
ReNew
Formerly Soft Technology
Issue 57 Oct-Dec 1996
Technology for a sustainable future
Jackie French's water-powered house
Recycling the dead
Solar panel buyer's guide
Friends for your plants
Make your own solar Xmas tree lights
ISSN 1327-1938
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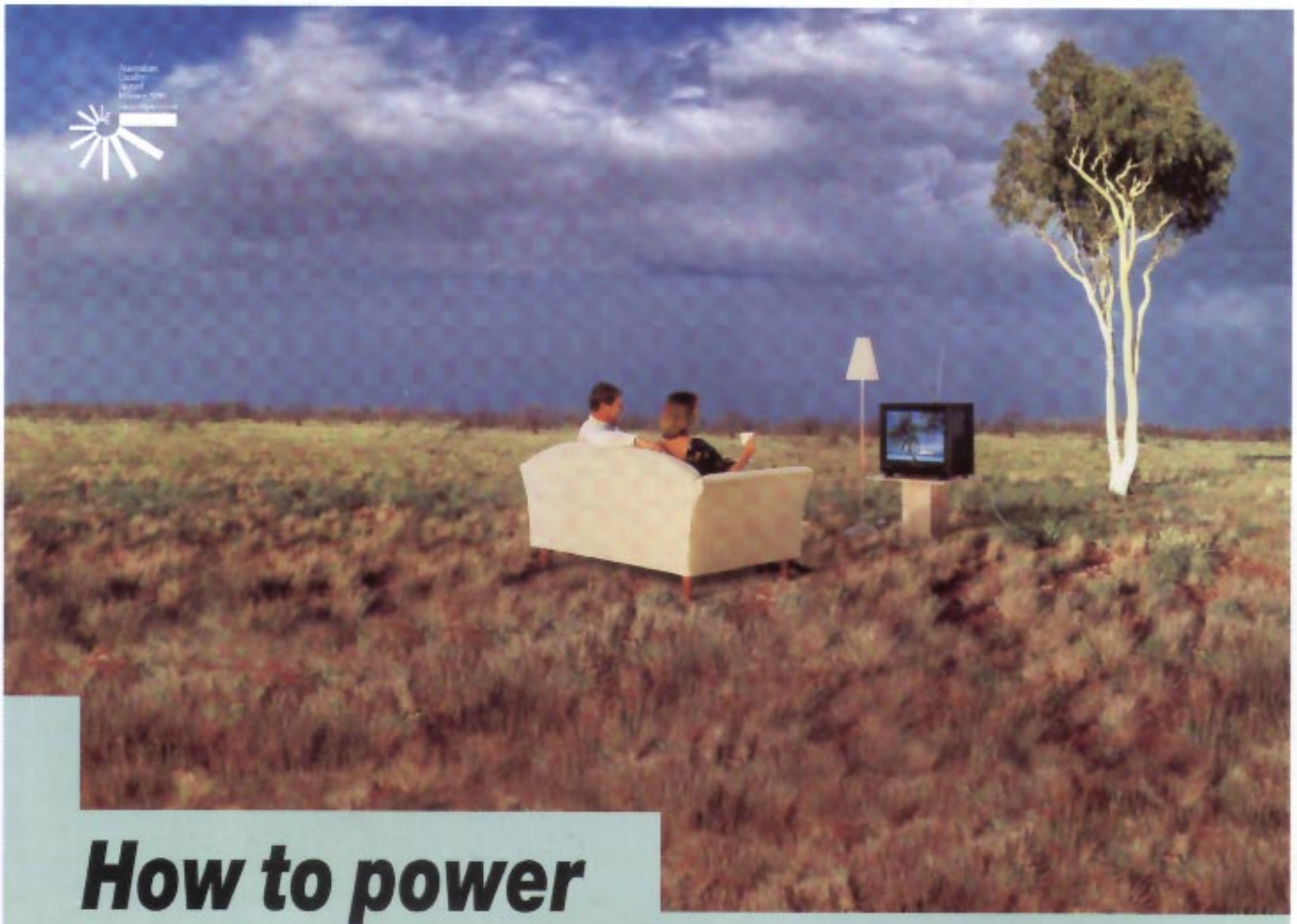
Moora Moora
A solar-powered community



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If you are located in an area where connection to the electricity grid is undesirable or uneconomical, you can still get all the reliable energy you need.

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With low maintenance renewable energy from Integral, you can minimise your energy running costs and avoid the expense of connecting to the electricity grid.

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NSW 2521. Fax: (042) 28 2890.
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CROC 3206C

BP SOLAR

Generator and Grid Interactive Sinewave Inverters

Continuous power @20°C	circa 2,000 VA	3,300 VA	3,300 VA	4,500 VA	4,500 VA
List Price excluding Sales Tax	$4,200	$5,400	$5,400	$6,100	$6,600
Model	SW2012E	SW3024E	SW3048E	SW4548E	SW4548EPV
Nominal DC input Voltage	12 VDC	24 VDC	48 VDC	48 VDC	36 VDC
AC output Voltage (RMS)	230 VAC	230 VAC	230 VAC	230 VAC	Tracks grid
Nominal frequency	50 Hz	50 Hz	50 Hz	50 Hz	50 Hz
Continuous AC output @25°C	9 Amps	14 Amps	14 Amps	20 Amps	20 Amps
Maximum AC Output (RMS)	26 Amps	34 Amps	34 Amps	34 Amps	
Peak efficiency	92 %	94 %	95 %	96 %	96 %
Automatic AC transfer relay	30 Amps AC	30 Amps AC	30 Amps AC	30 Amps AC	
Maximum charging rate	125 Amps DC	100 Amps DC	50 Amps DC	60 Amps DC	
DC input					
Search mode	0.08 A	0.04 Amps	0.025 A	0.04 Amps	5,200 Wp array
On mode (no load - idle)	1.0 Amps	0.66 Amps	0.33 Amps	0.4 Amps	connected as three
At full rated power	275 Amps	166 Amps	83 Amps	106 Amps	solar modules in
Short circuited output	700 Amps	320 Amps	160 Amps	138 Amps	series
Nominal DC input range	11.8 to 16.5 Volts	22 to 33 Volts	44 to 66 Volts	44 to 66 Volts	Batteryless
Weight - inverter only	42 Kg	48 Kg	48 Kg	63 Kg	63 Kg

Also available Sinewave Remote Control - SWRC List Price $430 plus Sales Tax
Sinewave Outdoor Enclosure SWODE List price $600 plus sales Tax

Modified Squarewave Inverter Chargers

Rating	**1,500 VA**	**1,500 VA**	**2,400 VA**
List Price excluding Sales Tax	$1,750	$1,650	$2,250
Model	DR1512E	DR1524E	DR2424E
Nominal DC input Voltage	12 VDC	24 VDC	
AC output Voltage (RMS)	230 VAC		
Nominal frequency	50 Hz +/- 0.04%		
Surge Power	3,500 VA	4,500 VA	8,000 VA
Maximum AC Output (RMS)	26 Amps	34 Amps	34 Amps
Peak efficiency	92 %	94 %	95 %
Automatic AC transfer relay	15 Amps AC		
DC input			
Search mode	0.045 A	0.03 Amps	
On mode (no load - idle)	0.7 Amps	0.35 Amps	
At full rated power	165 Amps	80 Amps	150 Amps
Short circuited output	400 Amps	280 Amps	560 Amps
Nominal DC input range	10.8 to 15.5 Volts	21.6 to 31 Volts	
Load sense	adjustable from 5 to 100 Watts		
Auto low battery protection	11 V or defeated	22 V or defeated	
Maximum charging rate	125 Amps DC	100 Amps DC	50 Amps DC
Three stage charging	Bulk, absorption and float		
Selectable charging profiles	10		
Dimensions	216mm x 184 mm x 533 mm		
Weight - inverter only	16 Kg	16 Kg	18 Kg

Good News

We've done it, BP Solar has convinced Trace to make the SW2512 available in a 230 VAC version. Power rating will be around 2kVA. In stock any day now.

Congratulations to Integral Energy on installing the World's first batteryless 230VAC Grid connected Trace, the SW4548EPV. This unit, with 60 x BP275 solar modules was officially connected at the end of July and has been pumping into the grid ever since

SEIAA conference - resounding praise for Trace sinewaves. In particular, Rainbow Power Corporation extolled the virtues of their grid connected Trace and the ease of installation and setup. This was the first grid connected Trace in Australia. Well done RPC

Things to consider

When choosing an inverter, look carefully at the standby drain, as this power has to come from somewhere, Ie your precious solar power system. Ignoring this can add to system and/or running costs. The Trace units have extremely low standby drain.

The Trace sinewaves are amongst the quietest around. Why invest in a quiet solar power system and a noisy inverter, unless you want a permanent, audible reminder of what you spent your money on!

Warranty - BP Solar is Australia's only Trace authorised warranty and service centre. Buy with confidence and the backup of BP Solar's engineers and technicians.

BP Solar Australia Pty. Ltd.
PO Box 519, Brookvale, New South Wales, Australia, 2100
Tel. no: (02) 9938 5111 ACN 005 548 603
Fax no: (02) 9905 1284

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+ sun-dried tomato damper recipe

A promising new solar food dryer design that combines eastern and western technology, plus **CLAIRE BEAUMONT'S** great sun-dried tomato damper recipe.

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SARAH HILTON investigates new sub-marine technology that is revegetating some oft-neglected Western Australian wilderness.

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Solar panel buyer's guide 56

A must-have guide for anyone planning to invest in photo-voltaic panels.

What's new in batteries? 60

New battery technology has exciting implications for renewable energy systems and electric vehicles. **LANCE TURNER** looks at some recent developments.

Make your own solar Xmas tree lights 54

We're approaching that crassly commercial hype-fest called "Xmas" once more...and we're cashing in on it with this easy to make project. Run your Christmas tree lights off solar power without doing any soldering or having any other special skills.

Coming up: (next issue out 11 December)

- **Make your own solar garden water feature**
- **Camira electric car conversion**
- **Do-it-yourself electricity from the wind**
- **A cheap data-logger for your power system**
- **Solar Challenge coverage**

Regulars

editorial

Well, here it is. The new name, the slightly new look, and hopefully a new era of successful magazine publishing.

It is both a promising and anxious time for renewable energy and environmentally responsible development in Australia at the moment.

On one hand we have growing environmental consciousness in industry (see Liz Walton's story on 3M on page 54), while on the other we have a Federal Government that is withholding funding to promising initiatives like the EnergyCard (see *Issues* on page 78).

For most of us, the sort of impact we can have on things like greenhouse gas emissions seems irrelevant in the scheme of things. But there will always be an important role for the individual, and it is the role of the individual that ReNew hopes to promote.

After all, as Penny Simsen points out in her electric bicycle article on page 38, pollution from cars is now a major health hazard, and it is the combination of individuals' actions that causes the problem. In providing the information, Penny gives us all a way to help tackle the problem, as individuals.

Even if you don't particularly care about the environment, there should be something in ReNew that helps you to save money on power bills, or just have some fun.

Michael Linke **Lance Turner**

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Editor: Michael Linke
Technical Editor: Lance Turner
Associate Editors: Claire Beaumont, Suelette Dreyfus
Business Manager: Libby Anthony
Products Editor: Marcus Ritchie
Cover photo: David Johns
Editorial and production assistance: Ross Blair, Adrian Braun, Zelco Zalac, Penny Simsen, Richard Turner, Margaret Farmer.

Advertising is available for products and services relevant to magazine content. We reserve the right to refuse advertising at our discretion. Please direct advertising enquiries to:

Michael Linke ph: (03) 9650 7883 fax: (03) 9650 8574

Alan Snowden, Media Team ph: (054) 26 4266

Contributions are welcome, guidelines are available on request. Please direct letters and contributions to:

ReNew
247 Flinders Lane
Melbourne VIC 3000
ph:(03) 9650 7883
fax:(03) 9650 8574

Email address: ata@ata.org.au

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an ATA publication
247 Flinders Lane,
Melbourne 3000, Australia
ph:61-3-9650 7883 fax:61-3-9650 8574

Welcome to ReNew

Technology for a sustainable future

A new magazine about people and their dreams.

dreams of cheaper power
dreams of cleaner air
dreams of self sufficiency
dreams of a better future
dreams of building a low-energy house
dreams of a giant vegie patch
dreams of owning a solar car
dreams of lower greenhouse gases
dreams of riding an electric bicycle

featuring...

solar power
wind power
micro-hydro power
low-energy housing
recycling
safe household chemicals
do-it-yourself projects

ReNew, formerly published under the title *Soft Technology*, is published by the Alternative Technology Association Inc.. We are a non-profit community group that seeks to educate people about renewable energy and resources, sustainable technology and energy-related environmental issues. The new name for the magazine came about as a result of ongoing confusion about the words *Soft*<ware> and *Technology*<connections with computing>. For those of you who knew *Soft Technology*, we hope you continue to enjoy the magazine, and for those of you who are new readers, we hope you enjoy sharing our dreams.

ATA Page

President's report

Barry Huxley
ATA President

It's 7.00am. The kids are awake and it's time we got up. I stagger to the bathroom, get into the shower and immediately start enjoying the warmth from our solar hot water service. Afterwards I put the kettle on for a morning cuppa and grin at the fact that the electricity used to boil the water (and power all our other household appliances) comes via an inverter from our battery bank storage, charged from an array of silent but efficient solar panels mounted on the roof.

Although it's winter, there is little need for heating this morning as the lovely winter sun we experienced yesterday has done its job heating the house – while at the same time being absorbed into our concrete slab floor and brick walls to slowly release its warmth throughout the night. Even now the first rays of the morning sun are creeping through our greenhouse into the kitchen and lounge area to start this process all over again.

When I think of the house I use to live in... sure, it might have looked nice from the outside but it was a real fridge in winter and an oven in summer. The only winter sun we ever saw was in the late afternoon as it peaked through a little window in the lounge room before rapidly disappearing over the horizon. Like many other people we depended on gas and electric heating to make up for what we weren't getting freely from nature, but not anymore; we got educated about such terms as 'passive solar heating' and 'photovoltaic panels'.

The funny thing is that it wasn't hard to learn. With a subscription to Soft Technology and involvement in the Alternative Technology Association (ATA) we soon learnt why we were living in a fridge in winter and spending ever increasing dollars on fossil fuels to try to keep warm, and that's really where this magazine comes into it – education.

I think it's fair to say that the whole purpose of the ATA is to educate people about the fact that there are many other and better ways of doing things that are less harmful to our world, and importantly, not hard for any of us to do. ReNew is our latest offering in this process and we trust you will enjoy reading it and spreading its message.

Getting in touch
ATA state contacts

ACT
Ron Tito
Ph: (06) 235 9172 bh, Fax (06) 235 9036

NSW
Bob Jones
Ph: (02) 235 5790 bh, (02) 498 5001 ah.
Fax: (02) 498 3170
email: bobjones@triode.apana.org.au

TASMANIA
Mark Mather
PO Box 37, Snug 7054
Ph: (018) 123 890 bh, (003) 6267 4141 ah

VICTORIA
Chris Moss Ph: 9885 2108 ah

QUEENSLAND
Daryl Douglas
Ph: (074) 3280 3445 bh, (074) 612 042
Fax: (074) 612 188.

NATIONAL
Libby Anthony (General Manager)
Level 2, 247 Flinders Lane
Melbourne 3000
Ph: (03) 9650 7883. Fax: (03) 9650 8574
email: ata@ata.org.au

For membership enquiries, please contact the national office.

NORTHERN QUEENSLAND
John and Suzy Watson
Lot 12, Community Mail Bag,
Great Keppel Island Qld 4701
Ph: (079) 39 5555 Fax: (079) 395 395

NEW ZEALAND
Ian Dorward
PO Box 33964
Takapuna
Auckland, New Zealand
Ph: +64 9418 9646

Letters

Why not drop us a line?

If you want to have your say about environmental or related issues, or just want to let others know what is going on in your neck of the woods, why not contribute to ReNew by writing a letter? You may also want to tell us what you think of the new look magazine, we would love to hear your views and comments.

In order for us to publish your letter, we require that you supply your name and address. You can, of course, request that your details not be printed with your letter if you wish.

While it is not possible to publish every letter that we receive, we try to select letters covering a broad range of topics. We also edit letters for length and clarity.

Panel sizing

You responded to a question in ST#56 regarding the powering of lights and using solar panels to recharge the batteries.

When I was reading your response to the letter for Greg Wilkins I was amazed with your response. You wrote that if Greg had 150 watts of light running for 10 hours, making a total of 1500 watt hours a day, he would require 300 watts of solar panels, based on a 6 hour day and then muliplied by 0.8 for battery losses. This equates to 1440 watt hours.

If Greg were to do this it wouldn't work. He is taking out 1500Whr and putting back 1440Whr. This is 60Whr short each day. If you were to relate this to a bucket of water, if he took out 1500 litres and only put back 1440 litres do you think that the bucket will ever get full?

On top of this you also based your figures on 6 hours of sunlight. This figure is the most you will get in the best conditions. Clear skies, panel facing north on correct angle and even if you did this, you more than likely will not get this figure in Melbourne.

I believe, in many years of designing PV systems, that you should base your sun-hour figures on either four or five hours (depending on where the system is located), this could then compensate for the cloudy days and lower sunlight levels in winter.

So, based on these design figures using Greg's load you would get the following:

Load: 150W for 10hrs = 1500Whr

Losses: 1500Whr/0.8 = 1875Whr

Sun hours: 1875Whr/5 = 375Whr (required to recharge batteries)

This means that you would require 375 watts of panels to operate this load; not the 300 watts mentioned in your response. This would equate to approximately six 64 watt panels in parallel.

If you are going to respond to people giving them an ideal for what they need to operate a particular load, then please ensure that it is correct. Otherwise the system won't work and solar power will have a bad name due to poor design.

Paul Edwards, Carindale QLD

Paul, after reading your letter and my original response, I have to agree with your figures on the most part. The six hours of sun a day was an assumption I made for this example, and you are right to say that five hours would be a better figure to use generally, and indeed more like four hours for here in sunny Melbourne.

The main aim of my response was not to provide the details of a working system as such, but to show that running inefficient lighting such as halogen lamps from a solar power system is not only expensive and potentially complex, but also wasteful. As the old saying goes, it is easier (and cheaper) to save a watt than to make a watt. My initial suggestion was that Mr Wilkins replace the halogens with compact fluoros, as I feel that spending $3000 or more to run six lights would be a waste of time, money and resources.

But you are certainly right in pointing out that my use of slightly unrealistic figures were misleading, and, of course, your input is welcomed and appreciated.

Lance Turner

Saving the Daintree

As part of the Save Daintree effort, we have managed to get the Queensland Minister for Mines and Energy, Tom Gilmore, to reverse his stand on the provision of renewable power to the region north of the Daintree river, by permitting the D and H RAPS schemes to go ahead again. This involves getting as many people to sign up as possible for the scheme, but Gilmore is intent on limiting the numbers so as not to interfere with the possible customers for provision of grid power. We need lots of intelligent applications that are hard to refute.

For this to be effective we will need some local consumer education - in particular a basic course on RAPS to be given, by me and anyone else that I can rope in, at the local school.

For this I would greatly appreciate some help in providing teaching materials – in particular slides and overhead transparencies that we can use for such a course. Photos of equipment and mechanisms of operation of appropriate technology systems, such as PV's, batteries, solar thermal, hydro systems, adsorption fridges, other fridges, composters and so on would be ideal.

While I have the material, I lack the wherewithall to convert it into pictures. I used to teach such a course (WEA, Wollongong) but that was fifteen years ago, and my slides have suffered the fate of the wet tropics (slides = sludge). Sandia National

Labs (Alberqueque New Mexico) provide loads of this type of material.

All help would be greatly appreciated – it may be a novel twist to saving the Daintree (eliminating the demand for grid power), but it seems to be the most likely to succeed.

Hugh Spencer,
Hugh.Spencer@jcu.edu.au

What's in a name?

I would just like to add a little to the reason that you are changing the name of the magazine.

Some years ago, and I am not sure where it was now, I had to spend some time waiting for a plane. As my hobby is electronics, I thought I would have a look in the newsagency nearby for a magazine which I could not get in my local town, to read while I waited.

While going through the section on electronics and not finding the particular publication that I was looking for, my eye had caught the name of your magazine, Soft Technology, and yes it was right there with the rest of the electronics publications.

I remember thinking to myself at the time that I hadn't seen this magazine before so I picked it up and turned to a page, and there was an electrical diagram for something, I am not sure now of what. So without looking any further I decided that this would do and I bought it.

When I finally settled down to read my new magazine and looked at the front cover, I realized that I had bought what I then called a 'Green's' magazine (I have nothing against the Greenies by the way).

I started to read the magazine and found myself very captivated by its contents. I have bought the magazine ever since.

I now live and work in Indonesia, and get the magazine sent to me each quarter. The bottom line is, had Soft Technology not been included with the electronic magazines I would never have read nor become a subscriber. I do not mind what you call the magazine, as long as the format of the contents do not change.

John G. Mahoney, Melbourne VIC

Thanks for the kind words, John. The experience you had in first discovering Soft Technology is certainly not unique, many people have found the magazine this way!

While we have had many reservations about the name change, including the loss of sales through such accidental discoveries, we are confident that the overall effect of the change will be a positive one.

Ed.

Letters

Fabric softener worries

I read with interest your table of phosphate levels in detergents. Can you tell me anything about the effect of fabric softeners on the environment?

Val Ferguson, Bendigo VIC

Milk carton insulation

Just wondering if you know of milk cartons being used as insulation in the roof of a house. I am looking for a cheap way of insulating my house, and this seems like a good option.

What would be the best way to achieve maximum insulation – individual cartons, or cartons folded/compressed inside other cartons in the same way as cartons collected for recycling?

Any other ideas on low cost insulation?

Janet Morley,
email: Janet.Morley@forestry.tas.gov.au

Speed controller update

I am in the process of building the low-voltage speed controller from issue #55. I am somewhat confused about the rating of this device. I would have thought that the current rating of the MOSFET would dictate the current able to be drawn by the load. I would like to control the speed of my wood lathe, the motor on which draws up to 40 amps.

Could you please clarify this point and if necessary provide me with a diagram of the additional circuitry necessary to drive several MOSFETs in parallel. There are also two references to resistor R10 in the article. I assume from the context that in fact this is R9.

Ian Johnston, Jeeralong VIC

While the MOSFET is rated at 200 volts, 50 amps, these are the maximum continuous ratings. Running the device at or near one of these ratings can cause one of several problems.

The MOSFET has two other important ratings, those being maximum power dissipation and Rds, or the 'on' resistance of the device. For the MOSFET used in the article, the power dissipation is about 250 watts, while the Rds is 0.045 ohms.

By calculating for the power dissipated, using the equation $P = I^2R$, we can see that the power dissipation at 40 amps is 72 watts for a single device, 36 watts with two devices in parallel, and only 18 watts (4.5 watts per device) with four devices in parallel.

At 40 amps, a single MOSFET would be producing quite an excessive amount of heat, way too much in fact for the heatsinking used in the project to handle. This would make the controller very inefficient, which is why you should use more MOSFETs connected in parallel.

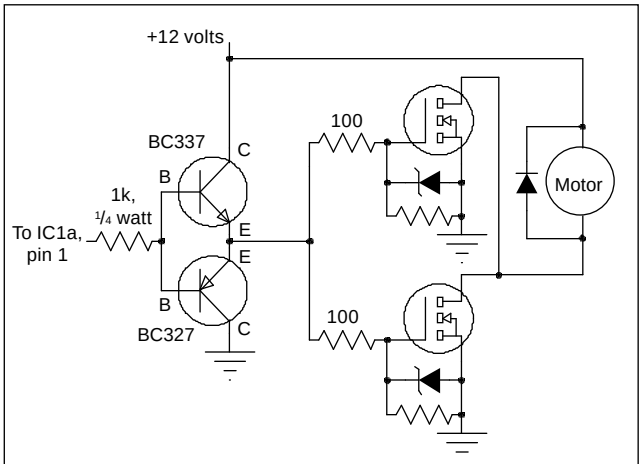
Running multiple MOSFETs in parallel is easy, you just need to make sure that the circuit that switches them on and off can do so quickly enough so that they don't waste excessive amounts of power. The circuit described in Soft Tech #55 should be able to run four devices without too much trouble, although a more powerful driver circuit would reduce power losses. A simple circuit can be seen in the diagram. The transistors are suggested types only, you could use others so long

as they are suitable. For more MOSFETs, larger transistors may be required.

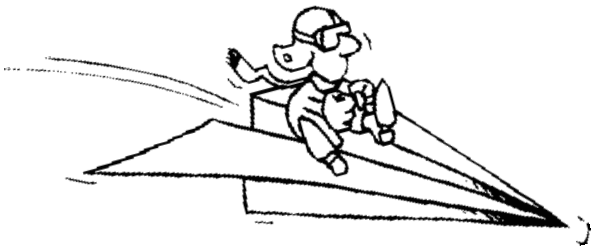
As you can see, the entire circuit after the MOSFET driver is duplicated for each additional MOSFET, which will also need its own 100 ohm and 10k resistors, as well as a 15 volt Zener diode for gate protection. Also, the protection diode across the motor will need to be rated to handle the full motor current, in this case, 40 amps. It will also have to be a fast diode, not a standard rectifier-type device, as these are not quick enough to protect the MOSFETs.

The references in the text to R10 should in fact be to R9.

Lance Turner



The updated circuit for using multiple MOSFETs in the low-voltage speed controller.



Energy flashes

Pass me that fax...

The Australian Conservation Foundation (ACF) has released a report highlighting the effect of office technology on the environment. *The Environmental Impacts of Paper-Consuming Office Technologies in Australia* outlines the full extent of the damage done by most modern offices, and points to the fact that the 'paperless office' is a misleading myth.

Some of the findings included: Copy paper use has increased 400% in the last ten years and is now at a level of 500 sheets per annum for every Australian worker; half the world's chemical pulp production is geared to producing pulp without chlorine bleaching, but as yet no Australian mill has converted to the safer technology; Australian office paper production is largely dependent on native forests from the Central Victorian Highlands; the majority (70 percent) of plain office paper in Australia ends up in landfill dumps; about 1.4 million disposable print cartridges are used in Australia annually, generating 1500 tonnes of landfill; and some imported office papers are associated with wholesale clearing of native forests, including rainforests.

The report, which was commissioned and funded by electronics manufacturer, Kyocera, also outlines solutions to each of the problems identified.

–ACF press release, 12 June 1996

Salt of the earth

Western Australia is losing 250 square kilometres of cropping land each year to rising salt, and within 50-200 years, one fifth of the state's wheat belt will be a giant salt pan.

