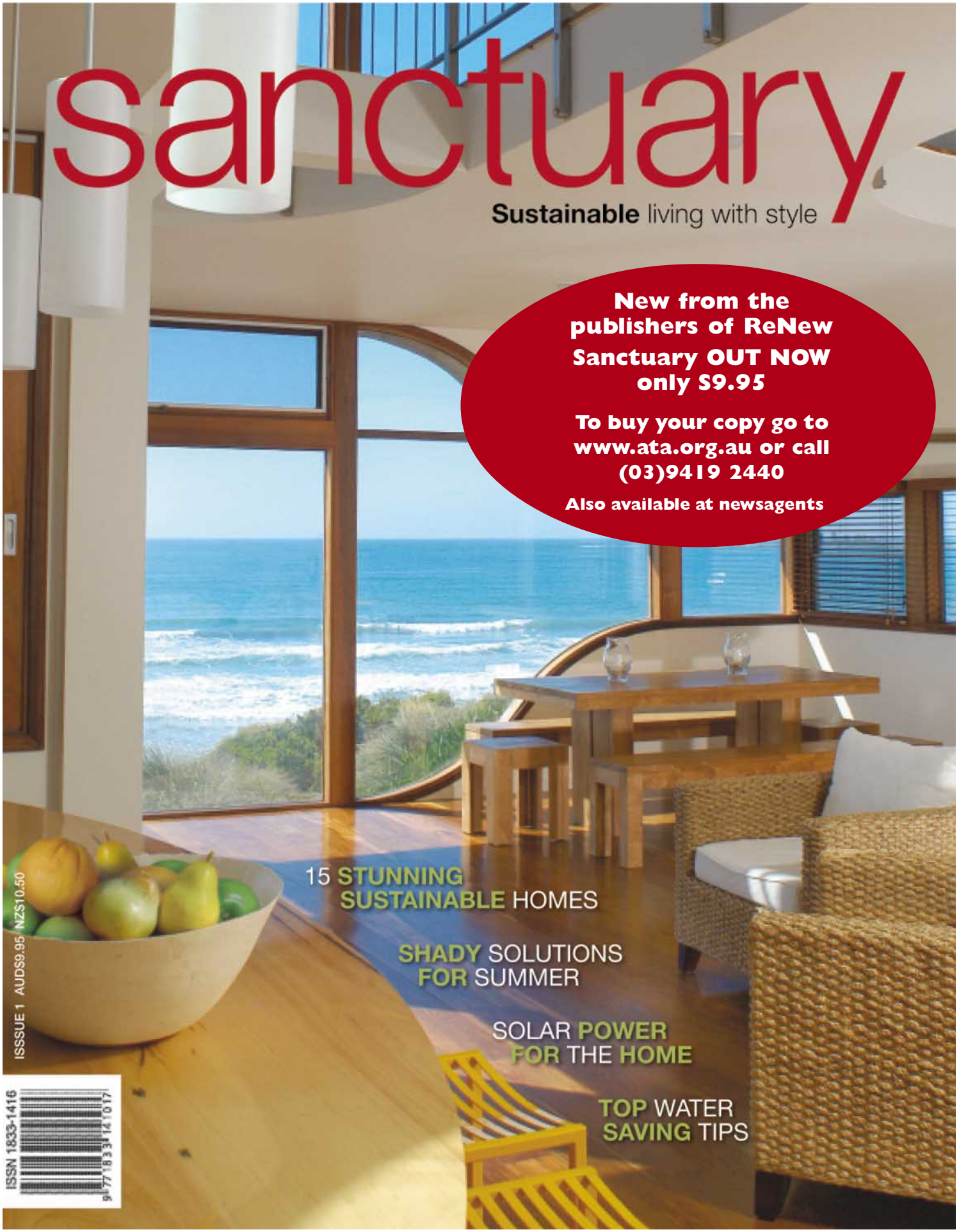
Don't miss out on your chance of winning a fully installed Working Water greywater recycling system valued at $2475. Simply take out an ATA membership, become a supporter or subscribe to *ReNew*.

Win a decogged Fisher and Paykel washing machine motor valued at over $200

We are looking for good build-it-yourself style articles, and will award one only Fisher and Paykel washing motor (kindly dobnated by Eco Innovation, www.ecoinn.co.nz) 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 5 May 2006.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Biofuel target to encourage biodiesel production?

With petrol prices soaring, biofuels have again captured widespread attention. In 2003, makers of biofuel, including those making it for their own use, were hit hard by the introduction of an excise levy. The Prime Minister wants increased investment in the biofuels industry, particularly ethanol. Kerry Archer reports

In September, Prime Minister John Howard released the *Appropriateness of 350ML Biofuels* report. Prepared by the Biofuels Taskforce and commissioned by the Prime Minister, its aim was to examine the latest evidence on the impacts and benefits of ethanol and other biofuels, especially in relation to the Federal Government's biofuel production target of 350 megalitres (ML) by 2010.

The report concluded that, although there are many positive benefits from increasing the use of biofuels in Australia, including those relating to health and climate change, the biofuels industry is facing considerable market barriers, such as low consumer confidence and high commercial risk. These factors will apparently make it difficult for the government to meet its 2010 biofuel production target.

For ethanol, low consumer confidence stems from debates two years ago about the potential damage it may inflict on engines, and a political scandal over accusations that Prime Minister John Howard had bent the rules to help an associate's business fend off competition from overseas. It is interesting that, with rising petrol prices leading to a rekindling of interest in biofuels, the Prime Minister has once again turned his attention to ethanol, despite the fact that ethanol blends will do little to ease petrol prices.

Biodiesel is also a biofuel and is made from renewable sources like reclaimed cooking oil, canola, sunflower, soya bean, and cotton. President of the Alternative Technology Association (ATA, publishers of *ReNew)*, Michael O'Connell, believes that the 350ML target is possible to reach today if attention is turned to producing biodiesel. 'There's 300 million litres a year of used vegetable oil being collected right now,' says Michael. 'If they made a commitment to convert that to biodiesel, we'd already be there.'

Michael also sees irony in the government now trying to promote the production of 350ML of biofuels after introducing an excise last year that put a huge dampener on the growth of the industry. 'In fact, if the same government hadn't introduced an excise on biodiesel last year, a decision that killed off the industry's investment possibilities, there would have been no reason why we couldn't have been producing up to 100ML a year by the end of next year.' Michael remarks.

The issue of excise is an interesting one, because it affects all producers of biofuels no matter what quantity. This includes production for personal use. Environment Australia's 'Cleaner Fuels Grants Scheme' provides an offset grant of 19 cents per litre of biofuel produced. However, to be eligible for the grants scheme, producers must satisfy a set of criteria that include the biodiesel meeting a Department of Environment and Heritage (DEH) fuel quality standard. However, according to the Biodiesel Association of Australia's website, this standard has not been determined!

In addition, the 19 cent per litre rebate will only last for the next five years with a sliding scale for the following five years. This means that by 2016 there will be no rebate at all.

Despite the setbacks, the biodiesel industry is gathering speed, with announcements last year of large-scale production facilities being planned in Adelaide and Darwin. The Darwin plant has been described by Northern Territory Chief Minister, Claire Martin, to be 'world scale' in size, producing over 130,000 tons of biodiesel per year from a feedstock of palm oil.

While large scale developments are a positive step for the biodiesel industry, the Federal Government's apparent bias towards ethanol as its biofuel of choice may hamper efforts.

Support for small industries and producers has a particularly long way to go. Michael O'Connell believes that we need to encourage regional production. 'Biodiesel should ideally be produced where it's needed,' he comments.

'This would bring substantial additional savings in transport, not to mention the creation of regional employment.'

Self confessed biodiesel moonshiner, Vince Jones, shares his experiences

Nine years ago, in my attempt to shrink the size of my carbon footprint on beautiful planet earth, I discovered I could run my old ferguson tractor on hot, used vegetable oil. I had a river flat on my property, which I used as an airstrip. Up and down the airstrip went the fergie and slasher on vegie oil and never missed a beat. You can imagine the savings.

Two years later I bought a 1994 landcruiser 80 series turbo diesel. Apprehensive at first, knowing the cost of a rebuild of one of those engines, I decided to forego the vegie oil. On the internet I discovered a young couple travelling around the world in a campervan using only biodiesel made from vegie oil.

Thanks to their unselfishness, the biodiesel formula was easy to find, and now 280,000 kilometres and 25,000 litres later I'd like to share with you some of my experiences.

After 270,000 kms the engine had no more than normal wear; the same could not be said for the pump and the injectors. The pump went off to Cooma Diesel where the manager noted he had seen similar damage on another pump using biodiesel.

He said the pump could not be rebuilt as it was pitted internally. The pump runs at a very high pressure and gets extremely hot. Any moisture in the fuel turns to steam and in turn damages the pump by pitting the cast aluminum.

I hoped it would be the last I'd see of the Cooma diesel man for a few years. I didn't take his advice and change back to diesel and never will. Thirty thousand kms and a rebuild later my new pump died. Back to Cooma Diesel. I'm now on my third pump and I bought a spare one on ebay just in case.

Recently I went to a biodiesel forum in Sydney, expecting to learn something. I was very disappointed; it felt more like a sales pitch than a forum. Some people have clearly invested a lot of money in large scale production of biodiesel and speakers were limited to hand picked pro biodiesel people with a distinct absence of the likes of the Cooma Diesel manager and no representatives from the automotive or fuel pump industry.

On the day, I was approached by the Australian Tax Office representative and discovered that us moonshiners are expected to register ourselves as fuel producers, thereby entering the 19 cent per litre tax/tax rebate cycle. And that's only if we have our fuel tested to make sure it meets the currently non-existent fuel standards. Why?

I figure if I make my own fuel, I'm responsible for the damage I do to my engine, if any, as long as I don't sell it. I can make homebrewed beer and nobody cares about standards as long as I don't sell it.

If you make your own fuel I believe recycling used vegie oil is definitely a positive environmental move. But is it viable? As a home brewer, a lot of work goes in to collecting used oil, setting up a moonshine plant, multiple washings and waiting for the fuel to clear.

On top of this we are faced with fuel pump costs and greedy biodiesel tycoons trying to squeeze us grass roots folk out, creating a scarcity of oil. Financially there is the $250,000 fine if we decide to sell it without a licence, plus the cost of getting biodiesel tested. Without passing such a test the ATO refuses a tax rebate and prevents you from actually collecting the oil (on the basis that you are unable to dispose of the oil properly).

And there is the cost of the two pigs you need to keep; if you have pigs you are apparently able to dispose of oil properly!

Nope, I have to accept defeat. The burning hoops we have to jump through are getting too hot. How simple it all used to be. My first 250,000kms, were blissfully naive.

Us grass roots boys and girls always get screwed in the end. Unless they can sell biodiesel to me at sixty cents per litre max and guarantee that there are plenty of spare pumps, gas is the better and cheaper alternative.

Or just classify us as homebrewers and leave us alone to make our environmentally sound fuel in peace!

Lights, power and action in East Timor

Michael Harris from the ATA International Projects Group tells us about the group's second trip to East Timor

It was 4.30 am. The powerful roar of the ferry's engine had dropped to a low rumble as we slowly approached the beach. On land all was dark except for a few spots of light from the kerosene lanterns near the ferry's arrival point. With a shudder we hit the sand and the ferry ground up onto the beach. We had arrived at Oecussi, the small isolated East Timor enclave surrounded by Indonesian territory.

Powerful winches sprang into action, lowering the ramp that would allow the hundreds of passengers with their bags of rice, chickens, canoes and motorbikes to unload onto the rough rock strip that served as a quay. We gathered up our luggage, solar panels, batteries and coils of wire and made our way to a patch of sand to wait for the dawn and the lift to the office of a local charity where we would commence our first solar power installation.

Over then next three weeks, 11 volunteers from the ATA's International Projects Group would implement 18 projects in five districts of East Timor. They included solar lighting for health clinics, power for small offices, lighting for community buildings, energy for refrigeration for an orphanage and recycling equipment for a women's craft cooperative.

The group aims to use the technical skills, industry contacts of the ATA and its members to provide sustainable technology solutions to poor communities in South East Asia. This is the second round of projects—18 on this trip— of the group. Twenty-three projects have now been implemented. This year's projects included a much greater variety of work than the first. However, small solar power systems were still the biggest slice of what was done.

A six panel solar power system with the capacity to produce 2.2kwh per day was installed at an orphanage, in the remote mountain village of Soibada.

Health clinics and community buildings

Most of the health clinics and community buildings received small solar lighting systems consisting of an 80 watt photovoltaic (PV) panel, a Plasmatronics regulator, a 120 amp-hour sealed lead-acid battery and low-voltage compact fluorescent lamps. Smaller buildings got a 50 watt panel and 65 amp-hour battery and fewer low-voltage compact fluorescent lamps.

We assumed an average peak output from the solar panels of five hours a day, leading to the availability of 400 watt-hours of energy. Using low-voltage fluorescent lamps with an average rating of 15 watts, this system is capable of running six lamps for around four hours. Panels are mounted directly on the roof using aluminum strips. A circuit breaker is used to isolate the battery and act as a fuse in case of overload. The battery and electronics were installed in a translucent sealable plastic container to protect the system from damage.

Offices and computers

We had a number of requests for power systems to help run offices with computer systems. In countries like East Timor, grid-supplied power is often intermittent. In many places power only comes on for four hours in the evening and even that can fail for months at a time due to fuel shortages and breakdowns. During the day, offices may run their own generators, but these can also fail or run out of fuel. Many users simply cannot afford the fuel and maintenance costs so a reliable solar system with no running costs is a very attractive option.

However, many of these offices use older donated computers that can consume a lot of energy. A computer using an old CRT (cathode ray tube) monitor can consume up to 200 watts. Run five computers for eight hours a day and you are consuming 8000 watt-hours per day. With container loads of old computers having been shipped to East Timor by well meaning people wanting to see their old computers put to good use, a real energy consumption problem arises.

Laptop computers use much less power, around 10 to 20 watts (depending on how they are being used), so five laptops running for eight hours a day would use only about 400 to 800 watt-hours. To power the old computers by solar would need twenty 80 watt solar panels costing $18,000. To power the same number of laptops would need just two 80 watt panels costing $1,800. This was an important message for us to get across to those who wanted power for computers and we supplied three laptops with the power systems.

Office power system

One of the office power systems we installed was for Caritas Australia. It consisted of four 80 watt PV panels, a 24 volt 212 amp-hour battery bank, regulator, 700 watt sinewave inverter and 12 amp battery charger. The battery charger increased the capacity of the system allowing the batteries to get an extra charge whenever the generator or grid power was available. If the generators and grid power were not so unreliable, the charger would have negated the need for solar panels entirely, but with panels installed the system could still operate reliably at a reduced capacity even in the event of generator or grid power failure.

The Eco Village on the island of Ataora combines local building techniques and crafts with sustainable solar technology.

This system was capable of providing 1.6kWh per day, enough to provide power for the lights (200Wh), a laptop (120Wh), and peripherals such as printers (100Wh). With extra charge from the generator and mains power, a small fridge and some energy guzzling PCs could also be catered for. The fridge can be run all day without mains power if it is turned off for a few hours at night and the lights and laptop are turned off when not in use.

Installing a solar panel on a health clinic in the isolated enclave of Oecussi. This panel was capable of running six compact fluoros for up to four hours per night.

Refrigeration and power for an orphanage

The biggest system we provided was for an orphanage housing approximately 70 children, in the remote mountain village of Soibada. Power was requested for refrigeration to preserve food, and lighting so the children could study at night.

In our original assessment for the orphanage, the only power came from an intermittently operating generator. When we arrived we found the power situation had improved slightly with four hours of grid power available in the evenings. This, plus a couple of hour's generator power at dawn, made it possible for the residents to run a freezer although this presented a real health hazard. The cycling of the freezer as power came on and off could result in the regular freezing and defrosting of food creating a perfect breeding ground for bacteria.

We installed a six panel solar power system with the capacity to produce 2.2kWh per day. We also added a 24 volt battery bank with a 420 amp-hour capacity, regulator, Selectronic 1.7kW sine-wave inverter and provided a Vestfrost 330 litre high-efficiency refrigerator with no freezer. This fridge consumes about 460Wh per day, much less than a conventional fridge, making it a good alternative for use with solar power systems. This system was designed to provide power for the Vestfrost fridge and lighting with some capacity to spare. However, the existing freezer, which we had not been informed of, put a spanner in the works. We advised the nun who managed the orphanage to make maximum use of the intermittent grid and generator power to run the fridge, freezer and lighting.

Local people were trained and assisted with the installation of all the systems.

The completed Soibada system with the installation team, the kids who act as the local 'electricians' and Sister Mary Lou who manages the orphanage.

Systems installed the previous year in Remexio were checked and the system at the police station was repaired. The wind had blown through a gap in the wall that we had used for cable entry and the cable movement had worn off the insulation. The other systems in Aileu were also checked and the only problem was a blown globe.

Where to from here?

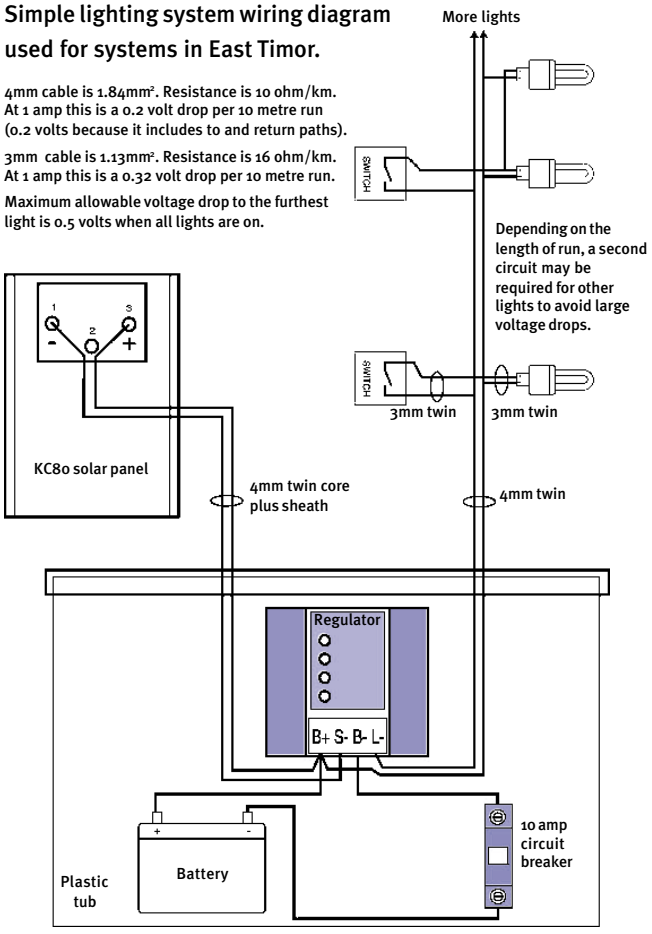
While we acknowledge we probably took on a bit too much work this year, all the projects were successfully completed and we are keen to expand our work next year. We are considering a wind power system for a village which would be reticulated to homes via the old disused town power grid. Other projects could include a small-scale hydro system, solar water pumping, generator-supported short-term battery systems (effectively uninterruptible power supplies), and some large remote PV systems. We also hope to add communications to the health clinic systems. We are developing an Expression of Interest form and will be looking for more projects in 2006 from Timor-based groups and organisations in Australia.

Getting Involved

Assisting poor communities with real tangible resources that help improve their standards on living is incredibly satisfying. However we need help to do this. We welcome volunteers who can help us plan and implement the projects, donations of equipment to be used in the installations and, of course, donations.

Donations are critical to our ability to complete most of the projects. All donations are tax deductible and we are happy to tie your contribution to a spe-

Simple lighting system wiring diagram used for systems in East Timor.



cific project. You get the satisfaction of knowing your contribution goes directly to fund a solar power system for a clinic, school or community building. We will even provide you with a photo of the facility you supported and details of the work undertaken.

Making the project possible

The projects were possible due to the hard work of our dedicated volunteers. The team consisted of myself (Mick Harris), Alan Hutchinson, Bill Bennet, Chris Moss, Emma Chessell, Duncan MacGregor, Jason Bond, James Patterson, Chris Halliwell, Jose Leong and Mike Watters.

We worked with local organisations that helped with transport, accommodation, identification of projects and other support. While installing the systems we taught local people basic maintenance and repairs as well as providing training and equipment to the Dili Institute of Technology.

Funds came from a range of sources including ATA members, Friends of Aileu, Friends of Oecussi, Friends of Liquica, Caritas Australia, the Sisters of Charity, Harvey World Travel - Sunbury and from an ATA fundraiser.

A huge thank you to the ATA members who made donations. Without your help we would not have been able to do so much.

A detailed report on the project is available at the ATA's website. If you would like to contact us send an email to michael@ata.org.au.

Donations were gratefully received from:

Selectronic Components
Assisted with inverters

M & H Power
Assisted with batteries

Plasmatronics
Assisted with equipment and funds

The Environment Shop
Assisted with paper recycling equipment and labour

Going Solar
Assisted with solar panels and labour

Green PC/Infoexchange Australia
Supplied a laptop computer for Bazatete

Computer Bank
Supplied a laptop computer for Caritas Australia

Vic O'Callaghan Transport
Free transport of crate from Melbourne to Darwin

Transhose
Warehousing facilities in Dili

Community Water and Sanitation Project
Advice and assistance in dealing with East Timorese bureaucracy

Some of the ATA team at the warehouse preparing for the installations.

Two and a half buckets of water a day

Stuart McQuire's family have cut their mains water consumption to 96 per cent less than the average Melbourne household, without compromising their lifestyle, and they can still water their thirsty garden

In 2003 we were lucky enough to receive a grant from the Victorian Government's Smart Water Fund to install new rainwater and greywater systems. It's part of an exploration of options for securing water supplies to Melbourne, and we found the new systems fit well with our desire to live sustainably. We'd previously been recycling water to the garden using simple diversion funnels and also had rainwater in use for the laundry, toilet and garden (see *ReNew 74*).

Through installing the new rainwater and greywater systems we've cut our mains water consumption to 25 litres or 2½ buckets per day. With four people in the house this is around six litres per person per day. Only two of our taps now use mains water, the kitchen cold water tap for cooking and drinking, and the bathroom basin cold water tap for brushing teeth. All other taps are supplied with either rainwater or recycled water from the site.

The Envirowater system also functions as a rather fetching water feature. The process of falling onto the pebbles helps aerate and circulate the water.

Rainwater system

The rainwater system uses four rainwater tanks to store up to 20,000 litres of water. The rainwater is used for showers (hot and cold water), the laundry, all water via the hot water system, and a couple of garden taps. A pump automatically provides pressure when taps are turned on. The rainwater system also has a device that switches across to mains water supply automatically if the rainwater tanks run low, but so far this hasn't been needed.

The rainwater tanks are all connected at ground level, and water flows between them via gravity as the water level rises and falls in the main tank adjacent to the house. The other three tanks are nestled under trees behind the garage about 25 metres away. Based on rainfall records we estimate that about 100,000 litres of rain will be available from our roof each year.

To improve water quality, double layered Enviroflow guttering has been installed in areas where there are overhanging trees. The top layer has filters every half a metre that prevent leaves and debris entering the bottom layer, but allow water to flow through. Rain diverters have been used on two of the downpipes, while at the front of the house a gate valve has been fitted to allow the pipe to be flushed out periodically at the low point of the 'wet system' transferring water to the tanks.

Rainwater now supplies about 60% of our water. Initially we installed a rainwater tank to use for watering the garden and found it was of limited use. It would fill up and sit full for most of the year which meant it would not be catching any more water. When dry weather came it would quickly empty. It wasn't until we got a pump and connected the rainwater to supply the laundry and toi-

let that we started to get the best value from having a tank.

Connecting your rainwater tank to something you use every day prevents the tank sitting full of water and so next time it rains, some of this water can be captured. We estimated that water use for the shower was over half our water use inside the house. By supplying rainwater for the shower we have made a major dint in our mains water consumption.

In terms of planning a rainwater system it's best to connect the system to something inside your house. In order of priority this would be the toilet, laundry, shower and then kitchen. This order is based on an increasing need for control of water quality and depends on your ability to match your storage capacity with volume of water you need.

Greywater system

The water recycling system uses a new water treatment technology called Envirowater. Developed in Melbourne, it is based on similar technology used at an industrial level. It uses biological and mineral filters to treat water and has the added appeal of doubling as a water feature in the garden.

The Envirowater water recycling unit uses an underground tank to receive water from the shower, bathroom basin and laundry, which it then processes in batches using mineral and biological filters. Initially, a stocking-like hair and lint filter screens water flowing into the treatment tank. It takes about two days for us to fill the treatment tank, and then a float switch activates a pump at the bottom of the tank that sends water up to the fountain on the surface. Landing on the pebble bed, the water is aerated and circulated before gravity draws the water back down into the treatment tank.

Inside the treatment tank, micro-organisms growing on balls filled with aggregate help clean the water. The cycle runs for 10 hours, after which a timer-controlled solenoid valve allows the water to be pumped out of the tank. The water passes through a particle filter and an ultraviolet light disinfects the water on its way to two large storage sacs, resembling waterbeds, under the house.

Storage standard

Prior to installing the Envirowater unit, batch tests were run to assess the quality of the treated water and as part of the permit conditions for installing the unit we are required to monitor water quality every three months. The unit is monitored for nitrogen, phosphorus and total dissolved solids (an indicator of salt) and has consistently achieved a standard called the 20/30/10 standard.

This standard stipulates a maximum 20mg/L Biological Oxygen Demand (BOD), 30mg/L suspended solids and 10 E.Coli/100mL. (Further information on greywater standards can be found in the document *Appropriate reuse of greywater* published by the Environmental Health Unit, Victorian Department of Human Services and is downloadable from www.health.vic.gov.au/environment/downloads/greywater_usage.pdf).

Water can now be stored indefinitely and used for toilet flushing, garden irrigation (even above ground) and laundry washing. A pump is used to deliver water from the storage sacs to our toilets and to a network of pipes connected to taps in the garden. Recycled water is automatically pumped from the sacs when the toilet is flushed or when one of the recycled water taps is turned on. However, odour has been an issue at times with the treated water. Because of this we are not using the recycled water in the laundry. In the absence of

Water consumption by source 12 Nov 2004 to 12 Nov 2005

Source	Total (litres)	Daily (litres)	%
Rain	66,779	182.9	58%
Recycled	38,397	105.2	34%
Mains	9,079	24.9	8%
Total	114,255	313.0	

Four rainwater tanks store up to 20,000 litres of water and supply about 60% of the McQuire's water needs.

space under the house, the water can be stored in tanks above ground.

Using less in the first place

As with energy, sustainable use of water starts by using less in the first place. Overall our household uses about half the water of a typical Melbourne home. This has been achieved in four ways:

- A low-flow shower rose, rated at 6.75 litres per minute (bought 14 years ago for less than $20)
- Dual flush toilets, (3/6 litres, cost: $120)
- A water efficient washing machine that uses between 35 and 60 litres per load (cost: from $700)
- Mulching the garden, to reduce evaporation and improve the soil.

Energy use

Solar electricity is used to supply energy for the pumps. The house was the first in Victoria to have grid-connected solar electricity and generates more than it uses.

Electricity use for the treatment system and pumps to deliver the rainwater and recycled water is estimated at around 35 kWh per month. When turned on, the pump in the treatment tank uses 90 watts, while the pressure pumps for the rainwater and recycled water use 600 watts. The ultra-violet lamp uses 15 watts and is only on when water is passing through it.

Issues

Technology

Issues that still remain include the need for a self-cleaning particle filter (rather than one that needs to be manually washed), and valves that allow the treatment tank to be pumped out quicker at the end of the cycle. Odour issues have now been overcome by increasing the flow rate of the fountain.

Regulation

The regulatory framework in Victoria for approval of water recycling treatment systems is cumbersome and is dominated by a risk management perspective, rather than a sustainability perspective that includes risk management.

Plumbers

There seems to be a shortage of plumbers with experience and enthusiasm for installing rainwater and recycled water systems.

Materials

The rainwater tanks in particular have used a lot of plastic. It is recyclable, but none of it is from recycled sources. There may be technical reasons for using only virgin resin, but otherwise ideally tanks would include at least some recycled resin.

Top: Designated hose for recycled water. Bottom: The rain diverter captures the first few litres of rain that may contain pollutants.

Approximate costs

Envirowater unit: $3500 (not on market, except ACT),
plus installation between $1000 and $3000 (site specific)
Rainwater tanks: $730 (4500 litre), $1100 (6800 litre)
Water storage sacs: $1300 (5500 litre)
Rainbank: $410
Pumps: $300 -$400
Enviroflow guttering: $30 per metre
Rubber diversion funnel: $7
AAA shower rose: $20
Dual flush toilet: $120

Envirowater performance

The Envirowater unit has effectively been a prototype and in using it we have experienced teething problems that have needed to be dealt with as they arose. However, these relate to performance and availability of suitable plumbing fittings rather than the biological treatment process.

Part of the appeal of the Envirowater unit is that it is designed primarily as a unit that allows recycling of water rather than simply an alternative method of disposal. The potential for recycling is maximised by treating water to a standard that allows it to be stored indefinitely and used in conventional irrigation methods rather than dispersion trenches under ground.

For more information go to Stuart's website: www.greenmakeover.com.au or to Envirowater: www.envirowater.com.au

The water passes through a particle filter and then an ultraviolet light which disinfects the water.

DIY reflective blinds for summer

Tom Chalko describes his simple DIY reflective blinds that make his home a lot more livable in summer

NASA's measurements from space indicate that Earth absorbs more solar energy than it is able to radiate back into space—at least half-a-million watts more for each square kilometer. Since pollution on earth grows daily, my prediction is that years to come will be hotter still.

While our leaders take pride in avoiding any responsibility for planetary overheating and inflame conflicts everywhere to increase their grip on power, peaceful people of Earth need to adapt to live in an unstable climate and the violent natural phenomena associated with it.

The issue of windows

So, how do we prepare for increasingly hot summers?

Having a well-insulated house is a good start, but what do we do to prevent an excess of solar energy entering through windows? Northern windows can easily be shaded with small fixed awnings because the summer sun is high above the horizon. But what about east and west windows?

On sunny summer days the sun used to heat up my house through the eastern window to an uncomfortable 36°C by 9am. The sunshine entering the western window was doing much the same before sunset. On sunny days my well-insulated house was like a sauna with no easy way to cool it down.