A new technology designed to map salty soil and other environmental problems from the air has won a BHP Landcare Research award for addressing land and water degradation.

'Saltmap' is an electromagnetic system that uses modified aerial geophysics techniques traditionally used in the mining industry. Magnetic, electromagnetic and topographic data is then combined to demonstrate the position and role of structures within a catchment and their relative importance in terms of salinity problems.

–Landcare press release

Frying along

The Flemish Institute for Technological Research has found a new use for used cooking oil – as fuel in diesel engines. Searching for a way to use the thousands of litres of oil used to fry chips each year, researchers found that the most serious pollution effect was a slight aroma of frying potatoes wafting behind the vehicles.

–Adelaide Advertiser, June 21 1996.

Tyred old problem

Each year in Western Australia over one million tyres are disposed of, the majority going to landfill. Local tyre recycler, Imtech, is set to build a new waste tyre recycling plant to help deal with the problem. The company has secured State Government funding to help establish the plant, which it hopes will utilise most of the State's discarded tyres. The plant will convert the tyres into rubber crumb for covering playgrounds, sporting venues and carparks.

Tyres are a huge waste problem in Western Australia, as they provide massive breeding grounds for mosquitoes, and in 1990 a fire at the Bindoon tyre-dump burnt for two weeks, costing over $600,000 to clean up.

The Greener Times, Conservation Council of WA, June 1996.

Asian power demand

Demand for electricity in developing Asian countries is rising at over eight percent per year. Asia will require about $400 billion worth of new power investment over the next ten years, according to the World Bank. On current trends, power generation capacity in the developing world will expand over the next 25 years by the equivalent of the entire capacity of Europe, North America and Japan combined – with most of that growth in Asia.

–APACE Newsletter No 67, April-June 1996.

A dangerous environment

The Federal Government has released its *State of the Environment Report* for

Imtech: eating away at the tyre mountain.

1996, which, according to Mr Brian Boyd – the trade union member of the SOE Advisory council – highlights some alarming environmental and health problems. The report found that another 40,000 Australians are expected to develop asbestos-related diseases over the next 20 years because of workplace asbestos exposure.

Exposure to chemicals now kills more Australians than car accidents. In 1992 over 1700 men and about 490 women died because of chemicals at work. The national cost of chemical exposure is over $160 million.

Other key results include:

• That 88 percent of sewage from human settlements is poured into the sea from 700 ocean outfalls, while 9 percent goes into rivers.

• In Victoria the EPA is paid $8.8 million by industry for discharge licences in order to dump toxic wastes into the environment.

• 60% of Victoria's C02 emissions come from coal-fired Latrobe Valley power stations.

• Some large cities are starting to experience 'capacity' problems – as demonstrated by severe photochemical smog, storm-water pollution, contaminated sites and pockets of poverty.

• Australia has more than 60,000 sites contaminated by toxic chemicals, many of which threaten water quality and human health.

• Melbourne smog is on the increase and sometimes reaches northern Tasmania.

• Seven out of ten Australians say they are worried about environmental issues.

Victorian Trades Hall Council media release, 27 June 1996.

Recycling made easy

A new facility capable of sorting the recyclable waste from around half of Adelaide's households in is now in operation. The Automated Material Recovery Facility at Wingfield is unique in that it can sort different recyclable wastes that have been mixed together.

It eliminates the need for householders or collectors to segregate recyclables into plastics, paper, glass, aluminium and other metals. Based on local and overseas technology, the plant is already processing about 100 tonnes of material, mainly from the Marion Council district.

–Adelaide Advertiser, 18 June 1996.

ATA on the move

ReNew's publisher, the Alternative Technology Association, has come a long way since its beginnings as an interest group in 1979. The ATA has more members than ever before, and recently opened three new branches.

The Tasmanian branch will operate from Snug, south of Hobart, and will be a great way for renewable energy enthusiasts to share ideas and resources on the Apple Isle.

The northern Queensland branch will be based on Great Keppel Island, and will work with the Brisbane branch to spread the word about renewable energy in a greater area of the huge state.

The New Zealand branch will be the ATA's first overseas venture (excluding Tasmania, of course), and will have a strong educative role in a country where the potential for water, wind and solar power is enormous.

To get in touch with the branch nearest you, see the listing on page eight.

browser

compiled by adrian braun
adrenal@netspace.net.au

In this installment we look at some of the newsgroups (or usenets) which cover renewable topics. If you haven't discovered newsgroups yet – it's worth getting into them. They're basically public mail boxes or bulletin boards listed by topic and are great forums for information exchange. Within each newsgroup there can be hundreds of postings covering the myriad aspects of a group's general topic. At first it's best just to observe some of the traffic on newsgroups that interest you. Much of this traffic will be ongoing discussions known as 'threads' and you'll be surprised how often these discussions are directly relevant to your own area of interest.

If you post a question to the a group, you'll also be surprised at how many people are itching to tell you what they know – which isn't much in some cases. Many newsgroups post a 'FAQ' (frequently asked questions) list so it's a good idea to check this before boring the group with some tired old perennial question. If you can't find a FAQ posting within the a group, try FTPing an archie site such as archie.au and looking at the 'usenet' subdirectory.

Here are some of the newsgroups that are directly relevant to renewables:

alt.solar.photovoltaic I found a reference here to a web site with a neat design for a passive solar tracker; go to http://www.netins.net/showcase/bigdog/elcheapo.html.

alt.energy.renewable and **alt.energy.homepower** Both cover general renewable topics, the later was started by 'Homepower' magazine.

sci.energy.hydrogen Check this one out for twilight zone discussions on Brown's gas as well as more conventional discussions on hydrogen as an energy source.

alt.solar.thermal When I looked there were some interesting discussions on small scale solar-thermal power system designs.

alt.transport.urban-transit and **alt.planning.urban** These two run hot with car V's PT V's urban sprawl debates.

alt.architecture.alternative and **alt.housing.nontrad** for solar passive topics.

alt.sustainable.agriculture for green-thumbed people.

Moora Moora a solar powered community

One of Australia's longest running demonstrations of domestic solar power, the Moora Moora Co-operative is today a model of an 'alternative' community that got it right. But as MICHAEL LINKE learned, the road to success was long and hard.

Bob and Yolanda Rich couldn't decide which was worse; trying to stare down an enormous bulldozer creeping toward them with ominous arms extended, or being dragged off their own property by the police.

The police beat the bulldozer to the punch line, and forcibly removed the couple, along with six of their friends, from their bush paradise high in the Dandenong Ranges to the east of Melbourne. They threw the frightened but stubborn protestors into the paddy wagon and carted them off to the station to be charged. The media moved in with photographers and film crews capturing the dramatic 1970s eviction for national TV and newspapers.

What was all the ruckus about? Protesting against the Vietnam war? Chaining themselves to trees to stop wood-chipping? No, something far more mundane. The Richs wanted to stop the State Electricity Commission of Victoria forcibly hooking up their area to the electricity grid.

The Rich's are still among Healesville's most famous dissidents, and while the days of confrontational protest are long past, they still show the conviction in their beliefs that led them to become environmental celebrities almost twenty years ago.

Visiting Bob and Yolanda at their home in the Moora Moora Co-operative on a cold, wet winter's day, it is difficult to imagine the place as the scene of a political and economic feud. Lyrebirds run across the access road, the mist wisps through the tree-tops in the valleys, and the clang and grime of the city seems a long way away.

Bob Rich stands in front of his latest building at Moora Moora, a passive solar workshop.

As I make my way up the winding highway on the far side of Healesville, a place best known for its world-class wildlife sanctuary, I curse myself for having left the directions at home. Did Bob say left at the white post, or right?

After five minutes of aimless driving through the Co-operative's dirt roads, the magnitude of the place starts to hit me. At 618 acres, the Co-operative is the size of over 2,000 suburban house blocks. I stop at a cluster of houses – one of six such groupings in the Co-op – to ask directions. Eventually, I reach the Rich's house and am welcomed inside. They give me a cup of tea and a seat near a warm stove-pipe that reaches from the kitchen into the living-area – two heaters for the price of one. Yolanda offers me a chocolate-topped Anzac biscuit. 'A new experiment in higher living,' she explains.

The house is made of stone, and inside it is easy to imagine being in a fairy-tale cottage. I suggest this to Bob, who recommends that I avoid eating the walls. 'I think of it as my above-ground cave,' he says.

Yolanda's textile decorations adorn the walls and furniture. With the warmth from the wood stove trapped inside by the thick walls and slate floor, it is difficult to imagine a more homey abode.

Cover models: Linden (left) and Tessa Smith in front of their solar powered house at Moora Moora. The glassed entrance area traps sunlight to provide free heating for the house, as well as creating an airlock between the front door and the often cold air outside.

The Co-operative started at Moora Moora in November 1974, a year before the fall of the Whitlam Government, part of a golden era for many Australians. A group of twelve people from various Melbourne suburbs realised their dream of escaping the rat-race and moving to the hills. They bought a piece of land containing diverse set of ecosystems – native forest, potato farm and scrubby bracken patches. Their dream was utopian; a more equitable, healthy, environmentally responsible and joyful society.

They knew little about things like building houses, installing renewable energy systems, collecting firewood or making water pumps. But they had committed themselves to learning along the way. With training in fields like school teaching and nursing, the new Co-op residents found carpentry and stonemasonry challenging vocations.

In the early days, the lifestyle was rough. Winters at Moora Moora can be very cold, with snow falling once or twice each year, and good, efficient heating was expensive. The solar systems were also far from ideal, with a lot of old car batteries used for storage – making it difficult to power more than a few lights. Dirty petrol-burning generators were used as back-ups.

There were also big decisions to make about the structure of the Co-operative, like how new members could join, who owned the land, and how responsibility and authority would be divided. Indeed, it was probably these early decisions, more than the stonemasonry and carpentry, which were responsible for Moora Moora's longevity.

Bob and Yolanda have been at Moora Moora since early in 1976. Bob took time off his job at the CSIRO Division of Building Research to start

Klaus Gottwald with a hand-made pine wind turbine blade.

building their house. After a year in the hills, he knew he was not going back to the office. Their house is one of five in the Mudburra cluster. Clusters were originally conceived as a way of looking after the land more efficiently. With over two thirds of the land forested, people needed to be dispersed for weed control and fire prevention.

The clusters are also social groupings, and each one is self-contained for power and water. There are solar panels on every roof, although the degree to which they satisfy users' needs varies widely. A backup diesel generator in each cluster supplies additional power, and the cost of fuel and maintenance is shared equally among households. Each cluster also has its own hydraulic ram pump which feeds crystal clear water from an underground spring to storage tanks.

To own a house at the Co-op you must first become a member, and to become a member depends on two things. The first is money. A share in Moora Moora costs around $12,500, and for an individual to build they must have purchased the equivalent of one and a half shares. A couple needs two shares before they are able to build or buy an existing house. The second requirement is the certainty that the Co-op is the right place to live. Building at Moora Moora is a cheap way to live on a large country property near a major city; smaller, undeveloped blocks of land around Moora Moora have been selling for around $80,000. But moving into Moora Moora can be a costly mistake if it doesn't work out.

For starters, it isn't easy to sell shares in Moora Moora. Shares are sold in the order that they are put on the Co-op's 'for sale' list, and there is a waiting period of up to ten years to sell a Co-op share. The money remains with the Co-op until a new buyer is found.

While the number of members has grown from twelve in the beginning to around fifty today, the rate of membership uptake is not high. This is probably due mainly to the way share ownership is structured. While houses at Moora Moora belong to the shareholders who builds them, the land they are built on is owned by the Co-operative. This means that if a home owner wants to buy another house somewhere else for example, they can't get a mortgage on their existing home at the Co-op. For this reason, the Co-op strongly advises potential homeowners rent a house at Moora Moora and try living there before buying shares.

Klaus Gottleib is a renewable energy installer who followed that advice. Renting a Co-op owned house for about 18 months turned out to be a big success for both Klaus and his family. He and his wife Julie spend hours after the children have gone to bed planning the 'dream home', which they plan to build next year in the Co-op. The new home will be completely self-contained for electricity, and will include a composting toilet – the first such toilet at the Co-op.

Existing homes at Moora Moora use conventional septic tanks. The conventional septic system works very well thanks largely to the porous granite based soil which distributes and processes the effluent very effectively. Indeed, the waste water system is one of the Co-op's great successes, for the slow release of nutrients and water fertilise fire retardant vegetation planted around the surrounding houses. Composting toilets, however, have a higher productivity rate, with effluent being treated in around twelve months compared with several years for a septic tank.

Klaus operates his renewable energy business on a part time basis, servicing and installing systems in the wider Healesville area. Since he began living at Moora Moora a couple of years ago, he has designed three solar power systems for Co-op residents. One of the improvements learned from the hard early years, is that home builders need to install the right system up front. In the past, home builders only bought the system they thought they could afford, rather than waiting until they could buy a system adequate for their needs. The result was expensive upgrades of system equipment such as inverters later down the track.

In the search to provide inexpensive stand alone power system equipment which can be upgraded easily and cheaply,

Klaus has developed a regulator that switches automatically between 12 and 24 volt. This adaptation also eliminates the problem of disposing of a redundant piece of equipment. Klaus' regulator typifies the sort of ingenuity Moora Moora community members have had to develop.

Passive solar resistance

Self-reliance for power is arguably the most rigid of the Co-op's values. The idea of being independent of dirty fossil fuel-powered electricity had been the Co-op's philosophy from the outset, but when the SEC wanted to connect properties in the area to the grid in 1979, the stage was set for a groundbreaking battle about the right to remain unconnected to mains electricity, and to remain free from development. The SEC wanted grid connection so it could power a communications repeater station to act as a link between the Latrobe Valley and Melbourne. According to Bob Rich, the commission used a local land-owner as a 'running horse' to push for connection in the area. In those days, the idea of remaining unconnected was at best unconventional.

Before the 1990s reorganisation of the utilities, state electricity monopolies across Australia tried to extend the power grid connection to rural towns, in part to expand their own control over the area. The electricity utility often enlisted the support of large farmers in rural areas – farmers who could afford to pay $10,000 or more for the grid extension.

At Moora Moora there was no threat of compulsory grid connection, as now commonly occurs in many new housing developments. The issue was mainly about leaving the area free from development and all its associated burdens on the environment. Sandra Cock, one of the twelve founders of the Co-op, believes that the feral animal problem in the area is just one example of the sort of things the Co-op members were trying to prevent when they lay down in front of the bulldozers.

Local investment property owners in the Healesville area eventually voted for the power to be supplied, but not before the Moora Moora residents had held up the process by legal means for two and a half years. The Moora Moora protests gained support from the Victorian Labor Party, then in opposition, which promised an environmental effects study if they won at the next election. Unfortunately for Moora Moora, the ALP lost by one seat.

Bob and Yolanda Rich lost one battle with the SEC, and electricity mains now flow through the Moora Moora property. But some good came out of the connection. The Co-op was compensated for the use of their property, and with that money were able to purchase a large Darius rotor wind turbine.

In defiance of State electricity suppliers, Moora Moora is still not connected to the electricity grid, despite grave predictions from neighbours that the Co-op would give into

Moora Moora's Darius rotor wind turbine

Due to their blade design, Darius rotor wind turbines actually rotate faster than the wind speed driving them. Their one drawback is that in their classic design, they are not self-starting.

Manfred Pruter, a mechanical and electrical engineer, first brought his plans for a Darius rotor wind turbine to Moora Moora in the early 1980's. It had fibreglass blades, and was originally designed to work in very light winds.

The Darius was approved by the Cooperative and the contract to begin building was signed. The Darius' big stumbling block came when the plans were submitted to the local council for approval. The council's building staff didn't understand it, so a consulting engineer was called in. The engineer's verdict was that the Darius needed more structural support, so struts and stays were added to satisfy the engineer. Unfortunately the additions meant that the Darius had added drag, and so no longer worked as it was designed to.

The result: a wind turbine that only worked in gale-force winds. Several modifications ensued, including replacing the fibreglass blades with stainless steel ones to reduce drag. The Moora Moora Darius was recently purchased by Monash University for a fraction of its original value, and is currently being worked upon in the original site by Monash Phd student Peter Freere, who has already made several of his own modifications. Design modifications include making it self-starting, and it is hoped that the Darius will soon provide power to Moora Moora Lodge.

Power systems at Moora Moora

There is a mixture of 12, 24 and 48 volt systems at Moora Moora. The average system, according to Klaus Gottwald, is 12 volt, 500 amp hour capacity.

Each housing cluster shares one diesel generator (Mudburra's generator is pictured here).

Some 12V systems are running without an inverter, running a few lights and relying upon generator back-up. Larger appliances such as washing machines are usually run off generators.

There are photo-voltaic panels from all the major manufacturers. There are a lot of very old panels installed, a few are around 20 years old. No solar panels have ever failed at Moora Moora.

Ex-government backup batteries are a cheap and reliable option. There are few, if any, 'first hand' batteries in use.

Sealed gel-pack lead acid batteries have not been very successful at Moora Moora, as they are commonly overcharged by the diesel generators.

the convenience of grid power within two years. The national media coverage attracted by their battles with the SEC also helped to raise awareness of solar electricity and to present the idea that grid connection is not a necessity.

The Co-op has been successful in achieving an impressive level of physical development, with twenty-four largely energy efficient houses, a clean and continuous water supply, sustainably managed wood fuel supply and timber plantations for future use. The co-operative is a well defined community, with its own community lodge.

Moora Moora Lodge is used as a guest house and a learning centre, and is promoted for hire as a conference centre. Co-op members also plan to use it as part of a renewable energy and sustainable lifestyle display complex, featuring the houses and people of the Co-op as real-life examples.

Wind in the hills

While there is plenty of strong wind at Moora Moora, it is not an ideal site for many types of wind-powered electricity generation. Air becomes turbulent as it reaches the hills around Healesville, and more than one turbine casing has been cracked apart from rapid changes in wind direction.

The Darius rotor wind turbine purchased with the SEC compensation payout is the most striking landmark at Moora Moora. Unfortunately, it experienced a string of engineering problems which has left it dysfunctional to this day.

Enter Monash University Phd student, Peter Freere. Showing the same spirit of those Moora Moora pioneers who live and learn, Peter is currently redeveloping the Darius. He who hopes to have it working in the coming months. (see box for more on the Darius). Klaus has also been studying the problem of wind at Moora Moora. He believes that conventional wind turbines could be viable if their direction was controlled electronically, rather than by the whim of the fierce wind. This could well be his next project.

Farming

The residents of Moora Moora have been giving careful consideration to the future in recent times. They are now looking to the land to supplement their income and to provide greater self-reliance.

Around six acres have been allocated for silviculture, where food trees like

Bob Rich

Bob Rich's name could well be a metaphor for his life. His experiences are many and varied, and he gives an impression of enduring hope for the future, though it is optimism grounded firmly in reality. He is a writer, an educator, a protester, a builder, a ginseng farmer, a wood carver and a philosopher. He also has an important organisational role at Moora Moora, and his many roles have included Co-op Directorship, Moora Moora festival organiser, and membership on the finance and farm committees.

Bob's Earth Garden Building Book is into the tenth print run of 3rd edition, and he has written a book about wood carving called *Woodworking for Idiots Like Me.* He has written for several magazines, including Grass Roots, Simply Living, and Soft Technology, as well as regular contributions to Earth Garden. His current project is a book on stress management.

Bob is pictured here with his wife Yolanda.

stone pine (pine-nut trees), chestnuts, wallnuts and carob are grown. There is also a small amount of plantation timber, and project coordinator Phil Smith estimates that there will be enough timber from the Douglas firs, cedar and oak trees for house-building in about thirty years.

Residents will also be able to earn an income close to home on the 75 acres of land which has been allocated for a horticulture project. Vegetables like potatoes, onions, garlic and brocoli tend to fare best in Moora Moora's cool climate. The project will use organic farming methods, and utilise renewable energy for its power needs. Savonius rotor wind turbines will be used to pump water to the crops, as they are not adversely affected by turbulence like other turbines, and unlike their carbon-based fuel alternatives, they don't contribute to air pollution.

The future

One of Moora Moora's greatest sucesses has been the influence it has had on residents' personalities. As Yolanda Rich explains, the effects are most noticeable in the children: 'the kids who have grown up here have all become very flexible. They are able to tackle a lot of things which their peers wouldn't think about, because they've grown up seeing people doing things for themselves rather than expecting an expert to come and fix it for them'.

Tessa and Linden Smith, aged six and eight respectively, count walking in the bush and swimming in the dam among their favourite pastimes, and consider the city a 'smelly' place. In an age where so much is made of children being addicted to television and computer games, it is heartening to know that there are pockets of resistance. And for the older generations at Moora Moora, it must be comforting to think that there are children who are equipped to tackle any challenges the Co-op may face in the future. ✲

Visiting Moora Moora

The Co-op has an open-day on the first Sunday of every month. Tours can be organised by calling (059) 624 090.

The biennial Moora Moora Festival is another great time to visit. With renewable energy displays, alternative health stalls and other demonstrations of independant lifestyles, the festival attracts thousands of people to the Co-op. The next festival will be held on the 22nd of February 1997.

Jackie French's water-powered house

ONE OF AUSTRALIA'S MOST CELEBRATED GARDENERS, JACKIE FRENCH LIVES IN AND WORKS FROM HER COUNTRY HOUSE WHICH IS POWERED ENTIRELY BY RENEWABLE ENERGY. SHE AND HUSBAND BRYAN SULLIVAN TELL HOW THEY DEVELOPED THEIR CUSTOM DESIGNED WATER WHEEL.

Our house has grown bit by bit... an extra room here, a balcony there, another storey added over part of the house and another wing about to snake out into the garden. Over the past fifteen years our power system has grown in the same fashion. It started off with a couple of solar panels and a bank of batteries about a dozen years ago. Then, as we added a fax, more computers and a video to the lights, kitchen appliances and amateur radio equipment, we added more panels too, from the original 200 watts to the current 700 watts which charge our 1000 amp-hours of batteries.

However, we found two disadvantages to solar power. The first is that down in our valley we get only five and a half hours of sunlight midwinter, as long as it isn't foggy or raining, and if the climbing roses haven't shadowed the panels again (they're supposed to stop growing in winter, but the reflection from solar panels appears to have an energising effect on roses).

The second disadvantage is that nowadays solar systems are more or less prepackaged. For Bryan, this means that most of the fun has been taken out of them. Bryan wanted a system he could start from scratch; one made from bits and pieces and his own ingenuity. And there was the creek, with all its untapped energy, flowing gently down past the house, except of course when it flooded and boulders crashed across the causeway, or when it dried up in a drought.

Bryan's first experiments with water power began with a Pelton wheel and black poly-pipe. The Pelton wheel turned, but not much else happened. With only a twenty metre head of water in our creek from the property boundary, we either had to syphon or hydraulic ram water to a header tank

Jackie at home with her geese

up the almost vertical hill above the house – or accept that we simply didn't have the water pressure to generate more than token power.

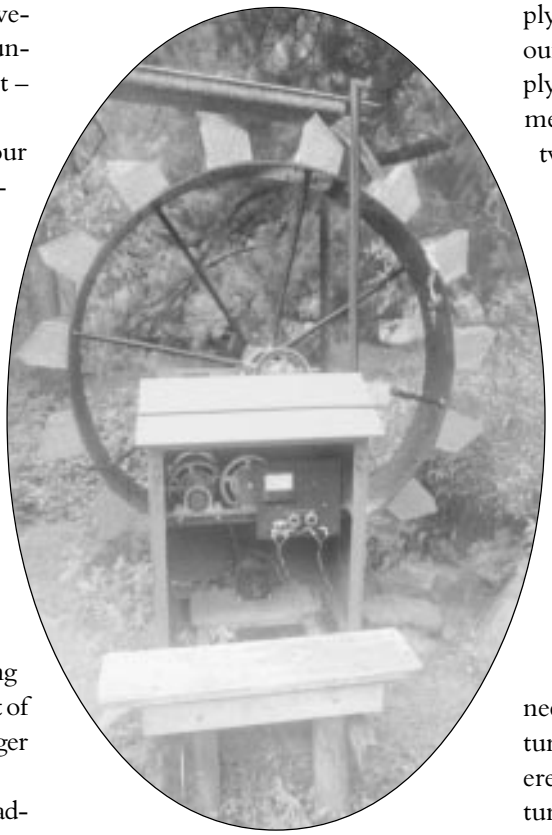
The idea is born

The idea of a large water wheel came from a visit to a nearby forest where there is a wooden water wheel located in a picturesque creek and picnic area. This particular water wheel was originally used by timber workers to recharge their truck batteries and has been restored by State Forests as a tourist attraction. Waterwheels rely on the volume of water, rather than the velocity. As long as our creek kept running – even if it didn't run very fast – we might still harness its power.

After much discussion amongst our friends, especially with Bryan's technical colleagues, and after many sketches and calculations on yards of paper, the search began for the bits and pieces. The project first focused on finding or constructing the wheel itself. It needed to be perhaps five or ten metres in diameter – and with limited carpentry and joinery skills the thought of a building a wooden wheel that size was daunting. Of course when considering such a project it is always advisable to consult with the local town engineering and welding works. After the briefest of project descriptions, the works manager immediately became enthusiastic.

After an hour of poking about the paddocks at the rear of the works, among old tractors, rusting hulks of earth moving machinery, sheet metal and pipes, he pointed to a huge, slightly oval-shaped rusty ring of metal, half covered by chest-high grass and leaning against the fence. Many years ago it had been the formwork for the pylons of a local bridge, and had been waiting for us ever since. It was perfect – over two metres in diameter – a ring of steel, eight millimetres thick with a width of three hundred millimetres.

Now for the axle. After some discussion and a few more pencil sketches it was agreed that the engineering works would simply weld a few pieces of pipe onto a piece of steel shaft. The spokes would consist of eight pieces of threaded 20mm steel rod purchased from a metal supplier. They were attached to the axle and wheel rim through clearance holes and held with nuts and flat washers. By adjusting the nuts, the slightly oval rim was pulled and pushed into a more circular shape. With a modest reimbursement for the time of the lathe operator and welder we now had a solid wheel weighing approximately 250 kilograms. It was lowered onto the roof-rack of the Landcruiser by the works overhead hoist, and transported home – ever so slowly!



The waterwheel with its gear housing and regulator box

Siting the wheel took some careful thought. It needed to be near the creek, but not too close in case of floods, close enough to the house to minimise transmission losses, and preferably in an aesthetic garden setting where we could hear the swish of water at night. The support structure for the wheel consisted of four round treated pine fence posts, two on either side of the wheel with two pieces of 4 x 2 hardwood to support the wheel axle.