To increase summer comfort, some people switch on their air-conditioner or buy a bigger one. As we have seen in some parts of Australia, this approach leads to exhaustion of power resources, power shortages, forced blackouts and an increase in greenhouse gas emissions.

The western window wall before sunset. On the outside, reflective blinds diffuse light and look surprisingly good from all directions.

Blocking the sunshine

How about preventing unwanted sunshine entering our dwellings to begin with? If we can accomplish this, our well-insulated house interiors can help us keep cool.

One option is to have trees shading east and west facing windows. The problem with this approach is that you cannot grow trees in a hurry. Or, you may have no room for them on your land. Vegetation also reduces the amount of light and sunshine in winter when we would prefer to let every ray of sunshine into our house. And if, like me, you live in a bushfire risk area, planting vegetation near the house is not a good idea at all.

External adjustable awnings and shutters are a possibility, but they are quite expensive, especially if your windows are high off the ground. External awnings are also vulnerable to violent weather phenomena that we can expect more of.

Curtains and blinds are another option, but most of them do not keep the sun's energy out. They absorb solar heat entering through the glass, get hot and work much like heaters.

Reflecting the sunshine back

After considerable success with my reflective solar heating for winter (described in *ReNew 88*) I decided to explore an idea of 'reflective blinds' that reflect 95% of the sunshine back outside.

Hoping that someone else encountered my problem and developed a product that addressed it, I started by checking products available on the market. I quickly discovered that the only reflective window product that I could find was a reflective blind for a car windscreen. (*We know of two reflective blind prod-*

ucts—see www.concertinafoilbatts.com/renshade.htm and www.reflectiveblinds.com.au Ed.)

For my reflective blinds I decided to make use of inexpensive 'roller blind kits' available in window furniture stores.

For the reflective part I used a commonly available aluminium foil building product called 'sisalation'. Cheaper versions of sisalation have a paper base, they tear easily and are quite thick. If you can afford it, I would recommend the tear resistant sisalation, not only for its tear resistance, but also because it is available in reduced thickness. The thinner the sisalation, the less bulky the blind when rolled up.

An important aspect of blinds is their aesthetic appearance. They should be coordinated with your taste and lifestyle. For the outside surface there is not much choice—we have to leave the aluminium foil uncovered for the reflective function to work best. However, on the inside surface we can laminate the fabric of our choice to match our décor. It is important to choose a fabric that is thin. My choice was thin cotton.

Laminating blinds

I used 'Bondcrete' diluted with water to laminate the fabric onto the back surface of the sisalation. A diluted water-based art adhesive may be used, but it can be more expensive. I rolled out the sisalation, aluminum foil down, on a flat, non-abrasive surface. Then I rolled my fabric tightly onto a piece of plastic pipe so that I could unroll it evenly onto a glued surface. Using a roller, I applied a thin layer of glue onto the sisalation and then rolled out the fabric from the pipe, pressing it with the pipe and smoothing any bubbles by hand.

An attempt at rolling the sisalation onto the fabric resulted in a disaster. The fabric absorbed too much glue from the roller and got glued to the table below. Not only that, when the laminate dried, the fabric shrank, wrinkled the entire laminate and rendered it totally useless.

Cutting to size

Don't try to laminate an exact-sized blind. It is much better to do an oversize lamination and then cut it to the required size when the glue is dry.

When my lamination dried, I marked two exactly parallel lines with a pencil and cut the required width with a sharp knife guided by a metal ruler. Since parallel edges are an important feature of a roller blind, this step is important. From this parallel-edge strip I cut the lengths required for each window.

At the bottom of each blind I have sewn a folded pocket for a dowel that helps the blind to stay unrolled. Installing the laminated blind on the roller blind kit was easy because the kit contained a self-adhesive blind attachment surface and all instructions.

Results

Even though the aluminum foil reflects 95% of all sunshine, it looks surprisingly good from all directions. On the inside, the fabric is cool to the touch, indicating that not much heat penetrates inside.

The blinds provide me with considerable control over the amount of solar heat that enters my house. I can simply let the sun in or block it almost totally within a few seconds.

Even on the hottest summer day my house interior can stay cooler than the outside air—without any air-conditioning. All I need to do is to ventilate it at night with cooler air and remember to keep the reflective blinds down on the sunny side.

An unexpected bonus of installing reflective blinds turned out to be their winter application. When down, they help to keep the interior warm. Their performance is not quite as good as double-glazing, but is certainly noticeable.

More information on Tom Chalko's home can be seen at www.mtbest.net

On the inside, reflective blinds stay cool to touch even on the sunniest day.

Greywater trial wrap-up

With the ATA greywater trial now ended, Robin Merrick asks our participants what we need to know before installing a greywater system

ATA's greywater trial has reached its conclusion, revealing the secrets that will help those thinking about installing a greywater system in their home this summer.

In this, our trial wrap-up, we ask our greywater families to reflect upon their experiences of selecting, installing and operating greywater systems in their homes: What were the pros and cons? What barriers did they face? And the critical question, would you do it again?

Greywater diverter systems

Two of our six households installed simple greywater diverter systems (see *ReNew 92*) that capture greywater from the home and direct it into the garden via an agricultural line running under an area of lawn.

The householders' experiences of these 'simple diversion' systems were similar. On the whole the systems performed very well, with both households experiencing similar benefits.

'We are delighted with the results,' declared Marion Eyers of Frankston, adding, 'It is embarrassing to look back at our water bills in the year 2000 and see our peak water usage was in excess of 3000 litres per day and 1200 litres just 12 months ago for our two hectare site. Our daily use in summer is now around 600 litres and we hope to reduce this further'.

Ringwood East resident, Evelina North-Coombes, was equally happy with the impact upon her garden. 'The fruit trees are loving it,' she said. 'Our gardener remarked how happy the first stage plants are, evidenced by over 20 buds on the citrus trees, and that the moisture was optimum.

Marion from the Frankston house is delighted with the performance of their simple greywater diversion system.

Whilst both systems are running well, installation of the systems was not without difficulty. In both cases the design of garden trenches involved some guess-work to balance greywater input with the garden's water needs and the systems had to be modified after installation to get them right.

Soil type (readiness to absorb and reticulate the greywater), thirstiness of plants and the garden's slope are particular factors that need to be considered when determining the location, diameter and length of irrigation lines. Design of the irrigation component of these diversion systems requires expert advice to get right, but such advice is expensive and hard to find.

Yet the risks associated with diversion can be managed easily if householders are informed. As Marion explains, 'I would certainly recommend the use of a greywater diverter [but] with two reservations. Firstly, the use on flat land in a small suburban block would require stringent monitoring to prevent unwanted seepage. Secondly, the use of chemicals may cause damage to plants and the soil.'

Diversion via drip irrigation

Trevor Yodgee's experience with the Greywater Gardener system at his Malvern home was less successful. Still under development, the Greywater Gardener system temporarily stores washing machine water in an above-ground surge tank which is then fed slowly into the garden via surface drip-feeders.

The system keeps the irrigation lines at the gardens surface, and by directing drippers to specific plants, the home-

Trial results at a a glance

- Greywater reuse has the potential to significantly reduce mains water use in private homes (by up to 33%!).
- Diversion systems are simple and inexpensive but difficult to get right—expert advice is required to marry greywater output with the water needs of a garden.
- Risks of harm to the environment or humans associated with greywater diversions are largely dependent upon levels of care taken by system owners (particular attention must be given to system inputs).
- All greywater systems require regular, ongoing maintenance.
- Approval processes for treatment systems are onerous and expensive, and consistent and accurate information about greywater reuse is hard to find.
- Treatment systems are complex and consume high levels of embodied and operational energy when compared with the simpler diversion systems. Such consumption is hard to justify at the single-household scale.

owner is better able to monitor the impact of the system and watch out for seepage. This addresses the 'small sites and flat gardens' issue raised by Marion.

However, at the Malvern site, the finely-tuned system failed to deliver the quantity of water required by Trevor's thirsty garden. This was in part because the greywater was only drawn from the washing machine but may also have been due to evaporation of dripping irrigation water. While this can be addressed by adding a layer of mulch, Trevor said he would prefer to capture the large quantities of shower water sent down the drain by his family of five.

While installation of the Greywater Gardener system was quick and easy, it required repeated maintenance to stop the filter and drippers from blocking. Drippers were particularly needy of a monthly flush out. Having said this, the system is low-risk and when fully developed may be ideal for small and/or flat suburban gardens.

By diverting greywater into her toilet cistern, Lisa Coffa from North Fitzroy has reduced her mains water consumption by 33%.

From shower to toilet

North Fitzroy resident, Lisa Coffa, opted for the Wattworks sytem. By diverting greywater into her toilet cistern the system proved highly effective, reducing her mains water consumption by 33%.

The Wattworks system catches greywater in a tank below the bath/shower and pumps it into the toilet cistern on demand. Unused greywater is pumped to the sewer system every 24 hours to prevent it from becoming septic. While Lisa felt it would be great if the system could catch more than just shower water, she was happy with its suitability. 'The system has really met our expectations and we are really satisfied with it. We only use greywater in the toilet so are saving water which is very rewarding. There is a slight odour, however it's not overbearing. The system suits our house and living,' she said.

Installation of the system took one day and maintenance is relatively low, amounting to little more than a monthly cleaning of the filter. All in all the system was quiet, low-risk, cost-effective, and did not require local council approval. However, reliability of parts, particularly the pump and timer, and ease of servicing of these parts are likely to be the big issues for this system.

Sandfilter treatment system

Having a level garden not large enough for a simple diversion system, the Robinson family selected the sand-filter greywater treatment system. The family of five felt that the amount of greywater they expected to generate would justify the system's complex design, approval and installation requirements. The decision was helped by the fact that

the Robinsons were building a completely new home and so were happy to allow the necessary excavation of their garden for installation. This meant they could also separate grey and blackwater pipes at very low cost, thereby capturing all household greywater.

Because greywater was being treated and the system would be permanent, local council approval was required. The approval process was difficult and took over eight months. Council officers were unfamiliar with greywater treatment systems and the regulatory approach for blackwater treatment was applied in the absence of appropriate protocols. Council's conditions included requirements for backflow prevention, public signage and an audio-visual alarm, adding $2,000 to the cost of the system.

Installation was also a lengthy process, thirteen months in all, and involved seven different trades, numerous separate suppliers and frequent coordination meetings on site, costing a total of $14,500.

The sand-filter system required monthly monitoring of effluent, removal of tank bio-solids every three years and annual water testing as well as a monthly clean-out of the pump filter. But since becoming operational in early March, there have been no adverse environmental or human-health impacts and the treated water is relatively clear and odour-free. More treated greywater will be produced by the system than used on the Robinson's garden and the family would like to use this treated water for toilet flushing. However, such use is currently not permitted in Victoria without a tertiary level of treatment.

Carolyn Robinson was philosophical about the family's experience. 'Whether people should put in such a complicated and expensive scheme as this one is questionable, given the expense, level of complexity, and difficulty in obtaining statutory approvals. Should people re-use greywater? Absolutely! Use of greywater gives householders the opportunity to irrigate their gardens at times when rainwater collection is not available. We suggest that simpler, less complex and less expensive systems are more appropriate for domestic situations'.

Peat treatment system

New Water's peat-based greywater treatment system was selected for the Edwards' home in Highett because the family uses large volumes of water to maintain a very productive vegetable garden and fruit trees. Untreated greywater diversion would have been too risky because many of their vegetables are eaten raw and they have two young children. The Edwards also expressed a reluctance to use environmentally-friendly products exclusively, so treatment of the greywater added an additional layer of protection.

Because the New Water system treats the greywater, local council approval was required. Maribyrnong City Council officers liaised regularly with the Edwards and the suppliers of the system, and visited the site repeatedly during its installation. Their fluid, cooperative approach and recognition that they too were learning about greywater reuse allowed the trial to proceed without long approval delays.

The New Water system is performing well and is producing class A effluent. However it is still in the development stage and is regularly 'tweaked' so it is difficult to determine the level of householder maintenance required, or to ascertain the reliability of the system. When asked what he would do if he could start from scratch, Andrew Edwards identified two specific areas relating to the design of the system: 'Specifically, we'd connect the laundry tub direct to sewer, providing an alternative route for the more harmful chemicals,' and because there is currently no winter use for the treated water '…I'll be connecting the system to the toilet cistern after the formal trial period has finished.'

Greywater trial outcomes

Greywater reuse has the potential to significantly reduce water consumption in the home (up to 33%), it's just how this is done that remains the question. Each home will have its own needs and idiosyncrasies but there are a few definite conclusions we can draw from the trial.

Treatment systems are well suited to large volumes of water but are complex, require council approval, consume far greater quantities of energy than diversion systems and can be very expensive. It can also be difficult to find reliable and consistent information about grey-

ATA's rough guide to selecting your greywater system

1. Answer each question in column 1 by selecting your preferred Column 2 response
2. Circle all ticks and M's located on that line
3. Select your preferred system based upon the maximum number of ticks, taking into account the level of management required, indicated by the frequencey of M's

Criterion		Diversion to toilet	Diversion to garden	Treatment system
Column 1	**Column 2**			
Quantity of greywater generated	low	✔	✔	
	medium	✔	✔	
	high	✔	M	✔
Household composition	young children present	M	M	✔
	young children absent	✔	✔	✔
Household visitation	frequent visitors	M	M	✔
	occasional visitors	✔	✔	
Willingness to minimize chemical inputs	high	✔	✔	
	low	✔	M	✔
Use of effluent	native garden		M	✔
	nutrient-hungry garden		✔	
	edibles eaten raw		M	✔
	Orchard/edibles eaten cooked		✔	
	toilet flushing	✔		✔
	clothes washing			✔
Garden size	large	✔	✔	✔
	medium	✔	✔	
	small	✔	M	
Soil type	clay	✔	✔	
	sand	✔	M	✔
Proximity to water body	close	✔	M	✔
	far	✔	✔	
Willingness to maintain system	high	✔	✔	✔
	low	✔	✔	M
Cost	< $1,000		✔	
	<$6,000	✔	✔	M
	>$6,000			✔
Total No. of ticks (✔) indicating suitability of the system				
Total No. of issues requiring careful management (M)				

M: this is a risk requiring careful management
Blank cell: the system is not suitable for the selected task (or the selected use does not justify the financial and environmental costs associated with this system)

water reuse, particularly when using a treatment system. On these grounds alone it is difficult to justify their application to individual homes.

This leaves us with diversion systems. These systems are simple and inexpensive but can require expert advice to make sure your greywater output matches your requirements. It is important to assess your needs before deciding on a particular diversion system. For example, if you live in an apartment or gardenless home with a few window boxes or a small patch of green, you may opt for the shower to toilet diversion system rather than a standard diverter or drip irrigation system. Likewise, a drip irrigation system may not suit your needs if you have a large garden or plot of land.

Ultimately, while there are a number of households willing to take the time to research possibilities for greywater reuse and install systems in their homes, a broad dissemination of practical and consistent information is required before reuse is practiced widely.

As a result, the ATA is using the results of the trial to advocate for policy changes and more reliable information about how best to reuse greywater in individual homes. The greywater reuse trial has played an important part in assessing the potentials of greywater use and the ATA would like to thank the many supporters of the ATA Smartwater Greywater Trial:

First and foremost, we thank the Smartwater Fund for funding the Greywater Trial. We also extend particular thanks to John Lawry, Jenny Bailey (Yarra Valley Water, Liza Dale-Hallett (Melbourne Museum), Paul Talbot and his staff at PJT Green Plumbing, Richard Playne (Envirosmart Plumbing), Gary Horton (Triangle Filtration), Max Ekins (Davey Products), Max Winrow (Everhard Industries), and Mal Gordon (New Water Corp.).

And of course, we thank our six marvellous greywater households—Jeff and Carolyn Robinson, Oliver and Evelina North-Coombes, Andrew and Karen Edwards, Norman and Marian Eyres, Trevor and Sue Yodgee, and Lisa Coffa, without whom the trial would not have been such a success.

Sustainable strawbale

Martin Freney shares his experience of how a storage shed evolved into the perfect passive solar strawbale home

Inspired by the teachings of the Food Forest Permaculture Design Course (PDC) in January 1999, my partner Zoe and I realised a sustainable lifestyle was both possible and within our grasp. By August 1999, we had purchased a 1.5ha sloping block of land in Ironbank, South Australia, and it was on this land we decided to establish a more ecological way of living. Our goals were to build a home using environmentally sound materials (salvaged wherever possible), to minimise pollution by reducing our energy consumption, and to grow as much of our own food as possible (for health, reduced food mileage, pesticides et cetera). This was it—our blueprint for living happily in an increasingly weird world.

Our block of land, facing NNW, was ideal for establishing a small permaculture 'farm' and it took about 12 months, until July 2000, to level the site and build a seven metre by 12 metre shed. The shed would be our home for a year and a half and a storage facility for salvaged building materials for our yet to be designed house.

Martin, Zephyr and Zoe in front of their healthy and environmentally-friendly home.

Research and design

After sketching hundreds of floor plans and reviewing countless eco product pamphlets, we decided we needed help. In early 2001 we enlisted the services of local ecological practitioners, architect Bohdan Dorniak and structural engineer Gerald Wittmann. We had fallen in love with the thick, curvaceous, organically aesthetic, insulating properties and DIY potential of strawbale walls and so decided on a strawbale construction with composting toilet and reed bed treatment system, and of course, passive solar design.

Not being connected to the sewer system and recognising there is no such thing as waste, choosing a compost toilet was a simple matter. The reedbed system required no contracted maintenance plan, no chemicals and was entirely DIY.

The passive solar design would keep us warm in the winter and cool in the summer, with minimal active heating and cooling and significantly reduced energy use.

We initially intended to build the house from scratch but in a bizarre twist to the plot we decided instead to convert the shed. It was perfectly located, facing north, high on the sloping block near the access track and already had electricity, water and telephone connected. We scrapped our original plans and gave Bohdan a brief to convert the shed into a house. One of the benefits of living in the shed for almost two years was that we got a great feel for how the block 'worked'—where the wind blew from, where noise came from, where the sun rose/set, and where shadows were cast by tall trees. It was clear that the shed was where the house should be. We set about building another shed so that we would have somewhere to store salvaged building materials.

Within a few months we had a set of plans prepared. Then insurance company HIH collapsed and our building contract fell through! What now? We decided to become owner builders. We had always wanted to have a lot of involvement with the building process so we could easily salvage materials and

building components and incorporate them into the house design. Here was our chance. We were also hoping to save money and this made it possible for us to 'tweak' the plans without great expense. As an industrial designer I could not resist fiddling with the floor plan, location of the cool cupboard, the roofline et cetera. My technical drawing and design skills were very useful, as I spent many hours making minor alterations to the plans before submitting them to council for approval.

Approval

The City of Onkaparinga council was quite receptive to our development proposal for a house with straw insulated, concrete-rendered walls. But they were openly surprised and bewildered by the reedbed and composting toilet which we soon found could (and should) be handled by the Department of Human Services (DHS).

A private certification authority (Katnich Dodd Pty Ltd) was enlisted to certify the building application to avoid hassles with prejudice about strawbale houses. The Country Fire Service (CFS) was also consulted and had no problems with the house. As long as it had 22,000 litres of fire-fighting water, water pump, sprinklers, hoses, 14 metres of clearance from trees et cetera, they were happy. Thankfully, Bohdan had recently organised and supervised CSIRO testing of strawbale walls that proved strawbale is okay in bushfire zones, which meant that we no longer had to clad our walls in concrete. What a relief, as we wanted to use the terracotta coloured clay from our excavated site.

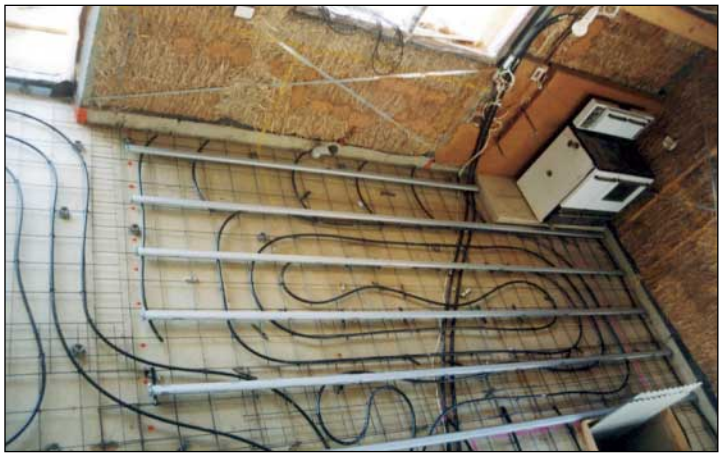
Finance

We needed a bank loan and had surprisingly little difficulty in borrowing $150,000. I think this was due to the fact that we owned the land outright which we used as collateral. About another $30,000 got pumped in (my salary) over the course of the building process.

Originally, we naively asked for just $80,000 so had to go back twice more for extra funds. Some of the things I failed to budget for were equipment hire (including six months scaffold hire—we should have bought some secondhand) and all the little stuff that just seems to add up: screws, tools, paint; it became a huge list of tools and materials.

Strawbale wall building

The farmer that grew our straw stored the bales for about six months as we were not ready to have them delivered. Eventually though, in early 2002, he needed to get them out of his hair and so we had to store them for about another six months until we were ready to use them. It was very important to



Above: Zoe applying some of the 40 tonnes of render to the outside walls. Top left: The in-slab floor heating system was installed before a concrete topping was poured over the existing shed slab. Left: The bathroom's stud walls before being 'baled'.

keep them well wrapped up with plastic and we set many mouse traps; the weather and vermin are a big threat to un-rendered strawbales.

Lance Kairl, one of South Australia's most experienced strawbale builders, was consulted often throughout our owner building project. He also had a lot of input and discussion with the architect during the design phase. Lance was on site for our weekend 'wall raising' in November 2002, which many friends and family (and Bohdan!) helped with. It was a weekend of fun and all went smoothly on account of Lance's supervision.

The wall raising only took a couple of weeks to complete, and in the same month we also managed to construct our ceiling (galvanised custom orb) and install a 1500 watt PV system. One advantage of an earth-rendered strawbale wall is that you don't need to use chicken wire on the walls, only around the windows and doors where the bales have been cut to length. However, the three coats of render (40 tonnes of sand and clay) took us about a year of weekend rendering. We investigated the option of spraying the render on but at that stage there were no local render spraying contractors (I think Lance has one now).

After the final coat of render had dried, we sprayed on a solution of potassium silicate (water glass). I think that it was too thick and didn't soak in far enough, creating a thin and brittle two millimetre layer on the surface of the wall which is susceptible to water damage. As a result we are having some problems with the northern wall which is hit by the full force of winter rain funnelling up our valley. Experiments with mixing the water glass into the render (rather than spraying) have been more successful but I would be interested to hear from others regarding their solution to this problem. I have some maintenance to do.

Materials

We had gone to great effort to salvage some doors and windows from an old mansion that was being demolished on the Glenelg foreshore. A friend was renting it and put us in touch with the new owner/developer. We carted off all the windows and doors, power points and light switches that we would need—all for about $1500!

But disappointingly, we found that the Australian Standard for Construction of Buildings in Bushfire-prone Areas (AS3959-1999) deemed that our windows were unsuitable because they

were not made of a hardwood. We traded them with our friend Ray (who we met at the Food Forest course) for his electrical services.

We used the salvaged doors as they seemed to be made from a hardwood and many of them were for internal use so did not need to be fire resistant. We commissioned a local joiner to manufacture double-glazed jarrah single sash windows, and one large sliding glass door. Beautiful, but expensive (about $23,000) and I'm still not happy about the impact on the West Australian forest that it came from, but the upside is that they are strong, durable, energy efficient and will bring us great joy for the life of the house—hopefully longer than my lifespan!

Other salvaged materials included jarrah floorboards which we have used in the kitchen and bedroom, pine timber for the stud walls, all the kitchen cupboards (some very funky art deco numbers), the claw footed bath (free from a friend and restored for $1000), the wood oven, red brick pavers, and the proverbial kitchen sink. The cladding for the bathroom wall was taken from the original shed.

Results

Our electricity bill is about $20 to $40 per quarter in the summer and about $200 per quarter in the winter. Most of this is on boosting the solar hot water.

The solar hot water system is fantastic in the summer but still needs a nightly 'off-peak' boost in the cooler months. We have insulated the tank with astro-foil which has reduced the nightly temperature loss from 14 degrees to approximately four degrees, but this depends a lot on the outside air temperature.

When it is 45 degrees outside it is 30 degrees inside which is too warm for comfort, so sometimes we use a small portable evaporative air conditioner—we used it on two days during the summer of 2002-2003, which was hot! We open the windows in the evening and there is usually a cool gully breeze that blows the hot air out.

When it is zero degrees or less outside it is still 15 degrees inside—without any heating. The small wood oven easily brings the temperature up to a comfortable 19 degrees in an hour or two. We only burnt about a tonne of wood this winter.

The floor heating system is a small disappointment. Although it is won-

House Features

• 1500 watt grid-connected photovoltaic system—Kaneka thin-film amorphous 27 panel (3 x 9) array. Approximately $13,000 after $7,500 rebate.

• 330 litre solar hot water system (with frost protection system)—twin panel, roof mounted tank, frame mounted at 30 degrees to improve insolation.

• Reedbed water treatment system—using roto-moulded polyethylene plastic tubs (manufactured by TeamPoly), designed by Chas Martin of Soft Technology. Treated water is used to irrigate the fruit orchard.

• Strawbale walls, earth rendered—10 tonnes of clay excavated from building site (cost negligible), 30 tonnes of sand (delivered). Bales are super dense, specially compacted for strawbale wall building.

• Compost toilet (batch system—Nature Loo)—our poo is now a valuable resource, fertilising our fruit trees, and we are not wasting precious water resources on flushing.

• Cool cupboard—passive cooling for food, especially fruit and vegetables, so only a small fridge is needed.

• Wood oven with 'wet-back'—acts as a space heater, floor heater (via in-slab water pipes), and a regular oven (although we also have an electric oven for use in summer).

• Hydronic floor heating—in-slab floor heating system was installed before pouring a 'topping' over the existing shed slab. Thermostat controlled electric pumps distribute water to various floor areas via polypipe circuits. A manifold in the laundry is used to control which floor area is heated.

• Rainwater storage (approx. 50,000 litres)—supplies the house for at least 11 months of the year, although we can switch to mains supply if necessary. The garden is on mains supply.

• Indigenous species wood lot has been planted to supply wood for heating and cooking.

• Passive solar design—large north-facing double-glazed windows with correctly designed eaves and internal thermal mass (slab floor and rendered walls).

• Permaculture fruit and vegie gardens—already harvesting about 10% of our food needs.

• Alpacas (two)—help to keep the grass trimmed (important for bushfire safety) and provide manure for the garden, wool for clothing and entertainment for the whole family! $990 for two male lawnmowers (not breeding stock).

derful to have a warm floor, it is slow to heat up and cools-off too quickly. It must need extra insulation (somehow) to stop the heat from leaking into the earth.

The system doesn't work well under the timber floors, and our small wood oven is only capable of heating one of the six circuits that have been installed, meaning only one patch of floor can be heated at any one time. I am hopeful that powering it with solar water heating technology may be the way to go.

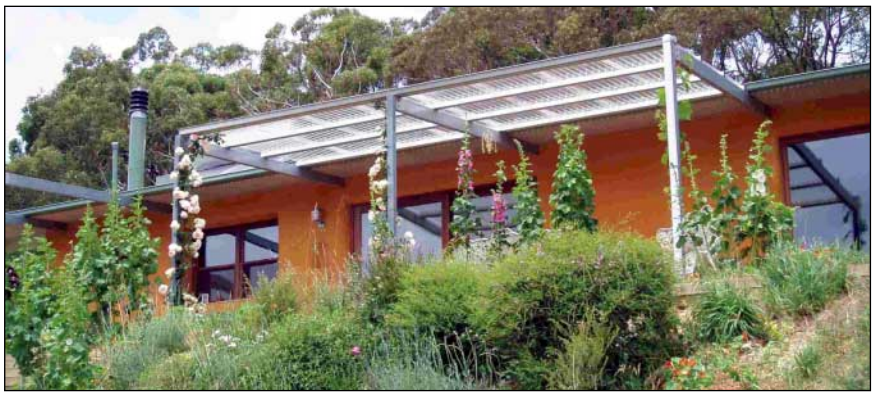
The open plan living space is used for everything and while this is occasionally frustrating, it is more often a blessing; the family is united, interacting and enjoying the open and healthy space together. It certainly helps us keep an eye on our toddler Zephyr while still getting something else done.

The double-glazed windows are excellent but they still get cold to the touch, indicating that there is substantial heat loss. Heavy duty curtains would be a big improvement and would reduce the amount of wood we need to burn to keep warm.

Resources

The most important resource throughout this project was people. Our network of friends, family and colleagues provided much support, encouragement, knowledge and manual labour. Our permaculture and professional contacts were consulted regularly and often they were happy to offer free advice.

My father, a recently retired mathematics teacher, was on site six to seven days a week for over a year! Without his handyman skills, tools, and enthusiasm, I hate to think what would have become of our house. He sure managed to get things square and level and he kept the various contractors on the straight and narrow too!



Reflections

Living in a sustainably-built home is fantastic; the reduced energy bills are very welcome, but mainly, it is the knowledge that you are protecting your family's health, reducing damage to the planet and promoting and supporting ecological technology. Facing the house towards the sun hardly sounds high tech but it can be as simple as that. In total it took just under three years, from building our original shed to moving in to our home.

As a lecturer in industrial design in the School of Architecture and Design at the University of South Australia, I have demonstrated my house to many architecture students and am privileged to work with some enlightened architects/educators. I am very hopeful that these students, the up and coming architects of the future, will make ecological homes accessible to the masses and one day such homes will be the norm.

Renewable energy courses

There are a number of options if you are looking to study renewable energy, Olivia Neville-Smith updates on what is on offer

Whether you are looking to enter the renewable energy industry as a system designer or installer, or wanting to install your own renewable energy system, there are a number of courses on offer.

Some institutions offer modules towards Business Council of Sustainable Energy (BCSE) Accreditation and Certificate 4 courses. You can then opt to complete a Diploma or Advanced Diploma or undertake a Bachelor of Engineering or postgraduate degree.

BCSE Accreditation

BCSE Accreditation is not necessary for anyone wishing to design or install renewable energy systems, but you do need it to qualify for the rebates and it may be a requirement for some commercial/industrial work. Recognition of prior learning, such as an existing electrical qualification, can help attain BCSE Accreditation, or you can pick selected modules within the course.