The wheel was carefully rolled to the site and positioned between the posts where it was progressively jacked up with wooden wedges. Two self-centring bearings were then fitted to the shaft and the wheel was lowered onto the support rails. The water supply to the wheel was an extension of our poly-pipe siphon garden water supply, with intakes extending half a kilometre up the creek which provided twenty metres of head. When the waterwheel is in use we don't have any garden water – but when the garden is dry there's usually quite enough sunlight to power the house anyway.

Water was delivered to the wheel in an 'overshot' arrangement to achieve the maximum power from the falling water. It falls into fifteen buckets made from pop-riveted zincalume sheet metal and attached to the wheel rim with small nuts and bolts.

This stage ended the heavy engineering phase of the construction. We turned the water on; the geese gathered round to watch...and the wheel turned! Visitors came. The men discussed the technology, the women commented on the aesthetics and asked pertinent questions like did it actually power anything yet, and the kids were both fascinated and curious at this huge structure whizzing around at twenty-five revolutions per minute and splashing water back into the creek.

We now entered the second and most interesting scientific phase – the electric engine, gearing, wiring, and connection with the solar system – and

Water wheel vital statistics

Maximum water flow rate	4.8 litres/sec
Available power from the water	88 watts (1/10 HP)
Estimated weight of the wheel structure	1/4 tonne
Capacity of each bucket	7 litres
Power loss in the gearing and chains	50 watts
Maximum power from the generator	36 watts
Main wheel speed (full load)	7.5 rpm
Gearing ratio generator shaft speed	420 rpm

Bryan relaxing on the farm

just how much mechanical energy would the falling water give us to perform useful work and generate electric power? The physics books told us that the power from the falling water was equal to the quantity of water flow in litres per second multiplied by the distance of water movement (radial fall in metres multiplied by 9.8, a constant of gravity). This result would be the mechanical power that was available for use in watts.

The next task was to couple an electric generator to the water wheel. Obviously the generator would need to run much faster than 25 rpm, therefore some belts and pulleys would be needed. After many months of experimenting with different generator devices, both AC and DC, and various vee-belts and pulley arrangements it became obvious that taut rubber belts produced enormous frictional losses resulting in very low generator speeds. Gearing was the obvious way to go. Finding a suitable gearbox was difficult, until a colleague found a unit consisting of a number of shafts, bearings and wheels all neatly contained in an angle iron framework amongst some discarded industrial machinery.

Modifications entailed the addition of some bicycle sprockets and chains, thereby giving the required step-up ratios with much improved efficiency from the chain drives. This convenient gearbox provided great flexibility to experiment with different sized sprocket arrangements and to vary the step-up ratios. Once a sprocket wheel was fixed to the main shaft of the waterwheel then the gearbox could be attached via a long bicycle chain. Now we were able to drive our assorted generators at speeds of up to 800 rpm. Many months were spent experimenting with all sorts of automotive generators and alternators which are of course designed to run at speeds greater than 1500 rpm.

Modifications to the windings were the next step under consideration, when a colleague produced a neat permanent magnet DC motor which, after having a sprocket wheel attached to its shaft, ran very well as a DC generator. At last we had a complete hydro system, converting the potential energy of the creek water to mechanical energy and then into electrical energy.

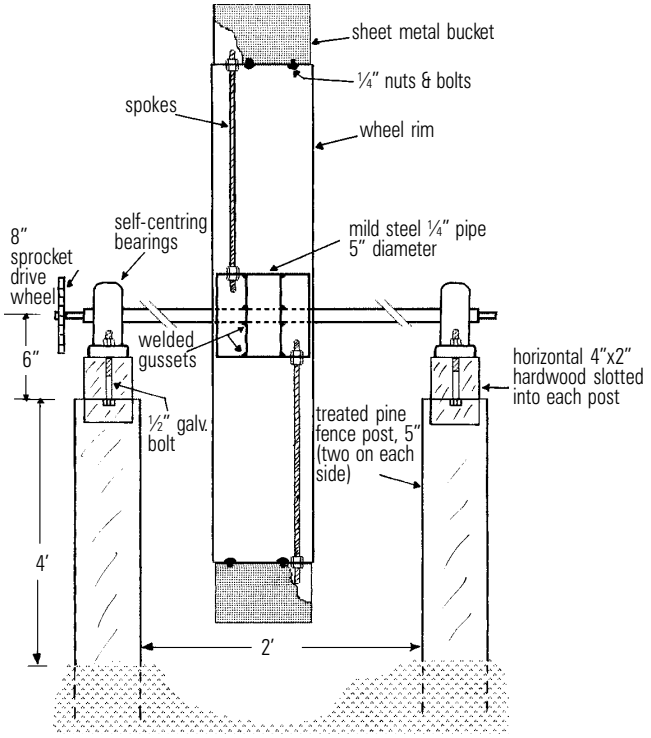
From Bryan's point of view this completed the original aim of the project – a demonstration of a hydro power system, even if it only illuminated a 12 volt incandescent bulb. From Jackie's point of view power only became really interesting when it powered something useful, and we were still some while off that stage yet.

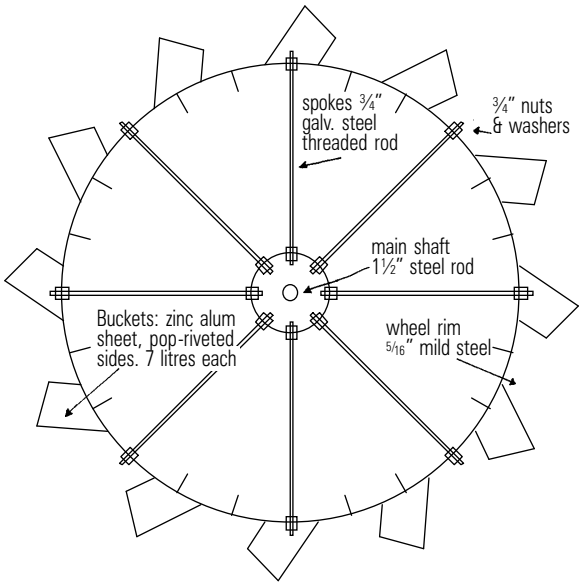
More visitors came. Bryan explained to the younger generation how to convert water into electricity. Technocrats wandered round the apparatus offering all sorts of ideas, like 'why don't you just...increase the water flow with a bigger delivery pipe...make a bigger wheel...improve the design of the buckets...increase the number of sprocket wheels and chains...install a bigger generator...'. One suggestion was to dig a water-race along the hillside of the gorge. Large concrete stormwater pipes were even suggested. Unlimited power – wow! Given Bryan's serene satisfaction with the fact that the creek had finally been harnessed to run a light bulb, it was some time before the system was tested and evaluated for the next stage – the integration with the existing house solar system.

Measuring the wheel's power

First the electrical output of the system was measured. This was done using the element out of one of those little bathroom fan heaters. Using crocodile clips, the resistive load was varied while measuring everything from the water flow rate, the main wheel speed, the gearbox efficiency, the generator speed, and the volts and amps delivered into the resistive element to the temperature of the generator at maximum load. Obtaining these measurements proved to be the technically exciting part of the project.

The job of connecting the hydro power up to the house presented another challenge – a distance of about 80 metres. Digging a trench across the grassy flat, through Jackie's rose garden and up a small hill was not at all appealing. Then a friend happened to mention that he had a large roll of copper wire 'behind the shed' and that he had not as yet found a use for it. It turned out that the roll of wire was indeed three millimetre hard-drawn copper aerial wire – just the thing. Three poles were erected and a pair of wires





Construction details of Bryan and Jackie's water wheel.

was strung on electric insulators from Bryan's vast collection (pale blue and purple to match the flowering sage below), terminating inside the battery house. After twenty odd years we finally had power lines to the house.

The final item needed to complete the connection was some sort of regulator to control the hydro system voltage and hold it steady at around fourteen volts. Again, a colleague produced a small printed circuit board full of components. He said it was 'surplus to requirements' and it proved to be just perfect for the job. To prevent the power from the solar panels from feeding back into the hydro system, a blocking diode was added to complete the connection.

We now have a fully integrated hydro/solar power system built from bits and pieces. It has charged our batteries through the past two winters, summer fogs and rainy patches. Theoretically we'll either have plenty of water or plenty of sun, though if we get six weeks of fog in a drought we may be in trouble. With our daily winter power usage of 400 watt hours, it takes the waterwheel about eighteen hours to trickle this amount of energy back into the batteries.

Most households of course do use more mid-winter power than this, especially if their home also contains an office, as ours does. But our methods of power conservation are another story. It is interesting also that to replace this modest amount of power over eighteen hours requires more than one quarter of a million litres of water over the wheel. The greater the energy demand from the system, the slower the water wheel rotates, but then, the slower the wheel turns the more water enters each bucket which develops even more power.

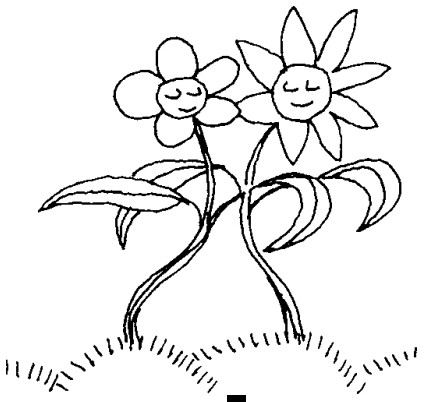
An ancient power source

Water wheels have been a source of power for millenia. We're basically harnessing an age old technology to run our computers, instead of mill our grain. Provided there's ample water filling the buckets, waterwheels provide an enormous potential energy harvest, and as our neighbours have noticed, the water is merely 'borrowed' before flowing back the short distance to the creek. Bryan claims the water is de-energised, and undoubtedly has wonderful medicinal qualities for the overstressed business world.

There are many ways in which this home-made bits and pieces hydro power system could be improved – and it probably will be. The experimental possibilities are endless. The project has certainly demonstrated the principle as well as the potential of this form of hydro-electricity; it complements our solar system very well, and it provided years of fun as it gradually evolved. The chooks love it, visitors want to be photographed next to it, and there is something extraordinarily reassuring about lying in bed on a winter's night, hearing the splash, splash, splash from the buckets, and knowing that in the morning we'll wake up to find the batteries recharged. ✶

Bryan Sullivan and Jackie French are the authors of *Switch: Home Based Power, Water and Sewerage Systems for the Twenty-first Century.* (Aird Books $17.95); Jackie is also the author of a range of books on gardening, pest control and self-sufficiency, as well as her award winning children's fiction. Her latest books include *Soil Food: 1,364 Ways to Feed Your Garden* (Aird Books); *Plants That Never Say Die* (Lothian) and *Summerland* (Harper Collins).

Friends for your plants



IMELDA EVANS looks at the age-old practice of companion planting. Does it really work? and which plants go with which?

Part folklore, part black art, and part science, companion planting is a cheap, easy, and environmentally friendly way to help your garden grow.

The Benefits

Plants situated with congenial companions are healthier, happier plants. They grow better, look better, smell better, taste better, produce more fruit and flowers and are more resistant to pests and diseases. A well-combined garden can also help to increase the population of beneficial insects, decrease the pest population and nourish the soil. And, if you can bear to part with total tidiness, flowers in your vege patch and herbs with just about everything can lend a natural exuberance to your garden which is a balm to the spirit.

Although the combinations of plants that people will swear by are almost endless, the reasons they work can be boiled down to a few main concepts.

Aromatherapy

Many plants (herbs, mainly) exude powerful chemicals through their leaves or roots that can assist or hinder plants around them. Nasturtiums, for example, are said to intensify the flavour of radishes planted nearby, and garlic growing among your rose bushes will make the flowers smell sweeter while protecting them from aphids. Foxglove stimulates the growth of potatoes, tomatoes and apples and guards them against fungus, while thyme will invigorate plants growing near it.

Insects are sensitive to smells, too. Marigolds and marjoram repel many insects bent on destruction of your veges, and lavender and parsley attract bees to pollinate your flowers. Nasturtiums even lay down their lives for their friends. Planted among cabbage, cauliflower, broccoli and turnips, they will attract many of the insects that would otherwise eat your vegetables.

Physical attraction

Often, a fairly basic knowledge of a plant's characteristics will tell you what you should – and should not – plant it with. Tall shading plants can assist nearby plants that like some shade. Plants with strong, deep-delving root systems can be good companions for more shallow-rooted plants. The stronger ones help to break up the soil, making root penetration easier for the weaker ones. They can also help by drawing up nutrients, which, as the plant drops leaves, become available to other plants with roots closer to the surface. Mixing plants of different shapes, textures and smells pleases the human eye and nose, and makes pests work harder to find their food. It also increases the variety of beneficial insects in the garden.

The way to a plant's heart

Just like people, plants appreciate friends who feed them well. Some plants have the ability to collect trace elements unavailable to other plants and convert them into a useable form. This makes them invaluable to other plants. The legume family is probably best known for this. Peas, beans and their relatives are nitrogen-fixing; that is, they take in nitrogen (from the air) through their leaves and transfer it to nodules on their roots, from whence it is released into the soil. Fruit trees, grape vines and potatoes all appreciate this habit, though onions don't.

Many of the plants that do this best are often considered weeds, so in some cases you might be better off leaving your weeding undone. Nettles are a good example. They excrete silica, formic acid, nitrogen, iron and protein, they protect against aphids, black fly and mildew, and they are especially good companions for potatoes.

Plants with 'active ingredients' also make good companions after their death. Left to rot back into the soil, put in the compost, made into 'teas' to use as liquid fertiliser, or as powders and sprays to fend off pests and diseases, they can continue to be of use to your

garden. Comfrey, yarrow and tansy are excellent additions to your compost. Pyrethrum, horsetail and seaweed make useful sprays.

Friends take turns

Crop rotation is companion planting over a number of seasons. Planting the same plant family year after year in the same spot will drain the soil of the nutrients that plant uses, leaving you with ever poorer growth and soil gasping for nourishment. Brenda Little's system, from *Companion Planting in Australia* (an excellent book which I would *highly* recommend: see reference list for details), is as good as I've seen. She suggests:

(i) Fertilise the soil with manured compost.

(ii) Plant heavy feeders, such as cabbage, cauliflower, celery, leeks, sweet corn, squash, cucumbers, spinach, lettuce and endive.

(iii) The following year, use the space for beans or peas, to put nitrogen back into the soil.

(iv) The third year, plant light feeders, such as carrots, beetroot, radishes, parsnips or turnips.

(v) Start the process all over again.

Other tips

• Don't plant together plants that need hugely different amounts of water or food (unless one supplies what the other needs, of course). You will end up over-watering or feeding one and under-supplying the other.

• Don't try too hard. Grow plants that suit your area and conditions, at a time of year that suits them.

• Talk to other gardeners, particularly ones in your area. Learn from others' experience—then pass it on!

• Look at the possibility of animal companions. Frogs, ducks and geese eat many types of pests, and provide manure, to boot. Attracting birds to your garden with appropriate bushes and trees can also keep pests down – just prepare to protect your fruit.

Some people say that companion planting is unscientific – all old-wives' tales and wishful thinking. It's true that not all combinations are easily explicable, but if they work, who cares? And it's free! You can't say that about a lot of other plant-helpers. Start with the principles and examples given here, and experiment. There are many more good combinations than bad ones. You have nothing to lose, and a healthy, productive garden to gain. Happy combining!

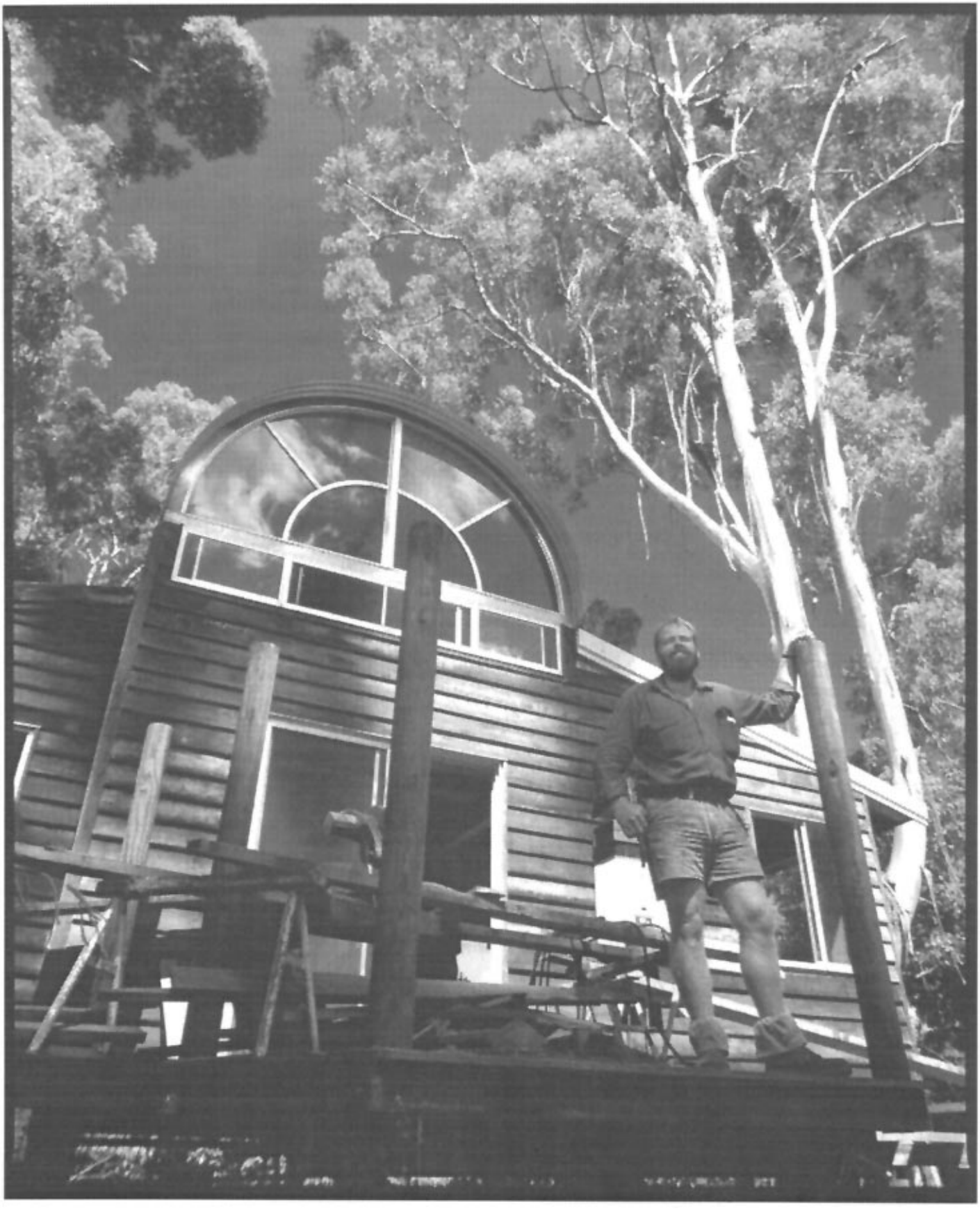
Resources

Companion Planting in Australia
Brenda Little, Reed Books, Chatswood, 1989. (Highly recommended)

Natural Gardening and Farming in Australia
Jeffrey Hodges, Viking O'Neill (Penguin), Ringwood, 1991

Yates Green Guide to Gardening
Allen Gilbert, Angus and Robertson (Harper Collins), 1991

A very useful **companion planting wall chart** is available from Perennial Products, PO Box 439, Lismore, NSW 2480



Kim Best stands proud in front of his new home at Adjinbilly eco-resort. Photo: Mike Larder

Great escape

When Kim Best bought 76 acres of rainforest in southern Queensland, he planned to use it as an escape from the city. Thirteen years later he has built a low energy resort with electricity generated from a nearby creek, and a three-legged dog to watch over the guests. MIKE LARDER pays him a visit.

A resort without telephones... unbelievable! A resort with out television...unendurable? A resort without room service, five-star restaurant, heated pool and valet parking...simply unthinkable!

Such a place exists, and it's in the middle of paradise. High in mountainous Condamine Gorge and adjacent to Blackfellows Knob National Park, just two and a half hours south west of Brisbane, Adjinbilly is a spectacular rainforest gorge jammed between towering volcanic plugs, sheer escarpments and majestic forests. Its babbling creek, home to shy platypus, yabbies and portly tadpoles, contributes to the headwater of the Condamine River system. But you won't find it on any map; Adjinbilly Resort has only recently been officially named by its owner, developer and caretaker, Kim Best.

Kim greets us as we arrive at Queensland's newest eco-resort. 'Ah, guests', he booms as he emerges from the thick bush, brushcutter in hand. 'Just clearing a way in', he bellows by way of greeting and explanation. 'I'll just get the Bobcat and you can follow me down to Mavis. I've got to do some track widening down there. Never waste a trip I say.'

Kim leaps energetically aboard the battered yellow mini excavator and roars off down the hill. We pant along behind to catch up. Our bearded and camouflaged host, dressed in green fatigues and covered with a fine layer of dust, is waiting for us near a little sign stuck in the rocks which reads 'Mavis'.

He applies a bone crushing handshake. 'Nice to see you', he enthuses and heads off down a gravel track. 'Watch out for the stinging trees', he warns over his shoulder and vanishes into the gloom of the canopy. Close by his heels hops the other half of the welcoming committee – Rocky, a three-legged kelpie of advanced age.

We'd found the enticing Adjinbilly brochure at the Warwick Tourist Cen-

Adjinbilly is a great place to put your feet up.

The power system

• Rainbow Power 110 Volt DC micro-hydro. Water is fed to the turbine via a 3 inch pvc pipe with an 80 metre head from the creek.

• A down converter converts 110V from the Micro Grid to 12V to feed the batteries.

• The units are equipped with Vogue Sierra wood stoves (the temperature can get down to zero at Adjinbilly).

• Refridgerators are LPG Electrolux units

• The main power supply to the house is converted to 240V through a Selectronics InverterPower inverter.

• Power for computers and fax machine in the house is provided by a Rainbow Sine inverter.

tre. 'I don't know much about it dear', confessed the volunteer at the help desk, 'But I'm told it's very different'. Thus semi-reassured we set off towards the mountainous Queensland-New South Wales border township of Killarney.

The brochure advised us to head towards the hills tracking alongside the Condamine for twelve kilometres, following the signs nailed to trees and fence posts. A four-wheel-drive, while not being a necessity to gain access to Adjinbilly, is pretty useful. Reaching your destination requires crossing the infant, shallow and rocky Condamine eleven times. If you don't have a four wheeler you can park at a nearby farm and wait for Kim and Rocky to collect you in an ageing International truck.

Our cabin was christened Mavis. 'She was my Aunty and my godmother', explained Kim, lighting the gas hot water system and pre-empting the obvious question. 'She was a lovely woman – never had a bad word for anyone. The other two cottages are Ruby and Bert. Ruby and Mavis were sisters and Bert was a half brother. They're all dead now. Wonderful, wonderful people', he sighs wistfully.

So this was the extent of the resort: three pole-house cabins hidden away from each other in spectacular and towering rainforest. Kim is also building a slightly larger timber pole house further up the gorge for himself.

Mavis, Ruby and Bert have been re-born in a most unlikely way. The architectural reincarnates of Kim's deceased relatives are totally self sufficient. The whole complex is powered by its own unique hydro-electric system called a micro-hydro, and the power is distributed through a Micro-Grid. Each cottage is battery powered and recharged from an endless and free source of hydro energy supplied by Adjinbilly Creek. There is a small water fall and swimming hole right below the cottages. 'That's what Adjinbilly means', explained Kim, 'it's Aboriginal for creek with permanent water'.

Next we were invited to inspect the toilet and bathroom. The compact bathroom boasts a shower, bath and wash basin complete with natty gold fixtures and, taking pride of place, an odourless composting toilet. 'Make sure your kids don't fall down it', warns Kim cheerfully, 'they really pong when we fish 'em out'.

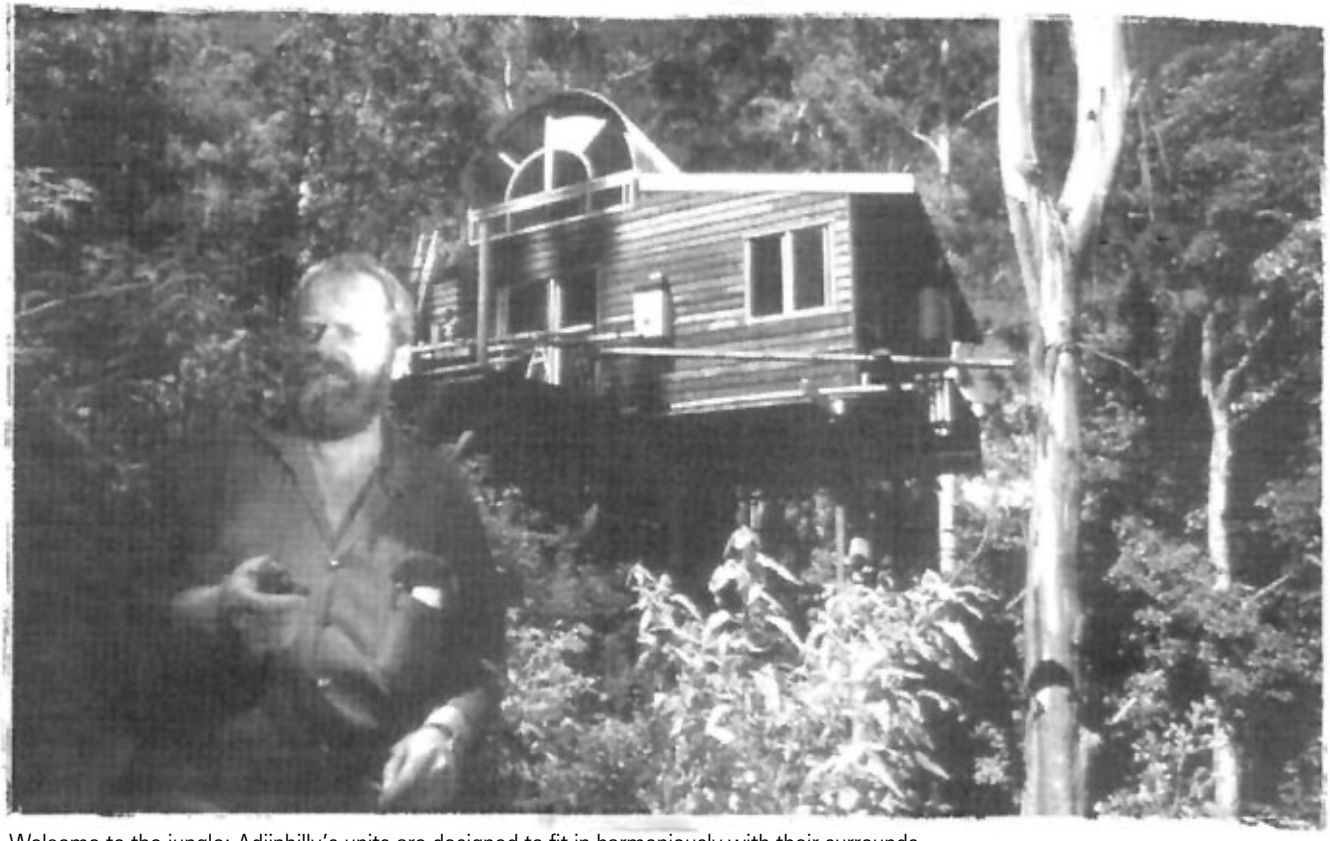
The two-year-old wooden cabins were architecturally designed and feature basic but modern facilities. A gas stove, small gas fridge and a wood-burning heater cover the major energy requirements. Sparkling cool rainwater flows from a brass tap connected to a tank outside, and creek water is piped into the sink and bathroom.

It's all very cosy, but you gradually become aware that something is missing. Power points! A diagram, pinned to the wall, explains how the place runs on twelve volt power. Lighting is provided by miniature fluorescent tubes.

We are invited to see the generator that whirrs away silently somewhere below us. Eighty metres up the valley a pipe siphons water from the creek, which picks up speed as it flows down to spin a Pelton wheel turbine, which produces 110 volts DC via a small dynamo. The power is then fed into a converter which in turn trickle charges the deep-cycle battery fitted beneath each unit. 'It's so simple and maintenance free, and above all cheap', enthuses Best. The system was designed and installed by Nimbin's Rainbow Power Company.

'I've always loved the bush', reveals Kim, as he settles his bulky frame into a plastic chair on Mavis's balcony. Kim has allowed us to settle in and has now arrived for a beer and a chat. His three-legged mate had joined us earlier and made himself comfortable in a cardboard box used for firewood. He stayed with us for the rest of our visit. 'He likes to make you feel at home', explains Kim.

Kim, originally from New Zealand, is a licensed builder by trade. He bought the 76 acres of rainforest thirteen years ago, 'Because I loved it and just wanted to live here. It's just



Welcome to the jungle: Adjinbilly's units are designed to fit in harmoniously with their surrounds.

me', he says. 'People told me that I was mad and that I'd paid too much for a "scruffy" bit of bush up a steep valley'.

He used the place for weekend escapes; a place to go and think. 'I sat up here for years wondering what to do with the place', he explains, 'and then my situation in Brisbane changed so I moved here for two years and lived in a caravan – just to think about it. I needed an income and a lifestyle so I decided to build an eco-resort. It seemed the perfect way of combining both'.

'I've put my life savings into this place...and some of Westpac's, he grins. He has permission to build seven more cabins. 'The rainforest retreat is only the means to an end. It will provide an income which will enable me to get on with my little dream.'

Kim's 'little dream' is to provide a place of learning. 'That's why I called the place the Adjinbilly Environment Centre. I'm going to build a barracks-cum-conference centre to accommodate 50 people. A place for kids, disabled especially, to come and learn how to enjoy the natural elements. I've got this thing about kids; they are our future'.

Kim begins to warm to his subject, lurches forward suddenly and thumps the table, upsetting a mug of tea, 'I want kids to be able to see what's possible and what's left and what you can create while causing minimal damage to their environment. Just five kilometres from here they're chopping down pristine old growth forest right next to national parks'. As we speak we can hear the distant muffled boom of explosives. 'That's them stump blowing', he thunders, becoming even more agitated. 'That's what I mean. I want people to come here and experience a little natural beauty while there is still some left'.

The evening is closing in. The lash-like call of the eastern whipbird and the enchanting tinkle of the bellbird intermingle with the screeching king parrots and black-faced monarchs. Below our deck on the forest floor a scrub turkey is industriously creating a nest. A crash in the canopy above announces the arrival of the possums. The volume of Kim's bullhorn-like voice is now reduced to a stage whisper as he cocks his ear in the direction of the forest and listens intently. 'Golden whistler', he says at length, leaning back satisfied.

As night falls, innumerable frogs begin their throat-clearing process and before long we are being serenaded by bree-breeps, croaks, and creaks... throaty, rhythmic and hypnotic.

Kim stumps off to his old caravan, leaving Rocky curled up in the wood box to keep watch over us. 'See you tomorrow', he shouts over his broad shoulder. We retire up the ladder to the loft and gradually nod off, occasionally being startled by a crash on the tin roof as another possum makes a noisy landing. I bid Mavis good night and feel sure that she is resting in peace. ✶

Rethinking home energy efficiency

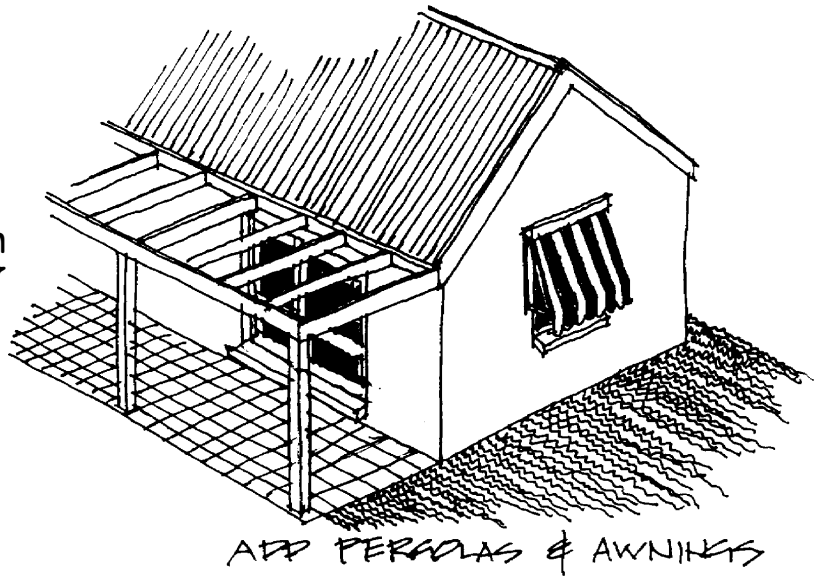
Is your house an oven in summer and a fridge in winter? **TREVOR SCOTT** shows that it isn't necessary to build from scratch to have an energy-efficient home.

Sun control

Eaves and pergolas are the best way to control hot summer sun to the north. If you have east and west openings they are best protected by vertical shutters or awnings.

Use shading devices such as screens and pergolas for control of the sun's rays.

These structures can easily be added on to existing facades and will complement the design of the house.

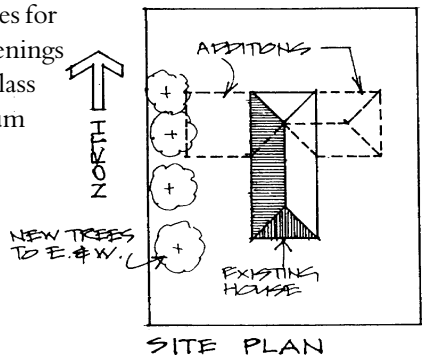


Orientation

Consider the worst possible case where your house happens to be rectangular and has its long axis aligned north-south.

Optimum shaping, siting and facing of the building in relation to north sun.

The addition of wings to the east and/or west will increase the length of the north facing wall, giving you opportunities for creating openings and using glass for maximum solar gain.



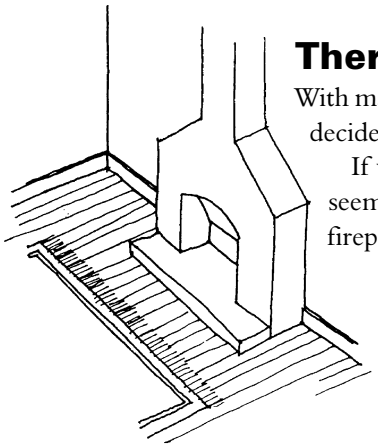
SITE PLAN

Climate & landscape

Strategic planting of trees and placing of earth berms or banks can deflect or channel breezes for summer cooling or winter calming. If your house is on a bush block and suffers from lack of solar gain in winter it may be that there are large trees within six to nine metres of the house and some of these may need to be removed.

Use earth berms, planting and landscaping in conjunction with the climate to provide additional shade, shelter and insulation.

Remember that if deciduous trees and vines are planted near houses or on pergolas, they will admit all the sun's rays in the winter and provide much-needed leafy shade in the summer time.



ADD A BRICK OR STONE FIREPLACE & WALL

Thermal mass

With many existing houses it may not be so easy to add thermal mass, but if you decide to you will find it most cost effective.

If your weatherboard house is heated by a gas wall furnace and the heat seems to go nowhere, try removing it and building it into a brick or stone fireplace.

Use heavy materials such as brick or stone that can store heat.

Not only will the brick or stone store excess heat for dissipation at night, but also the empty fireplace will slow the 'heating up' of your living room in the summer. For wood-burning heaters, don't forget you need to install a damper or closer to stop summer heat gain by admission of hot air.

Insulation

If you have large expanses of glass that you've put in especially for solar heat gain in the winter time, you do need to install heavy drapes and pelmets to prevent overnight heat losses.

Curtains are the simplest form of insulation and glass, which freely transmits heat and cold, needs it most of all.

Insulate all building elements to minimise winter heat losses and summer heat gains.

Many timber-framed houses built prior to 1960 did not have insulation in their ceilings or walls. Today, 'blown-in' bulk insulation in the ceiling space is relatively inexpensive and most effective in preventing heat losses and gains.

Because these houses usually only have one row of nogs (or horizontal legs) in their wall frames, it is not too difficult to blow in insulation to wall cavities. There is also a concertina type of foil sarking now available which can be fixed by staple gun to the underside of floor joists. This effectively seals off existing rooms. While we are talking of sealing off spaces, don't forget to close off gaps around windows and doors and remove or close off existing wall vents. All these things can greatly affect the thermal performance of your house.

Glass

Glass is often one of the most obvious areas to tackle. If your house is overheating in summer and you're about to go out and buy that noisy evaporative cooler, stop! Before you do, check to see how much glass you have facing east or west. It may be much cheaper to remove windows and glazed doors from these walls and install them in the north wall.

Use maximum glass on north walls.

If you have a view to the west or the south, consider installing double glazing. It will allow you to experience the view night and day, without closing off the windows with heavy drapes.

Planning & zoning

Often you will find that you own a house where the lounge has been designed to face the street, and its on the south side. 'It's OK in the summer', I hear you say, 'but it's like an icebox in the winter'. Well, it may not be too expensive to modify a bedroom on the north side and swap it for the lounge. In the same way you can regroup service areas such as bathrooms and laundries, and locate them to south, east or west. These service rooms make good buffers to intense east and west sun in summer.

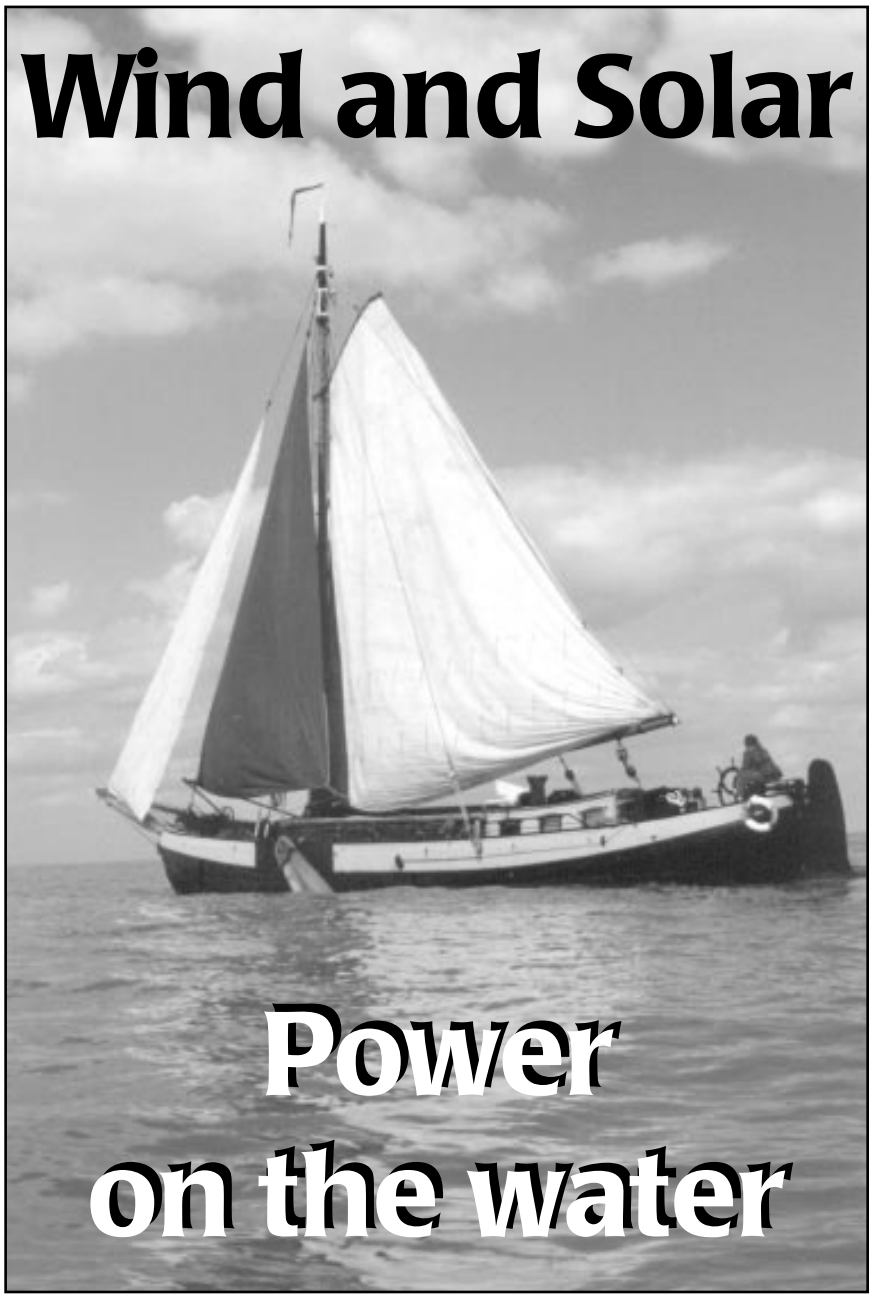
Group together all living areas and locate them on the north side.

Don't forget that air locks in the form of entry halls can prevent winter heat losses and summer heat gains. Also if you enclose an existing stair well and your living areas are downstairs, you'll get a lot more benefit from your heater.

Finally, remember that solar hot water services, low energy light bulbs, and appliances with low-energy ratings all can be installed in or on your existing house. Although initially costing more to install than conventional alternatives, the energy savings eventually do overcome the high costs.

• Trevor Scott is an architect based in Castlemaine in Victoria. He specialises in passive solar and energy efficient design. Ph: (054) 723 377.

Wind and Solar



Power on the water

Gebroeders is a home under sail for Martin and Ali (photo prior to the installation of PV modules).

Gebroeders is 117 years old, yet was built with renewable energy firmly in mind. What could be more renewable than using the wind to propel her iron frame to deliver her cargoes. Long since out of commercial service, Gebroeders is now home to **Martin Cotterell** and **Ali Ross**, moored in a small tidal estuary in southeast England.

Over the years the energy used to power Gebroeders became less renewable with the addition of an engine and electrical system. I like to think that I am now reversing that process. Rather than using dirty diesel I sail her whenever I can, and Gebroeders' rigging is now also capturing the wind to generate electricity.

Wind on the water

Part of my desire to live afloat was driven by the potential to be independent of the grid. Within a week or so of buying the boat I was installing my Ampair wind generator. I wanted it to be high, but did not want to mount it on the beautifully varnished mast and clearly it had to be out of the way of the sails.

The solution I adopted was to hoist the generator up the forestay. This meant that it has to come down every time I sail, but that seemed the best solution. I spliced three rope stops which are attached to bolts on the Ampair. These are hung from the forestay via a galvanized anchor swivel to allow the machine to yaw. A short section of pole beneath the generator is secured to three guys.

Raising and lowering the machine is easy – I simply clip it onto the foresail sheet and pull until the three guy ropes become taut, holding the generator firmly in place and away from the mast and any ropes. This has proven to be a very reliable system and has survived many a gale.

A splash of solar

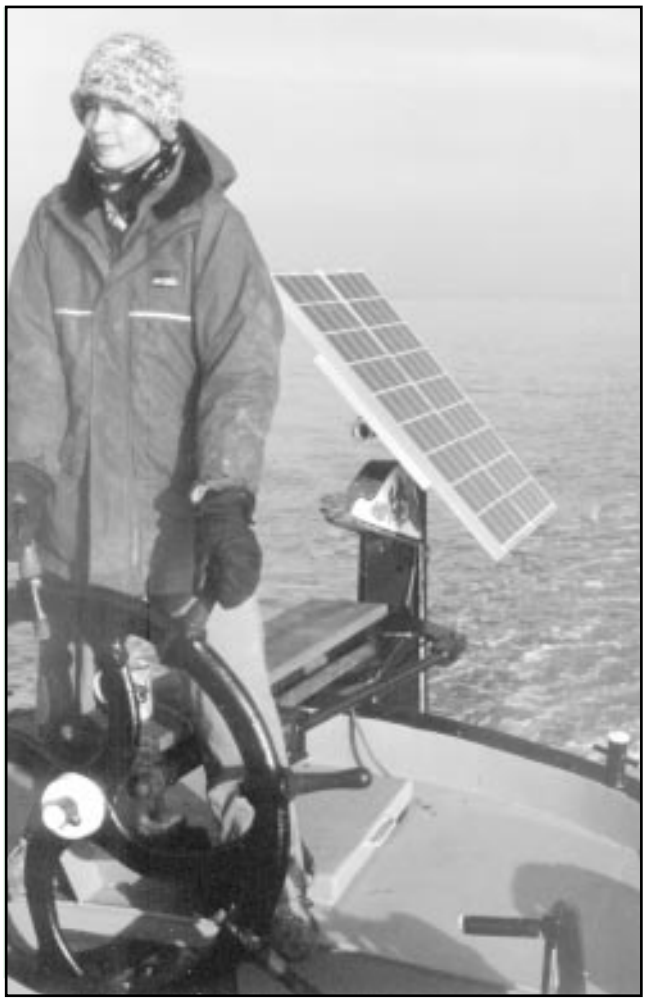
With the introduction of a new source of power, a few horrors of her previous modernization began to emerge. Lights dimmed and flickered as I turned on appliances. Although I found cables to be comfortingly thick throughout most of the boat, these were bridged by small sections of thin

cable with alarming twisted-wire junctions. Lurking in the depths of the bilge, hidden by insulation tape, I found an appalling junction of thin wire coming from the batteries. This turned out to be the battery connection for most of the boat's wiring. Over time, I have had to rewire most of the boat.

I survived for a while with just my Ampair, but electricity demand soon drove me to buy a solar panel. The electrical installation was straight-forward but again mounting was awkward. Although there is plenty of space on the boat, when she is sailing most parts are crossed by flying sails, ropes and shackles, or shaded by the rigging. I tried simply laying the panel on the deck, moving it out of the way when sailing, as I did with the wind genny. However, I soon abandoned this plan when I nearly lost it overboard at sea.

There were three problems to overcome in positioning the solar panel. The first was shading caused by so much mast and rigging towering over the boat. The second was the need to protect the panel from moving sails and ropes

Martin hoists the Ampair into position.

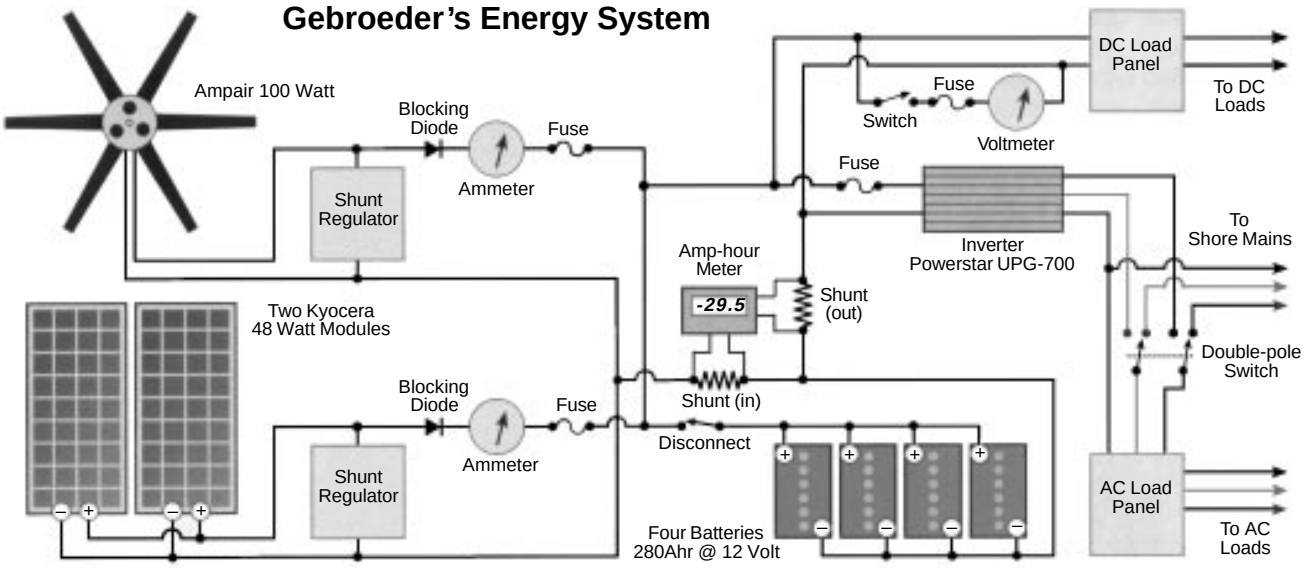


Ali at the wheel of Gebroeders.

when sailing. The third was how to maintain the aesthetics of a beautiful and historic boat. The answer I came up with was to mount the panel on a pole attached to the rudder. This position does not detract too much from the appearance of the boat and is well out of the way of ropes and rigging. It also has the added benefit that by turning the wheel I can manually track the sun, although this is not recommended practice while out sailing!

I have found that the combination of the Ampair and now two solar panels generates all the power that I need. For storage, I started off with some second-hand telephone exchange gel-cell batteries but eventually had to give up on them as the lights began to pulse in brightness with the wind. I now have four 70 amp-hour wet-cell lead acids.

I had previously avoided wet cells as the thought of acid leaking out when the boat pitched and eating away at the hull was unattractive, to say the least. However, a good battery box, safely secured, has alleviated these fears.



This is the wiring diagram of the power system used in the boat. As you can see, it is quite extensive, and would be quite adequate to run a small house!

I still have not fully secured all items in the boat, and the fridge is wont to wonder across the kitchen on occasion. But then, work on a boat is never done.

I use a voltmeter, homebrew amp-hour meter, and a couple of ammeters to monitor the system. The ammeter for the wind generator has a dual function – if the generator is putting out ten amperes then it is not a day for sailing and I think twice about going out! The amp-hour meter was built from a Home Power Magazine circuit.

The electrical load on the boat consists mostly of lighting and the water pump. A Powerstar 700 watt inverter is used to run various 240vac loads, including my computer and TV. It also powers my old valve amplifier for the stereo. I know that valves are hopelessly inefficient but I wouldn't change it for the world. I would rather switch off some lights.

Living off the grid and away from normal services, even if they are just up the creek, feels good, as I'm sure every remote boat or cabin dweller knows. I could have chosen to plug into the mains onshore but I am happy with the knowledge that all that ties me to the shore is a couple of knots.☼

Author: Martin Cotterell, Sunpower, c/o Mill Cottage, Seisdon Road, Trysull, UK, WV5 7JF.

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Home Power can be contacted at:PO Box 520, Ashland OR 97520, USA, email:hp@homepower.org

The Kyocera modules are mounted on the rudder post, keeping them out of the way of lines and activity on deck.

The Ampair hoisted into position hangs from the foresail sheet in the triangle between the mast and the forestay.

Power cycling

Every year, more bicycles are sold in Australia than cars, yet few are used for general commuting. **PENNY SIMSEN** looks at what might prove the most effective tool for getting more bums on saddles – the electric bicycle.

If you're tired of being squashed like a sardine on public transport in the morning, or risking the perils of pushy motorists on inner-city streets … there is a better way to get around. By bike – and you don't even have to raise a sweat!

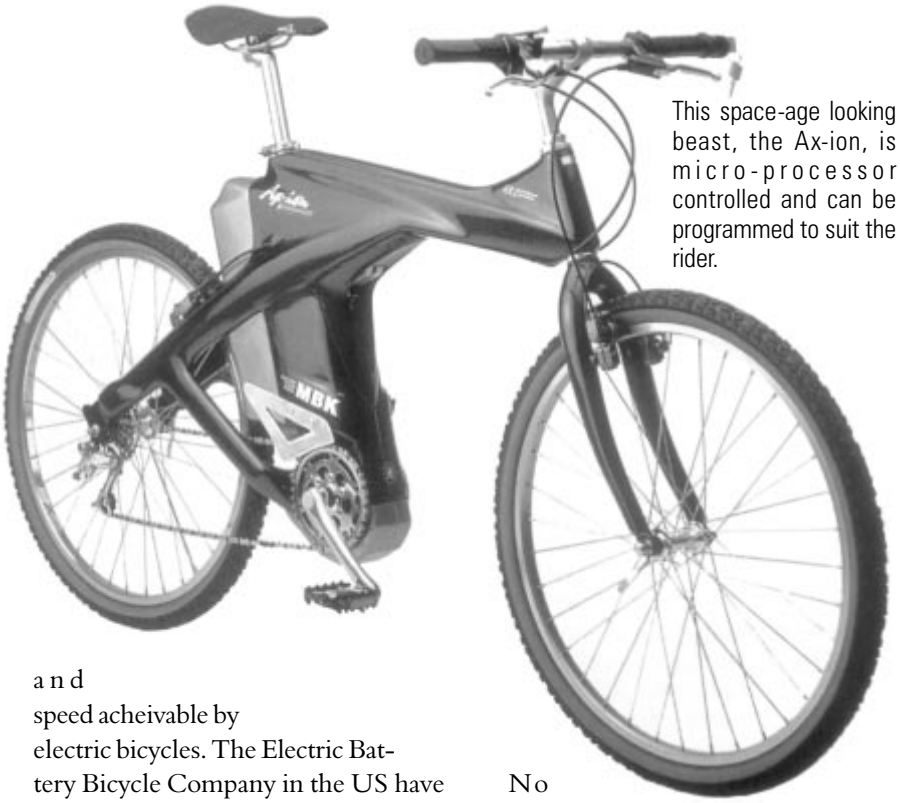
The electric powered bicycle is the perfect vehicle for short around town trips. They are easy to use, cost very little to run and are most enjoyable.