There are a number of TAFE institutes and Registered Training Organisations (RTOs) that offer accredited courses, though in regional areas they may be difficult to locate. If you are struggling to find a course provider try contacting your local institution, as some offer courses based on level of demand.

Some institutions offer distance or online modules, but remember you may have to complete practical exercises as part of your training. Practical elements of the courses can sometimes be completed while you are on the job.

BCSE Accreditation is directly linked to specific TAFE modules. Contact details for TAFEs that offer accreditation pathways are available from the BCSE website, or see the table overleaf.

Students practice making and wiring extra-low-voltage control boxes.

'If you are an experienced designer/installer but you're not qualified, the BCSE can recommend people who can assist you with your application for recognition of prior learning (RPL). This is a cheap and time-effective way to qualify for BCSE Accreditation,' says Mike Russell, Industry Development Officer at BCSE.

Statement of attainment

A number of TAFE institutions offer a basic Statement in Renewable Energy. These modules can be taken at any time and may count towards the Certificate 4 in Electrotechnology Renewable Energy.

Certificate 4

The Certificate 4 in Electrotechnology Renewable Energy offers a broader overview of sustainable energy technologies, but also allows you to pick selected modules to obtain your BCSE Accreditation. To gain endorsements to your BCSE Accreditation, Diploma modules such as Wind Energy Conversion Systems 1, Hybrid Power Systems and Micro-hydro Systems can be selected.

With the increased interest in grid-tied systems, grid-connect accreditations are available from the BCSE. They are Grid-connect (Design and Supervise) or Grid-connect (Design and Install) Accreditations. To qualify for the latter, you must be a licensed electrician as you will be dealing with low voltage (greater than 120VDC/50VAC).

Getting your Certificate 4 can either be a qualification in itself, or a step towards completing a Diploma and then Advanced Diploma.

Entry requirements for the Certificate 4 are year 12 maths and science or application as a mature age student.

Degree and Postgraduate

For more career options, you may consider taking a Bachelor of Science degree. There are a significant number of jobs in the industry for which you need more than the TAFE/BCSE training. There are positions available in the renewable energy field in the utilities sector, government agencies (both state and federal), and in private industry.

Completing a Bachelor of Engineering in renewable energy, or, if you are already an engineer, by taking a Postgraduate Diploma (Energy Studies) or Masters of Science (Renewable Energy), will enable you to work on a range of renewable energy projects. ✲

The BCSE website is www.bcse.org.au and accreditation instructions can be found at *Installing Renewables / Accreditation / Becoming BCSE Accredited.*

Institute	Courses available	Entry requirements	Next intake date	Course format. Online/distance options.	Course code	Course contact name	Comments
Brisbane North Institute of TAFE Bracken Ridge, QLD	Accreditation of selected modules for BCSE	Year 12 maths and science or mature age entry (an existing electrical qualification will reduce modules undertaken)	January 2006 (however you may enrol at any time throughout the year)	Full-time distance. Part-time on campus		David Berry and David McKee Ph:131 248 rec.bnit@det.qld.gov.au www.bn.tafe.qld.gov.au	Some modules from this course require practical exercises. Practical exercises may be completed on the job or through attendance at our campus, however this may be negotiated. Fees depend on the number of modules undertaken. Approximate cost per module ranges between $20 and $90
	Diploma of Electrotechnology Renewable Energy	Year 12 maths and science or mature age entry		Full-time and part-time. On campus and distance	39089QLD		
	Adv Diploma of Electrotechnology Renewable Energy				39088QLD		
Canberra Institute of Technology Canberra, ACT	Renewable Energy Introduction Statement of Attainment	Year 12 maths and science or mature age entry	January 2006	On campus	SA-2J07	Greg Hartup Ph:(02) 6207 4038 greg.hartup@cit.act.edu.au or Max Klemke Ph:(02) 6207 4017 max.klemke@cit.act.edu.au www.cit.act.edu.au	
	Certificate 4 in Electrotechnology Renewable Energy		May be offered July 2006		UTE41301		
	Training Program in Renewable Energy Systems and Technologies		January 2006	On campus	SA2-J99		
	Training Program in Renewable Energy Power Systems		Not known	On campus	SA-2J100		
Central TAFE East Perth, WA	Cert 3 in Electrotechnology Renewable Energy	Year 10 or mature age entry	January 2006	Full-time and part-time		John Paskulich Ph:(08) 6211 2267 john.paskulich@central.wa.edu.au www.central.wa.edu.au	Diploma offered 2007
Chisholm Institute of TAFE Berwick, VIC	Cert 4 in Electrotechnology Renewable Energy	Year 12 maths and science; Certificate 3 electrical; mature age entry	December, January and February	Full-time and part-time. On campus and some distance modules	UTE41301	John Flanders Ph:(03) 9212 4583 john.flanders@chisholm.vic.edu.au www.chisholm.vic.edu.au	Aimed at people interested in design, installation, commissioning, operation, maintenance, equipment sales, consultancy, energy management
	Diploma in Electrotechnology Renewable Energy	Certificate 4 in Renewable Energy or equivalent			UTE50601		
Cooloola Sunshine Institute of TAFE Nambour, QLD	BCSE Accreditation	Maths/science or equivalent or a suitable bridging program	Twice a year	Some components		Alex Thorogood Ph:(07) 5459 3719 alex_thorogood@hotmail.com www.csit.tafe.qld.gov.au	Full-time and part-time. Aimed at people wanting to become installers
	Diploma of Electrotechnology Renewable Energy	Maths/science or equivalent or a suitable bridging program	January and June 2006		39089QLD		Full-time. Aimed at people interested in consultancy/system design and installation, energy management and sales
	Adv Diploma of Electrotechnology Renewable Energy	Year 12 maths/science or mature age entry	January 2006		39088QLD		Full-time and part-time
Curtin University Perth, WA	Masters Engineering Science (Electrical Engineering)	Bachelor degree in Electrical, Electronic and Computer Systems Engineering	Twice a year	On campus only	300821	Margaret Pittuck Ph:(08) 9266 9200 pittuckm@ece.curtin.edu.au www.curtin.edu.au	Students can study these courses with an emphasis on Renewable Energy Engineering
	Masters Engineering (Electrical and Computer Engineering)				300550		
Electrotech Skills Centre Rhodes, NSW	Certificate 4 in Electrotechnology Renewable Energy				UTE41301	Mr Mike Horne Ph:(02) 9736 1950 mikeh@egt.com.au www.electroskills.net.au	
Gordon Institute of TAFE Geelong, VIC	Certificate 4 in Electrotechnology Renewable Energy	Nil	January 2006		UTE41301	Ray Black Ph:(03) 5225 0574 rblack@gordontafe.edu.au www.gordontafe.edu.au	Subjects available include Introduction to Hydrogen Fuel Cells and Hydrogen Fuel Cells - Commissioning and Maintenance

Institute	Courses available	Entry requirements	Next intake date	Course format. Online/distance options.	Course code	Course contact name	Comments
Lithgow TAFE Lithgow, NSW	Certificate 2 Electrotechnology Servicing				4292	Frank Westgate Ph:(02) 6352 0444 www.wit.tafensw.edu.au/campuses/Lithgow.cfm	
Mt Druitt TAFE Mt Druitt, NSW	TAFE Statement in Renewable Energy		30 January 2006		9974	Stephen Foote Ph:(02) 9208 6293 stephen.foote@tafensw.edu.au	
Monash University Melbourne, VIC	Engineering and Economics of Solar PV Energy Systems	Nil	Anytime	Online only		Ahmad Zahedi Ph:(03) 9905 5957 ahmad.zahedi@eng.monash.edu.au	This is a 10 week course. Students complete in own time
Murdoch University Perth, WA	Masters of Science (Renewable Energy)	Recognised degree in a relevant field. Students with alternative, satisfactory preparation may also be admitted	January 2006, July 2006 intake may also be available	Online and on campus options available	M1012	Philip Jennings Ph:(08) 9360 2274 p.jennings@murdoch.edu.au www.murdoch.edu.au	2 years full-time
	Masters of Science (Environmental Architecture)	Recognised degree in a relevant field			M1133		2 years full-time
	Postgrad Diploma in Energy and the Environment	Recognised degree in a relevant field. Students with alternative, satisfactory preparation may also be admitted			P1030		1 year full-time
	Postgrad Diploma in Energy Studies				P1000		1 year full-time
	Bachelor of Applied Science (Energy Studies)				B1201		1 year full-time
	Postgrad Certificate in Energy Studies				C1008		1 semester (0.5 year) full-time
	Bachelor of Science (Energy Studies)	Entry based on tertiary entrance rank			B1190		3 years full-time. Articulation from Certificate 4 in RE and Adv Diploma available. Fourth year/ Honours also available
Murdoch University Rockingham, WA	Bachelor of Engineering (Renewable Energy)	Entry based on tertiary entrance rank	January 2006	Full-time and part-time	B1186	Martina Calais Ph:(08) 9360 7070 m.calais@murdoch.edu.au www.murdoch.edu.au	
Northern Melbourne Institute of TAFE Epping, VIC	Certificate 4 in Electrotechnology Renewable Energy	VTAC entry or Certificate 3/ apprenticeship or mature age entry	Contact us anytime for an appointment	Limited subjects offered. (Intro to RE)		John Sakalauskas Ph:(03) 9269 1093 johns-alt@nmit.vic.edu.au or Gerry Cervasio Ph:(03) 9269 1068 gerryc-ae@nmit.vic.edu.au www.nmit.vic.edu.au/courses/electrical	Diploma course will follow if sufficient interest in 2007. $1.31 per contact hour. $150 materials (FT course). $130 student services fee, text books extra (optional), concessions apply
	Diploma of Electrotechnology Renewable Energy				UTE41301		
Regency TAFE Adelaide, SA	Certificate 4 in Electrotechnology Renewable Energy (various modules only)	Contact Regency TAFE	January 2006	Some distance	UTE41301	Aussie Kanck Ph:(08) 8348 4462 aussie.kanck@tafesa.edu.au www.regency.tafe.sa.edu.au/electrical	Diploma modules also offered. 2005 fee was $3.40/hr. May be a slight increase in 2006
Southern Institute of Technology Invercargill, NZ	Certificate in Applied Technology (Renewable Energy)		February 2006			John Knight Ph: 1800 197 485 john.knight@sit.ac.nz www.sit.ac.nz	Course is under Zero Fees - check details in information pack
Swan TAFE Bentley, WA	Certificate 4 in Electrotechnology Renewable Energy	Year 12 maths and science or mature age entry	Second intake January 2006. End September 2006 for 2007 entry		UTE41301	Colin Crocker Ph:(08) 9442 8356 colin.crocker@swantafe.wa.edu.au www.swantafe.wa.edu.au	
	Diploma of Electrotechnology Renewable Energy	Certificate 3/ Certificate 4	Second intake January 2006. End September 2006 for 2007 entry		UTE50601		
Swinburne University of Technology Hawthorn, VIC	Certificate 4 in Electrotechnology Renewable Energy	Mature age entry recommended	January 2006	Most subjects evening classes	UTE41301	Andrew Blair Ph:(03) 9214 8099 ablair@swin.edu.au www.swin.edu.au	Students may enrol in any of the modules offered. Fuel Cells and Advanced Storage Systems are offered in 2006, an Australian first. Provides BCSE Accreditation
	Diploma of Electrotechnology Renewable Energy		January 2006	Most subjects evening classes	UTE50601		
TAFE NSW - Hunter Institute, Muswellbrook Campus Muswellbrook, NSW	Certificate 4 in Electrotechnology Renewable Energy	Stand-alone systems - open entry. Grid-connect - electricians licence	July 2006	Distance education with practicals on campus	4291	Gary Brooker Ph:(02) 6542 1112 gary.brooker@tafensw.edu.au www.tafensw.edu.au	Provides BCSE Accreditation
TAFE NSW - South Western Sydney Institute, Granville College Granville, NSW	TAFE Statement in Renewable Energy	Nil	30 January 2006	Part-time only	9974	Alan Birse Ph:(02) 9682 0241 Alan.Birse@tafensw.edu.au www.tafensw.edu.au	Most subjects required for BCSE Accreditation are offered if demand is sufficient
TAFE NSW - Ultimo College Ultimo, NSW	TAFE Statement in Renewable Energy	Open entry	January 2006		9974	Information Officer Ph:1300 360 601 sydney.info@tafensw.edu.au www.sit.nsw.edu.au	
University of NSW Sydney, NSW	Photovoltaic Devices and Applications		Enrol anytime - though March best to be with larger discussion group. 12 week course	Online only		Rob Largent Ph:(02) 9385 5457 r.largent@unsw.edu.au www.pv.unsw.edu.au	
	Bachelor of Engineering Renewable Energy Engineering		August 2006 for 2007 start	On campus only			
	Bachelor of Engineering Photovoltaics and Solar Energy Engineering		August 2006 for 2007 start	On campus only			
Wodonga Institute of TAFE, Wodonga VIC	Adv Diploma of Renewable Energy		January 2006	Part-time only	39088QLD	Jon Bowdery Ph:(02) 6055 6637 jbowdery@wodonga.tafe.edu.au www.wodonga.tafe.edu.au	Provides BCSE Accreditation

Futureworld Eco-Technology Centre

Paul Cooper gives us a quick tour of a great eco-technology centre that is educating the general public about sustainable energy and water use

The Futureworld Eco-Technology Centre is a special place for the community where all forms of ecologically sustainable technologies and services are promoted. Located in Wollongong, New South Wales, the centre has been developed almost entirely through the hard work of Futureworld volunteers, many of whom are also ATA (publishers of *ReNew*) members.

Futureworld is a not-for-profit group formed in 1992, and after many years of preliminary work the Eco-Technology Centre was officially launched in November 2003 by the then Premier of NSW, Bob Carr. The centre is presently located in a rented 'recycled' industrial building, but Futureworld hope to raise funds for a purpose-built exhibition centre at a nearby six hectare site which is leased from Wollongong City Council.

The Eco-Technology Centre features a wide range of hands-on activities and displays designed to inspire visitors and provide an interactive experience. The idea is to motivate people to change the way in which they live and to provide information on how to make the right decisions for the environment—when buying appliances; designing a new home; renovating an existing home; installing renewable energy power systems; choosing an appropriate means of transport, et cetera.

A Chinese business delegation enjoys generating their own wind energy with the interactive wind farm display.

Greenhouse Gasometer

The Eco-Technology Exhibition features lots of unique displays and activities that have been designed by the Futureworld exhibition development team. One of the most popular displays is 'What is a Watt?' that incorporates the Futureworld 'Greenhouse Gasometer'. The display provides visitors with a tangible way to understand the link between domestic electricity use and greenhouse gas emissions. The visitor pedals an exercise bicycle, which progressively switches on appliances such as lights and fans via a micro-computer so that electricity is consumed at the same rate as the visitor provides pedal-power. Air (representing CO_2) is pumped into a column of water in proportion to the pedal-power produced by the visitor. This gives a physical and visual representation of the greenhouse gas that would be emitted by a conventional power station powering the same appliances in someone's home.

This is a powerful educational tool and the Futureworld volunteer guides can readily engage visitors with the implications of every Australian producing approximately 28 tonnes of greenhouse gas emissions every year.

The Eco-Technology Centre has many displays on renewable energy, including:

- Wind energy displays including an interactive model wind farm and a 150kW decommissioned wind turbine
- Solar photovoltaics covered by a grid-connected 12 panel PV array, solar water pumping experiments, a 'Pyramid' RAPS unit and several interactive exhibits
- The hydro-electricity display incorporating a working pico-hydro Pelton wheel
- Sustainable water transport including the *Marjorie K* solar boat, winner of the national solar boat race and prototype for the full-scale Solar Sailor Ferry now operating commercially on Sydney Harbour
- Wave energy with a 15m long wave tank incorporating a scale model of the Energetech Australia wave energy power plant that is currently being devel-

oped at Port Kembla (Wollongong).

In addition, the 'Mini Eco-House' demonstrates many aspects of sustainable building design and promotes practical ways of reducing energy and water consumption in the home through use of appropriate appliances. Futureworld also produces its own green electricity through its own grid connected PV system donated by Integral Energy.

Visitors from far and wide

Attracting Australian and international tourists to the Eco-Technology Centre is one of the key goals of Futureworld, and visitor numbers are progressively increasing. Visitors have sought out Futureworld from a great variety of backgrounds and geographic locations. For example, one of the first groups to visit were a group of Thai school students who were winners of an environmental essay competition. They found the centre through the Futureworld website and arranged the visit with a local travel agent. Futureworld also hosted a delegation of Chinese journalists who were fascinated by the exhibition of renewable energy systems and the group went on to see the full-scale Energetech wave power plant being commissioned in Port Kembla harbour.

Local newspapers, radio stations and TV have been extremely helpful and Futureworld has received a great deal of publicity for all their events, including monthly seminars on a wide range of sustainability topics. Recently such events have included workshops on wind farming, sustainable domestic water use, and creating an energy smart home. The recent workshop on solar electricity attracted nearly 50 attendees with several going on to have PV systems installed. Futureworld has also been leading the way in the region by informing the community through a series of workshops on the new BASIX system of energy and water efficiency for new homes and renovations in NSW.

A Futureworld volunteer explains wave energy to primary students.

Futureworld employs a full time education officer as a very large proportion of visitors are school students. In fact, the number of schools wishing to visit the centre seems to be growing exponentially. Futureworld initially focussed on the development of special activity programs for primary school students with these being specially tailored to meet the requirements of the NSW environmental education curriculum. However, this year the educational program has been extended to cater for high school students with some quite challenging activities developed for a wide range of abilities.

Futureworld has attracted broad funding from local and state government sources, and the private sector (including the IMB Community Foundation and Bluescope Steel Ltd). However, Futureworld are keen to explore new partnerships, particularly with new industry and other private sector sponsors.

It is hoped that with further community, business and government support the Futureworld Eco-Technology Centre will become firmly established as one of the premier renewable energy and sustainability exhibition centres both nationally and internationally.

ATA readers interested in becoming involved with the Futureworld project should visit the Futureworld website at www.futureworld.org.au or phone the Eco-Technology Centre on 02 4226 9147.

Former NSW Premier Bob Carr at the launch of the Futureworld Eco-Technology Centre.

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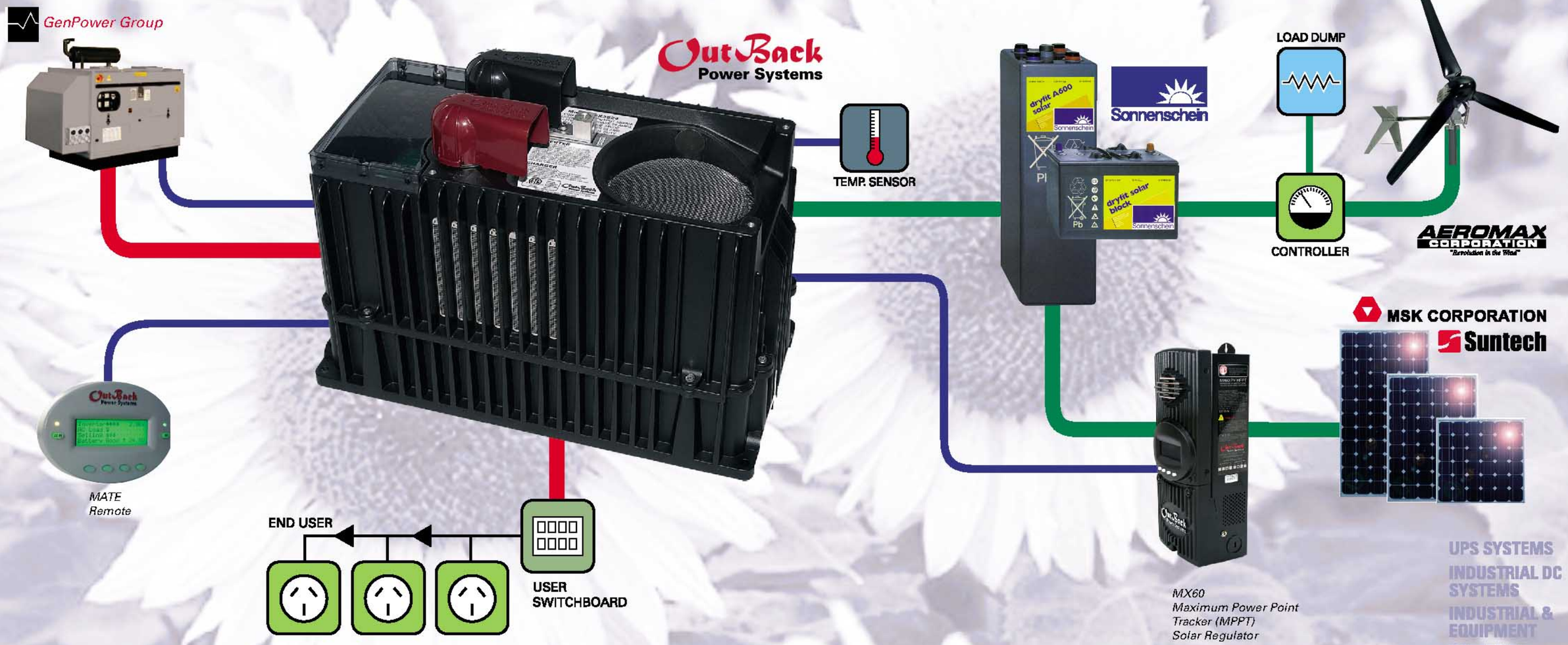

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Rolling out empowerment in Namibia

Former *ReNew* editor Michael Linke has taken his talents to Africa and is helping to provide affordable bicycles to some of Africa's poor

Six years ago, when I worked for this magazine, if anyone had told me I would end up running an NGO in Namibia I would have been incredulous. 'Where?' would have been my first question. But a few years and random turns of event later, here I am in Windhoek, the capital of this arid southwest African country, immersed in an organisation called the Bicycling Empowerment Network Namibia: BEN Namibia for short.

BEN Namibia

BEN Namibia began operations in May 2005 with the aim of distributing affordable bicycles among disadvantaged Namibians. Such personal mobility is an important tool in increasing access to healthcare, education, employment and social opportunities. It sources secondhand bicycles from specialised charities in the UK, US and Europe and ships them to Namibia where they are refurbished by local people who receive an income and training in bike mechanics. The bikes are then sold to recover some of the shipping costs, rent on a storage warehouse/training centre and other overheads, although the organisation is still partially grant dependent. Some bikes are sold direct to the public, while others are sponsored for donation to healthcare volunteers, orphans and other disadvantaged groups. The foundations have been laid for a national network of bike shops guaranteeing ongoing availability of maintenance and spare parts and establishing a national bike distribution network.

Some of BEN Namibia's trainee mechanics in the Windhoek workshop.

Poverty and AIDS

Namibia is a little larger than New South Wales and is bordered by South Africa, Botswana, Angola and the Atlantic Ocean. It has been a colony for most of living memory, only gaining independence from South Africa in 1990.

The legacy of apartheid pervades Namibian life, and much of the majority black population live in poverty. The social problems brought about by years of unequal access to education, employment, land, healthcare and the mechanisms of power would take generations to rectify on their own, but in Namibia they're coupled with one of the world's highest HIV/AIDS infection rates. A staggering 23 percent of the adult population is infected, placing a huge strain on families, communities and a relatively new democratic government. The average life expectancy in Namibia is just 40 years.

It could get worse. AIDS orphans are growing in number as their parents succumb to the disease, and are stretching the abilities of traditional extended family networks and communities to help. With around 80,000 AIDS orphans in a total population of two million, child-led households are increasingly common; within the next seven years many communities will be overwhelmed by children and adolescents with no parents. Imagine *Lord of the Flies* across an entire country and you can imagine why local and international healthcare agencies are seriously worried.

Mr Elephant's Bike Shop

Against such a bleak backdrop, a new visitor to the country might be excused for expecting life in Namibia to be a gloomy, depressing and downtrodden experience. To set the record straight, I would take them as soon as possible to a squatter camp called 'DRC' on the outskirts of the coastal town of Swakopmund. Amidst the mass of shacks made from old car panels, broken asbestos sheets and bits of driftwood I would lead them directly to Mr Elephant's bike shop.

Mr Elephant—yes, that's his real name—opened his shop two years ago with little more than a selection of broken spanners and an idea of servicing the rusting clunkers ridden by the people in his community. To most people living in the DRC camp, conventional bike servicing is beyond their means. But Mr Elephant found he could cannibalise old bikes for parts and offer his services at a reasonable price. With his 'always on' smile and enthusiastic self-promotion he soon developed a big customer base, and even started buying, repairing and reselling bikes.

Business was good, but he lacked the capital to buy more than a couple of old bikes and found he couldn't source new parts at a reasonable price. He knew he had all the business and mechanical skills to expand but no bank would give a squatter a loan. Mr Elephant was experiencing one of the inbuilt mechanisms through which poverty entrenches itself.

I don't know who was gladder to meet who. For me, Mr Elephant is the perfect example of a BEN Namibia partner—someone looking for a help up, not a hand out. For Mr Elephant, his stock problems are over. He has a supply of affordable second-hand bikes to sell (BEN Namibia provides them on consignment at a wholesale rate) and access to a range of new spare parts sourced by the organisation. For the people in the DRC camp there are some direct employment opportunities as Mr Elephant employs new staff to help him out, and multiple beneficiaries as the hour-and-a-half walk to the nearest health services and employment opportunities becomes a twenty-five minute cycle.

Top: Mr Elephant inside his bike shop. Bottom: HIV/AIDS home based carer Meme Gudrun tests a prototype bicycle ambulance developed by BEN Namibia for emergency medical transport.

Meme Gudrun the carer

In the unlikely event that Mr Elephant's story hadn't convinced the visitor of the resilience of the Namibian people, we would then take the 800km journey to Oshakati, the major town in the populous north of the country. Somewhere on the outskirts, several kilometres down a flat, sandy road, we would find Meme Gudrun's village. Meme Gudrun is a home-based care volunteer with TKMOAMS, an Oshivambu acronym that stands for 'God save us from this

Mr Elephant receives his first consignment of bikes from BEN Namibia directors Glenn Howard (left) and Michael Linke (right).

terrible disease, AIDS'. She has been trained by the organisation to deliver medication, sanitary supplies, home help and counselling to people and their families living with HIV/AIDS.

Meme Gudrun used to walk up to 15km per day to do her work, carrying her satchel of vital supplies for hours through the pounding heat. Now, through a donation sourced by BEN Namibia, she rides a bike on her rounds, seeing more clients, spending more time with each and reaching new people that were beyond walking distance.

Meme Gudrun is one of thousands of volunteers working with TKMOAMS and similar organisations. She and her peers are working at the coalface of the response to the disease, spreading demystification among remote communities with the least access to reliable information. As TKMOAMS founder Dianne Shikongo explains, 'People in the villages used to throw rocks at our volunteers because they were afraid they brought AIDS with them. Now they welcome us'. This is an important breakthrough in a country where traditional leaders have been known to publicly announce that condoms spread AIDS, and having sex with a virgin is still regarded by some as a cure. Even the national newspapers carry ads for witchdoctors advertising such mysteries as 'invisible shortboys and rats' alongside herbs that can kill HIV. Thankfully, superstitious beliefs like these are on the decline, largely due to the personal contact volunteers like Meme Gudrun have with community members.

Some more BEN Namibia projects

Bio-Bakkie

The BEN Namibia 'bakkie' (ute) is run on biodiesel made from used cooking oil from a local fast food chain, a skill that Director Michael Linke acquired while editing *ReNew*.

The glycerine byproduct is used as a handwash for BEN Namibia's mechanics, and the ultimate aim is to encourage Namibian research into jatropha, a drought-tolerant tree that produces oily nuts suitable for biodiesel production

Bike ambulances

Home-based carers in remote areas often find their clients seriously ill. With no other transport available, a long walk to the nearest clinic or a hand-held stretcher journey are the only options. BEN Namibia is developing a bicycle ambulance for emergency transport in such situations.

Transport planning

Namibia's capital, Windhoek, looks at first glance like a European city transplanted to Africa, however unlike most European cities its cycling facilities are nonexistent.

BEN Namibia is working with the Windhoek City Council to facilitate Windhoek's first bike lanes, and ultimately looking to develop a sustainable transport plan for the city.

The role of micro-credit

Like most Namibian women, Meme Gudrun also carries a disproportionate transport burden because of traditional gender roles. As I write, BEN Namibia is about to start its first micro-credit scheme aimed at women travelling to markets with home produce.

The women will receive ex-postal delivery bicycles donated by the Royal Mail in the UK, for which they will make small monthly payments. Their alternatives—walking long distances with heavy loads or using expensive taxis—should mean that bicycles make them significantly more productive.

These bikes will also help them with their other domestic roles like transporting food, water and firewood, greatly alleviating their 'time poverty' and enabling them to provide more care to orphans in their extended family. BEN Namibia's micro-credit scheme is a small beginning in chipping away at the tip of a very large iceberg, but empowering women is a crucial part of the HIV/AIDS jigsaw.

Into the near future

In the coming decades Namibia could follow vastly different trajectories. At the moment the political outlook, despite some serious corruption issues, appears positive and stable.

However, it's not difficult to foresee a fearful government in the near future losing control over a young, uneducated, unemployed and increasingly disaffected population, adopting Zimbabwe-style land reform as an act of populist desperation and spiralling downward into the 'African basket case' category. As in similar southern African countries, a share of the responsibility lies with the people and their government. But there will always be a smoking gun in the hand of the privileged West that fails to act and fails Africa once again.

Personal mobility isn't the grand solution to Namibia's problems, but it's an important part of building a future for hundreds of thousands of Namibians and millions of others across Africa. The good news is that it's within our means to help provide it.

Michael Linke is a former editor of *ReNew* magazine. Since leaving *ReNew* he has bummed around the world for several years. As founder and managing director of BEN Namibia he is doing something useful again. For more information contact Michael on michael@benbikes.org.za. www.benbikes.org.za/namibia

How eco is your laundry powder?

Are you using the safest laundry powder? Dr Robert Patterson, from Lanfax Labs, presents his latest testing results

Most people don't think much about their laundry detergents, but your choice of detergent can have a considerable effect on pollution entering our waterways.

Excessive levels of nutrients such as phosphorus can contribute to algal blooms, while excessive salinity can make the wastewater unsuitable for reuse on gardens.

Lanfax Labs regularly tests a range of commonly used laundry detergents and publishes their results on their website. We have reproduced some of those results here to help you gain an understanding of which detergents you should and shouldn't be using.