Unlike other electric vehicles (EVs) the electric bicycle is not beyond the means of everyday people like you and me. Prices range from $320 for a kit that fits most existing bikes, up to $3000 for the deluxe, no accessory spared, heaps of gadgets, EV Warrior.

Electric-powered bicycles can be divided into two categories; fully powered and power-assisted, also known as hybrids. For most people, hybrids are the preferred option, as the rider can add power to increase the distance they can travel.

The first electric bicycle was patented in 1895. Unfortunately it has taken a hundred years for the idea to start catching on. The abundance of fossil fuels has retarded the development of alternative transport, and until recently the batteries required to power an electric bicycle have been too cumbersome and heavy for a commercially viable product.

New battery technologies are certain to see further advances in the distance and speed acheivable by electric bicycles. The Electric Battery Bicycle Company in the US have been testing the nickel-metal-hydride (NMH) battery with encouraging results. The NMH battery was found to at least double the travelling distance of one bicycle when compared to a lead-acid battery of equivalent weight. Research is also being conducted by Acme Electric Corporation and Battery Automated Technology (BAT) International into fibre-nickel-cadmium (FNC) batteries. Acme expects a battery of this type to be ready by the end of this year. (See page 60: *What's new in batteries* for more details)



This space-age looking beast, the Ax-ion, is micro-processor controlled and can be programmed to suit the rider.

Photo courtesy of Bike Culture Quarterly magazine, York UK

No licence is required to operate an electric bicycle in Australia, provided state regulations are observed regarding the legal maximum power capacity of the motor. Victorian State law, for instance, forbids the use of an ancillary power device on a bicycle exceeding 200 watts or 25cc.

How they operate

Electric bicycle motors can run off either direct solar or stored battery power. The motor's motion is then transmitted to the bicycle through a

drive mechanism such as a direct-drive hub motor, belt drive, friction roller or chain drive.

Recharging is usually from mains supply, however more emphasis is being placed on renewable energy resources like solar power. With solar-power bicycle races such as the SunRayce in the USA and the Solar Cycle Challenge here in Australia, more attention is being drawn to solar powered vehicles. Another offshoot of these races is improved technology and better public awareness. The Solar Challenge will start in Darwin on 27 October and finish in Adelaide on 4 November.

Although electric bicycles do not emit localised exhaust fumes, they still cause some pollution. Although most of this pollution occurs in the production process, recharging the batteries from fossil-fuel powered electricity also causes greenhouse gas emissions. Electricity derived from renewable sources would be a more environmentally friendly alternative to recharge battery packs. However, in a direct comparison to small petrol-fuelled combustion engines that can be fitted to bicycles, electric motors are more efficient and less damaging whatever their power source.

Who's riding them

Up until now, electric bicycles have not been widely accepted. While early attempts were clumsy and badly designed, today's versions are greatly improved and are well designed and manufactured. Why then, aren't they more popular?

For the most part, Australians remain unaware that electric-powered bicycles even exist. Even if they were more widely available, they may suffer setbacks as commuter vehicles because of the poor on-road cycling facilities and negligent road planning in most Australian cities.

Photo: Penny Simsen

The EV Warrior: ideal for that morning commute to the office.

Driven via a hub motor, this bike is available through Silicon Technologies Australia.

While more non-motorised bicycles are sold each year in Australia than cars, people often aren't prepared to give up the creature comforts of cars for day-to-day travel.

It takes some time to get used to riding an electric bicycle. There is no noise, and it can be quite unsettling to be travelling with no visable or audible means of propulsion, although travelling in this manner is guaranteed to get you second glances from onlookers.

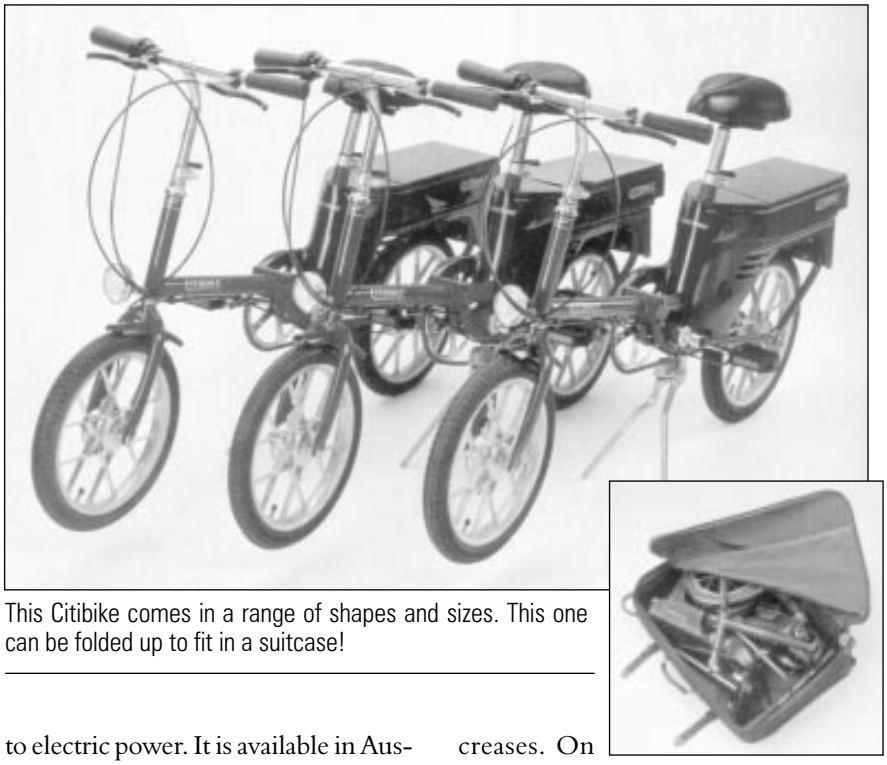
If cycling is not your style, there are also electric-powered motorcycles, scooters and skateboards.

The future

With urban roads becoming more congested every day, alternative transport is a necessity for the future. In time, combustion engines will become extinct in high-density areas to curb pollution. Recent research has found that more people are killed by pollution-related diseases in Sydney each year than die in road accidents. The vast majority of Sydney's air pollution is caused by vehicle emissions. The need for pollution alleviators is very real.

What's on the market?

The Zeta (Zero Emission Transport Accessory) is a rechargeable power pack that can be fitted to virtually any bicycle with tyres from 12-27 inches in diameter. The pack houses a 174 watt electric motor that transfers power by a toothed belt drive on the rear wheel. One 12 volt lead-acid battery provides power for 17-50km, depending on terrain and the amount of pedal power added. Top speed is 22km/h, and the pack weighs 4.5kg. The Zeta is a cheap, lightweight, easily fitted and compact way to convert an existing bicycle



Photos courtesy of Open Road Ltd, York, UK

This Citibike comes in a range of shapes and sizes. This one can be folded up to fit in a suitcase!

to electric power. It is available in Australia and costs AU$320 plus freight.

The CHRONOS Hammer is a uniquely designed kit comprising a battery and motor that drives the rear wheel. The battery fits into a standard cycle water bottle holder. It is designed to supplement pedalling only, not to provide all of the motive power of the bike. The Hammer can provide up to 149 watts to assist the rider and weighs a little over 2kg. It disengages automatically when the rider exceeds 19km/h.

Yamaha and Bridgestone have jointly designed the PAS (Power Assisted System), which incorporates an on-board computer system. A 'torque sensor' measures the rider's pedalling output and the bike's speed. The power required to assist the rider and maintain speed at a predetermined level is calculated and then delivered. The electronic control unit can be programmed to kick in at virtually any speed to suit the rider's ability or changable riding conditions. Assistance from the unit decreases progressively as the speed of the bicycle increases. On hills, the power assistance is proportional to the rider's input.

The PAS has a 245 watt motor connected directly to the crank with a hand-selected three speed integrated gearbox. The system is powered by two 12 volt lead-acid batteries, which take from five to ten hours to recharge from a standard household powerpoint. Top speed of the PAS is 24km/h. The PAS costs ¥134,000, with the battery charger sold separately for ¥15,000.

The Ax-ion is a newer version of Yamaha's PAS. It has a range of 20km (further with pedalling), and replaces the lead-acid battery with a 120 watt-hour nicad.

The Half 3 is a German-made, solar-powered electric four-wheeled cycle. In full sunlight its solar panel creates 180 watts of power that recharges the 36 volt batteries. Top speed is 25km/h and the entire bike weighs 55kg. Power is delivered to the rear wheels via hub motors.

The Citibike, from the UK, comes in a number of different forms, including a fold-up bike, a standard step-through style and an electric trike. There is also a powerkit for retrofitting standard bikes for electric power.

The folding model fits into a suitcase for easy storage and travel on public transport. The step-through model is a 200 watt, chain-driven, electrically assisted cycle powered by one 24 volt lead-acid battery, which gives it a range of up to 38 kilometres, depending on the amount of pedalling done by the rider. The top speed of this bike is about 24km/h, and the battery takes about five hours to recharge. The total weight of the bike is around 29kg,

Pros + Cons

✔ provides exercise and health benefits to the rider
✔ no harmful emissions while riding
✔ less pollution produced than by an equivalent car journey
✔ less perspiration and effort required than conventional cycling
✔ quiet power cycling
✔ assists the mobility of the elderly and disabled – affordable alternative transport
✔ much more economical than a car
✔ faster than a car for most short trips in the city, especially during peak hour

✘ 'unseen' pollution produced by the power plant when producing electricity
✘ batteries add to bike weight considerably
✘ non-hybrid electric bikes are restricted to fairly flat terrain
✘ some roller systems do not perform well in wet or muddy conditions

or 36kg with the optional long-range battery fitted.

Looking like something out of an episode of *Star Trek*, The EV Warrior is the perfect electric bike for people who like gadgets. It is powered by two 450 watt motors and uses a pair of 12 volt lead-acid batteries. The drive unit and batteries are located above the rear wheel in a large 'pod', and recharge time takes from two to five hours. The cycle can travel distances up to 24km, further with pedalling, and can reach speeds of up to 32km/h.

Features of the EV Warrior include flashing indicators, rear-view mirrors, a horn, hazard flashers, hydraulic front disc brakes, and energy use and battery charge gauges. Security devices have also been installed. A retractable combination lock cable is mounted below the seat and an electronic security remote control key disables power to the system.

The EV Warrior is available in a range of colours, like Environ Green, Powerhouse Blue, Corona Yellow, and ChargeUp Purple. The Warrior is available in Australia and costs around $3000.

Another unusual-looking bike, from Silicon Technologies Australia, has a fairly conventional yet old-style frame, with the batteries and controller mounted in a large flat box in the centre of the bike frame.

This bike is also unusual in that it uses a 198 watt hub motor to provide power to the rear wheel, thus eliminating all problems associated with drive chains, friction wheels, and other drive systems. Other features include a 24 volt power system, and a range of up to 40 kilometres with a 60kg rider. The bike comes complete with key operated on-off switch, variable speed control, battery charger and front suspension forks.

This bike costs around $1800, depending on the options required. The hub motor can also be purchased separately in a kit contaning everything required (except batteries) to upgrade an existing bike.

ZAP (Zero Air Pollution) Power Systems manufacture both electric-powered bicycles and power assist kits to fit existing bikes. The mainstay of their range, the ElectriCruiser, retails for US$995. The ZAP power system kit, which weighs about 12.5kg, sells for around US$495. The top speed of either system is around 24km/h.

ZAP incorporates a regenerative system into all its models, enabling the battery to be recharged whilst travelling downhill. A novel accessory is a stand that can be fitted to the bike so that the battery may be recharged while using the bicycle as an exercise bike in the lounge room. Another neat thing about the ZAP regenerative mode is that it can be used to power other appliances in a 12 volt household system.

ZAP also manufactures the PowerTrike 3, a three-wheeled, power-assisted vehicle with a large rear basket, making it ideal for shopping trips.

The Electrobike is a power-assisted bicycle with an easy, quick-change battery pack that can be easily replaced for longer riding times. For example, one fully charged battery at home and one at work would essentially double the distance capacity of the Electrobike. Top speed is 32km/h.

The Zeta can be fitted to almost any bike to provide power assistance.

The battery takes four hours to recharge and consists of two 12 volt lead-acid units. The motor connects directly to the rear wheel and has a peak output of 720 watts. Two models are available, one priced at US$999 while the other costs US$1299.

But wait, there's more!

The models we have looked at here by no means cover every available bike on the market. There are many others, of all shapes, sizes and specifications, available from countries all over the world, including the US, UK, Germany, and Japan.

If, after reading this article, you feel that you must have one, listed below are some of the Australian suppliers of electric bikes and power kits. Happy cycling!☼

Electric bike manufacturers and distributors

Electrobike:	BAT International Inc. 3601 Empire Ave, Burbank CA 91505 USA, ph:+1 818 565 5555, fax:+1 818 565 5559, email:bat565@aol.com
EV Warrior:	Davies Craig P/L, Port Melbourne VIC 3207, ph:(03)9646 3051, fax:(03)9646 2632.
STA:	Silicon Technologies Australia, 11 Aurora Ave, Queanbeyan NSW 2620, ph:(06)299 1592, fax:(06)299 1698.
ZAP:	ZAP Power Systems, 117 Morris St, Sebastopol, CA 95472 USA, fax:+1 707 824 4159.
Zeta:	Powered Cycles P/L, 360 Rokeby Rd, Subiaco WA 6008, ph:(09)380 4332, fax:(09)380 4336.

Recycling the dead

Ian Roddick provides accommodation for hundreds of people who have been, at some stage, a little down on their luck. His places are a melting pot of class, race, religious creed and age, though many of the inhabitants tend to be a little older. The residents never complain, and pretty much keep to themselves. Well, they have to really, because they're all dead.

Ian works at the Faulkner Necropolis, one of Melbourne's largest cemeteries, and one that is destined to run out of space in the coming decades. On the surface it is a mass of concrete, stone, lawn and dying flowers, while underneath it is what some people might think of as a waste of good fertiliser. He is explaining the conservatism that is still attached to funerals – one of the last bastions of strict European tradition left today. With the quirky humour unique to funeral industry workers, he describes a customer relations problem associated with some 'environmentally friendly' landscaping he once supervised at the Coburg cemetery: 'Those who had a tree on their grave and found out about it were horrified. They didn't mind them on someone else's grave, "but not on mine thank-you!"'.

For most of us, the period after our death is not something we invest a lot of thought in, at least not as far as our corporeal bodies go. We might include a line or two in our will about having our ashes scattered on the roses, or put aside some money for a funeral so as not to be a burden to grieving relatives. But the way we are laid to rest could change dramatically in years to come, as cemetery space becomes tighter and every joule of energy use is carefully monitored and taxed.

Today's options

There are two possibilities for laying human corpses to rest in Australia – burial and cremation. For many of us, burial will involve having around three litres of blood and other bodily fluids sucked out and flushed into the sewerage system, while our veins are flooded with twice that amount of embalming fluid, a mix of formaldehyde and other chemicals that will keep us looking good (if a little pale) for years, even decades to come. Our body will then be placed into a casket that is made from timber, coated with varnish, finished with metal fittings and lined with a cushioned velvet or satin interior. We will then be lowered into a hole and covered with a minimum of five feet of earth, to be sealed with either a large block of concrete and a big headstone, or lawn and a small bronze plaque. Finally, we will be mown and weeded until no-one remembers who we were.

If you choose cremation, you may again be embalmed and prepared in the same way as for burial. Your body is placed into a casket, and after any viewing or service, you are rolled into a furnace and burnt away with gas. A small pile of ashes from your body and the casket are collected and sprinkled (at

an EPA approved location) or stored as a memorial.

Last year the Australian funeral industry turned over 125,770 customers, with the division between cremation and burial almost equal. That means that over 60,000 burial sites had to be found, and based on current estimates, existing cemeteries may be full in a few decades. There are few accurate statistics on the total amount of land used for cemeteries in Australia, or indeed for most countries. Ian Roddick conservatively estimates that cemeteries occupy 3,500 acres of land in Victoria. While this is only a small proportion of total land area, Roddick estimates that more land will be needed in about forty years to house Melbourne's dead. There are some futurists who look further down the track, and suggest that whole countries could be covered with cemeteries 500 years from now!

Although gas is the cleanest of the fossil fuels, a fairly large volume is required to cremate one person inside a coffin, and with over 60,000 cremations a year, the total amount of gas used would fuel a lot of barbecues. And while emissions from crematoriums are a drop in the ocean when compared with other industries, the issue of airborne mercury from fillings in dead people's teeth has been raised in the US, with one environmental group estimating that 1.5 to 2 tons of mercury are released into the atmosphere each year in mostly heavily populated areas.

According to Aaron Smith from the Australian Cemeteries and Crematoria Association, one of the biggest emission problems is caused by people including potentially toxic materials in coffins, such as when a deceased surfer is cremated in their wet-suit. Surfers also present a problem when they request to be cremated with their surfboards, not only in finding a large enough casket, but also in the synthetic materials contained in their boards. Fortunately the industry is addressing these problems, and is currently finalising a code of practice on contents of coffins.

one of the biggest crematoria emission problems is caused by people including potentially toxic materials in coffins, such as when a deceased surfer is cremated in their wet-suit

While it is not compulsory to be buried in a casket, Aaron Smith estimates that less than one percent of people choose to be buried without one, and this is usually associated with Muslim ceremonies. It is difficult to estimate the amount of timber used each year for burials and cremations, and the timbers used vary enormously in thickness and type. Pine and particle board are most common, but there are also a number of very expensive imported timbers used, and there are even extra well-sealed variations for people who have phobias about being eaten by worms. People also bury a huge amount of valuables with their loved ones, and as Aaron Smith explains, 'Image would drive a lot of inefficient resource usage. Many people buy new suits for deceased family and friends because of public viewing'. It seems that keeping up with the Jones's knows no limits.

Alternative deathstyles

In England it is possible to do away with all the excesses of the modern funeral and be wrapped in a natural fabric shroud for burial on private farmland, or on one of sixteen natural reserve cemeteries. On the natural reserves trees replace headstones, and the bleak grey forest of modern cemeteries is replaced with a living green one that can be used as a timber resource in the future.

photo: Michael Linke

In China, where the government is renowned for its pragmatic population management policies, around as many people die each year as there are people living in Australia. A decree announced this year bans all burials on any land that can be used for farming, in an attempt to preserve increasingly scarce arable land. All cemeteries must now be located on barren, rocky and unproductive land.

While the land area used in Australia for cemetaries is a relatively small proportion of total land mass, it is quite energy intensive. The concrete and stone monuments, excavations, lawn mowing, weed control and general maintenance absorb a lot of resources, energy and money, not to mention the energy and pollution embodied in the huge quantities of flowers left at graves each year.

Paul Downey, a representative of Hickey and Co., a large embalming company, estimates that around 30 percent of people who die in Australia are embalmed. On this basis, over 100,000 litres of blood is drained from corpses each year, and all of it winds up in sewers. In cases where sewerage is pumped directly into the ocean, as is the practice around Sydney, this blood represents an additional health threat to people who venture into the surf. While AIDS is probably not resilient enough to survive long in the ocean, it is less certain that potential killers like hepatitis would be killed by salty water.

There have been concerns raised about another health aspect of embalming. The formaldehyde solutions themselves are a potential health threat to funeral industry workers, and can cause asthmatic reactions, and soft tissue irritation if not monitored closely. Formaldehyde concentrations in ground-water around cemeteries are also of concern, as it can take decades for the chemical to begin decaying. Research by the Hydro-geological Department at Sydney University found that while embalming chemicals were detectable at short distance from graves for a short period after burial, there was no evidence of ground-water contamination.

Fortunately embalming is not compulsory under most circumstances, though if a body is to be displayed as part of a service several weeks after death it is a necessity. In some states it is also compulsory to be embalmed if the body is to be buried above ground in a crypt or mausoleum, and if a corpse is to travel by air it must also be embalmed (there have been cases where blood leaking from a casket has corroded the structural aluminium of aircraft).

In Australia, the Crown owns the land that cemeteries are located on, and either the 'tenant', their family or friends pay from around $1200 for the right to be buried on a standard plot. In most Australian states this is a permanent arrangement, though in the ACT there is currently a limited tenure on grave sites of 25 years. The Victorian government is also considering limited tenure, where surviving friends and family are offered the option of renewing the deceased's sole tenancy on the site. If the tenure is not renewed, a new burial can occur on the site.

There are also alternatives to conventional coffins, though these are not yet popular or legal in Australia. One is to be wrapped in a simple cloth shroud and placed directly into the ground. This option is legal, and has been used in Muslim and other religious burial rituals for centuries, although the deceased must be carried to the cemetery in a health department-approved casket. Another is an Australian invention, the reinforced cardboard coffin, which is made entirely from easily biodegradable recycled newspapers. Unfortunately there are two obstacles in the way of this coffin being used for funerals. One is EPA approval – currently all caskets must be made from timber. The other is a pending patent on the coffin, which means the casket manufacturer in control of it is currently keeping it under wraps.

While there is nothing stopping someone being buried standing upright (to minimise land space occupied), without a coffin and directly under a tree in most regular cemeteries, the idea has not been popular at all in Australia. In response to the idea of a woodland cemetery in Australia, Ian Roddick is convinced that the public is too conservative to accept the idea, 'I am absolutely convinced that most people wouldn't like it'.

Perhaps the whole issue is best summed up by Eric Dando in his novel, *Snail*: 'it's just a waste of good blood and bone. imagine being planted under an apple tree – the mourning family and friends could go and water you, eat their lunch under you. little birdies could build their nests in your branches. instead of flowers, mourners could bring bags of cow shit and little weeding trowels. graveyards would become something to be lost in'. The idea of attaching loved ones' spirits to trees might seem a little strange, but then again, is it much stranger than attaching it to an urn or a brass plaque in the ground?

- Michael Linke

ATA eco-friendly Christmas gifts

Herbal Soap Making Kit

Making your own pure soap bars is not only good for your skin but is great fun for people of all ages. The soaps made from this kit are vegetable based and can be customised to treat specific skin types by adding different herbs and essential oils. They also make great gifts, and can be shaped by hand or with a pastry cutter.

The Herbal Soap Making Kit contains a soap powder that is totally free of animal products, perfumes or dyes. This is an ecologically sound product that will break down quickly without causing environmental damage.

Price: $29.95

Lavender Soap Bars & Fragrant Pouch

These soap bars are made with palm and coconut oils and are free of animal products. They contain lavender flowers and wonderful lavender essential and fragrant oils. Great for all skin types, lavender is a healing herb which gently cleanses and tones the skin.

The lavender pouch can be placed in your lingerie drawer or hung inside the wardrobe to freshen clothes. It can also be slipped inside your pillow-case to promote a peaceful night's sleep.

This gift is beautifully presented in a reusable, hand made wooden box with a sliding lid.

Price: $19.95

Natural Cosmetic Making Kit

Making your own natural cosmetics is lots of fun and doesn't 'cost the Earth'. Learn to make everything from facial masks, toners, cleansers and moisturising creams to body lotions and lip balms. Creating your own cosmetics is great for the skin, makes excellent gifts and is environmentally sound.

This Natural Cosmetic Making Kit contains ingredients that can be bought locally at health food stores or chemists. Most of the recipes in the instruction booklet are as old as the hills and the ingredients have been used for many centuries.

Price: $29.95

For the person who has *almost* everything!

Buy them a **Solar Fan Cap**. Not only is it novel but it's also practical. This popular cap has an amorphous solar panel which drives a fan that will keep those hot heads cool and the flies away. It comes in five colours, dark blue, mid blue, red, yellow, and white, and has an adjustable band.

Price: $20.00

For the office or computer buff

GreenDisks – Now 10 percent more for 10 percent less. These pre-formated IBM disks, as featured in *Soft Technology #54*, are the best quality disk that we've every used. These are a recycled product in an attractive recycled pack, and are ideal for giving to your office mates as an environmentally friendly Christmas gifts or as a stocking stuffer for the home computer buff.

Special Xmas price: $15.50 for a box of 11 disks. (Normally $19.50 for a box of 10 disks)

Keep the car cool with the sun!

Solar Car Fan with battery charger. Use the free energy of the sun to cool your car, not the petrol-hungry air-conditioner, and charge your batteries at the same time. This small but powerful solar powered fan circulates air in your car both while on the road and while parked. This handy little unit also doubles as a battery charger for 2 x AA or 2 x AAA batteries.

Price: $27.00

Teach the kids to care

Air Pollution Testing Kit. Let the kids monitor the state of the planet with this pollution testing kit. Check the amount of oxygen, pollen and pollution in the air.

Price: $12.00

ORDER FORM

Name: .....

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Send this form with cheque/money order to:
Alternative Technology Association,
247 Flinders Lane, Melbourne VIC 3000

☐ **Cheque/money order enclosed, or please charge my:**

☐ **Bankcard** ☐ **Visa** ☐ **Mastercard**

No:| _ _ _ _ | _ _ _ _ | _ _ _ _ | _ _ _ _ |

Signature: ..... Expiry Date:___/___

NB: Overseas credit card orders processed in Australian dollars

Item	Qty	Price	Total
Total			

East meets West

bamboo meets polythene

IAN REILLY has designed a solar food drier with the potential to help prevent huge crop losses in developing countries.

Preserving food by sun drying is a technique thousands of years old and is still widely used all over the world. Sultanas and other fruits are sun-dried in Mildura in northern Victoria; rice is often dried in southeast Asia by spreading it out over a road; and in Zambia, fish are dried on house roofs.

Direct sun drying is popular because it requires very little equipment or capital. However, because the crop is exposed to the weather, it can be contaminated by dust, insects, birds and animals. Sudden rainstorms can damage the crop and large land areas are often required. Some crop can end up over-dried while other parts are under-dried, resulting in decay while in storage.

To overcome these problems mechanical driers can be used to dry food, using fossil fuels as the source of heating. This is an expensive option, uses non-renewable fuel sources, and contributes greenhouse gases to the atmosphere.

Enclosed solar-driers, on the other hand, still use the energy of the sun, but dry the crop faster than conventional sun-drying and protect it from contamination and damage by rain. Solar-driers basically consist of a solar collector which heats air and passes it to an enclosed structure containing the crop. The heated air dries the crop and the structure protects it from contamination and damage. Sometimes the drier is simplified by combining the collector and the enclosure to form a box with a glass lid or a polythene sheet tent. More complex driers can consist of a large building with a set of solar collectors.

Solar driers have been successfully used for drying cashew-fruit in Honduras, desiccated coconut in Bangla-

Over 50 kilograms of chillies were dried in the process of developing the drier, and tests included measuring the core temperature of the drying chillies on various trays.

desh, and rice in Thailand. Although solar dryers are almost always technically superior to sun drying (they dry food faster than traditional drying and the quality of the food is better), solar drying has not taken off on a large scale in most parts of the world. Solar driers are found in universities and research institutions, but rarely in a village or farm in a developing country.

There are two major reasons why driers have not gained acceptance. Firstly, driers have been too complicated to build and use and too expensive for poor farmers. Secondly, solar driers have been developed to solve a technical problem without considering the wide social, cultural and economic factors involved.

A new design

To try and promote solar drying in developing countries, I recently developed a solar-drier design as part of a Master of Engineering Science at the International Development Technologies Centre, part of Melbourne University's Engineering Faculty. Over the years appropriate technologists have suggested using and improving traditional technology as a means of making technological improvements acceptable and appropriate.

I designed a drier with traditional woven bamboo trays used to sun-dry vegetables in southeast Asia. Six woven trays were imported from Indonesia; I designed the drier to hold five trays and used the other tray to compare the drier with sun drying by the traditional method. The drier was also made very cheaply and simply using materials and tools which would be available to poorer farmers in a village in South East Asia. The most expensive item was the UV stabilised polythene used to form the enclosure, but the remainder of the drier could be built using rough cut timber, scrap metal and cane or bamboo.

The fully assembled drier stands over six feet tall, and is capable of drying several kilograms of food at a time. Ian's drier is currently on display at the University of Melbourne International Development Technologies Centre.

I then tested the drier by drying chillies during late spring and early summer in Melbourne. To compare to sun drying I dried a tray of chillies by the traditional method alongside. Altogether I dried about 50 kilograms of chillies.

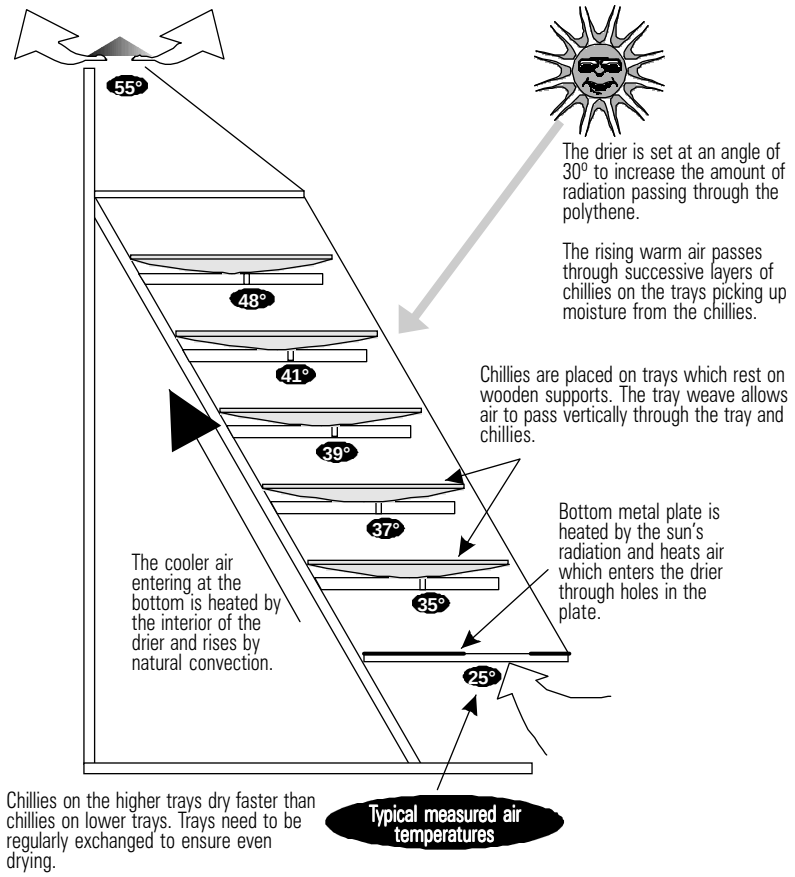
How the drier performed

It was encouraging to see that the drier dried the chillies 30 to 40 percent faster than the traditional method. Twice the amount of crop could be dried for the same amount of land area occupied, and the quality of the chillies was also much better from the drier. They were a better colour, had a lower and more uniform moisture content, and were not contaminated with twigs, leaves, or animal matter. Finally, even though there were many wet, windy and rainy days, the drier kept the crop dry while the traditionally dried chillies often had to be rescued from the rain and sometimes got wet.

How the drier works

The operation of this solar drier is very simple. Solar radiation enters the drier through the polythene cover, heating the crop and the interior of the drier. The drier behaves like a greenhouse so the inside of the drier can become very hot, particularly at the top. Cooler air enters the drier though holes in the bottom metal plate and is heated by the plate and the inside of the drier. The heated air rises up though the layers of crop until it emerges through the outlet at the top of the drier. As air is heated, the relative humidity of the air decreases, and its ability to absorb moisture increases.

The air rising through the drier absorbs moisture from the chillies until it leaves through the top of the drier as warm moist air. As you can see from the diagram, the temperatures in the drier can be quite a bit higher than the outside air temperature. The chillies dry faster than with exposed sun-drying because the chillies in the drier are consistently warmer and drier. It is also hotter as the air moves up the drier so chillies at the top of the drier dry much faster than those at the bottom.



How the solar drier works

The future

Building and testing this drier has shown that a simple drier can be built around traditional woven bamboo drying trays. The next step will be to trial the drier in a South East Asian country and determine the response from subsistence farmers. The drier would then be able to be further developed with the cooperation of the farmers, and take into account crucial social and economic effects. Only if farmers are enthusiastic about the drier will it be promoted by them and become widely used.

Why dry?

The world population is increasing at an alarming rate and is expected to reach six billion by the year 2000. To feed this number of people will require an increase in available food, but much of the population increase will occur in developing countries where land and water resources are often already stretched to the limit. One way of making more food available without planting more crops or using any more land is to reduce the amount of losses which occur after the food is harvested.

It is alarming to find out just how much harvested food is lost each year. For example, it has been estimated that in Nigeria up to 30 percent of total grain produced can be lost due to inadequate drying and storage facilities. The Food and Agriculture Organisa-

Sun-dried tomato damper

Sun-drying is not only a practical way to store seasonal fruit and vegetables; it is a window to new taste sensations! **CLAIRE BEAUMONT** presents her tried and tested sun-dried tomato damper recipe.

The sun-dried tomatoes in this recipe can also be substituted with semi-dried tomatoes. Semi-dried tomatoes are exactly what they sound like, and have a fresher, less-concentrated flavour than sun-dried tomatoes. They'll keep for a month or so covered with good-quality olive oil and sealed in an air-tight container.

Claire's sun-dried tomato damper

Ingredients

1/4 cup sun-dried or semi-dried tomatoes, chopped
1/2 cup grated carrot
1 small onion, chopped
1/2 cup grated tasty cheese
6 black olives, chopped (optional)
2 cups organic self-raising flour
good pinch of salt
freshly ground black pepper
2 teaspoons butter, cut into small pieces
3/4 cup milk

Method

Pre-heat oven to 200ºC. Place the vegetables and cheese in a large mixing bowl. Sift the flour over the top of them, then add the butter and milk. Add salt and pepper to taste. Mix together roughly with a fork until the mixture forms a moist dough. Knead the dough for about a minute until all the ingredients are well mixed in. Add some more flour if the mixture is too moist (that is, if it sticks to your fingers). Make the dough into a smooth ball. Place the dough ball on a buttered oven tray and flatten it out into a large circle, no more than 2.5 cm thick. Cut the damper into six to eight wedges, being careful not to cut all the way through to the bottom. Bake for 25 minutes, then flip the damper over and return to the oven for another five minutes. When you tap the base of the damper and it sounds hollow, it is ready to eat.

Serves two to three people with soup, or four to six as a snack or an accompaniment to a main meal.

tion estimates that between 10 percent and 30 percent of perishable foods are lost after harvest in the developing world. Losses occur during handling, transport, threshing, drying, milling and finally storage. During all these processes contamination can occur from insects, rodents and other animals while micro-organisms and fungi can attack perishable foods so that they are inedible or unsaleable.

Solar driers have the potential to significantly reduce losses during the drying process. They can keep the crop dry during rainstorms and prevent contamination from dust, twigs and animals. They can reduce the amount of labour required and produce a better quality product. Products of higher quality can fetch a higher market price if sold and add to the family income. Many people view solar drying as a technology which can potentially increase the amount of available food without using any more land, water resources, fuels or fertilisers.

Ian Reilly is a mechanical engineer who recently completed a Master of Engineering Science at the International Development Technologies Centre at the University of Melbourne. In addition to research work on the solar drier, the course involved study of renewable energy technology, energy policy, appropriate technology, and development theory. He is currently employed with Synergic Resources Corporation International, an international energy consulting company located in Melbourne.

Allergic to everything

20th century syndrome

KYLIE BOX reports on an illness where sufferers have severe, and in some cases life threatening reactions to everyday materials that most of us take for granted.

'Chemically sensitive to most of the marvels of progress, we have become exiles from our own time, aliens within our own civilisation'.
– Diana Crumpler, a sufferer of Multiple Chemical Sensitivity, in her book *Chemical Crisis*.

Diana Crumpler lives in a world where plush carpet, wallpaper and televisions are strictly forbidden. Her condition has become so severe that she cannot tolerate the energy produced by sunlight, and has not ventured beyond her four walls in over a year. A warm and hospitable woman, she kindly asks me to refrain from writing notes during our interview, as the combination of pen and paper may cause her severe skin irritation. Diana Crumpler is one of a growing number of Australians who can not tolerate many of the substances seen as twentieth century miracles, such as plastic, vinyl, polyester, and fibreglass. Research by the Environmental Protection Agency in the USA reveals that in the air inside the average home contains five times the chemical pollution of industrial areas. Indeed, with the onslaught of chemical pollutants, houses are no longer a safe haven from the world.

What is 20th Century Syndrome?

The symptoms of 20th Century Syndrome, or Multiple Chemical Sensitivity (MCS) are due to an abnormal response to chemical irritation of nerve endings, rather than a true allergy. The health effects cover a full range of acute and chronic symptoms, and have attracted various diagnostic labels such as Chemical AIDS, Sick Building Syndrome or Total Allergy Syndrome. Medical estimates show that up to fifteen percent of the population may suffer from some sort of chemical sensitivity, though MCS is often diagnosed as an allergy when doctors cannot categorise it any other way. Doctor Eric Morand, from the Monash Medical Centre Immunology Department in Melbourne, emphasises the high likelihood of misdiagnosis, with many doctors dismissing MCS as stress-related or originating in the sufferer's mind.

Signs around Diana Crumpler's home remind visitors not to bring hazardous chemicals onto the property.

Doctors are unsure why certain healthy people can become so sensitive to chemicals, while others remain unaffected. The symptoms include migraines, depression, fatigue, allergy-like symptoms, a weakened immune system, difficulty breathing, insomnia and huge mood swings.

The symptoms can arise quite suddenly. Diana Crumpler claims that one day while painting, a favourite pastime, her face and neck became a raw, bleeding mess. The doctors she visited told her the problems had all originated in her mind, dubbing it more psychological than physical.

Life with MCS

Acute sufferers are forced to make a host of lifestyle changes, from using a sealed glass box for reading and writing (to contain fumes from the ink and bleached paper), through to wearing a respirator outdoors at all times to filter out airborne pollutants. In the average household there is a huge array of chemicals and materials that can adversely affect MCS sufferers. It may take a lifetime to identify and eliminate them all.

Diana Crumpler tells of an Australian family who had a pure wool carpet woven for their baby's room, ensuring there were no glues or synthetic backing. The baby ended up in hospital as the underlay had been fumigated to get through customs. For MCS sufferers, even going to bed can be dangerous – urethane foam mattresses, once warmed by the body, emit toxic fumes, as may a favourite lounge chair.

Some MCS sufferers have built modified hardwood cabins, while others manage in conventional houses stripped bare. When designing and building a chemical free house, the site is all important. Diana Crumpler and

her husband live in country Victoria, miles from the nearest town, with signs surrounding their home warning that chemicals cannot be tolerated. James Banfield specialises in energy efficient and low allergy housing design, and is involved in building a house for a mother and daughter who suffer from MCS (we will call them the Smith's, as they do not wish to be named). The site is at Mt. Martha on the Mornington Peninsula, where fresh air from the Bay is relatively free of Melbourne's smog. Banfield explains that it is also imperative to have good air circulation in and around the outside of the house. In addition, the garage must be quite open, positioned at the front and away from the house so noxious car fumes cannot be sucked inside. A low-allergy house requires passive air vents so as not to trap volatile organic compounds.

Building a chemical-free house

Even 'natural' products are not necesarily safe: beautiful-looking building timbers such as pine and cedar gas-off fumes for around fifteen years. The Smith's two-storey home will be tiled throughout with terracotta, the ceiling downstairs will be the concrete floor from above, and the ceiling upstairs will be brush-box timber, one of the few timbers available that does not produce fumes harmful to these MCS sufferers.

Sufferers can not enjoy the small comforts that most of us take for granted, such as carpet, which may emit up to 120 volatile chemicals. In addition, there can be no vinyl, plastic fittings, or synthetic furnishings. Australian made Bio-Paints will be used for interior surface finishes. In the Smith's house, the majority of the bathroom and kitchen will be stainless steel, one of the few inert materials available. Coloured sand in the concrete will be used externally instead of paints, and the family will have to hunt down safe cotton and wool for curtains and bedding.

Building problems

Monitoring tradespeople during construction represents the greatest difficulty when building a chemical-free home. Diana Crumpler claims that many chemically sensitive people have to fight builders at every turn when trying to explain that their unusual requests are necessities. Carefully planned houses are often ruined when chemicalised products are used, on the assumption that what cannot be seen is undetectable. One sufferer thought herself safe in her new chemical-free house, only to discover the builder had glued the ceramic tiles to the concrete slab and the underfloor heating intensified out-gassing of solvents. The woman was forced to abandon her home.

There are few architects specialising in allergy-free homes, and Diana Crumpler can count on one hand the doctors in Australia who are sympathetic, true believers in MCS. There is immense skepticism surrounding the validity of the syndrome, with traditional segments of the medical society claiming MCS sufferers portray psychiatric disorders responsible for symptoms. The World Health Organisation concluded early this year that MCS 'cannot be recognised as a clinically-defined disease'. Yet sufferers are receiving more coverage and support now than ever before. In the USA, Social Security Administration will make payments to those who can prove they suffer from MCS, and only a handful of sickness benefits have been allocated to MCS sufferers in Australia. Public awareness should be boosted by a project called 'The Harmless House' being run by RMIT in response to proposals from Diana Crumpler as the head of The Australian Chemical Trauma Alliance. The project will examine all aspects of building with chemical sensitivity in mind, and is the first MCS project undertaken by a major Australian university. Perhaps it is a sign that chemical sensitivity will be taken more seriously by doctors, scholars and society of the future. After all, with fifteen percent of the population likely to suffer from some form of chemical sensitivity, the skeptics may well be the next victims.

Diana Crumpler with the box she uses to protect herself from printed materials, and an inverted fish bowl that minimises turpines emitted from pot-plants.

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Under-water tractor
replanting the sea

The Ecosub was developed in Perth to repair damage done to seagrass beds during years of sand dredging. As SARAH HILTON explains, this under-water 'tractor' could one day repair damaged marine habitat all over the world.

Conservation groups Australia-wide are working frantically to reverse the processes of erosion, salination and loss of native habitat by regenerating the bush with indigenous plant species. Recently, a similar focus has been turned to the ocean floor where marine plant life struggles to survive the damage done by practices like trawling and dredging. A new initiative funded by a large Western Australian company could have wide implications for the future of the sea bed and its inhabitants.

Cockburn Cement has commissioned another Perth company, Ocean Industries, to develop and trial a seagrass transplant machine as part of a $6 million environmental management plan. The concept arose when Cockburn was directed by the Department of Environmental Protection to implement an Environmental Management Programme because the company's operations include dredging shell sand from the sea bed.

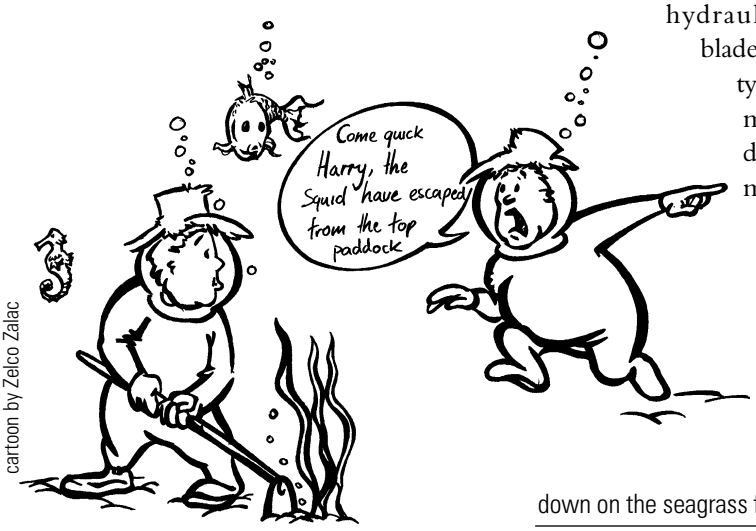
The prototype machine, known as Ecosub 1, is designed to remove sods of seagrass and transplant them in order to revegetate areas with little or no seagrass cover. Although rejuvenation of the sea-bed has been attempted with some success in the past, this is the first time such large scale mechanical transplantation has been trialled.

A team of scientists from Murdoch University's Institute of Environmental Science has been researching the seagrass and the best methods for successful transplantation. The team, headed by Dr Eric Paling, calculates that sods of seagrass up to 500 millimetres thick and 750 millimetres long give the plants their optimum chance for survival during the harsh winter storms that lash Owen Anchorage off the Fremantle coast. The size and weight of the sods make it difficult to plant them by hand, so a transplant machine was needed in order to carry out this task more effectively.

ECOSUB 1 is a four-wheeled vehicle weighing two tonnes and measuring 4.8 metres in length. Equipped with hydraulic cutting blades (and wide tyres to minimise any damage it might cause as it moves across the ocean floor), the machine is operated by a diver, and powered hydraulically from another vessel. Moving slowly along the sea bed, the prototype is expected to complete two harvest/replanting cycles a day. Each harvest reaps six sods, or nearly one tonne in seagrass, roots and all, which is lifted into a transport container and towed to the new site for transplantation.

The ecosub – part of Cockburn Cement's $6 million environmental management plan.

From its inception to its first small scale trials, the machine has taken only six months to develop. The first large scale transplants are expected to begin in spring and it will be some time before the results of these trials can be collated. Under the guidelines of the Department of Environmental Protection one tenth of a hectare of seagrass must survive for three years and one hectare for one year if the project is to be officially credited with success. Dr Paling is optimistic: 'We are confident it will work. If it does, it is wonderful news for environmentalists everywhere. There are many potential uses for the technology, in other parts of Australia and internationally'.



cartoon by Zelco Zalac

down on the seagrass farm

Elizabeth Walton reports on how

environmentalism in the 90's

is changing from the old confrontational variety. A new agreement between the ACF, 3M and the Government puts all parties at the discussion table.

EMS, ESD, ISO, EBP. The new environmental jargon of the 90's. These acronyms sound catchy, but what is their value if no-one knows what they mean? To help local industry become more familiar with the terms and tools of environmental sustainability, the ACF (Australian Conservation Foundation) has opened the SIO, or Sustainable Industries Office.

Di Dibley, Director of the SIO, says the creation of this new branch of the ACF has grown from a need to inform and skill industry, where there is often a lack of understanding of what environmental best practice is.

'I think that there is an understanding of a whole lot of discreet bits, which go to environmental best practice. Some people conduct an environmental audit, and prioritise its recommendations. They might then follow some of those recommendations,' she said. 'But they may know nothing about environmental accounting – they may never have heard of ISO 14001, and they may never develop a comprehensive environmental management system. They may have problems even contemplating this, because they have a mind-set which attaches environmental responsibilities at the end of everything else they undertake, and also see it as a burden.'

Di Dibley says before the mind-set can be turned around, a corporate cultural change must take place. 'We want people to see they have a competitive edge if they have an environmental management system operating, and for them to embrace it with enthusiasm, knowing it's in their best interests.'

Incentives for companies to voluntarily introduce environmental best practices are becoming stronger. Those who don't may soon find themselves unable to attract loans from banks. 'Increasingly banks want to know that environmental risks are competently managed', Di Dibley said.

In the United States, the reason why banks and insurers act cautiously is clear. By 1991, the Wall Street Journal estimated EPA-imposed environmental clean-up liabilities were already in excess of $US500 billion. Companies who neglect to manage these risks will inevitably become uninsurable.

Vision and FORSITE

FORSITE is the SIO's new initiative. The aim is to demystify the process of environmental best practice (EBP), by providing industry sponsored training, and creating a platform to encourage discussion of EBP across all levels – from community, through to government, trade and education. The name is derived from the agenda: For Sustainable Industries and The Environment.

'Would you like to be bawled out in front of all your mates, or would you like to be taken into an office, spoken to, and asked what the problem was?...some environmental groups need to take a long term perspective, rather than a short term publicity perspective.'
— Richard Wallace, Manager of Corporate Communications at 3M Australia.

Many companies are already negotiating agreements with the SIO, to sponsor training initiatives and seminars, and use their EBP experience to educate the industrial community. The focus of the training will change according to who is taking leadership. One company may have experience in environmental reporting or waste management. Another company may have expertise in ISO 14001 certification, and will lead companies through an educative process in that area. The SIO is intending the training to be eligible for accreditation towards university degree programs.

The 3M partnership

The first company to take the leadership role, and sponsor FORSITE for a period of two years, is 3M Australia. The 3M Corporation is recognised worldwide for its outstanding environmental management record. During its involvement, 3M will fund a training program and a national conference on sustainable development.

Richard Wallace, Manager of Corporate Communications at 3M Australia says there is currently no avenue for discussing EBP in this country. 'We don't have a national conference for sustainable development in Australia.' he said. 'This is something new.'

Richard Wallace said the conference will become an important vehicle for discussing the benefits of undergoing FORSITE training, and represents a significant contribution towards heightening awareness of the need for environmental best practice in Australia.

Training

The training is targeted at small-to-medium size enterprises who would ordinarily not be able to access such a comprehensive program due to the high cost involved. The focus is on communicating the environmental message through to senior management. 'The idea is to generate corporate change from within the ranks', Di Dibley said.

'We are aiming at senior management – people who can actually turn around the way a company works, or put pressure on the upper echelons of a company. So we're focusing on cultural change, marketing, and also the implications for financial and insurance arrangements.'

The training will draw on the experiences of 3M, but it is also the result of input from a wide range of highly experienced and qualified people from both public and private sectors. The initial program will be coordinated by Doug Holmes, of the Centre for Environmental Management at Monash University, whose background includes appointments in Papua New Guinea, Hawaii, and the Solomon Islands. 'Australian industry still has a long way to go before any legitimate claims to sustainability can be made', Doug Holmes said. 'However we are at the start of a new era, where the corporate sector is beginning to grasp the extent to which environmental considerations will effect the way business operates in the future'.

The Federal Government is also involved in FORSITE. 'They are very supportive,' Di Dibley said. 'The present government more than ever is about voluntary action by industry, and that's what this initiative is about. They applaud the leadership role that 3M is taking in this inaugural two year event. FORSITE is a tripartite project.'

Politics

The fact that FORSITE is a tripartite initiative represents a major turning point in the relationship between industry, government, and environment groups. The 3M Corporation operates in 62 countries across the globe, yet in its 94 year history, it has never before been involved with an environment group.

The agreement is symbolic of the cultural change required in industry. But it's required across the board, from environment groups and government too – not just industry. The new approach is about creating opportunities, rather than making demands for change. It's a radically different journey. It asks environmentalists to approach with a carrot, not a stick; to become reformist rather than radical. 'It's not the politics of confrontation,' Di Dibley says, 'it's about supporting people through change.'

Richard Wallace of 3M agrees the politics of environmental liaison could benefit from becoming less adversarial. 'Some groups don't speak – they shout and point the finger. My advice would be to take a far more conciliatory approach, to lower the aggressive tone of their challenges, and to speak privately to companies.'

Business has been burned in the past by political stunts, he says, and compares the company response to how any individual would feel in the same circumstances. 'Would you like to be bawled out in front of all your mates, or would you like to be taken into an office, spoken to, and asked what the problem was? It's the same analogy. I think some environmental groups need to take a long term perspective, rather than a short term publicity perspective.'

Di Dibley agrees that the SIO represents a new way of working with industry and government. 'I think people are realising more and more that positioning debates, where no-one ever progresses an issue, or truly negotiates, are a waste of time,' she said. 'I think what is required is a realistic point of view – looking at the reality of what's achievable, recognising that we all enjoy a certain standard of living. That is part of the reality we live with. We must also realise there's a way forward where compatabilities can be found, in economic and ecological sustainability. It will require change. And some activities are simply not sustainable.' ✲

3M's environmental history

- 1969- program to stop landfilling liquid solvents begins
- 1976- 3M Centre waste paper recycling program begins
- 1981- environmental audits of US plants begins
- 1989- Year 2000 goals set to reduce all releases to air, water and land by 90 percent
- 1993- Goal of 70 percent reduction in 3M worldwide air emissions acheived

Solar panel buyers guide

In Soft Technology #43 we published a buying guide for solar panels. **Adrian Oakey** reviews the state of the marketplace and the technologies available.

Photo: Burnley Environment Centre, Melbourne.

With the ever-increasing popularity of solar-pow ered calculators, watches and other electronic goods, *solar cells* have become a permanent part of our everyday lives.

However, the terms *solar power* and *solar panels* cover such a large range of solar technologies that they inevitably lead to confusion. What we are really talking about here is the photovoltaic or PV cell, module or array.

The photovoltaic effect

The PV cell gets its name from the photovoltaic effect. This principle describes the process whereby power is generated when a substance is exposed to light. That is, electricity is produced directly from the sun.

A PV module is a group of PV cells connected together, typically 36 cells connected in series. A PV array is a group of modules connected together in series and/or parallel to generate the required energy output.

Many different material combinations have been experimented with, but the most commonly used is silicon.

The silicon is treated with boron and phosphorus (a process called doping) which then allows the light (photons) to generate electricity through the displacement of electrons.