Please note that these results are for the wash cycle only, not the complete wash/rinse cycle, which are yet to be completed. Also, data on laundry liquids were not available at the time of printing.

Analysis

The detergents were mixed into water at the recommended ratios and the resulting mixed detergent was analysed for pH, electrical conductivity and total alkalinity within one hour of mixing.

The mixed detergent was filtered through a normal filter paper, acidified to pH <2 with nitric acid, and the filtered sample analysed for boron, sodium, phosphorus, sulphur, as well as

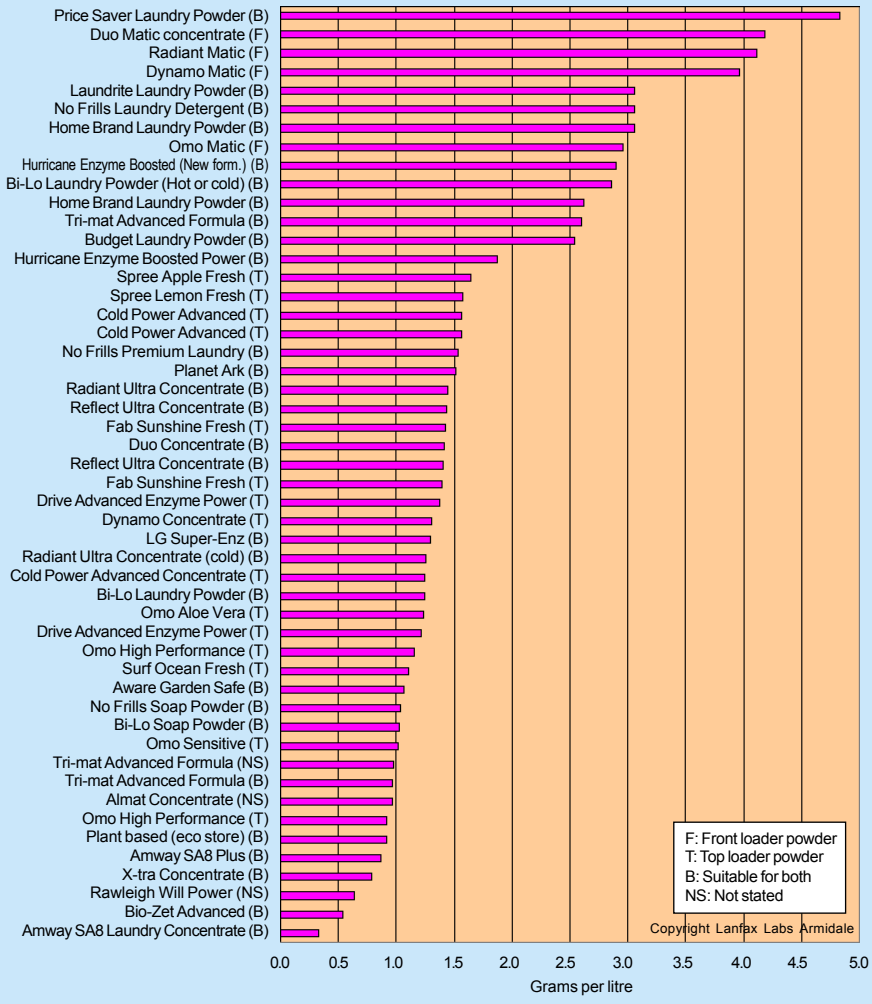
Salinity

Salinity is a measure of all the dissolved solids in an aqueous (water) solution and is expressed as milligrams per litre (mg/L). Two separate dosing rates (grams of powder used per litre of water) are used because front loaders use less water in the wash cycle than top loaders.

Salinity issues involve the ability of plants to survive in soil that has a high salt content and the likely adverse impact of high saline waters on the soil's physical properties. When wash water is discharged onto gardens or lawn, these salts have the potential to influence either plant health or soil properties.

High salinity in irrigation water may affect a plant's ability to take up water because of the osmotic effect of high soil salinity—the plant will appear as though it is lacking water (induced drought). Under extremely saline conditions, only a few plants are able to survive. For irrigation purposes, the ideal cut-off for water quality is less than 1g/L.

It is interesting to note in the graph that the highest recorded salinity is from the front loaders and many of the generic branded products, even at the top loading machine rate. When powders suitable for both top and front loaders (B) are used in front loaders, the salinity may be higher than reported above unless the quantity of powder required per load is reduced (possibly halved).

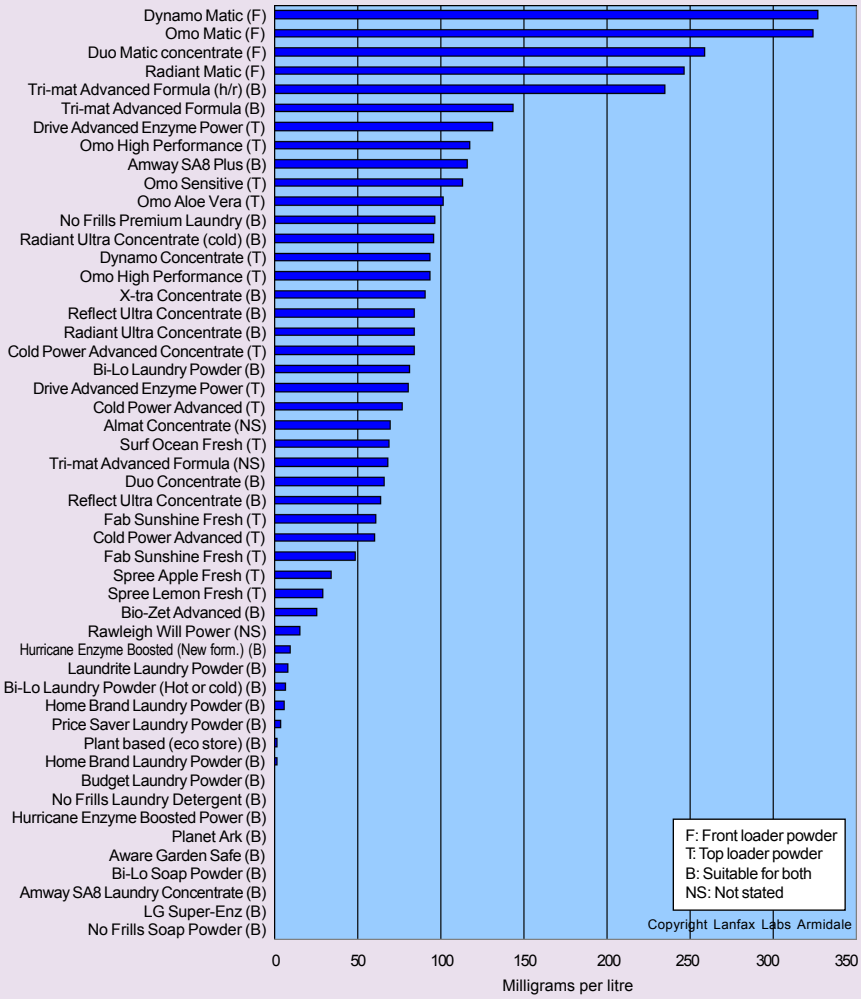


Phosphorus

Phosphorus in detergents is supposedly based upon an industry standard of 7.8 grams of phosphorus per wash. For a front loader to achieve a concentration below the industry maximum, assuming 38 litres of water per wash load (75 litres for a full wash), the concentration could not be more than 205 milligrams per litre (mg/L). Clearly, there are five of the 50 products above this value and four of those are specific front loading detergents.

Phosphorus is a 'builder' in the detergent and replacement of phosphorus with a substitute builder may not necessarily improve the environmental outcome of discharging the wastewater to land. Phosphorus is an essential plant and animal nutrient, a non-renewable resource that needs to be considered in light of its disposal. When discharging treated wastewater to rivers (as is typical of many municipal treatment works), the phosphorus has known environmental consequences that may lead to the deterioration of the waterway. When the same wastewater is discharged to land application systems, the phosphorus can become a valuable nutrient, reducing the need for chemical fertilisers.

It is not true that Australian native plants do not tolerate wastewater because of the phosphorus in the water. The high pH, the sodicity, salinity, or over-irrigation are also causes of failure in any horticultural scene. There is good evidence from tree plantations irrigated with municipal effluent that many Australian natives thrive with the nutrients in wastewater. Many golf courses are irrigated with municipal wastewater with few effects from the phosphorus—there are greater effects from the sodium and salinity issues.



calcium, magnesium and potassium.

Statistical variation is within ±5% for the sample analysed. Homogeneity of the detergents has not been assessed and it can only be assumed that the sample provided for analysis was representative of a larger (1kg) packet.

Interpretation

The results are presented as a series of graphs. For easy interpretation, the bottom of the graph shows the lowest values while the values increase up the graph. In most cases the preferred choice is one of the shorter bars at the lower part of the chart.

When interpreting the graphs, the identifier used after the product's name refers to the recommended washing machine type, and therefore the volume of washing water used in deriving these data. The identifiers are: NS—not stated; F—specifically front loaders; T—top loader; B—suitable for both but dosed at the top loader rate.

Conclusions

Clearly, some washing powders have serious environmental issues associated with them. In particular are the powders made specifically for front loaders. However, this should not be interpreted as a problem with front loading washing machines themselves. Front loaders will happily work with almost any laundry detergent, providing appropriately reduced quantites are used to reduce foaming. For example, in a 7kg front loader, one heaped tablespoon proves to be enough to wash even dirty clothes.

The graphs in this article may be printed separately and may, with permission be used for education purposes. The final choice of product is yours and these graphs do not endorse any product. For full report information, go to www.lanfaxlabs.com.au

Alternatives to the incandescent lamp—a lighting buyers' guide

Since we last looked at lighting options, there have been some interesting new developments, including a greater range of compact fluoros and more viable alternatives to halogen downlights

The aim of lighting is to provide enough light to suit requirements, with some rooms in a home needing more lighting than others. For example, kitchens need to be well lit for chopping veggies without chopping fingers, or reading recipes, whereas lounge-rooms, where bright lighting may be a distraction from watching television, will require less light (although some brighter task lighting may be required for reading). Bedrooms are usually better with lower lighting levels and rooms such as the bathroom need more light.

Because there are fewer reflective surfaces outdoors to 'contain' the light, higher powered lamps are generally needed to reach lighting levels similar to inside the home. People also like as much light as possible for security and safety, often resulting in the use of massive halogen lamps consuming more than 500 watts.

The Coolon spiral compact fluoro downlight kit is a complete replacement for halogen downlight fittings, and uses a tiny fraction of the energy. Their wide angle light output is also suited to general illumination far better than most halogen lamps.

Types of lighting

When considering lights and light fittings, you need to decide what type of lighting you want for each situation.

Lighting generally falls into four categories—general illumination; task lighting; ambient/mood lighting; and garden lighting. The degree of intensity will depend on personal preference, and the colour of the walls and furnishings. Darker walls generally need more light to achieve the same level of perceived brightness as lighter walls.

General illumination can be of a fairly low level—enough to easily see by, but not so bright that the whole room becomes suitable for reading. However, this is a personal preference and many people like to be able to light the entire room brightly when needed, whereas others may opt for a combination of low level general lighting and small task lights near their chairs for reading.

Mood lighting may also be a concern and needs to be considered at the planning stage. The house may have a feature that would benefit from a well placed spotlight or uplighter, but lights like these are often left on for long periods and can consume a great deal of energy if the wrong lighting is used.

Garden lighting is generally either floodlighting, with high power incandescent or halogen lamps, or feature lighting where particular plants or garden furnishings are lit individually (often by coloured lamps) for effect.

Zero energy options

While this guide deals with electric lighting, there are a couple of other options that should be considered. Skylights and light pipe systems can provide more than adequate lighting levels with no use of electricity at all, and if well placed, won't heat the room unnecessarily.

Another option is the fitting of reflectors to already installed fittings. Fluorescent fittings can particularly benefit from a reflector. Indeed, fitting a reflector behind a single tri-phosphor tube can result in lighting levels equal to using two cheaper quality tubes with no reflectors. This means that combining a reflector and good quality tube can effectively halve lighting energy consumption. For an example of a specular reflector, check out the *Products* section of this issue.

Energy consumption

Perhaps the thing that confuses people most is energy consumption.

Many lamps, particularly halogen downlights, are sold as 'low voltage', with the packaging implying that this

equates to low energy consumption. This is rubbish. The important factor is the power rating of the lamp. A 50 watt, 12 volt lamp uses the same energy as a 50 watt, 240 volt lamp, it's just that the voltage (and therefore the current) is different. A watt is a watt is a watt. 50 watts is 50 watts, regardless of the voltage it is supplied and used at. The power company charges you for kilowatt-hours (ie, watts drawn x 1000 x run time in hours), and because they only supply you with 240 volts, voltage is meaningless. A 12 volt bulb uses a 240 volt to 12 volt transformer to run it, so this transformer will draw 50 watts to run the bulb, plus a bit of extra that is lost in the transformer as heat.

So, when comparing bulb energy consumption, you must look at the wattage, not the voltage, plus an extra 20% to account for transformer losses. For example, a 50 watt bulb/transformer combination will draw about 60 watts from the mains.

Types of lamps

Now let's briefly look at the common types of lamps that you will find in most homes. Later we will look at the pros and cons of each type.

Incandescent lamps: These are the common standard light bulbs that you see everywhere. They consist of a glass bulb that is filled with an inert gas. Inside the bulb is a wire filament, made mostly of tungsten—a metal with a very high melting point—which is supported on thin wire supports. The outer two supports are electrically connected to the bulb base. When a current flows through the filament, it gets so hot that it glows brightly, giving off light.

Halogen lamps: These are another form of incandescent. They use a different type of glass envelope, usually made of quartz, and are designed to run hotter, and therefore brighter, than a regular incandescent.

Fluorescent lamps: These come in a variety of types, the most common of which are the strip fluoros found in shops and offices just about everywhere.

They consist of a glass tube containing a small amount of mercury vapour. At each end is a small filament, just like an incandescent lamp. The filaments are heated by a current, and a large voltage is placed across the length of the tube. This causes electrons to migrate from one filament to the other which in turn excite the mercury atoms in the tube causing them to give off ultraviolet light. This light then excites the phosphor coating on the inside of the tube and the phosphor emits white (or sometimes coloured) light.

Compact fluorescent lamps: These work in a similar way to regular fluorescents, but instead of using a long, straight tube, the tube is folded up into a more compact form. The ballasted lamp driver in these lamps is usually of the high efficiency electronic type.

Cold cathode fluorescents: Commonly known as CCFLs, cold cathode fluoros do away with using heated filaments at each end of the tube. They are smaller in diameter than other fluoros and are usually found as straight tubes three to seven millimetres in diameter and 50 to 400 millimetres long, although very compact spiral wound types are now starting to appear. They come in many colours as well as white, and so have become popular with people wanting to light up computer cases and car interiors.

Other gas discharge lamps: Other gas lamps, including sodium and mercury vapour lamps, can be used in place of fluorescent lamps and can be found in street lights and xenon lamps in some new car headlights. As these are not readily available for domestic uses (you can get them if you try, but they are rather expensive), we will not look at them in detail.

Light emitting diodes: Commonly known as LEDs, these are unlike any of the other lighting systems listed above. They contain no glass tubes or heating filaments, instead using a small piece of semiconductor material (computer chips and transistors are semiconductors too) that emits light directly when a current is passed through it. They produce light in a range of colours, without the need for coloured filters, but to get white light, a phosphor, much like those used in fluorescent tubes, is used over a blue LED chip.

Issues with light fittings

Most light fittings are designed to be used with incandescent bulbs, so bulbs that are larger than standard may not fit. Also, other lamps often require ventilation so their internal electronics don't overheat. Some fittings, such as bulkhead and oyster fittings, while they can be used with compact fluorescents, may cause them to run at a higher than ideal temperature, possibly shortening their lifespan.

Another aspect of light fittings is their efficiency—how much of the light generated by the light source they allow to pass into the room. Many fittings have 'frosted' glass, which can be either etched or painted. Frosted glass absorbs some of the light from the bulb, reducing the overall efficiency of the lighting system (and therefore wasting the energy that was used to generate the light). Obviously, a lamp with a shade or other form of diffusion—such as small bubbles, grooves or lenses—will produce similar results but with greater light transmission.

For task lighting, halogen downlights are generally the first choice for most people, but there are lower energy use alternatives. These include incandescent downlight fittings with compact fluorescent lamps, or miniature fluorescent fittings designed for a particular task.

Now let's look at each type of light source in more detail.

Incandescents

Generally incandescents have an efficiency of between 2% and 7% (the rest of the energy—93% to 98%—is turned into heat!). This equates to a light output of, at best, 15 lumens per watt (from just over a possible 200 lumens per watt for white light sources). This reduces as the light bulb ages and the filament degrades.

Incandescents run very hot and need light fittings that can handle these temperatures. Even so, the continued exposure to high temperatures degrades many lamp fittings, particularly the bulb socket and electrical contacts.

As incandescents contain a white hot filament when running, they can be quite fragile when illuminated; small vibrations can result in broken filaments and a useless bulb. The average lifespan of an incandescent is usually around 1000 hours, but this depends on how the light is used, and the local grid voltage. For example, a 10% increase in grid voltage over the rated voltage of the bulb will result in over 20% more energy flowing through the bulb. This makes it emit more light, but also means the filament is running hotter and degrading more quickly, costing 20% more to run! There are bulbs designed to run for up to 20,000 hours, but these are hard to find in Australian voltages.

Incandescents lend themselves well to dimming, but as a light bulb is dimmed and output decreases, so too does efficiency. So, if a 100 watt light bulb is dimmed to 50 watts, it may only be emitting the same light as a 25 watt bulb. The latter is designed to run at 25 watts, whereas the 100 watt bulb is designed to run at 100 watts, not 50.

The colour temperature of a lamp is, in layman's terms, the degree of 'warmth' of the light being emitted. A 'warm white' lamp (incandescents generally put out a warm white coloured light) has a colour temperature somewhere between 2000K (Kelvin) and 3200K. Neutral white is around 4000K to 5500K and cool white is 6000K and higher.

Perhaps the main reason that incandescents are so popular is their very low initial cost. Often available for 50 cents or so at the supermarket, many people buy them thinking they are a good buy. But when you realise that a 100 watt bulb will use about $15 of electricity for every 1000 hours of use, compared to more efficient lighting that will use around $3 worth, then they are not such a good deal.

However, being the oldest common form of electric lighting, there is a huge array of types, sizes, shapes and colours of incandescents available, and they are the one bulb type that is available just about everywhere. Because the light source is quite small, the bulbs themselves can be made quite small, and so light fittings that take advantage of this—such as multi-bulb candelabra fittings—are quite common.

Halogens

Halogen lamps are another form of incandescent lamp. They use a different filament design and a special quartz glass envelope to allow the filament to run hotter than a regular incandescant. As a result, they put out more light per watt of energy consumed, and the colour temperature of the light is usually higher, making the light appear brighter and whiter.

However, they are still quite inefficient, running at approximately 25 lumens per watt, giving them an efficiency of 12% at best. Again, all the remaining energy is turned into heat. Because halogens can run at very high temperatures, if used incorrectly they can present a significant fire hazard. This is why inceiling halogen downlight fittings must not have roof insulation placed within 100mm of the fitting.

A few manufacturers are now making 20 and 35 watt halogen lamps that, it's claimed, emit as much light as a normal 35 or 50 watt halogen respectively. This would give them an efficiency of around 15%, which is not bad for a glowing white-hot piece of metal!

As halogens run more efficiently than incandescents, you can generally use a bulb rated at around half the wattage to get a similar amount of light. So while they are not great efficiency-wise, they are a better option than incandescents, provided the light fitting is appropriate for the task.

And this is the big problem with halogens. Downlight fittings, which are really designed for task lighting, are commonly used for general illumination. The end result is poor overall lighting with very bright spots of light on the floor. Often, so many halogen lamps are used in each room that the result is high energy consumption and lots of heat generation.

Bare halogen lamps that replace conventional incandescents can be found if you look around, but often have frosted envelopes to disperse the glare of the intensely bright white filament, resulting in a rating of only 10 to 15% less than the incandescent they are designed to replace.

While halogens can be dimmed, they are designed to run in a narrow temperature range. Dimming can mean they not only run inefficiently, they also have a dramatically shortened lifespan. And while some halogens are designed for dimming, they are not readily available and have to be ordered through electrical wholesalers.

Having a white-hot filament means they also have a degree of fragility, though the filament is often more robustly designed than a regular incandescent.

Readily available halogens are only available in a limited range of lamp

styles, the most common being dichroic downlights. These range from narrow to relatively wide angles (roughly 12 to 60 degree beam spread), and are available in coloured versions.

Costs of these lamps vary from less than $1 to several dollars a piece for some better quality units. They are now available at almost all supermarkets and hardware stores.

Fluorescents

Most people are familiar with the common strip fluoro, which usually uses a two-foot or four-foot long straight tube (or sometimes a 32 watt or similar circular tube). The tube is driven by a simple inductive ballast (basically a lump of steel with a copper coil wound on it!) and fluoro starter (the little round device that fires the tube to start it).

Fluoros generally have a very high efficiency, with tubes ranging from 40 to 80 lumens per watt (higher on some of the newer tube designs). The ballast wastes a bit of energy, usually about 10 watts in a 40 watt fitting, so efficiency is reduced slightly, but electronic ballasts reduce this energy to just a few watts.

Because of their higher efficiency, fluoros run a lot cooler than incandescents and halogens—generally less than 70°C—making them much less likely to cause a fire. Greater efficiency also means that a 20 watt fluoro will emit at least as much light as a 100 watt incandescent or a 50 watt halogen.

There are several perceived disadvantages with fluoros that have largely kept them out of most rooms in modern homes. The first is their size. Like it or not, fluoro fittings are large. This isn't a problem in shops and other commercial buildings, but for many home owners it isn't desirable to have a 1200mm x 300mm light fitting in the ceiling of each room.

Flickering is another problem many people will state as their main dislike of fluoros. Flickering is only perceptible to some people and can usually be fixed by changing the tube to one with a better quality phosphor with a longer persistence. The other fix is to replace the electromagnetic ballast with an electronic one. Some fittings come with these as standard and have the advantage of instant starting (the flick-flick-flick of a standard fluoro ballast and starter setup is also quite annoying to many people) and greater efficiency.

Some electronic ballasts also have a dimming option, though not with a normal dimmer switch. They have a low voltage output that is connected to a suitable wall-mounted control that, to the user, works just like a normal dimmer. Generally though, a fluoro cannot be dimmed down until it is completely off: 20% output is usually the lowest value a dimming ballast will go to.

Another common complaint is the type of light produced. Cheap fluoro fittings usually come with a cheap and nasty tube that puts out quite a bluish light with a high colour temperature. This light can appear glary and make colours look quite strange (called a low colour rendering index). The simple fix for this is to fit a good quality tri-phosphor or quad-phosphor tube, readily available from hardware stores. Tubes are now available in a range of colour temperatures, including warm white, neutral white, daylight, and many colours for effects lighting.

The lifespan of fluorescent lamps is one area where they excell over all other forms of lighting. It is not uncommon for a lamp to last 10,000 hours of general use. While they are better used in situations where they are not constantly turned on and off, they will still greatly outlast an incandescent lamp. This means far fewer lamp replacements, a particularly important factor if you have high ceilings or problems climbing up to change lamps.

Being made of glass, fluoro tubes are quite fragile. However, I have dropped tubes from almost two metres in height and they have survived with nothing more than a bent pin on one end so are obviously more robust than you might expect.

One issue that is often mentioned by fluoro-hating incandescent lovers is that fluoro tubes contain mercury, pre-

senting a toxic waste hazard. This is true to some degree, but in most cases, the amount of mercury inside a fluoro tube is so small compared to the amount of mercury emitted by coal-fired power stations in making the extra energy used by incandescents, that fluoros come out miles ahead. If you only buy Green Power, or get your electricity from gas-fired power plants or hydro plants, then this equation changes, but for the vast majority of Australians, choosing fluorescent lamps is the best move on a mercury emission basis. Also, at least one manufacturer, Philips, recognised this problem and has been making fluoro tubes with only 30% of the mercury vapour of a regular tube for some time. These tubes, the Alto range, are available from larger hardware stores, though they are more expensive than regular tubes at around $10 each.

Fluoro tubes are commonly available from four watts right through to huge 58 watt tubes and can usually be bought from local supermarkets for just a few dollars. However, if you want higher quality tubes large hardware stores often have a broader range.

Compact fluorescents

Compact fluorescents work on the same principle as regular fluorescent lamps, except their tube is smaller in diameter and folded into a number of loops or wound in a spiral shape. This allows CFLs to run at efficiencies similar to a regular fluoro, without taking up so much space or needing dedicated fluoro tube light fittings. There are some very small CFLs now available and many will easily fit into light fittings designed for incandescent lamps.

Because they contain electronic components, CFLs run relatively coolly and therefore last longer. Using them in completely unventilated fittings may reduce their lifespan but this varies between brands and models. Lower wattage lamps obviously produce less heat, and so will be less affected by heat buildup inside fittings.

Because they use electronic ballasts, flickering is not a problem with the vast majority of CFLs, and the use of electromagnetic pumps, a major cause of flickering, is now rare.

Being made of plastic with short folded tubes, CFLs are generally more physically robust than strip fluoros. However, they can still be broken with mishandling, particularly when holding the glass tube instead of the plastic base while screwing them into lamp sockets.

CFLs are generally not suitable for dimming. They are designed to run on a specific voltage range, and a dimmer will reduce the voltage below that range, causing the ballast to overheat and fail as it tries to draw more current to maintain light output. The only CFL we know that is designed to be dimmed is the Dimlite from Luxlite in Hong Kong (www.luxlite.com).

Compact fluoros are available in colour temperatures from 2700K through to 6800K or higher, so finding one of the right light colour for your needs should not be a problem. Pricing on CFLs has dropped dramatically in the last couple of years and it is not uncommon to find them for $5, or even less, in your local supermarket. Generally, you should not be paying more than about $10 for a standard lamp although specialty types, such as reflector lamps or sizes over 30 watts, may cost a little more.

The range of shapes and types has also improved and you can now get CFLs in many shapes and even lamps with frosted outer glass envelopes in 'fancy round' and 'candle' designs, though these are usually a bit larger than the incandescents they are designed to replace.

Lastly, some light fittings are designed specifically for use with removeable compact fluoro tubes. These fittings usually contain the ballast (sometimes electronic, sometimes electromagnetic) and only the tube itself needs to be replaced when it fails. While these fittings are more common in commercial situations, you can sometimes find them in domestic lighting shops.

Cold cathode fluorescents

CCFLs (cold cathode fluorescent lamps) are relatively new to the domestic lighting market and are quite rare at the moment. Their tiny tube sizes allow them to be made very small indeed, often smaller than the incandescents they are used to replace.

They work in a similar manner to CFLs, with an electronic ballast inside

A range of compact fluorescent lamps. From left to right are: Megaman 'Palm light', 7 watt spiral CCFL, 20 watt spiral CFL, Luxlite 85 watt CFL and a Megaman 20 watt Par38 style CFL.

the plastic base. They come in a range of colour temperatures, and almost always have an outer glass envelope to protect the fragile CCFL tube. The envelope is usually clear glass so as not to reduce light output by any appreciable degree.

CCFLs generally run at temperatures below 100°C, but again, the cooler they run the better, so ventilated fittings are best. Flickering is not an issue with these lamps, as they all have high frequency electronic ballasts. Like CFLs, they are generally not suitable for dimming, and often fail if used on a dimmed light circuit.

While usually not large enough for lighting rooms completely, CCFLs can be used inside cupboards and small spaces to great effect and are ideal for use by computer modders and mechanics trying to get access to those small enclosed spaces. They contain a CCFL tube, usually 150 or 300mm long, in a strong slim plastic case, connected via a short length of cable to the separately cased ballast. The ballasts are usually 12 volt driven with the voltage easily supplied using a plugpack. Switchmode types offer greatest efficiency.

Both warm and cool white lamps, as well as many colours, are available. While direct plug-in 240 volt lamps are not common yet, expect to see more in the near future as people realise the advantages of such compact fluoros.

Straight lamp/ballast sets can be bought for as little as $10 if you look around, but don't expect to see them in the supermarket or hardware store just yet. Computer stores might be the best bet to start with. Also, 12 volt units for use in stand-alone renewable energy systems are available from some renewable energy equipment suppliers for around $20.

LEDs

We have looked at LEDs numerous times in the last few years. Slowly but surely, LED efficiency is increasing, and so is the range of LED lamps available. However, the majority of lamps are still LED replacements for MR11 and MR16 12 volt halogen lamps.

There are several problems with this. Firstly, the lamps are fed from a 240 to 12 volt transformer (either electromagnetic or electronic) so there are energy losses even before the power gets to the lamp. While this is no different to a normal halogen lamp setup that uses 12 volt globes, LED lamps contain current limiting circuitry, so the LEDs don't use all of the energy that the lamp uses. Therefore, the overall efficiency of a LED halogen is not much better than the halogens they replace.

Add to this the misinformation from many suppliers about how much light a LED halogen will put out (a typical sales blurb might read 'produces as much light as a 20 watt halogen'), and many people are disappointed with the output of LED lamps.

Most white LEDs have efficacies of 25 to 40 lumens per watt—better than halogens and, in some cases, close to compact fluorescent lamps. However, because they need current control circuitry, LEDs will need to improve before they become viable replacements for many lighting types.

Also, when being used to replace halogen downlights, LED lamps can really only be made up to about 5 watts in power consumption. Any more than that and they generate too much heat for the fitting to dissipate. A halogen lamp can happily run at 200°C, but a LED equivalent must run at less than 70°C or the LED will suffer accelerated light degradation.

As LEDs need current control, it is better to have a lot of LEDs in series and run them from a higher voltage, than to have multiple paralleled strings, each string wasting some energy in its current limiting circuitry. For this reason, LEDs are better run directly from 240 volt mains power. While this sounds like a strange thing to do (each LED has a voltage requirement of 3.4 volts, after all), it is the most efficient system. The only problem is that there are very few 240 volt LED lamps available. There are a few in the form of spotlight bulbs, some containing more than 100 LEDs, but most of these use cheap LEDs from China and light output degrades fairly rapidly after a few hundred hours due to the heat produced by so many LEDs in a small space. Considering the price of these lamps, this is not an acceptable lifespan, especially when you consider quality LEDs can have rated lifespans of 50,000 hours or more.