There are three main types of silicon PV cells – amorphous, monocrystalline and polycrystalline. Amorphous cells are probably the most familiar, as they are used extensively in low-power devices such as calculators, watches and other electronic items.

Amorphous cells are manufactured by depositing silicon onto glass or another similar material and are highly suited to mass production. They can also be made into flexible panels for use on curved surfaces or for ease of transportation – the panels can just be rolled up!

The crystalline cells, which are more efficient than amorphous cells (twelve percent compared to six percent for most commercial cells) tend to dominate in higher power applications.

Monocrystalline cells are formed by cutting wafers of silicon from a large, circular, single-crystal ingot. The cell is then processed (including doping) and is used as a round cell or is trimmed to improve its packing density.

Polycrystalline cells consist of silicon wafers cut from a multi-crystal, square cast ingot, but are slightly less efficient than the monocrystalline cell. However, on a dollar-for-watt basis, these two types of PV cells are comparable.

The construction of both types of crystalline panels are similar. The silicon cells are connected together by thin metal strips and the cells are then sandwiched between two sheets of various materials for protection. The outer layer is usually glass, although plastic is sometimes used. The layer underneath the cells can be glass, plastic, aluminium or stainless steel.

Amorphous panels have a similar construction, except that the amorphous layer is deposited directly onto the glass outer layer. A layer of plastic provides the protection for the rear of the panel.

Virtually all solar panels have some sort of frame to improve strength and allow easy mounting during installation. This is usually made from aluminium, although plastic and fibreglass

are used for panels designed for marine environments.

PV cell characteristics

The electrical performance of a PV module is usually described by its current-voltage (I-V) curve, as shown in Figure 1. The curve varies depending on the amount of solar radiation and temperature of the cell. A module is usually rated at an insolation (light strength) level of 1000W/m² and a temperature of 25°C.

The power rating of the module is based on the maximum power achievable, typically at around 17 volts for a 12 volt panel. The power output of the module depends on the operating voltage of the attached load. If the load causes the panel voltage to drop or 'sag' excessively, then output power will suffer. An example is shown below:

> If a panel has an output of 3.5 amps at 17 volts, then the power output will be:
>
> Power = 17 x 3.5 = 59.5 W
>
> But if the panel voltage falls to 12 volts due to mismatching of the load to the panel, then the power will be:
>
> Power = 12 x 3.6 = 43.2 W

Some panels, known as self-regulating panels, have fewer cells connected in series. The theory is that the lower voltage produced will tend not to overcharge the battery when no regulator is installed. However, these panels are not really suitable for large power installations, as their output voltage is often not adequate for proper battery charging in lower light conditions.

PV applications

As a useful power producer, the PV cell did not come into its own until the 1960s. At this time, extensive development occured using PV cells in spacecraft and satellites. These cells were very expensive (somewhere in the region of $8,000 per watt).

Through the 1970s PV cells reduced in price to the point were they were viable for specific commercial use. In particular, the telecommunications industry used PVs for providing maintenance-free power in remote repeater stations. Their investment in research pushed PVs forward another step. For the last ten years PV modules have remained at an approximate cost of ten dollars per watt, which means, in real terms, that they have gradually reduced in price.

With prices at this level, PVs have become an economical solution for the provision of power in areas were the cost of extending the electrical distribution grid is prohibitive. These systems, referred to as remote area power supply (RAPS) systems (or more accurately, independent power supply (IPS) systems), are increasingly utilising PV technology as the prime source of energy input, the alternative options being wind, micro-hydro and the diesel engine.

In fact, the costs of maintaining electrical distribution systems is becoming so high that some electricity ulitities are finding that PV installations can provide economical solutions to managing their distribution lines. Alternative options include disconnecting remote lines and installing IPS systems or connecting PV arrays to the end of a line to reduce the load the line carries, eliminating the need for line upgrades.

In a grid-interactive PV system, PV arrays are connected to the mains grid via special inverters. Projects of this type are springing up all over the world. In terms of the overall electrical consumption they don't provide much of the world's power, but they are a start.

We have several of these projects in Australia, with sites in Western Australia, Victoria, New South Wales and Queensland. There is little evidence to date that these projects are a cost-effective proposal (using conventional economics) and many of them are subsidised. But a foothold has been made and many of the issues of interconnecting to the grid are being dealt with.

One interesting development arising from grid-interactive PV systems is the integration of PVs into the skin of a building – not just as an 'add on', but as an integrated architectural feature.

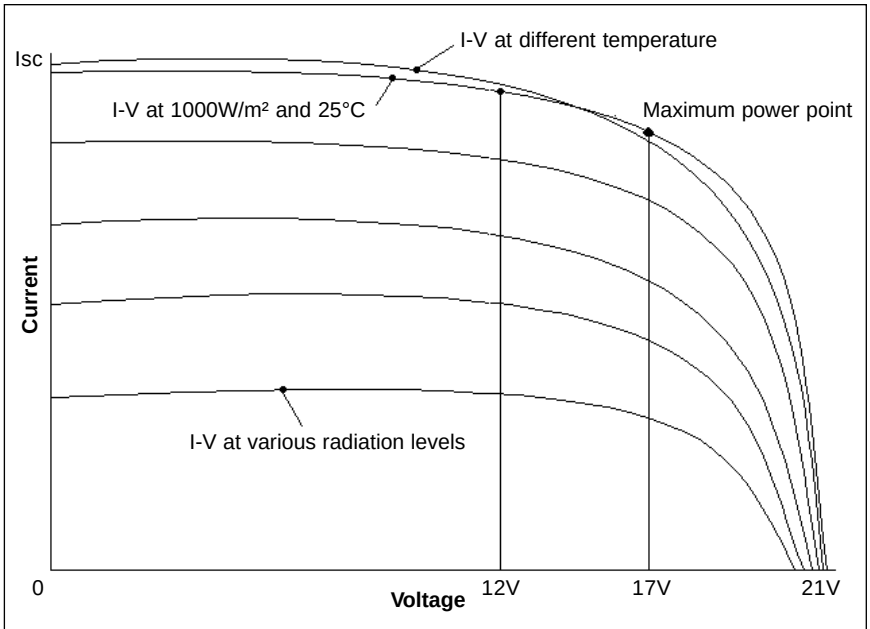


Figure 1. I-V curves for different levels of radiation on the same solar panel.

PVs are also being used in many commercial applications, from garden and street lighting, navigation beacons and lighthouses to warning and promotional signs.

Transport is another area where PVs are proving to be useful, with solar-powered fans cooling stationary cars, powering appliances in recreational vehicles, and even providing power for solar cars and boats.

Advancements in PV technology

Only with some major breakthroughs in solar panel construction techniques, reductions in the use of expensive materials and increases in cell conversion efficiencies will a considerable drop in the cost of PVs occur.

Various developments involving solid and flexible films are being considered, with concepts such as solar windows and roof tiles being examined.

Alternative materials are also being considered to generate the power from light, including cadmium-telluride, cobolt-chromium attached to PET (as used in softdrink bottles) and copper-indium-selenide.

Many developments have also been made with amorphous technologies. Energy Conversion Devices in the US, in conjunction with Canon Corp., have developed a nine-layer, three-junction amorphous solar cell with a stainless-steel substrate. This cell has a higher efficiency than conventional amorphous cells – up to ten percent. It is expected that this technology will skyrocket in the next few years, with amorphous panels appearing just about everywhere.

There are also examples of development taking place in Australia. These include high efficiency silicon cells being made at the University of New South Wales. Pacific Solar have depositied a layer of silicon on glass only 5-10µm thick. Researchers at the Australian National University have used liquid phase epitaxy (LPE) techniques to coat low-cost silicon wafers with a high-grade active silicon layer, producing cells with seventeen percent efficiency.

Photovoltaics and the environment

Photovoltaics are sometimes promoted as the energy source of the future, the saviour of mankind. And why not! They are the simplest way to generate electricity without producing any greenhouse gases, noise or other environmental pollutants.

However, PVs do have some impact on the environment, at least initially. Raw materials (high-quality sand) have to be mined from somewhere, and the silicon has to be processed, which requires the use of chemicals. Considerable energy is used in the manufacturing process. (It is purported that early PV cells took more energy to produce than they would produce in a lifetime). Modern panels take from one to five years to recover the energy used to make them.

Storage of energy is also required for when the sunlight is not adequate, as well as at night. All of the available storage options have material requirements that are either hazardous, exotic or expensive. The environmental impacts of storage also have to be considered.

The table

Listed opposite are the details of a range of modules that are available in Australia today. If you compare this table to the one in Soft Technology #43, you will notice that there are only minor changes to the specifications and prices. There are, however, more models available, and there are some additional players on the market. Some larger modules are also now available but the price per peak watt has only marginally improved.

BP Solar and Solarex, provide the majority of panels sold in Australia. Both companies source the silicon ingots from overseas but do most of the treatment and assembly operation in Australia. All other panels on the market are fully imported, though there is development taking place which could see more manufacturing in Australia. ☼

Glossary of Terms

Solar radiation (insolation) is expressed in units of watts per square metre (W/m^2).

Voltage is a unit of electrical potential. A close analogy is water pressure. The units are volts (V).

Current represents the electron flow in the circuit. A close analogy would be the amount of of water flow in a pipe. The units are Amps (I).

Power is a measure of power and is the product of voltage and current; ie V x I. The unit is Watts (W).

Information sources

BP Solar: BP Solar, PO Box 519, Brookvale NSW 2100, ph:(02)9938 5111.

Jaycar: Jaycar Electronics, 8-10 Leeds St, Rhodes NSW 2138, ph:(02)9743 5222, fax:(02)9743 3070.

Neste: Neste Advanced Power Systems, ph:(07)3871 1377, fax:(07)3871 1171.

Siemens: Michael Farmer, Sylvania Lighting, ph:(043)29 8888, fax:(043)28 2605.

STA: Silicon Technologies Australia Ltd, 11 Aurora Ave, Queanbeyan, NSW 2620, ph:(06)299 1592, fax:(06)299 1698.

Solarex: Solarex, 78 Biloela St, Villawood NSW 2163, ph:1800 802 762.
Solar Charge, 115 Martin St, Brighton VIC 3186, ph:(03)9596 1974.

Model	Made in	Power (Watts)	Volts	Amps	Cell Type	Construction	Size (mm) (L x W x H)	Warranty (years)	Price ($)	$/W
BP Solar										
BP283F	Australia	83	17.1	4.85	mono	alum/glass	1283 x573 x 44	20	795	9.58
BP275F		75	17.1	4.35			1188 x530 x 44	20	735	9.8
BP275L		75	17.1	4.35		glass, no frame	—	20	710	9.47
BP160F		60	17.1	3.51		alum/glass	1188 x530 x 44	20	609	10.15
BP255		55	17.1	3.2			1004 x448 x 39	20	579	10.53
BP140		40	17.1	2.34			958 x 433 x 39	20	428	10.7
BP246SR		46	15.6	3.05	mono, self regulating		875 x 447 x 39	20	497	10.8
BP1230SR		30	15.6	2.03			602 x 447 x 39	10	377	12.57
BP222SR		22	15.6	1.45			478 x 448 x 39	10	322	14.64
BP1215SR		15	15.6	1.02			490 x 430 x 39	10	257	17.13
BP212SR		12	15.6	0.78			478 x 238 x 39	10	235	19.58
BP1205SR		5	15.6	0.33			258 x 238 x 39	10	146	29.2
BP1220SRU		20	15.6	1.3		fibreglass/glass	534 x 504 x 24	5	310	15.5
BP1210SRU		10	15.6	0.63			234 x 294 x 24	5	225	22.5
Jaycar Electronics										
ZM9026	Taiwan	4	16	0.25	amorph	alum/glass	305 x 305	3 mth	67.95	17
ZM9024		2	16	0.125			180 x 340	3 mth	37.95	19
Neste										
NS120	Thailand	120	16.9	7.1	mono	alum/glass	1476 x526 x 50	10	1180	9.83
NS110		110	17.4, 34.8	6.4, 32			1293 x660 x 50	10	1040	9.91
NS55		55	17.4	3.2			1293 x330 x 50	10	550	10.1
NS28		28	16	1.75			677 x 329 x 33	10	340	12.1
NS14		14	16.5	0.85			387 x 340 x 33	10	230	16.4
A115P	Europe	6	15	0.4	amorph	glass/glass	495 x 313 x 8.5	5	132	22
A11P		4	15	0.3			343 x 313 x 23	5	109	27.25
Siemens Solar										
M55	USA	53	17.4	3.2	mono	alum/glass	1293 x330 x 36	10		
Silicon Technologies Australia										
F-7.5	USA	7.5	15.6	0.48	amorph	flexible	715 x 240	3	198	26.4
F-15	USA	15	15.6	0.97			715 x 410	3	298	19.9
SolarCorp										
SC6	China	6	14.6	0.410	amorph	alum/glass	419 x 316 x 20	—	84	14
SC10		10	12	0.83		alum/glass	925 x 316 x 20	—	155	15.5
104	UK	5.5	15	0.37	amorph	alum/glass	477 x 315 x 29	6	120	21.8
107		11	15	0.73		alum/glass	925 x 315 x 29	6	155	14.1
SCC 5.4	China	5.4	17.4	0.31	mono	encapsulated	—	—	162	30
SCC 10		10	3, 6, 9 12	2.3, 1.2, 0.87, 0.58		encapsulated	323 x 312 x 5	—	378	38
MBC131	—	5	12	0.42	amorph	flexible	692 x 197	—	182	36.4
MBC262	—	11	12	0.92			692 x 394	—	297	27
MBC525	—	22	12	1.83			1283 x394	—	479	21.8
Solarex										
MSX83	Australia	83	14	5.23	poly	alum/glass	1109 x660 x 50	20	815	9.8
MSX64	Australia	64	14	3.97	poly	alum/glass	1109 x502 x 50	20	635	9.9
MSX53	Australia	53	14	3.36	poly	alum/glass	1109 x502 x 50	20	530	10
MSX10	Australia	10	14	0.59	poly	alum/glass	420 x 269 x 50	10	172	17
MSX30L	Australia	30	14	1.8	poly	lightweight	616 x 495 x 10	1	422	14
MSX5L	Australia	5	14	0.27	poly	lightweight	273 x 267 x 10	1	161	32
SA5	USA	5	14	0.33	amorph	plastic/glass	305 x 346 x 10	5	127	25

What's new in battery technology?

There have been considerable advancements in battery technology in the past few years. **LANCE TURNER** takes a look at what's on the horizon.

While most people don't give them much thought, storage batteries, or rechargeable batteries, as they are more commonly known, are everywhere. From the tiny, lightweight battery that runs your mobile phone to the huge battery banks that provide rural residents with their power needs, they have become a part of our everyday lives.

Indeed, it is not until you find the car won't start on that cold winter's morning that you realise how dependant the modern world is on this convenient form of energy storage.

For the most part, the world has relied heavily on the century-old technology of lead-acid batteries. These have become part of power systems of almost every size and type. They are used to start virtually all vehicle engines, provide emergency power for telecommunications networks, provide backup power for computer systems, and produce the motive power for electric vehicles, including forklifts and wheelchairs.

What's in a battery?

All chemical storage batteries consist of a series of plates, the electrodes, which are surrounded by a liquid or gell, the electrolyte. A chemical reaction causes the current to flow from one set of plates to the other, via the electrolyte, usually changing the composition of the plates, and sometimes the electrolyte itself, in the process.

This chemical process produces a potential difference, or voltage, from one set of plates to the other, allowing a current, and hence power, to be drawn from the battery.

During recharging, current is forced through the battery in the other direction by a voltage higher than the battery voltage. This causes the chemical reaction to run in reverse, thus charging the battery.

This system is not 100 percent efficient, however, as a proportion of the charging energy (up to twenty percent) is lost in the charging process.

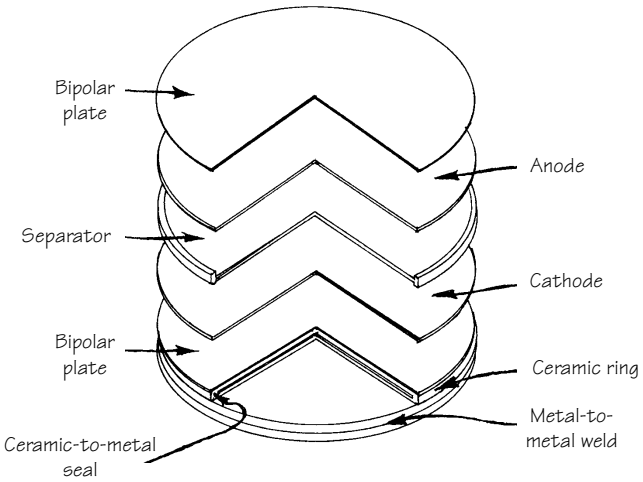


Figure 1. An exploded view of the bipolar lithium-sulphide battery being developed by 3M Corporation.

New technologies

While lead-acid batteries have served us well, they are slowly being replaced with battery technologies that are lighter, more energy efficient and less environmentally damaging.

One contender for the throne of the battery kingdom is the nickel-cadmium (nicad) battery. While these can provide more power for the same battery weight than a lead-acid battery, they also have their drawbacks. They contain environmentally damaging materials and suffer from a unique problem called 'memory effect'.

Memory effect occurs when a nicad is continually partially discharged, to say, 50 percent of its capacity. After a few cycles of charging and discharging like this, a build-up of crystals inside the battery cause it to act as if it can only supply 50 percent of its actual capacity, appearing flat beyond that point.

There are also a number of other contenders to replace lead-acid batteries, the most likely of which appear in the

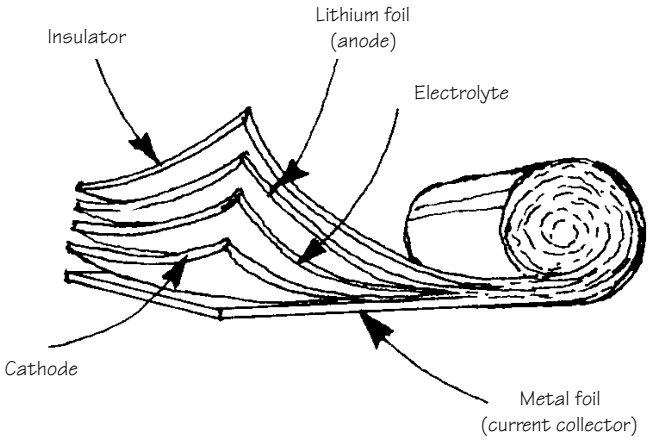


Figure 2. The lithium-polymer battery, also being developed by 3M, could provide up to 200Whr/kg of energy storage.

table opposite. Nickel-metal-hydride (NMH) batteries are similar to nicads, except that they use a metal hydride for one electrode in place of the cadmium. This is not only less toxic, but results in slightly higher storage densities than nicads, with batteries currently providing up to 90 watt-hours per kilogram (Whr/kg) of battery weight.

Lithium cells

Of the other contenders, the lithium-based cells are the most interesting, with at least three completely different types being developed. These include lithium ion, which are being used more and more in smaller applications like computers.

Lithium-ion batteries under joint development by *Nissan* and *Sony Corporation* offer about three times the energy storage capacity of most lead-acid batteries – about 100 watt-hours per kilogram, and about one and a half times that of nickel-metal-hydride batteries.

In terms of power density, or the amount of instantaneous power output, lithium-ion batteries offer about 1.2 times the density of lead-acid batteries and one and a half times that of NMH. Furthermore, charging and discharging efficiency is higher than lead-acid and NMH batteries, resulting in a more energy-efficient system overall.

Batteries at a glance

Battery Type	Applications	Advantages	Price	Storage densities	Toxins	Other disadvantages
Lead-acid	most common rechargeable battery	large current outputs	low – $100 per kWhr or less	low – up to 50Whr/kg Theoretical limits much higher	lead, sulphuric acid, traces of other metals	heavy for power stored
Nickel-cadmium (nicad)	torch batteries, also as large format for RAPS systems and electric vehicles	not many, but higher capacities than lead-acid	expensive in large format	up to 90Whr/kg	potassium hydroxide and cadmium metal	suffer from 'memory effect'
Nickel-metal-hydride (NMH)	same as nicad, especially electric vehicles	do not suffer 'memory effect', less toxic than nicad	very high – expected to drop dramatically with mass production for electric vehicles	up to 100Whr/kg	potassium hydroxide	complex to manufacture
Lithium-ion	computers, cameras, electric vehicles	fairly high energy density	very expensive	up to 150Whr/kg	lithium	
Lithium-polymer	computers, cameras, electric vehicles	high storage capacities, made in thin sheets that can be moulded to different shapes	high initially, expected to drop dramatically with mass production	high – up to 200Whr/kg	lithium metal (burns in contact with water)	still experimental, contains metallic lithium, which is highly reactive
Lithium-sulphide	electric vehicles and other large storage applications	high storage capacities	high	high	lithium	runs at high temperature – uses a molten salt as electrolyte
Manganese-dioxide	most commonly found as 'alkaline' torch batteries most applications	old, well-tested technology	medium cost – about $200 per kWhr	150Whr/kg or higher	fairly low toxicity	lower cycle life than some others
Zinc-air	commonly found as hearing-aid batteries, have been developed in large format for electric vehicles	old, well-tested technology, reliable, power limited during short-circuit, low internal pressure	variable	very high – 250Whr/kg or higher	low toxicity	low cycle life, but improving rapidly with new development
Flywheel	large format – electric vehicles and RAPS systems	no chemicals, almost unlimited life	very high at present	about 50Whr/kg	none other than used in manufacture	battery is ruined if flywheel fractures

Table compiled by Adrian Braun and Lance Turner

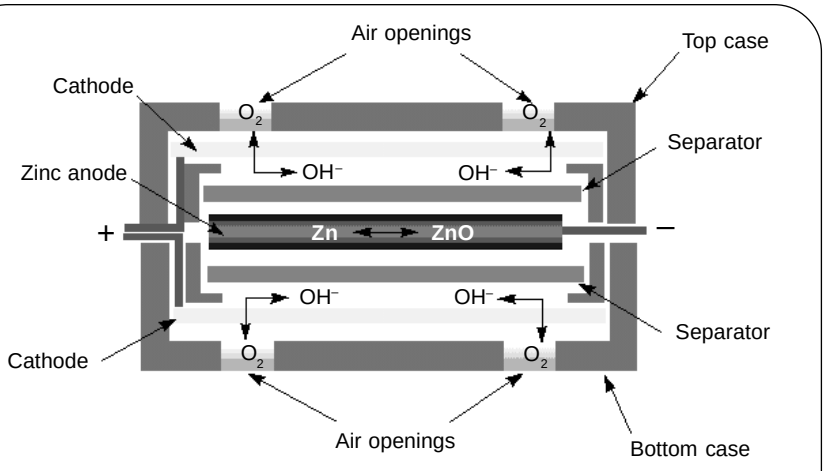


Figure 3. Cross-sectional diagram of a zinc-air battery.

Then there is the lithium-sulphide cell (see Figure 1) which actually uses a molten salt as the electrolyte, and must be kept at high temperatures in order to operate.

The lithium-polymer battery (see Figure 2) consists of layers of lithium foil, insulators and other foils used to collect current from the cell, and the most unusual part of all, a layer of solid electrolyte. These layers are all sandwiched together to form cells as little as a tenth of a millimetre thick.

It is expected that lithium-polymer batteries will eventually produce energy densities as high as 200Whr/kg, and may even be formed into functional components for use in electric vehicles, such as door panels and fluffy dice.

Old ideas renewed

It should be noted that much of the battery development work being carried on around the world involves improvements to the tried-and-tested lead-acid battery.

Bolder Technologies Corporation in the US have developed a battery that uses very thin sheets of lead rolled into a cylinder. This thin metal film battery currently only exists in a small-scale version. But if the battery can be scaled up successfully, it could be a superior automobile starting battery and energy source for electric vehicles and renewable power systems.

Another spiral-wound lead-acid battery already in production is the *Optima*. This battery has such a low internal resistance (all batteries have a resistance inside them that limits the amount of instantaneous power they can put out) that a six-volt, 56 amp-hour battery will maintain a voltage of around 5.8 volts with over 300 amps being drawn from it. Most other conventional batteries, even those of double the storage capacity of the Optima or more, would not be able to maintain such a stable voltage.

There is also another promising lead-acid battery, the *Horizon*, which has a storage density of around 50Whr/kg. This is the highest storage capacity of any lead-acid battery produced to date, and proves that lead-acid technology is far from dead.

Another old technology where interesting advances are being made is the manganese-dioxide alkaline battery. While these have been around for many years, it is not until recently that they have been able to be recharged reliably. By using a new plate design, Rechargeable Battery Corp. in the US has been able to make a true rechargable battery using this technology. These batteries are very promising, as they have the ability to provide up to 150Whr/kg of energy storage.

Zinc-air batteries, used widely as hearing aid batteries, have now been developed in larger sizes for use in electric vehicles. A diagram of this type of battery can be seen in Figure 3.

These batteries have energy storage capacities up to six times that of lead-

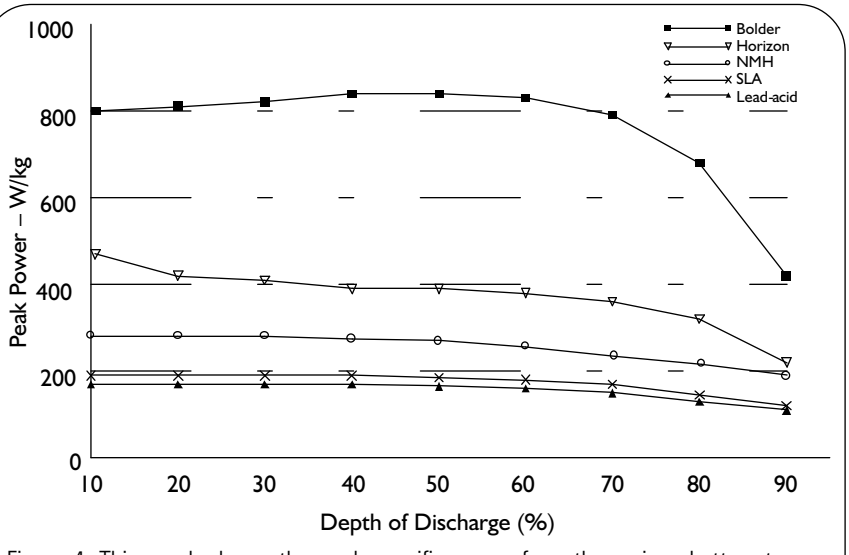


Figure 4. This graph shows the peak specific power from the various battery types. While only experimental, the Bolder thin foil battery has a much higher output than most other types. Note: figures for Optima not available.

acid, making them a viable alternative for use in long-range electric vehicles and other uses where a lot of energy must be stored in a small volume.