So, why would anyone want to use LEDs? There are a number of reasons, including robustness (no glass) and the fact that LED efficiency improves every year. In a few more years, say by 2010, LED efficiency will most likely be higher than any other light source, while prices will probably drop by a large degree.

However, there is currently one area where no other light source comes close to LEDs for efficiency, and that is when producing coloured light for mood lighting and architectural and garden highlighting. Why is this, when white LEDs are generally only of average efficiency? Well, coloured LEDs are also around the same efficiency, with efficacies of 15 to 50 lumens per watt, depending on the colour. However, LEDs produce colours directly, whereas with most other light sources, white light is produced and then most of that light is filtered out by a coloured glass filter. This results in a lamp efficiency of only a few percent.

The upshot of all this is that a 5 watt LED lamp really can replace a much higher powered incandescent when it comes to coloured lighting. An example of this is the low wattage LED

lamps that are now replacing the incandescant lamps in many traffic lights across the country. This results in a massive energy saving and much cooler running of the light. LEDs are also exceptionally versatile and can be fitted to circuit boards, used on curved facias of building, or used to replace neon in signs.

LEDs are easily dimmed using standard dimmers, though this does depend on the type of drive circuitry in the LED lamp. Simple resistive (for DC lamps) or capacitive (for AC lamps) current limiting makes for easy dimming. As with most lighting systems, LEDs must be run as cool as possible, so the more ventilated a light fitting is, the better.

In terms of colours, LEDs are available in just about every colour imaginable including warm and cool white. In addition, RGB (red, green, blue) LEDs, contain three LED chips in each diode, and can produce almost any colour in one unit. There are even remote controlled MR16 style lamps that can produce a huge range of colours.

The main drawback of LEDs is their cost. An LED halogen replacement lamp will cost $25 for the real cheap, short-lived ones, through to $100 or more for more advanced, higher quality units. Indeed, with a little know how, you can make LED lamps more cheaply yourself. We may take a look at some DIY projects along these lines in future issues of *ReNew*, so if you have any ideas, send them in!

So, where do you get LED lamps? They are still rather hard to find but are popping up in more places now. Some specialty lighting shops have a limited range, as do renewable energy equipment suppliers. You can also find them online with quite a few on eBay, although you must we wary of what you are buying. There is both real junk and good quality lamps out there.

There's no need to waste power using 150 watt Par38 lamps when you can replace them with 20 watt compact fluorescents. This one comes from Lighting Pro and costs just $19.50. At five hours use a night, it would pay for itself in around 200 days.

So, what's the best option?

Well, that depends on what you want your lighting to do. In general, look for fluorescent fittings, they will be the most reliable, use the least amount of energy, and so will cost the least to run. If you don't like the fittings available, then consider compact fluorescent lamps in standard incandescent fittings. If you want downlights, there are CFL fittings designed for this purpose, or you can use standard incandescent downlight fittings (which normally take a 60 watt screw based bulb) and fit them with a suitable compact fluoro lamp.

Task lighting can be done quite efficiently with halogen downlights, but don't use them for general illumination—they are not very effective and you will need a heap of them to bring light levels to a reasonable level in many rooms.

Incandescents should be your last choice. They are okay in rooms which are used for short periods of time, such as walk-in cupboards and toilets, but for anywhere else they use too much power and heat the room too much. Remember, if you have 400 watts of incandescents on at once, that is like having a 400 watt heater running—rather a bad thing in summer, and a plain waste of energy at any time.

About the tables

The tables list selected lamps from each supplier, to give you an idea of what is available and where to get them. It is by no means an exhaustive list—indeed, it barely scratches the surface! There are so many sizes and shapes and types of lightbulbs available nowadays that you should have no problem finding ones that suit your needs.

There are two tables—the first covers 240 volt lamps (lamps that fit directly into 240 volt sockets) and the second covers all extra-low-voltage lamps, from 12 to 48 volts AC and DC. This includes lamps designed for halogen downlight fittings (these lamps are all 12 volt powered).

The listings that are missing data are due to the companies failing to supply any information. We have tried to fill in the gaps from data available from their websites. Where a table heading was not applicable to a particular type of lamp, 'NA' will appear in that column. Where no data was supplied or was unavailable, '–' appears.

For information on the minimum energy performance standards for lighting, see: www.energyrating.gov.au/library/pubs/tech-lamps2001.pdf

Table 1. Extra-low voltage DC energy efficient lamps.

Brand/Manufacturer	Model	Type of light or fitting	Voltage	Wattage	Beam angle - for downlights	Light output - Lumens	Efficacy (Lumens per watt)	Colours available	Shape	Price	Available from	Comments
Resolux	LSFR40	Corrosince CFL lamp and fitting	12 or 24	40	N/A	3500	88	4000K or bright white	Rectangular	$320.00	ARRID Distributors in a states of Australia	IP rating 65.
	LSFR18			18		1200	67		Rectangular	$195.00		
	LSFR11			11		900	82		Rectangular	$130.00		
EVG	EVG 4-13	CFL	48	11		900	82		Light retrofit kit	$165.00		Kit only to retrofit standard light fittings.
Marlec	MAR-MR12 or MR24 '2D'	CFL	12 or 24	12	NA	1000	83	3500K	150mm square with diffuser	$80.00	Conergy Pty Ltd PO Box 340, Botany NSW 2019 Ph:(02) 9700 9960 email: energytoday@quirks.com.au www.quirks.com.au	Very reliable & rugged fitting - used in LAV's, good output.
	MAR-MR12 or MR24 '2D'			12		1000	83	3500K	Recessed version of above	$88.00		
Sino	SDC-M 1203	CFL with BC22 or ES27 base	12	3		150	50	6400K	2 or 3 loop CFL	$11.00		
	SDC-M 1207			7		350	50	6400K		$12.50		
	SDC-M 1211			11		600	54	6400K		$14.30		
	SDC-T 1215	CFL with BC22 base		15		800	54	6400K		$17.00		
	SDC-T 1223			23		1220	54	2700K/6400K		$18.50		
	SDC-T 1230			30		1600	55	2700K/6400K		$24.30		
	SDC-M 2403	CFL with BC22 or ES27 base	24	3		150	50	6400K		$12.10		
	SDC-M 2407			7		350	50	6400K		$13.20		
	SDC-M 2411			11		600	54	6400K		$15.00		
	SDC-T 2415	CFL with BC22 base		15		800	54	6400K		$18.00		
	SDC-T 2423			23		1220	54	2700K/6400K		$22.00		
	SDC-T 2430			30		1600	54	2700K/6400K		$25.40		
Sundaya	ML2	CFL	12	10		350	35	—	Ceiling mount lamp with shade	$60.00		Complete fitting with power lead.
	ML3			10		350	35	—	Lamp with shade	$70.00		Complete waterproof fitting with power lead.
	AL-210	Fluorescent	12	10		280	28	—	Lamp with fitting	$35.00		White ABS fitting c/w 10w tube & on-off switch - no diffuser. Reliable economical fitting.
Osram	High efficiency LED	MR16 downlight	12	20, 35, 50	36 or 50	—	—	—	MR16 downlight	$11.95	Environment shop 221 High Street Northcote VIC 3070 Ph:(03) 9489 4855 www.environmentshop.com.au	
Ventrior	LED Lamp	MR16 downlight	12	4.2	30	—	—	Warm white and 6500K	MR16 downlight	$82.00		
Hotbeam	Ventrior	LED halogen replacement	12	5	30	250	50	Warm white/cool white	Round	$89.00	Going Solar 60 Leicester Street Carlton VIC 3053 Ph:(03) 9348 1000 www.goingsolar.com.au	G4 Bi Pin Base Halogen fitting.
Nelson	CCFL05G4NW	Cold cathode	12	5	60	180	36	Warm White	Spiral with glass cover	520.00		
	CCFL05G4NC		12	5	60	180	36	Cool White				
Phocos	CL1203C-2 / CB	CFI	12	3	N/A	138	46	Cool White	CFI	$17.25		Bayonet or Pelson Screw -27. Includes an over temperature cutout
	CL1203W-2 / WB	CFL	12	3		138	46	Warm White	CFL	$17.25		
	CL1205C-2 / CB	CFL	12	5		230	46	Cool White	CFL	$20.41		
	CL1205W-2 / WB	CFL	12	5		230	46	Warm White	CFL	$20.41		
	CL1207C-2 / CB	CFL	12	7		320	46	Cool White	CFL	$21.74		
	CL1207W-2 / WB	CFL	12	7		320	46	Warm White	CFL	$21.74		
	CL1211C-2 / CB	CFI	12	11		550	50	Cool White	CFI	$23.07		
	CL1211W-2 / WB	CFL	12	11		550	50	Warm White	CFL	$23.07		
	CL1215C-2 / CB	CFL	12	15		750	50	Cool White	Spira	$26.73		
	CL1215W-2 / WB	CFL	12	15		750	50	Warm White	Spiral	$26.73		
	CL1230C-2 / CB	CFL	12	30		1500	50	Cool White	Spira	—		
	CL1230W-2 / WB	CFL	12	30		1500	50	Warm White	Spiral	—		
	CL2415W-2 / CB	CFI	24	15		750	50	Warm White	Spiral	$26.73		
	CL1215W-2 / WB	CFL	24	15		750	50	Cool White	Spiral	$26.73		
Jaycar Electronics	ZD-0342	MR16 LED halogen	12	3.5	12	80	23	6500K	MR16 downlight	NA	Jaycar Electronics stores Ph.1800 022 888 email. techstore@jaycar.com.au www.jaycar.com.au	Requires well ventilated fittings. Can run on 9-15 volt AC or DC.
	ZD-0320	MR16 LED halogen	12	1.5 to 2	Spot (narrow)	—	—	White, blue, green, red, yellow	MR16 downlight	$19.95 to $24.95		Uses twenty 5mm LEDs.
	ZD-0330	MR16 LED halogen	12	Around 3	Spot (narrow)	—	—	White	MR16 downlight	$39.95		Requires well ventilated fittings
	SL-3016	16" tube fluoro fitting	12	10	NA	—	—	White	390mm W x 85mm W x 25mm H	$49.95		Has 5 watt incandescent courtesy light
	SL-3008	20 circular fluoro fitting	12	16	NA	—	—	White	230mm diameter x 65mm high	$49.95		Has 5 watt incandescent courtesy light
	SL-2850	CFL with ES14 base	12	13	NA	60 watt incandescent equivalent	—	Warm white	Tri-foil CFL	$18.95		
	SL-2852	CFL with ES14 base	12	20	NA	100 watt incandescent equivalent	—			$23.95		
Lighting Pro Australia	Low voltage CFL	Spiral CFL with ES or BC base	12	15 or 20	NA	75 watt or 100 watt equivalent	—	Warm white	Spiral tube	$14.95	Lighting Pro Australia PO Box 7080 GCMC QLD 9726 Ph:0414 273 679 email: shop@lightingpro.com.au www.lightingpro.com.au	$15.95 for 20 watt unit. 8000 hour life.
	Energy saving dichroic	MR16 halogen downlight	12	20 or 35	—	—	—	—	MR16 downlight	$9.95		35 watt or 50 watt normal halogen equivalent light output. Infra-red reflective coating gives higher efficiency than normal MR16 lamps.
	High power MR16 LED lamp	LED halogen replacement	12	5	110	8-90 depending on colour	1.8-18 depending on colour	Warm white, cool white, red, green, blue, amber	MR16 downlight	$59.95		Contains three 1 watt LEDs. Input voltage 11 to 18VDC or 11 to 13VAC.
	Multi-colour MR16 LED lamp	LED halogen replacement	12	<5	110	Up to 105	Up to 21	White plus a range of colours	MR16 downlight	$98.50		Remote control of all functions, including four-step dimming. Remote is $35 extra.
	MR16 LED lamp	LED halogen replacement	12	1.5 to 2	Spot (narrow)	—	—	—	MR16 downlight	$29.95		Uses twenty 5mm LEDs.

Table 1—continued. Extra-low voltage DC energy efficient lamps.

Brand/Manufacturer	Model	Type of light or fitting	Voltage	Wattage	Beam angle - for downlights	Light output - Lumens	Efficacy (Lumens per watt)	Colours available	Shape	Price	Available from	Comments
Sollatek	Lumina	CFL	12	7	NA	400	57.1	Cool white	Lamp and inverter fully enclosed.	$45.10	NENSYS New Energy Systems ph (07) 3812 0665 sales@nensys.com.au www.nensys.com.au	Push switch. Reverse polarity connection, short and open circuit protected. Filtered against radio frequency interference.
				9		600	66.7			$45.10		
				11		900	81.8			$45.10		
				18		1200	66.7			$57.20		
			24	18		1200	66.7			$48.40		
Suncaya	A-Light	Fluoro	12	6	NA	210	35	Cool white	Straight	$14.00	Rainbow Power Company PO Box 240 Nimbin NSW 2480 ph:(02) 6689 1430 sales@rpc.com.au www.rpc.com.au	Pull cord switch, World Bank tested tube 5000 hrs; electronics 30,000 hours; reverse polarity protection.
				10		280	28			$14.00		
	Multilight			7		245	35		PL Compact	$32.00		Waterproof to 25m. Includes 4m cable and shade. Lifespan: tube 10,000hrs, electronics 50,000hrs. World Bank tested.
				10		350	35			$32.00		
	Jlux			3		120	40			$22.00		ES17 base. Tube lifespan 10,000 hours or 100,000 cycles. World Bank tested.
				6		240	40	Warm white		$22.00		
				9		360	40	Warm white		$22.00		
				18		800	44	Cool white		$22.00		
Top Light	Flexi-Bright	Cold cathode Fluoro	12	7		210	30	Cool white	ES	$28.00		ES base. Dimmable.
Ventrilor	LED 3W	Downlight	12-24VDC/12-18VAC	3	30	Cool white: 50 warm white: 40	16.66/13.33	Cool/warm white (4000K/2,700K)	MR16 downlight	$72.00	Solar Charge Pty Ltd 115 Martin Stree: Brighton VIC 3186 ph (03) 9596 1974 mail@solarcharge.com.au www.solarcharge.com.au	Replacement MR16 12V downlight. 50,000 hour life.
Solarcharge	Maxi Flood	Outside Spotlight	12	11	—	550	50	Cool white 4000K	Rectang.lar spotlight	$77.00		12v CFL spotlight for outside use. ES base. 6000 hour life.
Solagon	PL11	PL11 with fitting	12 or 24	11	NA	840	76.36	Cool white 4000K	Rectangular	$88.00		12V surface mounted light (complete) for caravans etc. 5000 hour life.
Steca	Solsum Lamp	CFL	12	11	NA	550	50	Cool white 4000K	Standard CFL shape	$18.00		12v CFL suitable for DC applications. 6000 hour life.
Sylvania	Infrared MR16	MR16 halogen downlight	12	20 to 50	10, 25, 40, 60	Not available	Not available	3000K	MR16 downlight	NA	Electrical wholesalers and lighting suppliers. See www.sylvania.com.au for more information.	Can use a lower wattage to achieve the same light output as regular MR16 lamps. 4000 hour life. Only suitable for fixtures designed for 'cool beam' lamps.

Table 1. 240 volt AC energy efficient lamps.

Brand/Manufacturer	Model	Type of light or fitting	Wattage	Beam angle - for downlights	Light output - Lumens	Efficacy (Lumens per watt)	Colours available	Shape	Price	Available from	Comments
Megaman	Compact Reflector GU10	Downlight	7	108	—	—	2700K and 4000K	Downlight	$21.90	Environment shop 221 High Street Northcote VIC 3070 Ph:(03) 9489 4855 www.environmentshop.com.au	Standard 240V halogen down light fittings. 15,000 hour life.
	Compact Reflector GU10	Downlight	9	116	—	—			$23.90		
	Snap In Reflector	NA	NA	NA	NA	NA	NA	NA	$7.95		Used to narrow the beam of the compact reflector.
	Palmite	Downlight	7	108	—	—	2700K and 4000K	83mm diameter x 25mm high including base	$49.90		Low profile lamp and fitting.
	Par38	Floodlight	20	108	—	—	2700K	Standard Par38 lamp shape	$45.00		Edison screw base
	Party Colour	CFL	7	NA	—	—	Red, blue, green, yellow and orange	Small fancy round bulb	$19.90		
	Ultra Compact Candle	CFL	5	NA	—	—	2700K & 7000K	Candle shaped CFL	$19.90		
GE	Tiny Spiral	CFL	8, 11	NA	8W = 400 Lumen	8W = 57.5	Warm white, cool white and day light	Spiral	$8.95		B22, ES, small bayonet and small ES bases
Cooler	Energy saving recessed downlight	MR16 lamp, fitting and driver set	11	Wide	550	50	Warm white and cool white	MR16 downlight	$39.95		GU5 Comes complete with fitting and ballast
N.E.C. Osram, Phillips, etc	Tri Phosphor	FL oversheet Tube	36, 18	NA	—	—	Warm White, Cool Light, Day light:	Straight tube	$9.00		
	Quad Phosphor	FL oversheet Tube	36, 18	NA	—	—	Warm white, cool light and day light:		$18.00		
Brite Lites	Par 38	CFL	25	NA			Warm White, Cool White, Day light.	Flood	$29.95		
Luxalight		CFL	85	NA	—	—	Cool white		$59.00		The Biggest Compact Fluoro around
Jaycar Electronics	SL3153/SL3755	CFL with bayonet base	15	NA			Red and blue	Bi loop CFL	$15.95	Jaycar Electronics stores, www.jaycar.com.au	Equivalent to a 70 watt colour corrected incandescent
Lighting Pro Australia	Candle CFL	CFL with bayonet base	5	NA	25 watt incandescent equivalent	—	Warm white	Candle shaped CFL, 42mm diameter x 138 mm long	$12.95	Lighting Pro Australia PO Box 7080, COMC QLD 9726 Ph 0414 270 879, email shop@lightingpro.com.au www.lightingpro.com.au	
	Slimline energy efficient	CFL with ES or EC base	10	NA	50 watt incandescent equivalent	—	Cool white and daylight	Tri-fold tube, 42mm diameter x 112mm long	$8.95		Also available in a four-pack for $16.50.
			15		75 watt incandescent equivalent			Tri-fold tube, 42mm diameter x 134mm long			
			18		90 watt incandescent equivalent			n-fold tube, 42mm diameter x 140mm long			
	Globolux	CFL with ES base	20	NA	100 watt incandescent equivalent	—	Warm white	100mm diameter ball	$16.50		
	GLS shape CFL	CFL with ES or EC base	10	NA	50 watt incandescent equivalent	—	Cool white	58mm diameter bulb x 125mm long	$7.95		
		CFL with bayonet base	15		75 watt incandescent equivalent						
			18		90 watt incandescent equivalent						
	Mini spiral	CFL with BC15, BC22, ES14 or ES27 base	5	NA	25 watt incandescent equivalent	—	Day light:	Spiral tube, 45mm diameter x 112mm long	$5.75		
	Mini spiral	CFL with BC15, BC22, ES14 or ES27 base	8	NA	40 watt incandescent equivalent	—	Day light:	Spiral tube, 45mm diameter x 112mm long			
	Par38	Reflector CFL with ES base	21	—	100 watt incandescent equivalent	—	—	Par38 shape, 120mm diameter x 175mm long	$19.50		Not well suited to movement sensors
	R80	Reflector CFL with ES base	15	—	75 watt incandescent equivalent	—	Cool white and daylight	R80 shape, 75mm diameter x 120mm long	$11.95		Not suitable for dimming. Cool white is $13.95
	R95	Reflector CFL with ES base	25	—	120 watt incandescent equivalent	—	—	R95 shape, 92mm diameter x 153mm long	$16.50		Not suitable for dimming.
	Very big spiral CFL	CFL with BC base	85	NA	425 watt incandescent equivalent	—	Day light:	Spiral tube, 110m diameter x 225mm long	$45.00		ES base adaptor available if required. Should be used in ventilated or open fittings only.
	Multi-colour ES27 LED lamp	LED lamps with ES base	5	110	—	—	White plus a range of colours	ES27 based flood/spot, 50mm diameter x 98mm long	$68.50		Remote control of all functions including 4 step dimming. Remote is $35 extra.

Table 1—continued. 240 volt AC energy efficient lamps.

Brand/Manufacturer	Model	Type of light or fitting	Wattage	Beam angle - for downlights	Light output - Lumens	Efficacy (Lumens per watt)	Colours available	Shape	Price	Available from	Comments
Luxlite	Mini-twist	CFL with BC, ES, BC22, ES14 or ES27 base	7, 9, 11	NA	385, 495, 605	55	—	45mm diameter x up to 125mm long mini CFL	—	Luxlite Industries Pty Ltd Mobile 0417 302 944 www.luxlite.com	
	Compact-U	CFL with BC22 or ES27 case	15, 20, 25		900, 1200, 1500	60	—	55mm diameter x up to 175mm long compact size CFL			
	Spiral	CFL with BC22 or ES27 case	11, 15, 20, 25, 30		660, 900, 1200, 1500, 1800	60	—	58mm diameter x up to 162mm long spiral CFL			
	Megalux	CFL with BC22 or ES27 case	15, 20, 25, 35, 42		900, 1200, 1500, 2100, 2520	60	—	58mm diameter x up to 190mm long tri-tube CFL			
	Classix	CFL with BC, ES, BC22, ES14 or ES27 base	7, 11, 14, 20		350, 550, 700, 850	50	—	50mm diameter x up to 122mm long bulb shaped CFL			
	Candlex	CFL with BC, ES, BC22, ES14 or ES27 base	5, 7, 9		250, 320, 450	50	—	40mm diameter x up to 143mm long candle shaped CFL			
	Sparkle	CFL with BC22 or ES27 case	15, 20, 25, 28		825, 1100, 1375, 1540	55	—	60mm diameter x 149mm long cylindrical CFL with glass cover			Either white glass or ribbed clear glass available.
	Globex	CFL with BC22 or ES27 case	14, 20, 25		825, 1100, 1375	55	—	58mm diameter x up to 155mm long globe type CFL			
	R30 reflector	CFL with BC22 or ES27 case	14		500	36	—	80mm diameter x 135mm long			
	R40 reflector		20		800	40	—	98mm diameter x 133mm long			
	Par38 reflector		20		800	40	—	—			240V replacement for Par38 spotlight.
Megaman	CFL GU10	CFL Downlight (GU10 fitting)	7	118	—	—	Cool/Warm white (4000/2700K)	Round - halogen downlight substitute	$18.95	Neco GPO Box 3413 Sydney NSW 2001 P: 1300 88 26 40 mail@neco.com.au www.neco.com.au	240V halogen downlight replacement. GU10 base. 10,000 hour life.
	CFL GU10		9	106	384	42.7			$19.95		240V halogen downlight replacement. GU10 base. 10,000 hour life.
	CFL GU10		11	119	—	—			$22.95		
	CFL PAR30	PAR30 Spotlight (ES fitting)	20	110	1100	59	Warm white 2700K	Standard PAR30 Spotlight replacement	$39.95		240V replacement for Par30 spotlight (not suitable for infra-red sensors). ES base. 10,000 hour life.
	CFL R50	CFL Compact Reflector (SES fitting)	7	110	—	—		Incandescent Reflector replacement	$17.95		240V incandescent reflector replacement. SES base. 10,000 hour life. 50mm diameter.
	CFL R63	CFL Compact Reflector (ES fitting)	11	117	—	—			$19.95		240V incandescent reflector replacement. ES base. 10,000 hour life. 63mm diameter.
	CFL R80	CFL Compact Reflector (ES fitting)	15	111	—	—			$21.95		240V incandescent reflector replacement. ES base. 10,000 hour life. 80mm diameter.
	CFL CX53	CFL Palmlite	9	106	280	31.1	Cool/Warm white (4000/2700K)	Round - Halogen Downlight alternative	$39.95		240V alternative for halogen downlight. No cut-out required for installation. 10,000 hour life.
	CFL Ultra Compact Classic	CFL with ES, SES, BC or SBC base	7	N/A	255	40.9	Cool/Warm white (4000/2700K)	Small globe available for most fittings	$16.00		240V replacement for low wattage incandescent lamps. 10,000 hour life.
	CFL Ultra Compact Candle	CFL Candle with ES, SES, BC or SBC base	5	N/A	180	36	Cool/Warm white (4000/2700K)	Small candle globe available for most fittings	$16.00		240V replacement for low wattage incandescent candle style lamps. 10,000 hour life.
Megaman	Compact Reflector CU10	Downlight	9	108	384	42.7	Cool/Warm white (4000/2700K)	Round - halogen downlight substitute	$22.00	Solar Charge Pty Ltd 116 Martin Street, Brighton VIC 3186 ph (03) 9596 1974 mail@solarcharge.com.au www.solarcharge.com.au	240V halogen downlight replacement. GU10 base. 10,000 hour life.
	Compact Classic 1	CFL	15	N/A	850	56.7	Cool/Warm white (4000/2700K)	CFL housed in round incandescent form	$22.00		CFL replacement for incandescents. Bayonet or ES base. 10,000 hour life.
	CFL PAR30	PAR30 Spotlight	20	110	1100	59	Warm white 2700K	Standard PAR30 lamp shape	$37.00		Replacement for Par30 spotlight (not suitable for infra-red sensors). ES base. 10,000 hour life.
Philips	Genie	CFL with BC or ES base	5, 8 and 11	NA	25, 40 and 60 watt incandescent equivalent	—	Warm white and daylight	Bi-folic tube CFL	—	Large supermarkets and hardware stores, and electrical wholesalers. For more information, see www.lighting.philips.com.au	Smaller than a standard incandescent bulb. Wide voltage range of 170 to 250 volts.
	Essential	CFL with BC or ES base	11, 14 and 18	NA	—	—	Warm white and daylight	Tri-fold tube CFL	—		Smaller than a standard incandescent bulb. Wide voltage range of 170 to 250 volts.
	TL5 HE	T5 size high efficacy fluorescent tubes	14	NA	1200	86	3000 and 4000K	16mm diameter x 562mm long	—		Only for use in HE fittings.
			21		1750 to 1900	83 to 90.5	4000 and 6500K	16mm diameter x 862mm long			
			28		2400 to 2600	86 to 93	3000, 4000 and 6500K	16mm diameter x 1162mm long			
			35		3100 to 3300	88.5 to 94.3	3000, 4000 and 6500K	16mm diameter x 1462mm long			
	Alto	T8 high efficacy tri-phosphor tubes	18	NA	—	—	—	26mm diameter x 590mm long	—		HI efficacy, low mercury tube.
			36					26mm diameter x 1200mm long			
Sylvania	HI-Spot 12C (PAR 38)	Par38 spot/floodlight	75 or 100	10 or 30	—	NA	2900K	Standard PAR38 Spotlight replacement	List $27.80	Electrical wholesalers and lighting suppliers. See www.sla.net.au for more information.	Replacement for Par38 spotlight. ES base. 3000 hour life.
	Lynx Energy Saver Smartlife	CFL with ES or BC base	15	NA	—	NA	2700K	48mm diameter x 140mm long with tri-loop tube	List $55		Has automatic light sensor to turn itself off in daylight hours. 6000 hour life.
	Lynx Energy Saver Classic		20		1200	60	2700 and 4000K	58mm diameter x 121mm long quad-loop tube	List $25.50		10,000 hour life
			28		1800	64		58mm diameter x 154mm long quad-loop tube			
	Mini-Lynx Ultra		15		800	53		60mm diameter x 105mm long quad-loop tube	List $13.95		6000 hour life.
			9		490	54		39mm diameter x 135mm long bi-pose tube			
	Mini-Lynx Economy		11		600	55	2700, 4000 and 6000K	39mm diameter x 140mm long bi-pose tube	List $18.95		
			15		900	60		39mm diameter x 165mm long bi-pose tube			
			18		1080	60		39mm diameter x 175mm long bi-pose tube			
	Micro-Lynx F	Flat circular CFL	7	120	220	31	3000, 4000k, red, blue and green	75mm diameter x 25mm thick.	List $75-$85		
	HE FHE	T5 size tri-phosphor tubes	14	NA	1350	96	3000, 4000 and 6000K	16mm diameter x 562mm long	List $15		Up to 20,000 hour life. Only for use in HE fittings.
			21		2100	100		16mm diameter x 862mm long	List $16.8		
			28		2900	104		16mm diameter x 1162mm long	List $17.5		
			35		3650	104		16mm diameter x 1462mm long	List $18.75		
	HE Luxline Plus	T8 size tri-phosphor tubes	16	NA	1350	75	2700, 3000, 3300, 4000, 5000, 6000K	26mm diameter x 590mm long	List $8.60		Up to 20,000 hour life. Direct replacement for standard T8 fluorescents.
			36		3350	93		26mm diameter x 1200mm long	List $9.10		
Osram	Duluxstar T5	CFL with ES or BC base	5	NA	240	48	2700 and 4000K	27mm diameter x 105mm long	—	Larger supermarkets and hardware stores, and electrical wholesalers. For more information, see www.osram.com.au	6000 hour life.
			8		420	52.5		43mm diameter x 108mm long			
			11		600	54.6		43mm diameter x 117mm long			
	Longlife energy saver		14		750	53.6		43mm diameter x 130mm long			15,000 hour life.
			7, 11, 15, 20, 23								
	Economy energy saver		5, 12, 18, 27								6000 hour life.
	Vario				—	—	—	—			Switchable between full and 25% output.
	Sensor plus		NA								Has automatic light sensor to turn itself off in daylight hours. 6000 hour life.
	Candle										Replacement for candle incandescent lamps
	Classic		5, 7, 10, 15								Same shape as a regular incandescent.

The Solar Sponge—a low-cost DIY solar air heater

David and Nicole Jones tell us about their low-cost solar air heater that will drastically cut their heating bills

What can you do after you have applied some basic energy saving techniques to your house, such as compact fluorescent lighting, reducing latent power, insulating the walls and roof, and switching to 'Green Power'? We asked ourselves the same question, and looked at our electricity bill. It was obvious that heating was the dominant factor in winter time. Could we heat our house better and cheaper than our current oil heaters, or do something to supplement them?

We did some research and found that solar air heaters looked quite promising. The drawback was that prices for commercial units were prohibitively expensive, approaching $3000. This seemed excessive for what looked like a metal box with a couple of fans, so we decided to investigate further and see if we could design and build our own for significantly less. If nothing else, it would be a load of fun and educational!

The result is the Solar Sponge, an active solar air heater which can be built for under $500 installed with parts from the local hardware store. As a bonus, its performance equals or outperforms commercial units of the same size!

How it works

Solar air heaters come in two varieties—active and passive. The active types use fans to force the heat through the collector and ducting, while passive types rely on thermal syphoning to circulate air through the house. In both cases cooler air is extracted from either outside or inside the house (at floor level), heated, and then pumped back into the house. The passive type have very specific requirements for mounting (usually outside a window to the ground) so we opted for the more versatile active type which could be mounted on the roof.

To start with you need a collector—a box which collects the heat. The traditional design for a solar collector comprises a black metal plate which absorbs the solar radiation and converts it into heat, and a sealed cavity on top to trap the heat within. This is essentially how a greenhouse works. The heat is extracted from the back of the plate (via another sealed cavity) and circulated by fans. This is often known as the 'dead air space' design.

That's all there is to it. Such designs have been around for many decades, and commercial units are very popular in the US and Europe.

There are variations on this basic design in which there is a single enclosure of a metal box and a glass plate on top, and air is pumped through this single sealed enclosure. However, this design suffers from higher losses through the front plate, which requires the use of expensive and fragile glass. Pilkington SunPlus glass is designed for this purpose but is very expensive—more expensive than our entire Solar Sponge design and installation!

We opted for a cheaper and simpler solution based on the traditional dead-air-space design, but it was our choice of materials that would prove to be the deciding factor in cost and ease of construction.

Galvanised steel is the traditional material used for such designs, but we opt-

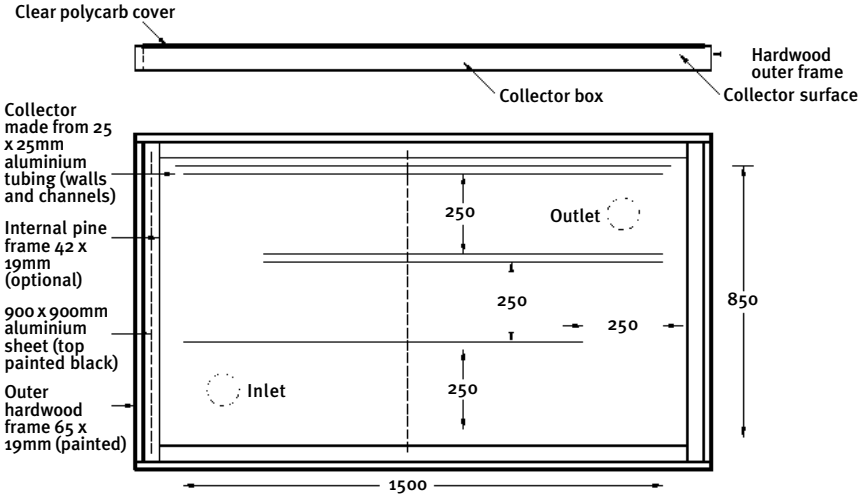
ed for aluminium due to it having four times the thermal conductivity. In fact, we built our entire collector box out of aluminium as it was easy to work with various pre-made sheets and tubing sizes from the local hardware store.

Another key aspect of the Solar Sponge design is the use of very thin (less than 1mm) polycarbonate sheeting for the front cover. This drastically reduced our cost compared to glass or thicker 3mm polycarb sheeting. Polycarbonate sheeting has similar transmissive properties (around 90%) of the purpose-designed low-iron SunPlus glass but at a fraction of the cost. It is also extremely tough and can withstand hail. The thin material does however warp a fair amount compared to thicker sheeting, but this had no noticeable effect on the performance, and aesthetics weren't important to us.

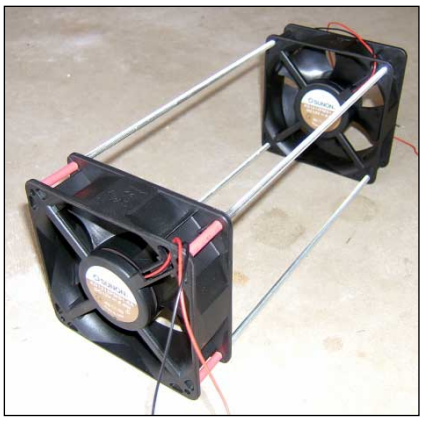
The design of the collector box was obviously crucial. It needed to be a certain minium size, and efficiently transfer the heat to the air as it passed through. The design of any solar collector will always be a rather delicate balance between air flow rate, internal surface area, and losses to the outside world (back through the polycarb cover plate and out the sides of the box). Pump the air too quickly through the collector and it won't have time to heat up, pump it too slowly and it'll get hot but the volume won't be there to heat your room and heat losses will be greater.

Somewhat contrary to common sense, the hotter the collector plate the greater the overall losses will be. So you want to actually minimise the collector plate temperature by having sufficient air flow rate and 'heatsinking' within the design. The aluminium construction of the solar sponge is fairly optimum in this regard. But you can go overboard and have too much heat sink material—being too cool is bad too!

It was important to have as long an air flow path as possible within the collector and to have the cold air being drawn in from the bottom of the (angled) collector and coming out the top. Hot air rises and we wanted to make use of that fact to improve our efficiency. So the Solar Sponge was designed to be rectangular, with the longer sides on the horizontal, the inlet port on the bottom, and the outlet port on the top. Internal channels were added to 'snake' the air around the box, picking up heat as it goes. With a 1.5m long box, this equates to a total air path of 4.5m, a length long enough to pick up sufficient heat. Holes were also drilled on the bottom side on the internal square channel walls to help break up the airflow.



The design used for the prototype of the Solar Sponge.



The fan assembly without the cover.

We based our prototype collector size on two 900 x 900mm pre-cut aluminium sheets, giving us a total collector area of 1.6m^2. Although this is on the small side, it was suitable for a first prototype.

Fans

After initial testing it was obvious that fans are crucial to the design. They must be the right capacity, use a minimum of power, and must be configured correctly, based on the total ducting length.

Fans can be used in parallel and in series. Fans in parallel will give an increase in total airflow rate for low pressures (short ducts), but show little gain at high pressures. Conversely, fans in series will give a greater airflow rate at high pressures (long ducting), but show little gain at low pressures. So there is no point in having four fans in parallel on a long duct, as you won't see much improvement over one fan. Fans are also rated into free air, so a 100CFM (cubic feet per minute) fan does not produce 100CFM into a duct! In fact it will most likely be one-tenth of that value or less. This is important to know when it comes to energy and efficiency calculations.

A typical solar heater installation will have at least five metres of inlet and outlet ducting, plus the collector itself (say, another five metres). That length of ducting is going to be 'high resistance', leading to high pressure. So we need fans in series to increase our airflow rate.

We constructed two fan boxes wrapped

in aluminium sheeting, each using two 120mm² x 38mm thick, 12 volt DC 107CFM fans. These are separated to avoid any loss due to air vortices. We used all the fans on the outlet side ducting, but ideally they would be on the inlet side to increase fan operational life (as they would run at a lower temperature).

Toxin free

From the outset it was important to us that the entire system be free of toxins. After all, there was no point sitting in a warm house if you were breathing in toxins!

This meant that the entire air path (with the exception of the fans themselves) had to be made of metal, including the collector box and the ducting. Although we chose an all-aluminium construction for the collector to improve thermal performance, this also happens to be the perfect toxin free environment. Even the neutral cure silicon used to seal the aluminium box is toxin free, and we used aluminium rivets to join it all together. The front of the collector plate and the wooden frame are painted, but they are not part of the air collection path.

Solar power?

We considered powering our fans from solar cells, but then realised we already had Green Power so were already using solar and wind power. Not to mention that the cost of solar cells (we needed 50 watts) would be prohibitive, with a payback period in the order of 50 to 100 years.

What about heat extraction?

Some designs allow you to extract heat in summer as well. We looked at this but decided that the extra complexity was not warranted considering you can buy a simple exhaust fan for this purpose.

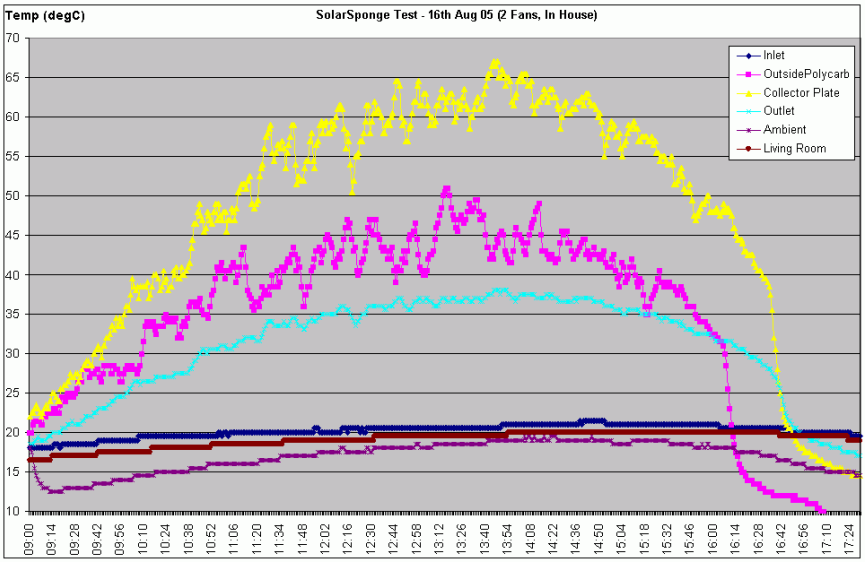
Installation

The angle of the collector to the sun is most important. However, as most installations would be fixed, compromises have to be made. Some designs have angled collector fins inside the box to supposedly improve performance, but this is a false assumption. Angled fins do not increase the total surface area relative to the sun. Solar radiation will be absorbed the same from any angle.

We fixed the Solar Sponge to the roof beams using four bendable metal mounting strips that protrude from under the tiles, although we found we also needed a wooden frame to extend the height of the collector. Tile-tites were used to replace the roof tiles and allow the ducting to penetrate the roof.

During testing we found that having our inlet on the ceiling along with the outlet (even with them in different rooms) we got a laminar flow across the ceiling which was very inefficient. Ideally you want the inlet on the floor level, but our house design did not allow this.

So in the end we simply disconnected the inlet duct and drew air in from the outside. As a bonus we now have shorter ducting, fresh air circulation, and no laminar flow problems. However, this may not work in all climates.



This graph shows the inadequacy of two fans for this installation. The collector temperature is much higher than the outlet temperature, indicating that further heat could be extracted.

Conclusion

Based on the initial results graph I don't think we have yet reached the maximum air flow rate for our particular collector size—some more research will have to done in this area.

The design at present does not have a controller for automatic operation. But we plan to add a simple temperature sensor to the collector plate to automatically switch on the fan when the sun hits the collector.

Unfortunately we just finished the Solar Sponge at the end of winter, and the warmest winter on record to boot, so we didn't have much time to put it to real use. However, the results we got were quite encouraging for such a small collector. Whilst the prototype Solar Sponge worked fairly well, we feel that it was a little on the small side for our large living area. Typical heat output was in the order of 500 watts on an average day. Not bad for a mere 25 watts of fan power!

The prototype has shown us that solar air heaters are a viable technology and can be made cheaply. It sure is nice sitting under a vent pumping out 40°C air. We can't wait for next winter!

More information can be found on the project website www.solarsponge.com

Waterwise gardens

Mary Trigger from Sustainable Gardening Australia gives us tips on how to save water in the garden this summer

The Yarra Trams depot in Preston, Melbourne now has a beautiful new sustainable garden. For years the front garden was a square of grass that needed regular mowing and watering and the shrubs were mostly local environmental weed species.

Sustainable gardening is all about gardening in a way that minimises the negative impact our gardening practices have on the natural environment, while maximising the positive impacts we can have.

Gardening can have a positive benefit to the health of our environment. If we plant local plants we provide food and shelter for birds and butterflies. By conserving water in the garden we help maintain water levels in our reservoirs. If we reduce the use of chemicals in the garden we help to keep our stormwater runoff into creeks and streams chemical free. By composting our household and garden organic waste we can reduce the amount of waste going into landfill and therefore reduce the amount of greenhouse gas produced. If we purchase renewable resources for the garden instead of non-renewable resources, we can help to protect our old-growth forests and river ecosystems.

It is easy to create beautiful gardens that suit our local climate and soil and have a low impact on our natural environment. Sustainable gardens can be introduced gradually—when an exotic plant dies, replace it with a local plant. Sustainable gardens are low maintenance, as they require less watering, lower application of fertilisers and chemicals, and less mowing and pruning.

Australia is the driest habitable continent in the world and yet we are also the highest consumers of water per capita. We have been in drought conditions for several years. We are using more water than gets replaced, and each year the reservoirs have less and less water. Up to 30% of domestic water gets wasted in the garden through problems like water not being able to penetrate the soil deeply, not using mulch to stop water evaporating, inefficient irrigation and bad garden design. Water-efficient gardening is a great example of an important aspect of sustainable gardening.

There are a number of easy steps that can be taken when watering your garden that, in some cases, can lead to a saving of over 70% water use. Implementing even just a few of these changes not only increases the amount of water available to maintain healthy flow rates in our rivers and wetlands, it offers a significant economic incentive, drastically cutting water bills.

One of the most effective ways to reduce water consumption is to simply water your garden less. Knowing when your garden actually needs watering, as opposed to watering it 'just in case', can significantly reduce the water you use. A simple test is to press your finger gently into the soil, just past the knuckle, to see if it's damp.

If plants are thirsty, hand watering is an efficient and relaxing way to rejuvinate your garden. Aim to water the ground close to the base of plants and water for long periods and less often, avoiding watering over the leaves. This encourages plants to develop deeper, stronger root systems making your plants more drought tolerant. Mulch is also very effective at saving water within the root zone. A layer of mulch will prevent evaporation by shielding the soil from the sun, and reducing water

Tips to save water in the garden

1. Add organic compost to your soil. This not only adds valuable nutrients but enables the soil to hold more water
2. Mulch your garden beds and pots. Up to 70% of water can be lost through evaporation from the soil. Mulching not only reduces water loss but helps suppress weeds and can add nutrients to the soil as it breaks down. Mulch should be applied about 8cm deep and topped up about once a year, depending on what type of mulch you use
3. Water in the cool of the evening and direct the water to the plant root zone with long, infrequent watering
4. After you have watered, dig down to see how far it has penetrated—it should be at least 10cm. Water the same area three times the same morning or evening to make sure the water soaks in
5. Use local plants; they are suited to your local soil and climate. Intersperse them with native plants or exotics with similar water requirements
6. Group plants according to their water needs
7. Check and clean your irrigation system every spring
8. Have either a timer on your taps or shut-off valves on your hoses
9. Mirco-sprays waste up to 70% water through drift and evaporation—and if the soil is mulched, water will not penetrate to the soil
10. Consider soaker hoses that deliver water to the roots of plants under mulch
11. Water pots and plants with low pressure on the hose. The water should be running slowly, not on a spray, as this does not penetrate very deeply
12. Try and reduce your lawn area. Consider extending mulched beds, using porous paving or a drought-tolerant lawn. If you do have a lawn, cut it long over summer (8 to 10cm)
13. Go for a tough drought-tolerant grass like 'Sir Walter Buffalo'; a native grass such as *Microlaena stipoides* or a native groundcover like *Myoporum parvifolium* for the front garden
14. Greywater from the bathroom and laundry are a great source of water that is available every day
15. Check the weather forecast to avoid watering before rain

runoff during rain and watering. Think of it as a natural slow release water storage device. But storage is not much use if the water is not getting to where it needs to be, so use a trigger nozzle to switch off water as you walk between different parts of the garden.

Wind and heat significantly reduce the amount of water entering the soil, so avoid watering during the day, instead aiming to water in the cooler morning or evening.

You may want to consider installing an irrigation system, particularly if you are short of time or your garden is large. If you do, make sure the system applies water at a known and variable rate. A rain sensor can be fitted to prevent the system operating when it is raining and timers can be added to guard against forgetting to turn the system off. They also allow your garden to be watered even if you are not there.

The most water thirsty of gardens are generally those with a lawn. You may want to consider planting areas of low water-use grasses for use as soft places for recreation instead. Cool season grasses may brown off, but should green up again with Autumn rain. If you must have a lawn, sprinklers and pop-ups are the most suitable irrigation systems. However, many sprinklers provide water too fast to be absorbed by your soil so make sure the sprinkler you use has a low application rate.

Drip irrigation systems are particularly good for larger plants, fruit trees and shrubs. They release water slowly and efficiently, and as such can also be used for plants on steep ground and pots. Also suitable for those hard to reach places are porous hoses. Porous hoses also release water slowly, but can be buried, with the added advantage of supplying water to the plants' root zone.

However, planning is the best way to reduce water consumption in your garden. Think about the different regions you have in your garden. Some places may receive more sun or shade than others, some are wetter or drier and some are more exposed to the wind. Choose plants that are suited to these areas and clump plants that have the same requirements together. In this way, not only will you have to water less, but the plants will also thrive.

Local indigenous plants are suited to the climate and soil of your area. Think about selecting some indigenous plants that will grow well in your area or grow plants that have low water requirements. Planting trees can create shade and reduce evaporation. In short, wise plant choice can dramatically reduce the need for lots of watering.

Little by little we can all make a difference in our own backyards by working with our natural environment rather than trying to grow European gardens in Australia.

SGA is a not for profit organisation focused on making it easy for Australian gardeners to reduce the environmental impacts of gardening on the environment. For further information go to www.sgaonline.org.au

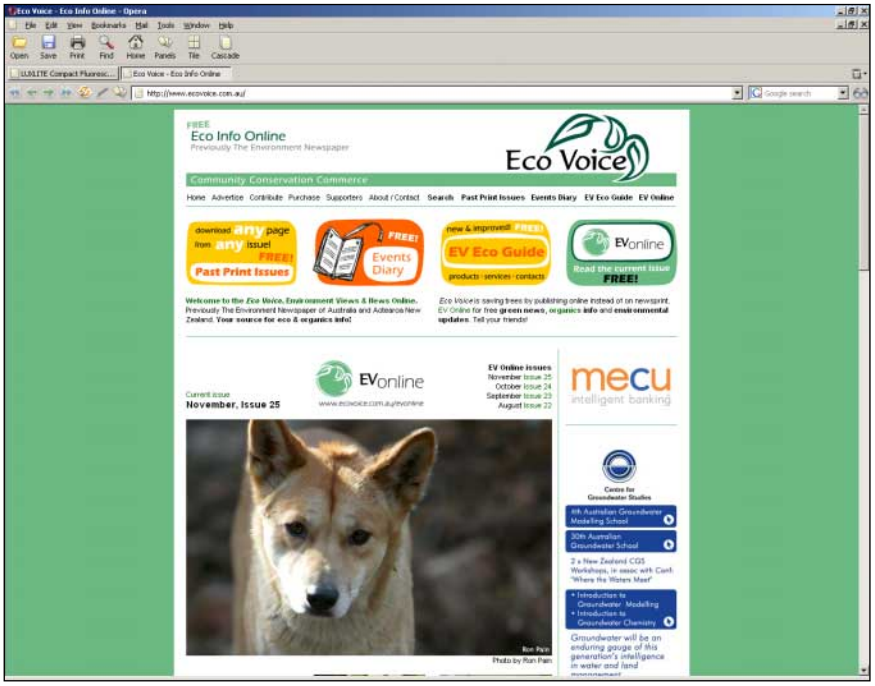
www.ecovoice.com.au

Eco Voice is an online newspaper, originally published on paper, that provides a wealth of environment-related news and events while using no trees.

You can still purchase printed back issues from the Eco Voice site. The current issue, and all issues are available from the site for free.

Many topics are covered, such as the benefits of bamboo flooring, organic cotton, calculating greenhouse emissions, volcanic eruption effects on climate, and recycling. In fact, just about any environmental topic is fair game for this online journal.

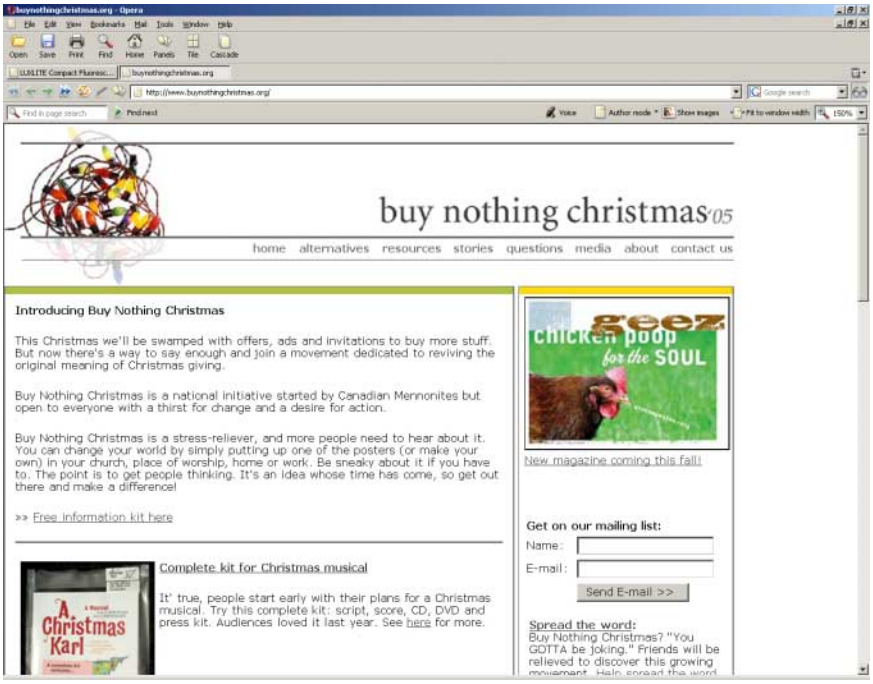
There is a small photo gallery, contributions from readers, an events diary and a categorised directory of eco-friendly products and service suppliers. Adverts for suppliers of products and services are scattered throughout the site.



Easy to navigate and with an efficient search function, Eco Voice is an ideal hub for all environmental issues and events.

www.buynothingchristmas.org

It's nearly Christmas time again, where most people seem to focus on expensive material things and how many presents they will give and receive. Wouldn't it be nice to forget all the materialism and focus on what really matters?



The buynothingchristmas.org website encourages people to have a festive season where they don't buy all the expensive, consumer goods they usually would. Instead, the site is dedicated to reviving the original meaning of Christmas giving.

The site presents many alternative gift ideas, such as filling a basket with homemade goodies, making a piece of art, making handmade soap or candles, creating coupons for a massage, spring cleaning, child-minding, or perhaps a manicure.

There are lots of great ideas on this site, and as many people's lives seem to become more and more empty in the endless pursuit of material wealth, making a change such as having a Christmas where you don't feel that you must buy, buy, buy, might just make you feel a whole lot better!

Practical solutions for sustainable living

Support the organisation that supports ReNew.

The ATA (Alternative Technology Association) is a not-for-profit organisation that has been providing advice on how to make homes more energy and resource efficient for over 20 years.

ATA members and supporters:

- Make it possible for ATA to publish magazines like *ReNew*, our new annual magazine *sanctuary: sustainable living with style*, and other ATA publications like the Solar Hot Water, Solar Electricity and Wind Power booklets.
- Keep our voice active in public forums calling for better support from government and industry for people making sustainable choices at home.
- Support practical projects in the community, like our International Project Group's work providing simple renewable energy solutions for remote communities in East Timor.

ATA members also receive:

Free advice and practical tips

Receive free technical advice from the ATA experts either over the phone, via email or through the ATA web forum.

ReNew magazine

Receive a free subscription to **ReNew** magazine—packed with practical advice and product information on sustainable building and energy and water conservation.

Discounts from the ATA shop

The ATA webshop others a range of publications, energy-efficient lighting and other products to help you with your sustainable lifestyle.

Discounts from a wide range of suppliers

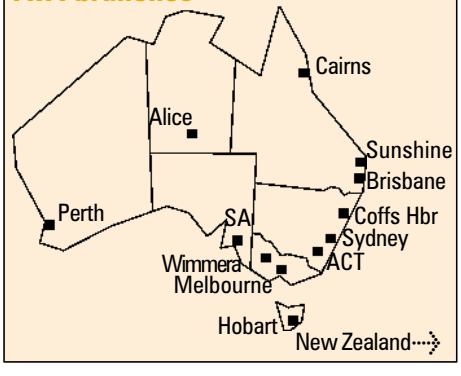
Mention you are an ATA member and receive a discount from more than 50 suppliers of sustainable building and renewable technology products and services.

To become an ATA member or supporter go to the ATA webshop at www.ata.org.au or call (03) 9419 2440. Alternatively, fill out the order form on page 82.

Member discounts

• A B & S Solar Industries 10% • Advanced Energy Systems 10% • Alternative Fuels 10% • Aqua Block 10% • Aqua Clarus 10% • Australian Correspondence Schools 5-15% • Biome Living 10% • BPArchitects - free 'Green House Plans' book • B/W Solar 10% • CERES nursery 5-10% • Cycletrek Bunbury WA 5-10% • Design Habitat 20% • Earth Basics 10% • EcoSouth $250 off power systems • Environment Equipment 5-10% • Everglaze Industries 5% • F2 Design - free energy rating with design sketch • Federal Batteries 10% • Going Solar 10% • InSolar 10% • K & C Stork Solar 10% • LEDsales 5-10% • Metcalf Building Consultants 10% • Natural Paint 10% • NENSYS New Energy Systems 10% • Ogden Pumps 10% off pump building instructions • Outback Energy Supply 10% • Pearcedale Conservation Park 10% • Permaculture Visions 10% • PV Solar Energy 10% • Sandford Electronics & Solar 10% • Sharpe & Jephcott 10% • Smartflo 10% • Sola-Kleen 10% • Solar Charge 10% • Solar Energy Australia 10% • Solar Powered Solutions 10% • SolarTasmania 10% • Solazone 5-10% • Sun Plus CPC Solar 10% • Sustainable Impact 5%, plus 5% donation toATA • Talisman Consulting 10% • techbits 10% • The Environment Shop 10% • The Solar Shop $300 off complete home solar package • Tri Nature Greensborough (VIC) distributor 10% • Wattagan Innovations 10% • Wren Industries 20%. NB: the ATA website has full details of member discounters outlets.

ATA branches



ATA shop by mail

Your Home Technical Manual

Price: $49.50. NB: $10 postage on this item

Gives you the information you need to design and build a more comfortable home that is less expensive to run while being more environmentally friendly.

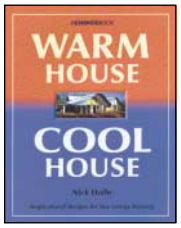
Contains over 60 fact sheets on sustainable solutions for designing and building your home. *Item code: YHTM*

Building with earth bricks and rammed earth in Australia

Price: $27.50 ($26.50 for ATA members)

This book represents the collective experience of the modern generation of earth builders, expressed in a form relative to building regulations in the 21st century.

Covers design, materials, earth brick and rammed earth wall construction, service installation etc. A good primer for anyone wanting to build from mudbricks, rammed earth or similar materials. *Item code: BWEB*



Warm House, Cool House

Author: Nick Hollo

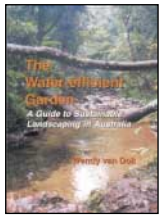
Price: $33.00, Paperback, 172pp

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*

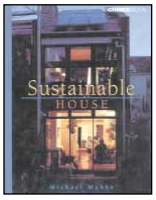
The Water-efficient Garden

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

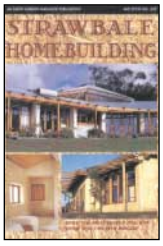
Author: Michael Mobbs

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



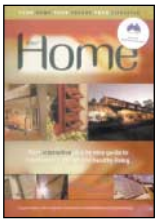
This book details practical strawbale building practices you can use to build anything from a small cabin in the bush to a mansion in the city. A great book that details many homes that have been built around Australia. *Item Code: SBH*

Renewables on CD ROM

ReNewROM

Price: $65 ($55 for ATA members) plus $4 postage

Our long-awaited second CD ROM of the issues 41 to 70 of *Soft Technology* and *ReNew* back issues, many of which are no longer available. This disk is fully searchable with 30 complete magazine issues in PDF format, so it can be used on PCs, Macs and Linux boxes. *Item code: RENEWROM*



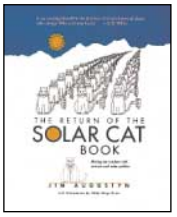
Your Home Technical Manual DVD

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

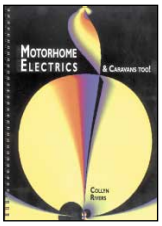
Solar Cat book



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



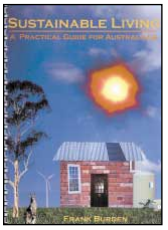
Motorhome Electrics & Caravans Too!

Price: $35 ($33 for ATA members)

Running motorhome and caravan electrics from solar 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 the first time.

Item code: MECT

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*

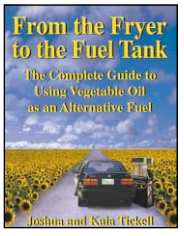
Windpower Workshop

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*

From the Fryer to the Fuel Tank



Author: Joshua Tickell

Price: $34.95, Paperback, 160pp

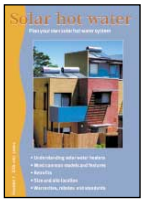
A great book that shows the reader how to make a clean-burning renewable fuel from waste vegetable oil. Includes detailed instructions on making and using the fuel in a standard diesel vehicle. *Item code: FFTFT*

ReNewROM II

Price: $65 ($30 for ATA members) plus $4 postage

This is the third CD ROM in the series, and covers issues 71 to 89 of *ReNew* back issues, many of which are no longer available. This disk is fully searchable with 19 complete magazine issues in PDF format, so it can be used on PCs, Macs and Linux boxes. *Item code: RENEWROM2*

Solar hot water

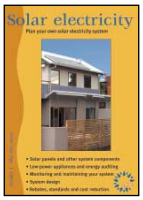


ATA Booklets series: Solar Hot Water

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.

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.

2006 Sustainability Info Diary

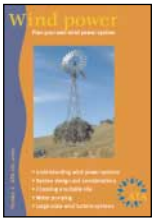
Price $19.95 ($18.95 for ATA members)

Get daily hints on how to live sustainably and remember all your important dates with the little things: 2006 sustainability info diary. Printed on 100% recycled paper, hard cover, spiral bound the diary makes a perfect christmas gift. *Item code: TLTD*

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*

Aluminium 4 LED torch

Price: $8 ($6 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 at least 24 hours of usable light.

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*

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

1-wire weather monitoring kit

Price: $200.

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.
Item code: WEATHER-AAG

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. *Item code: NIGHTSTAR*

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

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

Cool new products

Universal fast charger

$99 ($90 for ATA members)

This charger will charge up to four AAA, AA, C or D nicad or NMH batteries in any combination, as well as slow charging up to two 9 volt batteries. Features full microprocessor control and automatic discharge for nicad cells to prevent memory effect. You can even charge a combination of nicad and NMH at the same time! Other features include a constant current pulse charging system, automatic current selection for each battery, negative delta V end-of-charge detection, short circuit and reverse battery protection, defective cell detection, and separate indicator LEDs for each battery being charged.

New

This is the ultimate charger if you have large capacity NMH cells. Powered from the supplied 12 volt DC 1 amp plugpack. This charger should also work from a 12 volt battery system, though we haven't tried it. *Item code: BATTCHARGERLARGE*

Miniature wind turbine kit

Price: $49.95 ($47.95 for ATA members)

This great little kit allows you to make a tiny wind turbine that is both educational, as well as a functioning turbine that can produce power. Maximum output is up to 10 watts, though we would rate it more like a watt or two realistically. *Item code: WINDKIT*

More cool products

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-Mate energy meter

Price: 10 amp version is $295 ($280 for ATA members); 15 amp version is $405 ($390 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.

New lower prices!

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 Power-Mate for hire for $50 a week!

Low-power halogen replacement bulb

Price: $50 ($45 for ATA members)

This bulb can be plugged into almost any 50mm halogen downlight socket that uses an MR16 halogen lamp. It uses a 3 watt ProLight LED as the light source, which is available in either warm white or cool white. The LED is driven by an inbuilt switchmode power supply. Beam angle is around 30 degrees, suitable for task lighting or highlighting. The body is made of aluminium for good heat dissipation. Power consumption is around 4 watts, and the bulb will run from any power source of around 12 volts, either AC or DC, so can be plugged straight into a halogen socket without changing the transformer. *Item code: LEDHAL3W*

New

LED bike light

Price: $29.95 ($28.95 for ATA members)

This light has five white superbright LEDs and is powered by four AAA batteries. The light has two modes—continuously on and flashing—and is waterproof to 20 metres.

The light comes with a slide locking handlebar clamp to allow easy removal of the light from the bike to prevent theft. This means that the light can also be used as a general purpose torch and even a diving torch, providing you don't exceed the 20 metre rating. *Item code: BIKELIGHT5LED*

Power House kit

Price: $290 ($280 for ATA members)

Make a renewable energy powered model home!

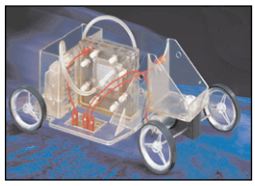
The kit focuses on the heat and light energy from the sun, the energy from the wind, as well as with electrochemical and plant energy.

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*

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*

Wireless weather station

Price: $249 ($239 for ATA members)

We now have a new wireless weather station that measures not only wind speed and direction, but indoor and outdoor temperature, humidity, barometric pressure, and even rainfall.

The data is collected by two sensor packs that are connected to a wireless transmitter. This sends the data back to the base station every minute or so, which then uses the information to give averages, accumulated totals, maximums, minimums and trends of the various data.

The transmitter requires two AA batteries while the base station is mains powered, with three AA batteries for data backup. The base station does not have the facility to connect to a PC, so you can't download data, but it does just about everything else. *Item code: WIRELESSWEATHER*

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.

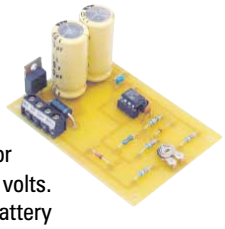
Now available: 3 watt LEDs and 1 watt warm white LEDs! See our webshop for details.

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.

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: $45 ($40 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

Hexagonal lens/holders for Luxeon LEDs

Price: $6

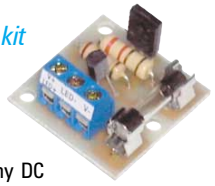
These assemblies consist of a 20mm diameter lens in a hexagonal holder which is designed to fit to 3 and 5 watt Luxeon star LEDs. They come in 6, 15 and 25 degree angles and the 4 x 25 degree line optic. *Item code: LED_OP6DEG, LED_OP15DEG, LED_OP25DEG, LED_OPLINE.*

Simple 1 amp rectifier kit

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

Item code: RECKIT

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

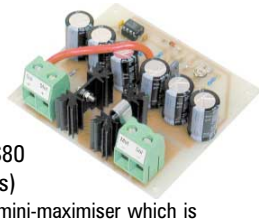
The Superflux LEDs are about the best value for money available in LEDs today. Each 8mm square Superflux LED has the equivalent light output of several of the best 5mm LEDs, for the same or less cost as a single 5mm device! Available in red, green, cyan, blue and amber.

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

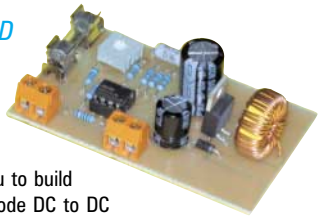


Price: 12 amp: $70 ($65 for ATA members), 20 amp: $80 ($75 for ATA members)

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, 90, 91, 92 and 93.

ATA order form

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❒ *Tick here to receive occasional email updates.*

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The national picture

ReNew's regular policy columnist Alan Pears questions the commitment of governments to reducing greenhouse gas emissions

Markets and fuel-efficiency

The Productivity Commission's final report on energy efficiency was released in October 2005. It has been re-titled *The Private Cost-effectiveness of Improving Energy Efficiency*. The inclusion of 'Private' in the title acknowledges that this is only part of the rationale for most energy efficiency policy. Since all regulation (and most public policy) is based on public benefit, not just on private benefit; the draft recommendations blocking regulation have been toned down.

The federal government's accompanying press release stressed its commitment to energy efficiency, effectively distancing itself from the Commission. The government specifically mentioned support for energy efficiency standards and the Energy Efficiency Opportunities program, both criticised in the report.

But the report has mobilised industry opposition to strong energy efficiency measures, and the Commission has identified a number of weaknesses in data supporting energy efficiency measures, particularly lack of solid field data showing real savings. So we should read it carefully and heed its messages.

For me, an interesting example of the difficulty of separating private and public aspects of energy efficiency emerged when looking at attitudes of car buyers. For new car buyers, fuel consumption has generally been a fairly low priority (most cars are bought by business or people with significant discretionary funds), and fuel (even at today's prices) is a relatively small proportion of new car ownership costs. In contrast, a 2003 ABS survey showed fuel consumption was the number two issue for householders buying cars (38%, compared with 50% for purchase cost), most of which are second-hand.

Attempts to just look at new car sales as a separate market ignore the fact that the range of vehicles available to second-hand buyers (who pay for running costs for the bulk of vehicle life) is constrained by the choices made by new car buyers. Of course, advocates of markets can argue that resale value will be influenced by the preferences of second-hand buyers and this will influence the behaviour of new car buyers. This doesn't seem to be borne out by experience, as it is an uncertain factor a long way in the future.

This is a good example of a situation that requires government intervention to protect the interests of second-hand car buyers, society and the environment. Yet governments seem to be more interested in protecting the viability of a local car industry that has trapped itself in the large car niche market. The challenge is to help the local car industry to develop a viable low greenhouse impact path forward. This could be done by utilising a variety of locally developed technologies such as super capacitors, smart hybrid drives, innovative engine technologies and ultra-lightweight materials combined with radical vehicle design.

Emissions trading

State governments are developing an emissions trading scheme that can be introduced regardless of what the federal government does. A Background Paper has been in the public arena, with comments closing on 11 November. There should be ongoing opportunity for input via www.cabinet.nsw.gov.au/greenhouse. I've put my submission in.

It's likely that any emissions trading scheme will be very limited for quite a few years, so that investments in coal-fired power stations and certain industries are protected. But it is important to get a framework in place and at least start moving on this issue. At a minimum, it's one way of generating revenue that could be used for more effective greenhouse strategies such as incentives for abatement.

A danger of supporting emissions trading is that it may be used as an excuse by governments to avoid implementing measures that would actually make a big difference in the short term.

Emissions and air travel

The Intergovernmental Panel on Climate Change has estimated that the overall warming impact of air travel is between 2.5 and seven times as large as its direct emissions from fuel burning would suggest. This is due to a number of effects including contrails (cloudy trails). If they're right, even switching aircraft to renewable fuels will not fully avoid the greenhouse impact of air-

craft, because most of these indirect effects would remain.

The international air industry's emissions are not included in any country's greenhouse inventory (as is also the case for international shipping). Some airlines are beginning to acknowledge their responsibility to act, but this is a major emerging greenhouse response issue.

There are also some interesting implications for countries like Australia that rely heavily on international transport. In the short term, you can offset your emissions from air travel using a number of web-site based tools at a cost that is surprisingly small compared with the cost of your holiday. It would be great if the airlines would let me use some of my unspent frequent flyer points to offset my emissions.

Hazelwood expansion

The ancient Hazelwood brown coal power station has, as reported previously, been given access to more coal so it can continue to operate for at least 25 more years. But the shocking outcomes are in the agreement between its owners and the Victorian Government.

If Hazelwood exceeds its emission cap, the Victorian Government could force its closure, or enforce penalties equivalent to about 1.5 cents per kilowatt-hour. But this still leaves it price-competitive and these penalties only apply to 'existing boilers'.

In addition, Hazelwood's owners are entitled to credit for the emissions avoided through the first ten years' generation from any renewable energy projects in which they are the 'lead developer', even if they sell their share immediately after commissioning. This is a very valuable benefit that no one else receives.

The agreement also requires that Hazelwood be treated 'equitably' (whatever that means) under all future emissions mitigation schemes. And the Victorian Government is required to make representations to the federal government regarding treatment of Hazelwood under future national schemes.

Please Mr Bracks, can I have a deal like that?

Yet again...

The Victorian Government's VenCorp has published its vision for development of electricity supply infrastructure for Victoria. Massive expansion and up to eight billion dollars of investment are, of course, considered critical for ongoing development over the next 25 years. One of the scenarios even includes a doubling in electricity use for aluminium smelting. How bizarre—see last issue's column on this topic.

Essentially this is an ambit claim, a bit like those road strategies and energy visions we have seen in the past. The problem is that they can become self-fulfilling prophecies.

Worse, in his introduction to the report, Victorian energy minister Theophanous repeats the erroneous statement that energy growth is critical to maintaining economic growth. This same minister has previously stated (in his Hazelwood press release of 6 September) that business needs cheap energy prices to be competitive.

When will one of his advisers or the public service explain to him (and most other politicians, senior public servants and business leaders in Australia) that energy is a very small component of input costs for most Australian business (as confirmed by the Productivity Commission)?

The total cost of energy services, not energy prices, is what matters when looking at energy. Improving energy efficiency can offset higher energy prices and reduce total energy cost. Shifting to distributed generation can avoid infrastructure costs. I thought this was obvious twenty-five years ago.

Sad joke of the month

Many people find it difficult to tell who some Victorian public servants work for—is it Hazelwood or Alcoa? It's a worry. And a similar joke could be made in most other states, too. *

El-cheapo two-hour time switch

Hugh Spencer shows us how he made a simple genset controller from a garden tap timer

Our Choice Electric Sunmaster controller died early this year. It needed a new CPU (the brains of the unit) but because it was over 10 years old, no parts were available anywhere. It was one of those excellent devices that controlled the battery charge, calculated the ampere-hours, controlled the generator twice a day (set via a keypad), and had the ability to check all operating parameters such as voltage and current. To my knowledge, nothing remotely like it exists today. It was so easy to use—something that in the modern practice of 'menu-driven' systems seems to get forgotten.

So, until I found time to re-design the system, we needed some temporary generator timing assistance. It used to be wonderful to just key in 'On-time: 18.00', 'Off-time: 22.00' and go to bed knowing that the genset would switch off at 10pm. Now, it's out of bed, wander down to the generator (great fun if it is raining!) and turn the thing off at 10-ish.

Being able to set the genset for a two-hour run-time would help a bit, but I was unable to find simple one-knob stand-alone timers suitable for the job—until I happened to be in a supermarket browsing through the garden section. I spotted a $12 Garden-Mate two-hour 'Tap Timer', from RIS Irrigation Systems in South Australia. Having a fair idea of how these devices work, I took a punt and bought it.

The timer installed. With a Hatz diesel, connecting the timer simply meant paralleling the wires from the timer with the 'remote' control from the Sunmaster. So long as the switch doesn't have to control the start solenoid current, all will be fine. If a high-current connection is required, then a second 12 volt relay will be needed, with the coil switched by the timer.

A simple conversion

At home, I was delighted to discover that it had a very robust, sealed, clockwork movement (that you don't need to touch at all!). Better still, it had a screw plug at the bottom that revealed the actuating pin (which is pushed by a cam on the setting knob). This made conversion incredibly simple—all that needed to be done was install a microswitch so that the pin (which has a nylon cap on it) can push the microswitch actuator. The plug screws out easily with long-nosed pliers, just don't lose the little return spring. There is considerable pressure available from this arrangement, and, unless you needed change-over switch configuration, you could use an old pair of relay contacts instead of the microswitch.

I made a base plate out of scrap Perspex (see the photo opposite), with a slot to accommodate the microswitch at the appropriate position. Once the correct position is found, the switch is then cemented in place. Keep the bits that you remove, as the timer can always be returned to garden service. Before using the timer as a generator controller, it is advisable to put caps on the water connections, or at least stuff them with paper, to deter mud wasps or geckos taking up residence. A couple of 'ears' on the base plate allow two self-tappers to secure it to the plastic timer body. A pair of stand-off pieces allow the timer to be screwed to the wall and provides clearance for the wires.

I'm sure other tap timers would work as well, provided there is direct access

to the valve from the rear of the unit.

So now I can set the run-time from anything from zero to two hours just by twisting a knob and I don't have to get up at night for that! In fact, as it has a 'manual-on' facility, all generator control can be carried out using the timer.

A couple of points though—the timer isn't all that accurate, so the time can vary by plus or minus 15 minutes. Don't pull the yellow top knob off to look at the innards (pulling the knob off breaks the seal with the shaft), as the spring that fits on the little nylon push rod is quite strong and can push the knob off completely! (hint—if you can, find a weaker spring). If you have a microswitch with a built in spring actuator, you may be able to dispense with the spring altogether. Alternatively, you can drill out the hole that the push rod runs in so the rod moves freely, then the springiness of the microswitch itself will be more than sufficient. Being a conservative type, I didn't do that, as I wanted eventually to put it back to use as a water timer, and drilling it would ruin it for that job.

The timer from underneath. The orange plug and the little spring are obvious in the front, as is the actuator pin with its white nylon cap. It is essential that the switch is sufficiently springy to push the pin back once the switch knob has reached 'o'. You might have to use the little spring from the timer to provide more return pressure. I needed it. It fits in a groove on the cap, and sits around the actuator button on the microswitch.

While this simple timer has made running the genset a lot easier, I still want my Sunmaster back! ✶

Hugh Spencer works at the Cape Tribulation Tropical Research Station, PMB 5 Cape Tribulation, 4873. hugh@austrop.org.au

Ten simple ways to save water

We keep hearing about how we should save water, but just how easy is it? We give you the top 10 ideas that can make a real difference to your water usage

1. Reduce water usage

One of the simplest ways to save water is to use less just by changing a few habits. You can do this by reducing shower times (and don't shave or brush your teeth in the shower!) and by flushing the toilet less often—the adage 'if it's yellow, let it mellow, if it's brown, flush it down' applies here—unless that's too gross for you!

2. Fix leaking toilets

Leaking toilets can waste a lot of water—up to 10 litres per hour or more. If you can visibly see water flowing into the bowl, or hear the cistern 'hissing' as water flows into it to replace what is leaking, then you should get it fixed immediately. Another telltale sign is rust/water stain marks down the back of the bowl, which are caused by minerals in the water. If you can't see or hear water flowing, try this simple test. Put a few drops of food colouring into the cistern. If the dye appears in the bowl within 15 minutes or so, then you have a leak.

3. Fix dripping taps

Like a leaking toilet, a dripping tap can waste a large amount of water—up to 10 litres a day or more for a fast drip. Having new tap washers installed is usually all that needs to be done to fix the problem, which is easily done by a competent handyperson, but if you're not sure, it is usually best to call a plumber. For old taps, the tap seat may need repair (called reseating), and this can also be done with the appropriate tools (a reseating tool costs around $20 from the hardware store, but make sure you buy a quality unit!).

4. Convert your toilet to a reduced flush

Reducing the quantity of water flushed by your toilet is very easy, and can be as simple as filling a two-litre soft drink bottle with water and placing it inside the cistern. Other options include bending the float arm down so that the cistern stops filling sooner, and using weight devices to allow you to control the flush precisely. These are simple weights that drop down inside the flush valve tube and prevent the valve staying open when you take your hand off the flush button. This means that flushing is controlled by how long you hold the button down.

Of course, if you need to replace your toilet suite, then make sure you get an ultra-low flush toilet like the new 4.5/3 litre units that are now available. Alternatively, consider a composting toilet!

5. Install a AAA rated shower head

Again, this is a simple modification that many people can do themselves. Most shower heads simply screw off the shower arm, and so a new water-efficient one can be screwed back in place of the old wasteful one. If you need to replace the complete head/arm assembly, then it may be best to call in a plumber, as a poorly fitted arm can leak water into the wall cavity, causing damage to the house.

There is a huge range of AAA (or better) rated shower heads available. A trip to your local hardware or home renovation store will provide many options, and some stores are even set up so that you can test the flows of the most popular models.

6. Install flow restrictors

Flow restrictors fit either inside the tap or on the tap to reduce water flow. Sink swishers like the one seen here make much better use of the reduced water flow than a standard tap, allowing tasks like rinsing of dishes to be done more efficiently with less water, just like a water saving shower head.

7. Install a rainwater tank

A rainwater tank can collect many thousands of litres of water each year. If you don't like the idea of drinking this water, it can be used for many other uses, such as for washing clothes, washing the car, directly on the garden or for flushing the toilet via a small pressure pump.

What size of tank you install will depend on the available space, the size of your roof, and rainfall patterns in your area.

No matter where you are in Australia, a rainwater tank can at least partially offset your mains water usage.

8. Install a drip irrigation system

A drip irrigation system, especially a sub-surface one, can save a great deal of water in the garden compared to hand watering with a hose and spray gun. Drip systems allow you to get water directly to the plants' roots with minimal evaporation, and they also allow you to use recycled water at lower risk of potential health issues.

9. Reuse your greywater

Whether you use the simple 'bucket' method to collect greywater, or have a complete greywater collection and reuse system installed, reusing this valuable resource can greatly reduce your water use.

It makes very little sense allowing water that has only been used to rinse clothes in a washing machine (unless you are washing nappies), or rinse a human in the shower, to go straight into the sewer. Water from most greywater sources is more than safe enough to be used on the garden or even to flush the toilet, providing a few basic rules are followed.

10. Buy efficient appliances

New appliances such as washing machines and dishwashers have water ratings labels on them that tell you how much water they use. If you have an appliance that needs replacing, then you should look for a machine that uses as little water and energy as possible. Front loading washing machines always use far less water than top loaders, require a lot less detergent and are usually low energy users as well.

A good dishwasher can wash a load of dishes using just 14 litres of water—far less than most people use when washing the same amount of dishes by hand. Of course, a dishwasher uses electricty to run the pump and in-built water heater, but if you supply water to it directly from a solar water heater, then energy consumption should be low.

Juice the old-fashioned way

The best juice is always freshly squeezed, but it isn't always convenient to use an electric juicer, especially if you live off-grid with a small power system.

The hand-powered Oscar manual juicer, from vitality4life, can be used for all your vegetable and fruit juicing including all fibrous herbs and wheatgrass. It comes complete with mincing and juicing screens, juice bowls, and a five year warranty.

Vitality4life also have several other manual and electric juicers that may suit your needs, as well as water filter and distillers, air purifiers, grain mills and food dryers.

RRP: $169.00.

The Oscar juicer is available from vitality4life, freecall:1800 802 924, www.vitality4lifeshop.com.au

And not just juicers!

If you think the manual juicer above is cool, how about a hand-powered blender! The Vortex hand-crank blender from GSI Outdoors is a full sized blender (1.5 litre capacity) that will do many tasks that an electric model will, no matter where you are.

It is excellent for camping, boating, out on the patio or in the holiday home and will mix shakes, cocktails, sauces or pancake batter. Made of stainless steel with a polycarbonate jug, it has a two-speed gear system that even lets you crush ice.

Other features include a 'pour through' locking lid, and the base nests in the jug for compact storage. It also comes with a 'C' clamp to allow it to be clamped to a table or bench for stability. The blender weighs 2.3kg and measures 133mm diameter by 405mm high.

RRP: US$69.95.

Available from GSI Outdoors, 1023 S. Pines Road, Spokane Valley WA 99206, USA, email: sales@gsioutdoors.com, www.gsioutdoors.com. The Vortex blender is available in Australia from www.gogogear.com.au for $135 including free delivery.

Maintenance-free lawns

Ever wanted a lawn that you don't have to mow and that never needs water, yet still looks like a real lawn? Pro-tech's no-mow, no-water Eco Logical Lawn could be the answer.

This new form of synthetic lawn is known as fibrillated lawn. It looks very similar to the real thing and is suited for suburban gardens and a variety of commercial and government applications. It is also good for the homeowner who finds looking after a backyard lawn a problem.

The Pro-tech Eco Logical Lawn system is also suitable for pool areas, under trees and on sloping terrain where it is difficult to grow healthy real grass.

According to the manufacturers, the Pro-tech Eco Logical Lawn system requires virtually no maintenance, will last for at least ten years in extreme weather conditions and has excellent drainage qualities.

Another benefit of this system is the optional Eco Logical Lawn Water Capturing System, which allows rain landing on the lawn to be captured for use around the garden.

The only drawback we can see with this product is the initial material production (it is a synthetic after all) and the end-of-life environmental issues, such as disposal/recycling. However, when weighed against the huge quantities of water, lawn fertiliser, and petrol and oil for lawnmowers, it may well be the best option for those people who really must have a lawn.

Available from Pro-tech Corp, PO Box 3337, Rhodes Waterside NSW 2138, ph:1300 554 334, email: info@pro-techgreens.com.au, www.pro-techgreens.com.au

Commercial recycled towels

If your workplace uses paper towels in the bathrooms, there is no reason why they can't be a bit more environmentally friendly and be made from recycled paper.

US company Wausau Paper make a range of paper towels and toilet tissues, in roll and folded form, that contain 100% recycled paper. With a minimum of 40% post-consumer recycled content in paper towels and 25% in toilet papers, the Ecosoft commercial bathroom range has been assessed by both the Australian Environmental Labelling Association and the USA Green Seal program as having very high levels of environmental performance from a whole-of-life perspective.

These products are suitable for use in clubs, pubs, entertainment centres, large office buildings, manufacturing plants, schools and council facilities.

Available from E Sime & Co Pty Ltd, PO Box 2551, Taren Point NSW 2229, email: john@esime.com.au, www.simes.biz

Water savings with just a clic

It's not always easy to change habits and behaviour to save water, but fitting water saving devices can make saving water easier. Water restrictors are simple and easy to fit to most taps, but are pretty boring things to look at.

The AquaClic range of water saving flow restrictors change all that. Not only do they regulate the water flow to a constant 6 litres per minute, regardless of the water pressure, giving them an AAAAA water rating, they also jazz up your sinks and basins. Rather than being plain brass or stainless steel, each AquaClic has a mural or other design painted onto it. There are many designs, ranging from oceanic (see the pic) to animals, flowers and aboriginal-style art.

Available from Aqua Magic, PO Box 235, Clifton Beach QLD 4879, ph:(07) 4059 2893, email: info@aquaclic.com.au, www.aquaclic.com.au. Also see www.aquaclic.ch

Direct methanol fuel cells

Fuel cells are slowly starting to appear on the market, at least in small versions for battery charging. The latest system to appear in Australia is the SFC A50 from Smartfuelcells.

Unlike other small fuel cells that use straight hydrogen, this fuel cell uses methanol directly. This allows for much simpler storage of the fuel, as the methanol is supplied in leak-proof containers (either five litre or 10 litre sizes) that simply connect to the fuel cell unit. They can even be changed while the system is operating. The only emissions are water vapour and CO_2, so provided the methanol comes from a renewable resource, the fuel cells will be greenhouse neutral.

The SFC A50 can supply up to 4 amps continuously to charge a 12 volt battery, making it ideal for small remote power systems, UPS systems, caravans and motorhomes. It can run continuously, producing around 100 amp-hours, or 1.2kWh, of usable energy per day—equivalent to around 400 to 500 watts of solar panels!

RRP: TBA

For more information, contact HBM Solutions, 16/100 Racecourse Drive, Bundall QLD 4217, ph:(07) 5574 0410, email: robert.wieder@hbmsolutions.net, www.hbmsolutions.net. Also see www.smartfuelcell.de

Automatic inverter/charger

As renewable energy systems become more advanced and owners demand more from their systems, there is a need for fully automatic inverter/chargers that control the backup generator without user intervention.

Selectronic's latest addition to its new PS1 range of interactive inverter/chargers, the PS1 3/24, has a continuous output rating of 3kW from a suitable 24 volt battery bank.

When operating with a suitable generator the inverter can operate as a five-stage battery charger at up to 120 amps, or run in parallel with the generator to provide 3kW (plus the generator's output) to the AC load. Generators up to 15kVA are supported, providing up to 18kW total output power. Once the AC load has reduced, the PS1 will recommence battery charging while maintaining an optimum load on the generator.

When installed by a Selectronic-accredited installer a two year warranty is offered which can be extended up to five years.

RRP: $6998 including GST.

Manufactured by Selectronic, freecall: 1800 006 474, www.selectronic.com.au

Every colour you could wish for!

Natural paints are becoming available from more and more suppliers, but wouldn't it be great if you could work out what you wanted from home and order online or over the phone?

Well, Bauwerk allows you to do just that with their online store, shipping anywhere in Australia and overseas. They have a huge range (over 750 colours) of lime paints, and can supply raw pigments, brushes, and pot paint (for sprucing up those daggy houseplant pots). They even do plaster, sinks and countertops!

Bauwerk paints use matured, filtered, hydrated rock lime, burned in a traditional kiln and blended with natural oils for a wipeable finish. The lime paints are suitable for interior and exterior use, will not flake or peel, are free from petrochemicals and other toxins, and will allow your walls to 'breathe'.

Bauwerk lime paint is available off the shelf in 250mL, 1, 2, 4, 10 and 20 litre containers. Larger quantities are available on request.

For more information and full colourcharts contact Bauwerk, 271 South Terrace, South Fremantle WA 6062, ph:(08) 9433 1008, email: info@bauwerk.com.au, www.bauwerk.com.au

Speccy reflectors

Fitting a reflector is a quick and easy way to increase the amount of useful light from a fluorescent tube. By adding a specular reflector to a fluoro lamp fitting, the wasted portion of light is redirected. The Quicksilver specular reflectors from Energy Doctor can halve lighting energy bills by reflecting 97% of the light hitting them. With their simulated parabolic shape the light from the back and sides of the fluorescent tube is redirected to where it is needed.

In many cases a reflector can be fitted to one of the tube slots of a two-tube fitting, a tri-phosphor tube installed, and the second tube removed altogether with little or no loss of lighting levels. This not only reduces energy use for lighting, but provides indirect energy savings such as reducing the need for air-conditioning. Cost paybacks of such a system can be less than two years.

The reflectors are suited to many situations including use in retail shops, supermarkets, hotels, educational institutions, hospitals, service stations, offices et cetera, and come with a seven year conditional guarantee.

Energy Doctor has reflectors in 600, 1200 and 1500 mm lengths and a variety of profiles to suit most fluorescent fittings. Custom designed reflectors are also available.

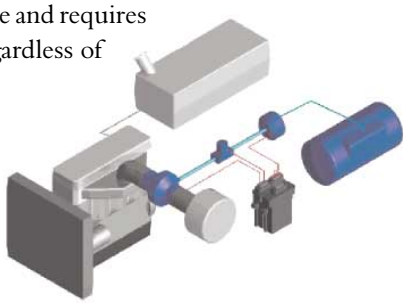
Available from Energy Doctor on ph:(03) 9783 1111, email: info@energydoctor.com.au, www.energydoctor.com.au

Make your diesels cleaner

If you run a diesel vehicle (or a whole fleet of them) then you may have thought reducing emissions was too hard—the much touted biodiesel, while it can certainly make a diesel greener, is hard to get. However, there is an alternative—run the engine on gas.

The Diesel on Gas (DOG) system from Diesel on Gas in South Australia, allows you to substitute between 25% and 85% of the diesel used in your engines with CNG (compressed natural gas), LNG (liquified natural gas) or LPG (liquified petroleum gas). This not only saves up to 40% in fuel costs, but also considerably reduces the many toxic emissions that diesels produce.

According to the manufacturers, the system is simple, has no moving parts, lasts a lifetime and requires no modification to the original engine. The system can be fitted to any diesel engine regardless of size, whether in a train, truck, generator, car, or even a ship.



For more information, contact Diesel on Gas (Australia) Pty Ltd, 209 Richmond Road, Richmond SA 5033, ph:(08) 8351 7577, fax:(08) 8351 7588, email: sbattersby@dieselongas.com, www.dieselongas.com

Rad Pads—menstrual products that don't cost the earth!

Like disposable nappies, the cost to the environment associated with manufacturing menstrual and incontinence products is ever increasing. The chemicals used in conventional products can also cause skin irritation so many women are now seeking to be pro-active in reducing these costs and at the same time improving their health. These cloth products from Rad Pads can help reduce the landfill and costs associated with manufacturing menstrual and incontinence products. Additionally, Rad Pads are now being used for mild to moderate urinary incontinence problems.

Rad Pads are 100% cotton or cotton/hemp fleece and are comfortable, economical, re-usable, earth and health friendly, long lasting, and according to the manufacturer, they wash and wear well. They make great gifts for friends and relatives as well as for yourself. Rad Pads are designed, produced and packaged in Australia.

RRP: Single cotton pad $11.95, single hemp fleece pad $15.25, cotton starter packs from $47.45, hemp fleece starter packs from $59.95.

For more information, contact Rad Pads on ph:(03) 5330 3010, www.radpads.com.au

Solar storage on the go

If you use one of the many small rechargeable gadgets that pervade the modern world, such as a mobile phone, PDA or MP3 player, then chances are you have been stuck with a flat battery from time to time.

The Solio solar charger, from Better Energy, is designed to be a backup source of power for many of these devices. It has an internal lithium ion battery that is charged from the three inbuilt solar panels. Because it contains its own storage, the Solio can charge your device even if it isn't exposed to the sun. And can provide output voltages from four to 12 volts, at up to 1 amp of charge current.

It is very simple to use—just open it up so that all three panels can face the sun, and plug in the device to be charged with the appropriate plug and you're away. The Solio comes with plugs to suit most Nokia, Motorola, SonyEricsson, Samsung and Siemens mobile phones. Solio's intelligent internal circuitry and interchangeable plug system let you charge your iPod or other mobile device at about the same rate as their dedicated wall chargers.

Better Energy seems committed to making greenhouse neutral products. According to their website, they have made Solio a carbon neutral product by planting trees in a protected bio-diverse forest. The Solio comes with a one year warranty.

RRP: US$99

Available from Better Energy Systems Ltd, 20 Mulberry House, 583 Fulham Broadway, London SW6 5UA, UK, email: solio@betterenergy.co.uk, www.solio.com

Altronics energy meter kit

Catalogue number: K4600
Price: $129.95 inc GST

The ability to be able to measure the energy consumption of an appliance allows you to determine which appliances are using the most electricity and therefore are costing you the most to run.

For some years the ATA has sold two different energy meters, but while they provide an off-the-shelf solution for appliance energy metering, they may be too expensive for some people.

The SparOmeter, the cheapest of the two, retails for $180, while the Power Mate is closer to $300. If these meters are out of your budget range, then the best option may be to build one from a kit, especially if you are the kind of person who likes to know how their gadgets work.

In July/August 2004, *Silicon Chip* magazine published a design for an energy meter kit. Its inbuilt LCD can display power in watts, energy usage in kWh, measurement period in hours and the energy cost in dollars and cents. It also has adjustable brownout protection and programable energy cost in cents per kilowatt-hour. The meter is rated to measure up to 10 amp loads continuously, although it can display power levels up to 3750 watts.

Several suppliers offer versions of this kit, and we decided to trial the Altronics version.

Assembly

Firstly, we should point out that this kit obviously measures mains voltages and currents, so the entire circuitry is connected to the mains. If you are not an experienced kit builder, you should not attempt this kit on your own, but instead seek the help of someone experienced in dealing with mains voltages.

The kit assembly went relatively smoothly, although there were a few glitches.

The first problem was when assembling the LCD board. There are a number of PC pins on this board and they need to be inserted from the copper track side of the board, not the component side as would usually be the case. This is not mentioned in the instructions but becomes obvious when you realise how the switches that these pins are for are mounted.

Another problem, also related to this board, was the pre-drilled holes in the transparent case lid. These holes were a very snug fit for the switch buttons, and caused the buttons to stick, resulting in erratic operation of the meter. The holes needed to be enlarged to $^{27}/_{64}$" (10.7mm) for reliable operation of the switches. I expect a 10.5mm drill bit would be adequate for the task, I just didn't have one when building the kit.

The other main change made to the kit was to have the input and output mains leads at opposite ends of the case, rather than having them both exit next to each other as shown in the instructions. As the kit is designed to be an inline meter, this cable positioning made a lot more sense.

Operation

Once the calibration had been performed (this process is a bit convoluted, so I cheated and compared it to a Power Mate), the meter performed very well and has now been in use for months. Accuracy seems to have been maintained over this time, so drift doesn't seem to be a problem with this design.

The only problem I ran across with the meter in use was when it was fitted with a 9 volt backup battery. This is an option that allows the meter to retain data during blackouts, or when moving the meter from one powerpoint to another. I found that when the battery was left installed and the meter not connected to the mains for 12 hours or so, the meter could become confused upon the next power-up, with only the top line on the LCD being visible. The meter seemed to take measurements correctly, it just didn't display them on the second line. The only fix for this was to unplug the meter and remove the battery permanently. Obviously, there is a glitch in the software of the microprocessor that causes this problem.

Aside from that, the meter performed well, and I have now purchased it to use as my main meter at home!

This meter is available from Altronics, who now have shops in Perth, Sydney and Melbourne. Phone 1300 797 007 or see www.altronics.com.au to order.

Basic electrical safety

Dr John Mills give us some tips on staying alive when working on electrical projects and systems

Electrical safety is very important when working on electrical projects, such as those sometimes presented in *ReNew*, that involve high voltages, especially mains voltages. Also, owners of RAPS systems often have to work on systems themselves, so they must also have a good knowledge of safety issues and procedures.

The most important purpose of safety measures is to prevent injury or death to users of the system, including those working on the system. The second purpose is to limit damage caused by an electrical fault.

Usually, contact with 240 volts gives only an unpleasant surprise, but it can cause serious injury and death. So take the unpleasant surprise as a warning that you might not be so lucky next time!

In all cases, wiring and earthing must be done to the relevent standards including SAA wiring rules.

You should also have a defined set of procedures for working on your system to minimise risk and to be able to take effective action should an accident occur. Working with a buddy and a checklist is a very effective way of minimising any dangers.

Effects of shock

There are three main dangers to the human body from electric shock. Firstly, burns resulting from heavy electric current passing through the body. While these can occur with high voltage systems, they are rare with 240 volt system. Secondly, muscle paralysis can leave the victim unable to let go of the live metal. If the chest muscles are paralysed, the victim is unable to breath, and without help he will die.

Thirdly, an interruption to the normal heart rhythm, known as ventricular fibrillation, which leaves the heart fluttering weakly and not pumping blood. It is caused by current passing through the chest, for example from hand to hand or from hand to foot. It is unlikely to cease naturally before death.

Immediate actions

First, turn off the power! It is no help if the rescuer becomes the second victim. If it is not possible to turn off the power, then do not touch the victim! Pull him away, or move the live wire away, using some insulating material; dry clothing, dry wood or dry rope for example.

Second, apply first aid measures. Time is vital (literally!). If the blood supply to the brain stops for four minutes then there is a risk of brain damage.

If the chest muscles are not working, then artificial respiration—'the kiss of life'—is needed. If the heart is fibrillating, which can be felt in the pulse, then cardiac compression is the appropriate first aid measure. Don't give up too soon; there are case on record of patients recovering after an hour of treatment.

The best place to learn first aid is at a properly conducted course, given by a qualified instructor, and anyone who plans to be self sufficient could benefit from such a course.

Failing that, a good manual could be a life saving investment. The manual published by the St John Ambulance Association is one such text.

Voltage and current

The effects of shock depend on the current which flows through the body, and on its path. The current depends on the voltage and the resistance in the path. The internal resistance of the human body is very low, so it is the contact resistance which is important. The contact resistance can vary greatly, depending mainly on moisture. Contact with a 240 volts will usually give only a nasty surprise, but in damp surroundings like bathrooms, it can cause death. In some circumstances, working with boats in the water for example, voltages much lower than 240 volts can cause death. This is a good reason for using battery-powered tools.

The most susceptible organ in the body is the heart, and a current of 50mA or more passing from hand to hand, or from hand to foot, can cause death from ventricular fibrillation.

Normal power supply connections

The term 'earthing' means connection to the general mass of the earth. A wire can be earthed by connecting it to a stake driven deeply enough to be in contact with moist soil, or to a metal water pipe which is itself in contact with moist soil. Earthing is discussed in more detail later.

In a single phase AC supply there are two conductors which carry the current. Normal practice is to earth one conductor, known as the neutral, at the supply source or supply transformer. The other conductor, known as the active is then at the supply voltage, usually 240 volt above earth. For DC systems it is usual to earth the negative conductor.

Some DC systems, particularly

smaller or older installations, use a positive earth or are not earthed at all. Also, many telecommunication (telephone) systems use a positive earth. It is important to determine what kind of earthing is installed before attempting any work on the system.

In connecting cords, as well as the current-carrying conductors (active and neutral), there is usually a third conductor—the earth—which is connected to exposed metal parts of electrical devices. This conductor is earthed via the socket wiring, usually near where the power is used—outside the house, for instance.

When installing wiring it is important that switches, fuses and circuit breakers should be in the active conductor. If only the neutral were switched, then the circuit would still be live even though switched off. There are simple devices available to check that sockets have been correctly wired. Flexible cords and plugs also must be correctly wired; the colour code for cords is brown for the active, blue for the neutral, and green and yellow striped for the earth. It is worth noting here that approximately 20% of all electrical related deaths in Australia and New Zealand are associated with flexible cords and accessories.

Electrical faults

With the three wire system described above the active and neutral are connected to the internal circuit of the appliance, and the case is connected to earth. If a short circuit occurs in the internal circuit a heavy current will flow from the active and back along the neutral, causing the fuse or circuit breaker protecting appliance to operate, disconnecting the faulty appliance. If a short circuit occurs from the internal circuit to the exposed metal, a heavy current will flow from the active and through the earth connection back to the supply, again disconnecting the device. Since the metal case is solidly connected to earth, there is no risk of shock to anyone touching the metal when the fault occurs.

Some appliances have only two-wire leads, and are marked 'Double insulated: do not earth'. In these, the internal circuit is completely isolated by insulation from exposed metal, if there is any, and earthing would be pointless or impossible. Indeed, earthing double insulated appliances is illegal and may actually increase the risk of electrocution.

Safety switches

There is one danger for which overload devices offer no protection to humans. It is possible for old or wet insulation to break down, allowing a small current to flow, but not enough to operate the fuse or circuit breaker. If this is combined with a poor earth connection and a well earthed human, in a damp place for instance, then some of the current will flow through the human body. A current of only 50mA, less than 1% of that required to operate a circuit breaker, can be fatal in such circumstances.

The solution is to use a device known as a 'Residual Current Device', or 'Safety Switch'. This device measures the difference between the currents in the active and neutral conductors, and disconnects the power if the difference exceeds about 30mA. Even at 30mA the switch may sometimes trip unnecessarily, and it is common to have a separate line, not connected through the safety switch, for refrigerators and freezers. This can save a disappointing end to a holiday! Portable safety switches are available for power tools in dangerous sites.

Earthing

It is vitally important that where earth connections are made, there is good contact with the general mass of earth. This means, in practice, connection to permanently moist soil. Metal water pipes can be used, but not if there is only a short length of metal pipe connected to plastic pipes. Stakes driven into the ground must be deep enough to be permanently in contact with moist soil.

It is possible to measure the resistance to the general mass of earth from an earth connection; there are instruments designed for the purpose, and a competent electrician should have one. For those interested in the details, the test involves driving two temporary test electrodes into the soil. The test electrodes must be in a straight line with the main earth electrode, and on one side of it, with equal spacing. A current is passed between the outer test electrode and the main electrode, and the voltage between the main electrode and the other test electrode is measured. The resistance from the main electrode to the general mass of earth is the ratio of the measured voltage and current. The measurement is best made with AC, of a different frequency from the supply frequency, to avoid polarisation effects and interference.

This information is provided for readers who build DIY projects that involve mains electricity. It is not intended for use by unqualified people to work on fixed mains wiring. All fixed wiring must be done by qualified electricians. In any RAPS system, the owner should not be doing any work on the 240 volt side of the system. The only maintenance required should be on the ELV (extra low voltage—12 to 48 volt DC) side. Extreme care should be taken if the ELV side of the system is higher than 48 volt DC, such as in some grid-connect systems. In these cases, only a qualified person should work on the system.

Gas or a heat-pump?

I am specifying a new house in Melbourne which will be 6.5 stars after construction. I have a question that no-one seems able to answer.

Regarding heating (and it shouldn't need it very often!), is it more 'energy efficient' overall (and does this mean it produces less CO_2, less pollution or whatever) to use gas or electricity?

I know that gas produces approximately one third of the CO_2 of electricity. However, if I chose electricity it would be by reverse cycle heat pump—which is said to have an efficiency of around three—so this would make it the same as gas!

Do these figures take into account the particularly dirty electricity generated by Victorian brown coal or, for example, does this make electricity here four times more polluting than gas? (actually I buy Green Power but set that aside for the purposes of the question).

As I have located a heat pump (the Panasonic model number CS-HE9DKE/CU-HE9DKE) which has an amazing efficiency (both heating and cooling) of over five, does this make it better than gas?

And which gas units are three times cleaner than electricity? If I go gas, I will be putting in a Brivis 5.5 star unit (HE30). But how much does this extra efficiency improve over the 'general figure' of gas being three times better than electricity?

I would appreciate your guidance, or at least a pointer to a specialist who can help (sustainable housing architects do not seem able to answer this one!). The table on page 61 of *ReNew 92* is the closest I have seen to putting the information on different fuels in one place, but does not quite answer my questions.

Jonathan Keren Black,
jonkerbl@bigpond.net.au

Generally speaking, brown coal is about the dirtiest fuel there is, so even a heat pump with a COP (coefficient of performance) of three is borderline as to whether you should use it. With gas heating, on average about 80% of the heat makes it into the house. This varies between heaters and installations, some are better than this, such as your 5.5 star unit, and some are worse (a lot worse, in a few cases).

With electricity, about 30% of the energy in the coal makes it to your house as electricity. While this would seem to make the electric option marginally better if using a heat pump with a COP of three, you have to take into account all of the other pollutants that coal produces, including higher levels of NOx and sulphur compounds, as well as nasties that natural gas doesn't have at all, such as mercury and radioactive thorium.

If you are using accredited Green Power, then the equation changes completely and electricity generally becomes the better option as you are using a renewable energy source rather than a fossil fuel (natural gas may be a cleaner fuel than coal, but it is still a fossil fuel). A heat pump with a COP of five makes the equation even better, and that is the option I would go for. A quick check of the energy rating website (www.energyrating.gov.au) lists a lot of six and 5.5 star reverse cycle units with COPs above four.

Lance Turner

Solar panel toxicity

A friend of mine claims it's not a good idea for everyone to get PV setups as they are difficult to dispose of because they contain toxic chemicals et cetera.

Does anyone know of people who recycle PV cells? For instance, the end-of-life situation—who would be versed on this?

Madeleine Pieper,
Northcote VIC

The biggest single component in most PVs is glass. Non toxic and stable. Next is aluminium. While energy intensive to produce, it is pretty harmless and can be fully recycled. Then there's the laminate backing. I'm not so sure of the composition but as far as I know it is a stable material with little impact after it has been produced.

Then there's the solar cells themselves. They are made of purified silicon which is made from sand. They are harmless. The cells do contain very small amounts of impurities which in large quantities could be an issue, but these quantities are tiny in PVs. Lastly there is the wiring connections and solder. These contain very small quantities of lead and copper, although lead is being phased out of electrical goods as of 2006.

I think it is important to maintain a sense of proportion about this. The average TV contains much more nasties than a PV panel. PVs last around 30 years, recover the energy used to make them in less than three years and after that produce pollution free power for decades.

As regards recycling, the aluminium frame is easily recycled. There has not been much demand for recycling of PVs as yet, as most panels made are still working fine. An easy way to recycle them would be to use the panels in building projects. They are incredibly strong and long lasting and the sheets could easily be incorporated into walls or roofing. They could also be used in furniture—they would make great coffee tables!

When the demand finally does build up, no doubt old panels could be broken up to recycle most of the materials. The glass, aluminium, copper and lead could all be recycled and it would not surprise me if the other components could also be recycled in the future with the development of appropriate recycling technology.

I think your friend should quote his/her source before spreading untrue rumours about the toxic contents of PVs. Compared to many other items of equipment out there they are insignificant.

Mick Harris

Genset voltage matching

Your answer to a question in *ReNew 93* has prompted me to do a rethink.

I've got an 8hp Lister (rated at 4kVA) back-up system driving a 24 volt Trace inverter/charger and battery bank. The batteries really should be charged harder than the 20 amps available when the genset is used for periodic maintenance

over-charging (equalisation).

The inverter is a 2400 watt modified squarewave, but I also have two 1500 watt sinewave units that I plan to use later when I get around to splitting the house circuits up a bit.

However, I have an old 32 volt generator from a pre-war farm lighting plant that was originally run by a kerosene engine. This can deliver around 40 volts at 40 amps. It has occurred to me that I might be better off (and might be more efficient) using this generator with my spare 5hp Honda diesel motor I use to charge the batteries when required, and only use the Lister as a back-up 240 volt AC supply.

My question is, do you know of a suitable regulator/charge controller that could charge a 24 volt battery bank from this higher voltage?

A second, unrelated question. I need a reading light above my son's bed. The 20 watt 24 volt fluoro has died and rather than replace it, I thought that a LED downlight might be better. Is there a LED bulb available for a standard downlight fitting that has a narrow enough and bright enough beam to work as a reading light from about two-thirds of the way up a wall? Either a 24 volt lamp or a pair of 12 volt lamps would do.

Warwick Brooks,
warwick@regscom.com.au

Frankly, I would connect the 40 volt generator directly to the battery bank, as the battery bank will pull its voltage down to the correct charging voltage, rising to around 30 volts when equalising. Do this and monitor the temperature of the generator, and if it doesn't get too hot, then you should be ok. If it does get hot, then you will need to find a way to drop 6 volts or so. Using some form of switchmode converter is the ideal way, but not easy as you will have problems finding a converter designed for those specific inputs and outputs, especially at that current. You might just be better off using an appropriate resistor, although this is a bit crude. At 40 amps, if you wanted to drop a full 10 volts, then you need a 0.25 ohm, 400 watt resistor. You will probably have to make one up yourself out of stainless steel or nichrome resistance wire.

However, with gensets, output voltage is generally proportional to generator speed, so throttling the engine speed back should allow you to control the charging voltage.

If you want to run this generator and have it switched off at an appropriate time, there are various genset controllers available to do that. All you need really is a voltage triggered switch that trips the cutout on the generator motor. This should be easy enough to find or make.

Re the reading light, the ATA has some LED halogen bulbs that should do the trick. I recommend the warm white version of the LED halogen lamp. It should be bright enough to read by, but they are rated at 12 volts and because they have switchmode power supplies inside them putting two in series might not do so well. If you do put them in series, I recommend putting a 1000uF (at least) 25 volt capacitor across each socket. These caps are polarised, so make sure you wire them the right way around.

For more options on energy efficient lighting, have a look at the lighting buyers' guide in this issue.

Lance Turner

Write to us!

We welcome questions on any subject, whether it be something you have read in ReNew, a problem you have experienced, or a great idea you have had. Please limit questions to 350 words. Send letters to: ReNew, PO Box 2919 Fitzroy VIC 3065, email: renew@ata.org.au

Nicad or lead-acid?

We're at a standstill with a RAPS project that we've been gradually building in our little corner of paradise. The small 12 volt solar power system that we use has been adequate for lighting and a car CD sound system.

We now need to upgrade as we are installing various 12 volt water pressure pumps for mains pressure from our water storage tanks, and pumping water to a solar hot water system. We would also like to install a solar fridge.

Could you inform us of the pros and cons of nickel-cadmium batteries compared to sealed acid types we currently use. I've received conflicting information and am somewhat confused. Are they worth the extra expense?

Rob and Cecelia Rochelli,
thatsit@nsw.chariot.net.au

Nicad batteries will generally last a lot longer than lead-acid, as they don't suffer the same type of degradation, such as sulphation et cetera, but they do have a number of drawbacks.

The first is price—they will cost you a great deal more than an equivalent capacity lead-acid battery bank, although this is somewhat offset by the much longer lifetime.

Secondly, cadmium is a lot more toxic than lead, so you have to make sure that the batteries can be fully recycled at the end of their life. This should not be a problem, but remember, these batteries will last 30 years or more if the system is sized correctly and the batteries maintained, so there is no guarantee that the company that makes them will be around to recycle them at the end of their useful life.

Nicads also have different charging requirements, and a nominally 12 volt bank may need to charge to 17 volts to attain full charge, so your regulator will need to have a nicad program, or at least have adjustable voltage setpoints. Also, your inverter, and any DC appliances attached to the battery bank, will need to be able to handle the increased voltage. Some inverters allow for voltages this high, some don't, and will shut down with an over-voltage error or such.

Personally, I would stick with good quality sealed lead-acid batteries—they are robust, reliable (again, assuming the system is sized correctly—this is the key factor in whether a system works well or fails miserably) and almost maintenance free. And, they are easy to dispose of, as all non-ferrous metal recyclers will take them and may even pay you a few dollars.

Lance Turner

Classifieds/ Suppliers Directory

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

For Sale: 1kW Soma wind generator with slip rings. 24V DC. Blades in GC, tail broken (plywood), no controller. $1250. *Located Mackay QLD. Contact Thomas ph: (07) 4959 8610 or Mob: 0417 074 447, tjpluessy@bigpond.com*

For Sale: Southern Cross 18metre Wind generator tower, NOS Pump jack, Beasley hot water solar panels, Micro Minibore complete central heating system, 110V Diesel generator, square wave line filter *ph: (02) 6335 6210, handh@bordernet.com.au*

For Sale: Inverter Selectronic SE22 12/24V Sine Wave, Regulator Plasmatronic PL60, Wind Turbine AirX 12V, Batteries set 12V NiCad 640Ah. Fridge Electrolux Gas/240V 217 litre. Price negotiable. Yackandandah (N.E. Victoria). *Phone (02) 6027 1058.*

For Sale: 1986 Mazda 626, white sedan. Two litre diesel, 5 gears. Fuel efficient.Air conditioning. Very good condition. Service records available. $3990. *Reservoir, VIC. Ralf, phone (03) 9478 4618, or email: ralfp@alphalink.com.au*

Home exterior/ interior

ARCHITECT: BP Architects: Design with the benefits of sustainable and low allergy living. Awarded MBA National and Green Buildings Award Bridget Puszka MSc(Lon) BArch(MelbUni). *Studio 14/149 Fitzroy St, St Kilda 3182, ph:(03)9525 3780, bp@bparchitects.com.au www.bparchitects.com.au* §

COMPOST TOILETS/GREYWATER: A&A Worm Farm Waste Systems: Sewerage, grey water and garbage – one chamber. NATURALLY. No smells. No pump out. We deal with Councils in VIC, NSW, QLD. *Ph:(03) 5979 1887 www.wormfarm.com.au*

COMPOST TOILET: Clivus Multrum Australia: The Australian suppliers of EcoLet® and Clivus Multrum™ composting toilets. Use no water or chemicals. See display ad. *Local call for nearest Distributor, ph:1300 13 81 82 or info@clivusmultrum.com.au*

COMPOST TOILETS: Environment Equipment: Rota-Loo, NO-FLUSH™ urinals, OnZite Wormfarm and greywater systems (domestic and commercial) to process blackwater, greywater and compost. *Ph:(03)9587 2447, enquiry@rotaloo.com www.rotaloo.com* §

DOUBLE GLAZED WINDOWS: Everglaze Industries: Fabricators and installers of quality uPVC framed double glazed windows and doors. Custom made. 4.5 star plus WERS rating. *Ph:(03) 9486 1422, fax:(03) 9486 1411 enquiries@everglaze.com.au www.everglaze.com.au* §

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EDUCATION: Permaculture Visions: Accredited, Affordable, Informative, Worldwide - Time to Grow. Permaculture Design courses, online tools and suitable plant list. Award winning demonstration site at Mt Kembla. *Ph: (02) 4272 9619, www.PermacultureVisions.com*

EDUCATION: Wind Turbine Design Course: One day, straight forward course run by Andrew Reid (previous Swinburne RE Course Co-ordinator). Develop spreadsheet giving unique solutions for high speed or high torque applications using NASA lift and drag / x&y blade profile data. *windraider@yahoo.com www.imagingassociates.com.au*

ETHICAL INVESTMENT: Australian Ethical Investment: Specialising in environmental and socially responsible investment. Offers public trusts and superannuation. Supports enterprises in sustainable energy and waste management. *Freecall: 1800 021 227, www.austethical.com.au*

GREEN PLUMBER: AquaBlock: Aquaflow greywater and septic treatment system. Designed using a peat format with submersible drip. Requires little power to run and 1 annual service, reducing overall septic costs. *Ph:1300 132 356 www.aquablockplumbing.com.au* §

PAINT: Bio Products: Paint made from natural and non-toxic ingredients! Wall Paint, Enamel Paint, Varnishes, Oils, Waxes and Thinners. *Bio Products Australia P/L, 25 Aldgate Tce, Bridgewater SA 5155, ph:1800 809 448, www.bioproducts.com.au*

PAINT: Natural Paint: Casein Marble Powder base plus variety of colour pigments, Oils, Lazures, Waxes, Tadelakt and Stuccolustro! *Natural Paint P/L, PO Box 287, Port Macquarie NSW 2444, ph:(02) 6584 5699, fax:(02) 6550 4131 www.naturalpaint.com.au* §

REAL ESTATE: EcoProperty®: Selling Programs, Property Assessments, Consulting, Research, Training, EcoDirectory, EcoHomeStay, LocalsCAN, Newsletters, Buying/Building/ Developing Resources. EcoProperty and The Eco Real Estate Network. *Ph: 1300 796 326, cj@eco.com.au www.eco.com.au*

TRANSPORT: Greenspeed: Recumbent Trikes. Manufacturer of a wide range of energy efficient and ergonomic recumbent trikes and human powered vehicles (HPVs). *69 Mountain Gate Drv, Ferntree Gully VIC 3156, ph:(03) 9758 5541, www.greenspeed.com.au*

Renewables National

Advance Trident: Australian agents for the Xantrex, Cristec and Alessi range of high quality power inverters, battery chargers and battery accessories. Products available in all sizes to meet your requirements. *Ph:(07) 3390 6900, fax:(07) 3390 6911 ozsales@advancetrident.com*

Alco Battery Sales (Aust) P/L: Suppliers of leading brands of Lead Acid, Gel and AGM deep cycle batteries. Trojan - Raylite - MK - Delkor - Fullriver. *Head Office 3/92-94 Batt St Penrith NSW 2750. Ph:(02) 4722 2588, ph:(03) 9336 4477, ph:(07) 3299 2600 alcobatt@bigpond.com*

ARRID: Wholesale distributor of UniSolar shade tolerant solar panels and Sharp 80W, 123W, 165W and 175W panels. Manufacturer of quality light inverters for CFL and standard tubes incl. 48V, regulators, 12V DC timers and battery chargers. *WA ph:1300 663 563 or see www.arrid.com.au*

B/W Solar: Sole Australian importer for Lorentz solar HR submersible pumps. PS200 = 100V max. 50m PS600 = 150V, 140m TDH PS1200 = 200V max. 240m Badu-Magic for pools. DIY Tracking kits inc. drawings. *Ph:(08) 9341 8790, www.bwsolar.com.au* §

Choice Electric Co: Wholesale Distributors for: SHARP Solar, Fronius IG Grid Inverters, Latronics, UniRac PV Mounting Frames, SHURflo Solar Bore and Pressure Pumps, Enersun Solar Batteries, Choice D.C. Lighting and Electronic Ballasts. *Freecall: 1800 074 007, sales@choiceelectric.com.au*

EcoInnovation: Manufacturer of cost effective water and wind turbines using converted Smart Drive motors. Our manual details the conversion of Smart Drive motors to generators. *enquiry@ecoinnovation.co.nz www.ecoinnovation.co.nz*

EcoWatch: Australian agent for Davis Instruments, Weather Stations. Wind, Rain, Humidity, Temperature, Barometer, Optional UV, Solar Radiation and PC Link. Evapotranspiration and Soil Moisture option. *Free Catalogue and Price List ph:(03) 9761 7040, fax:(03) 9761 7050, www.davisinstruments.com.au*

Electric Parts Supplies: Solar Warning Beacons - uses a Solar cell to charge a battery during the day, flashes at night automatically. No wiring, no battery or bulb changing. Uses BRIGHT LEDs with 100,000 hour life. Weatherproof polycarbonate body and lens. *Phone: (08) 9472 9202.*

Federal Solar Batteries: Import / distribute deep cycle batteries for solar applications. Wet, Gel Cell and AGM types from around the world. *Ryde Batteries P/L, F2/22 College St, Gladesville 2112, ph: 1300 133 980 contact@federalbatteries.com.au* §

Latronics: Reliable and performance enhanced true sinewave inverters. Stand alone and grid connected inverters from 400W to 7000W. Designed and Manufactured in Australia. *Ph: 1300 550 204, sales@latronics.com, www.latronics.com*

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NSW

Bunya Solar: Design, Installation and Maintenance of Renewable Energy Systems. Full BCSE Accreditation. BP Solar Sales & Service. *PO Box 369 Moruya NSW, ph:(02) 4474 0911, bunyatrade@bigpond.com*

Regional Solar Systems: Design, Supply, Installation and Maintenance of Solar, Hydro and Wind power systems. BSCE Accredited. *Wal Clothier mob:0408 287 984, PO Box 8334 Kooringal, Wagga Wagga 2650. w.clothier@bigpond.com.au*

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Natural Technology Systems: Station, Rural, Domestic, Grid Connect Solar Power, Solar Diesel for Homesteads, Domestic—Solar—Electric. *120 Prospect Rd, Prospect SA 5082, ph/fax:(08) 8344 7298 www.naturaltechnology.com.au*

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The Solar Shop: Proudly in association with Planet Ark. Design and installation of Grid connect and RAPS systems. Supply and installation of Solar Hot Water systems. Supply of Solar panels and Wind turbines. *ph:1800 988 877 www.solarshop.com.au* §

TAS

Brett Carter Solar Energy: Renewable energy consultant, designer and installer of remote and grid systems. System maintenance and power audits. Full BCSE accreditation. *ph:(03) 6295 0842, mob: 0419 528 048 brett.carter@keypoint.com.au*

Power Plus: Accredited installers of Remote / Grid Connect systems, batteries, eco-fridges, solar hot water, testing and system maintenance. *Offices in Hobart and Launceston, ph 1300 768 225 , sales@power-plus.com.au*

Solar Tasmania: Tasmania's leading renewable energy specialists. Consultants, designers, suppliers and installers. Professional advice, quotes and information on request. *Call Noel Stutterd at VK Electronics P/L, 5 Corcellis St, Wivenhoe Tas 7320, ph:(03) 6431 7733 fax:(03) 6431 6555, solartas@hotmail.com* §

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A B & S Solar Industries P/L: DIY Solar pool heating kits or installed. Solar controllers. Second hand pool panels. Pool covers and rollers. *29 Shafton St, Huntingdale VIC 3166, ph:(03) 9543 7249 fax:(03) 9562 9547, abssolar@abssolar.com.au* §

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WA

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