Disadvantages

There are several drawbacks with chemical batteries. Some of the lithium batteries actually use metallic lithium in their construction. Lithium reacts violently, and indeed burns, when it comes in contact with water. Like many other battery technologies, lithium batteries are very costly.

Virtually all chemical storage batteries use toxic chemicals that can become an environmental nightmare if not recycled correctly. Lead-acid batteries contain lead and sulphuric acid, while nicads contain cadmium, a highly toxic heavy metal. Also, both nicads and NMH batteries contain caustic potassium hydroxide as their electrolyte.

Mechanical batteries

The flywheel battery is a totally different type of battery still in the developmental stages. This battery uses mechanical means rather than chemical reactions to store electricity.

The battery contains two or more flywheels contra-rotating on the same shaft. The flywheels are supported on magnetic bearings, and the whole assembly is contained in a semi-evacuated case (a box about 30cm cubed in size) to reduce the effects of air friction slowing down the wheels. The flywheels themselves are made of composite materials such as carbon fibre and spin at extremely high speeds, typically up to 200,000rpm.

The battery generates power by inducing voltages in stationary coils placed close to the spinning wheels. The coils are used to charge the battery by increasing the rotational speed of the flywheel, much the same as an electric motor.

In the future

For small-format applications there are many types of rechargeable battery to choose from. The most common is still the nicad, followed by lead-acid and NMH batteries.

For large format, lead-acid is by far the cheapest choice, although many of the newer technologies are expected to overtake them in the next few years.

Many of the emerging batteries have the potential to revolutionise energy storage systems, both large and small. Once the problems of safe disposal and recycling have been dealt with, the batteries of the future will provide cheap, reliable, long-life energy storage options for just about every application. ☼

Rechargeable battery breakthrough

Bryan, Texas – The Rechargeable Battery Corp. (RBC) is reporting a breakthrough in the development of rechargeable manganese dioxide (MnO_2) alkaline batteries. The company says batteries, including electric vehicle (EV) batteries, that use its technology will have triple the energy capacity of lead-acid batteries, yet will be made of environmentally benign materials and be less expensive.

Alkaline zinc/manganese dioxide batteries have been in wide use in common C- and D-cells since the 1950s, but – until now – there hasn't been a reliable way to recharge them, RBC says. The company's specially treated manganese-dioxide material has been cycled more than 2,000 times under laboratory conditions and 455 times in a prototype cell.

RBC said it would license its technology for computer and portable equipment batteries within nine months, while EV-size batteries could be production-ready within three years.

Solar Christmas tree lights

Photo by Penny Simsen

These Christmas tree lights require no mains power, have a very long life (no more blown bulbs!) and are safer than the conventional type. **Lance Turner** shows you how to make them.

The Christmas period provides the opportunity to liven up a room with all manner of decorations, not the least of which is the Christmas tree, complete with flashing lights.

Unfortunately, the most commonly available lights all use miniature incandescant globes, which not only waste over 90 percent of the energy put into them, but get hot and can pose a fire hazard. What's more, if one bulb blows, the rest also go out, which can mean checking each bulb in turn until the culprit is found.

The power consumption of such lights, while not huge in comparison to many appliances, can be considerable due to the long running periods.

A better alternative

One of the most common electric light sources today is the LED, or light-emitting diode. LEDs can be found in just about every piece of electronic equipment and are usually used as 'power-on' indicators and the like.

LEDs are available in all shapes and sizes, use very little power to provide quite usable light levels, and have extremely long lives. The low power requirements of these little 'coloured bulbs' make them ideal for use with small solar power systems. Indeed, it is possible to make a Christmas tree lighting system with fifteen flashing LEDs, all powered from the sun, for less than $80.

While this sounds like a lot for a Christmas decoration, the solar panel and battery can be put to good use elsewhere for other lighting or low-power projects when the festive season has finished. (The MEGA-LED torch that appeared in Soft Technology #56 is a good example. The battery used in my Christmas tree lights is of the same size and type used in that project).

The most expensive components required, the battery and solar panel, might be substituted with parts from elsewhere.

The battery, for instance, could be your spare 12 volt lead-acid camcorder or laptop computer battery. You could even use a 12 volt nicad pack if you have it. In that case, you wouldn't even need the regulator components. The solar panel could be salvaged from an old electric fence setup, or even a solar-powered garden light that has bitten the dust.

How it works

There are several options for making your lights flash. One is to make some fairly complex circuitry. The preferred option however is to buy LEDs with built-in flashing circuits. Inside each of these there is not only a bright LED chip, but also a tiny electronic circuit that flashes the LED on and off. Flashing LEDs come in several different colours, but the red ones tend to be the cheapest, so I chose them for this project.

Another great feature of these LEDs is that they can switch a number of other LEDs on and off at the same time, providing that they are all connected in series with the flashing LED. What's more, flashing LEDs limit the current flow through themselves, so you don't even need to use resistors. This means that, for a 12 volt battery, you can have about five LEDs in total connected together and they will all flash on and off with no other parts needed.

But five lights is not enough for a Christmas tree. So, we need to have a number of parallel-connected strings of series-connected LEDs, as shown in figure one.

What you will need

Three red flashing 10mm LEDs (J)	$2.95 each
Three yellow 10mm LEDs (DS)	$0.80 each
Three orange 10mm LEDs (J)	$0.95 each
Six green 10mm LEDs (DS)	$0.80 each
One 12 volt, 1.2Ah sealed-lead-acid battery (DS)	$26.95
One 12 volt, 1 watt solar panel, model SC1 (SC)	$23.00
One small 12 way, 10 amp terminal strip (J)	$1.25
One single-pole bedlamp switch (J)	$1.70
One 13 volt, 1 watt zener diode – ZD1 (J)	$0.45
Two 1N4001, 1N4004 or similar 1 amp diodes – D1, D2 (DS)	$0.15 each
One inline fuse holder (J)	$1.10
One 500mA, 3AG fuse to suit holder (J)	$0.35
Six metres light duty, figure-8, two-core cable (J or DS)	$0.40 a metre
One metre light duty 'hook-up' wire (DS)	$0.20
Two crimp connectors to suit battery terminals (J)	$1.65 (pkt 8)
	Total: $78.25

Key: J = Jaycar Electronics, all capital cities and many dealers
DS = Dick Smith Electronics, just about everywhere
SC = SolarCorp, 259 Broadway, Broadway NSW 2007, ph:(02)566 4340, fax:(02)566 4360.

The rest of the circuit is very simple. The diode, D1, and the 13 volt Zener diode, ZD1, are connected so as to limit the terminal voltage of the battery to a safe level. This simple 'shunt' regulator prevents the solar panel from overcharging the battery and damaging it.

A Zener diode is normally connected in reverse to take advantage of its reverse voltage breakdown characteristics. In other words, when connected as in our circuit, a Zener diode will allow current to flow through it, but will have a much higher voltage drop (in this case, 13 volts) across it. If connected in the way a normal diode, such as D1, is, then it will have a voltage drop of about 0.7 volts, just like most common diodes.

This brings us back to the regulator. By connecting the zener diode and a normal power diode as above, you create a crude but effective 13.7 volt regulator (13 volts from the zener and 0.7 volts from the diode), which is a good voltage for charging 12 volt sealed-

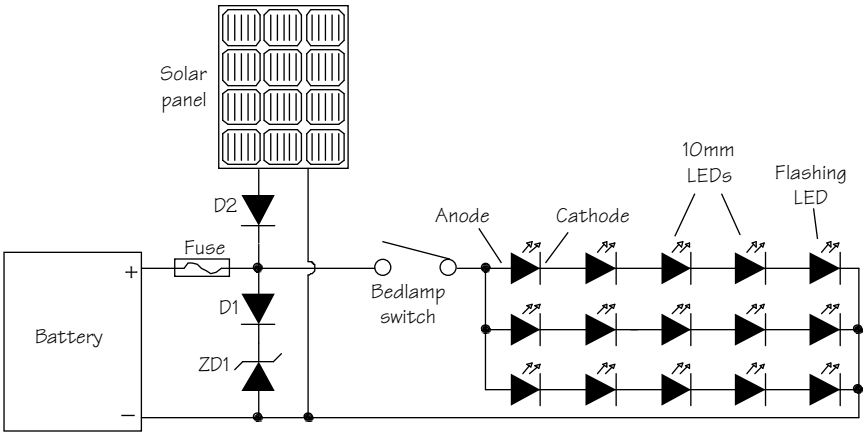


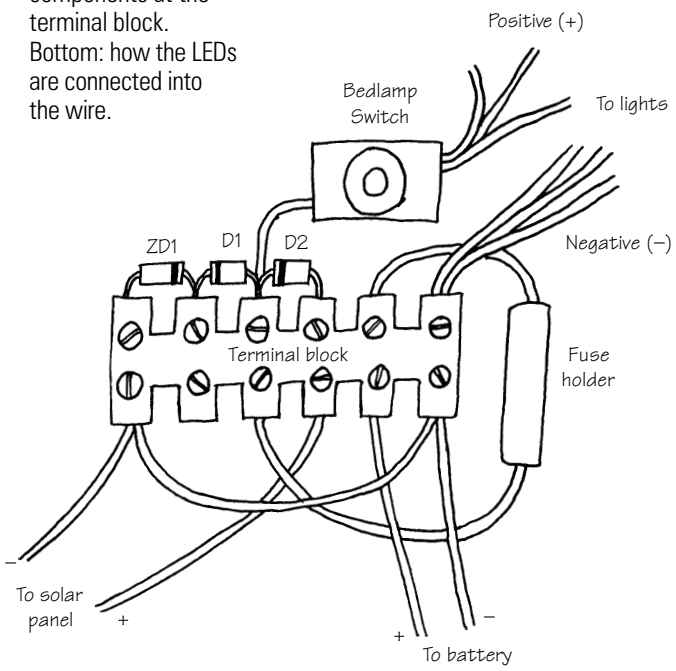
Figure 1. Wiring diagram for the Christmas tree lights, showing three parallel strings of five series-connected LEDs. Remember, when wiring the LEDs together, that the cathode, or negative lead of each LED (the one the black triangle points to in the symbol), is the shorter of the two leads. Also note that the cathodes of the zener, ZD1, and power diode, D1, are connected together.

Warning: This project requires that you have a good understanding of the safety procedures associated with working on electrical power systems. If you have any doubts as to your ability to complete this project safely, we suggest that you get help from a suitably experienced person. The publishers of ReNew take no responsibility for injury or damage caused by inexperienced people attempting this project.

lead-acid batteries. As the Zener has the vast majority of voltage across it, it will have to dissipate most of the excess power from the solar panel.

This is a fairly crude form of 'shunt' regulator, but does the job for our purpose. If you plan to use a panel larger than 1 watt, which may be a good idea if you want to use the display in the colder months of the year, you will need to use a bigger regulator. (A simple shunt regulator was described in Soft Technology #49).

There is not much else to describe. Diode D2 is there to stop power flowing back through the solar panel when it is dark. The switch is used to turn the lights on and off, while the fuse is there for safety. Even a tiny battery such as this one can provide enough power to start a fire should a short circuit occur.



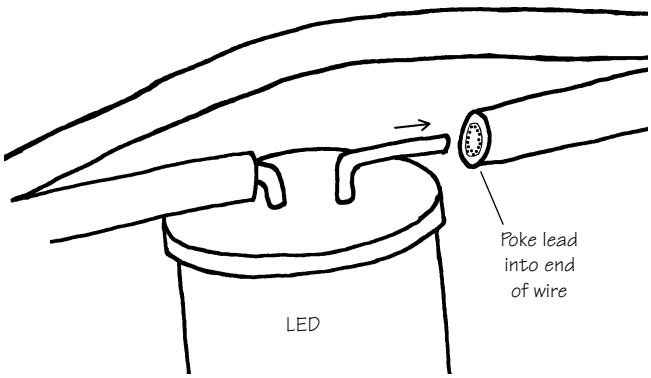


Figure 3. Connecting the components at the terminal block. Bottom: how the LEDs are connected into the wire.

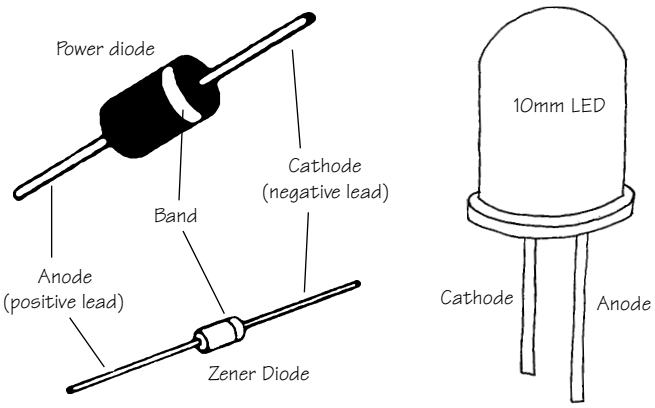


Figure 2. This is how you identify the leads of each device. The bands on the diodes are closest to the cathode.

Putting it together

The various wires and component leads are simply inserted into holes in the terminal block and the screws carefully tightened – no soldering is required. The wire ends first must be stripped with a knife or a pair of wire strippers. While no special layout is required, it is best to position the components so that the layout is neat and cables are not tangled.

The diodes, Zener diode, and the LEDs are all polarised components, which means that they have to be inserted in the circuit the correct way around. Figure 2 shows how to identify the leads. The cathode, or negative lead, is the one closest to the band on the body of the diodes. The cathode of the LEDs has the shorter of the two leads. The wiring layout I used can be seen in figure 3. It is fairly simple, and only uses half of the terminal block. The unused portion can be cut off and used for other projects.

You then need to mount the terminal block, solar panel and battery on a base board. I used a piece of MDF (medium density fibreboard) about 170mm square. The solar panel was glued to a metal bracket which was screwed to the wooden base at an angle of about 50°. The battery was glued to the board so that it also supported the solar panel.

Now comes the hardest part. Cut the cable into three 2 metre lengths. Then, at one end of each length, open up the end of each of the two wires using a drawing pin or similar tool. Then cut the leads of the LED so that they are about 5mm long. Now push the leads into the end of the cable, and bend them at right angles so that the base of the LED sits against the cable.

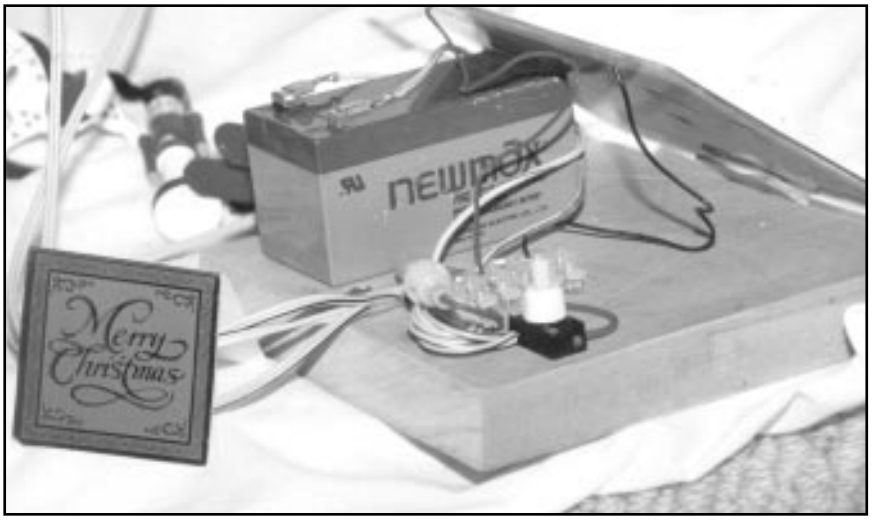
The other LEDs are inserted into the cable at 300mm intervals by separating the two sides of the cable for about 40mm with a knife and cutting through one side of the cable. Then cut the LED leads to about 5mm, insert them into the ends of the cable after opening the end with the drawing pin (making sure the polarity is correct – mark the

anode with a felt-tip pen so you don't mix them up), and then bending the leads away from each other until the cables are flush against the base of the LED.

An alternative method is to solder the wires to the LED leads instead of inserting the leads into the cable ends.

Once all the LEDs are mounted in the cables, seal the connections with hard-setting glue. I used hot-melt caulking compound. This insulates the bare connections, stops the cables from moving on the LED leads and strengthens the cable.

Now connect the cables to the terminal block, making sure of the polarity or the lights won't run. Double-check your work and connect the battery leads to the battery. Most small lead-acid batteries have push-on connectors. You will need to crimp one onto the end of each battery lead. Use a crimping tool made for this purpose, but if you don't have one, a pair of pliers may be used.



Here is the board with all of the components mounted onto it. As you can see, there is very little to it. Note how the battery is used to support the solar panel.

Alternative energy

As an alternative way of powering your Christmas lights, you could use a 9 or 12 volt DC plugpack in place of the battery. This would require that you connect the wires from the plugpack to the terminal block in place of the leads from the battery. You would also leave out the diodes D1 and D2, the Zener diode and the solar panel.☼

We would like to thank Dick Smith Electronics for donating the battery used in this project.

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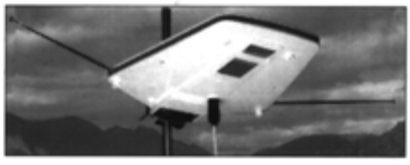

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This antenna has its own built in signal booster (masthead amplifier) and runs on 12VDC (not 240VAC) and current draw is only 65mA at 12V. The antenna is a plastic UFO looking arrangement with two telescopic antennas which extend from the rear. (These help pick up channel 10). Cable is supplied (6 metres) from the antenna to the amplifier. The amplfier is also a splitter, so two TVs can be run from it. Amplifier has an on/off switch and LED on it. Mounting bracket also supplied. •Actual gain: 470-890Mhz 20-24dB / 40-260Mhz 24-26dB
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Products

Earth wall forms

Building walls of stone, concrete, poured or rammed earth is much easier using the Wallbuilder Forms wall formwork system.

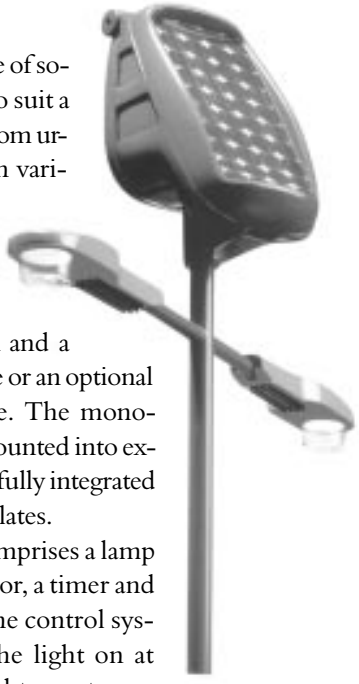
The forms comprise frames, bracing and clamping arms, and side panels. The frames and arms are made of tubular steel, while the side panels are made of 15mm structural plywood or 17mm form ply. The arms are used to connect the two sides, creating a rectangular box which is then filled with concrete, rock or earth. To build the next layer, the forms are then moved further up the wall and clamped to the wall section that has just been built.

Various sizes of form are available, from 1.2m long by 400mm deep, to 1.8m long by 600mm deep, while a 900mm deep form is expected to be available shortly. The forms can be adjusted to build walls from 110 to 450mm thick.

rrp from $250 to $480 depending on size.

For further information contact Wallbuilder Forms on ph:(02)9570 2231, fax:(02)9570 3169 or write to PO Box 247, Oatley NSW 2223.

Solar lighting



Showers Solar now have a range of solar-powered outdoor lighting to suit a range of outdoor applications, from urban parks to remote areas, with various styles to suit each application.

The systems comprise solar modules, an electronic controller, luminaires, a battery bank and a hot-dipped galvanised steel pole or an optional marine-grade aluminium pole. The monocrystalline solar modules are mounted into extruded aluminium frames with fully integrated steel and aluminium backing plates.

The integrated controller comprises a lamp inverter, battery charge regulator, a timer and battery temperature sensor. The control system automatically switches the light on at dusk or on demand and the light can stay on from between fifteen minutes to all night. Four different types of luminaires are available, including a heritage classical style.

The units can be programmed independently so that not all lights need to switch on or off at the same time. The ability to run the luminaires solely from mains power or a combination of solar and mains power sources is another advantage.

rrp depends on the application and style required.

For further information contact Showers Solar on ph:(03)9827 5666, fax:(03)9827 5700 or ph:(02)9793 9900, fax:(02)9793 9377 or freecall 1800 684 111. They also have offices in Adelaide, Brisbane, Cairns, Darwin and Perth.

Tandem recumbent trike

Greenspeed recumbent bikes and trikes have light, accurate steering, greater comfort and superior brakes in comparison to many conventional bikes. While the Greenspeed recumbent tandem touring trike has been designed to take two riders up to six feet tall, the wheelbase can be reduced to virtually any size rider.

The trike is fitted with twin Sachs hydraulic disc brakes and 63 speed gears. A rear mudguard, rack, mirror and safety flag are standard fittings. Greenspeed have even made a full tandem trike with a child trailer.

The larger, reclining hammock-type seat not only eliminates sore bums and aching wrists and shoulders, but also allows ventilation and cooling of the rider's back. It is also laced with elastic cord for insulation from road shock.

Safety features include fluorescent-coloured frames and safety flags for enhanced visibility.

rrp $6,000

For further information contact Ian Sims on ph:(03)9758 5541 or fax:(03)9752 4115.

Creative timber veneers

Enviroven is an earth-friendly timber veneer which is a substitute for conventional and exotic timbers. It is made of timber from sustainable plantation-grown poplars and is available in an extensive range of grains, shades and colours.

Enviroven comes in four forms, Enviroven 1 and 2, Navcord and Navlam. Enviroven is produced in veneer leaves suitable for use in all interior applications, such as reception areas, kitchen facades, shops, restaurants and table tops.

Navcord has a backing of phenolic kraft papers, enabling the veneer to be affixed to a substrate using contact adhesives. Navlan has the same backing as Navcord but it comes with the surface impregnated with melamine resin, giving a finish similar to standard laminates.

rrp $15.20 per square metre for conventional grains and around $40 for exotic grains.
For further information contact New Age Veneers Pty Ltd on ph:(02)9987 4033, fax:(02)9477 6776 or ph:(03)9357 1875, fax:(03)9359 6396.

Power off the grid

For anyone who wants the independence of having their own power station, or where connecting to the mains electricity grid is too expensive, the Eco-pack may be the answer. Made by South East Energy P/L, the system comes in a compact colorbond housing that protects it from the elements and allows easy transportation to virtually any location.

A major benefit of the Eco-pack is its flexibility. Both solar panels or a generator may be used as the primary power source, with the other used as the backup. There are several choices of generators, including a Powerlite or Lister water-cooled diesel or a compressed natural gas powered model.

The Eco-pack can provide from three to fifteen kilowatt-hours of power per day to meet home or business needs.

rrp approximately from $16,000 depending on power needs and desired components.
For more information contact South East Energy Pty Ltd on ph:(044)74 2993 or fax:(044)74 4890.

Intelligent solar regulator

The SolarReg is a microprocessor-controlled solar regulator developed by Psi-Niax, an Auckland, NZ based company. This regulator has many features claimed to place it well ahead of similar devices for regulating power from solar panels.

The SolarReg provides monitoring of the battery, solar panel and regulator in real time. All the charging parameters can be easily modified for customising to a particular installation. A windows-based data-logging application is included with the regulator, allowing data analysis and parameter modifications to be carried out. The software communicates with the SolarReg via an RS-232 serial port which even enables remote communication via a modem.

Parameters such as battery voltage, photovoltaic current, temperatures and amp-hours per day can be graphed in real time, and all information can be transferred into a spreadsheet program. There is also an alarm output which can be used to start a generator or to disconnect an external load.

rrp A$540 and A$140 for the data-logging module. For further information contact Psi-Niax Ltd on ph/fax:+64 9 377 7624, write to PO Box 68656 Newton, Auckland NZ or view their web site at: http://www.psi-niax.co.nz

Products

Solar camping oven

There are many advantages in using a solar oven, such as retaining food nutrients, saving on power bills and eliminating harmful pollution. Jura Sol now have a two-third sized solar oven that is ideal for camping .

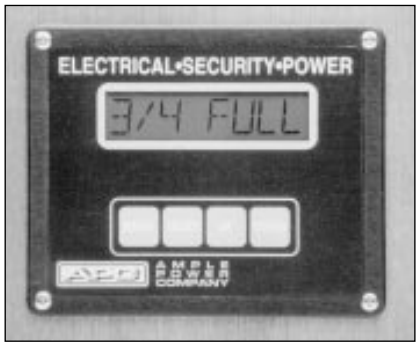
The oven can be used for steaming, boiling, stewing, roasting, simmering and baking. The sun's rays are trapped beneath the double-glazed cover while additional sunshine is reflected by the adjustable lid. Temperatures up to 150°C can be generated.

The exterior is constructed from radiata pine and waterproof plywood and remains cool to the touch, while the cooking mould is made from 0.6mm thick aluminium sheeting coated with oven paint.

The oven has a polycarbonate cover which is lighter than glass yet virtually unbreakable. It is 500x 530 x 400mm in size and weighs 9kg.

Jura Sol also have a table with a rotating top to allow the oven to be turned easily to face the sun.

rrp $295 to $350 (including postage and handling) depending on the size and model. For further information contact Jura Sol Industries on ph/fax:(063)37 4104 or write to 'Jura Heights', Gowan NSW 2795.



Energy monitor

By completely monitoring one or two battery banks the Emon II battery monitor provides protection of expensive batteries in your RAPS system. There are two versions, a one battery-bank unit, the H1, and a two bank unit, the H2.

The H1 measures voltage, current and temperature of the batteries, voltage for the generator starter battery and has an optional auxiliary input which can be used to measure the current and accumulated amp-hours produced by the solar panels and other sources.

The H2 measures voltage, current and temperature for two house battery-banks. The alarms for both banks cover high and low battery voltage, full charge, as well as 50 percent discharge and high temperature alarms for one or both battery banks. Both the H1 and H2 can display amp-hours consumed and remaining battery charge.

The alarm set points are programmable, allowing them to be set at meaningful values in relation to the particular battery. All data, including that from programmed functions, is saved in non-volatile memory, and can be downloaded to a PC for later analysis.

The Emon II has other features including individual enabling or disabling of the alarms and automatic generator controls.

rrp $707.21 to $773.88 depending on the model.
For further information contact Ample Power Technology on ph:(059)71 4802, fax:(059)71 4744 or write to PO Box 846, Frankston VIC 3199.

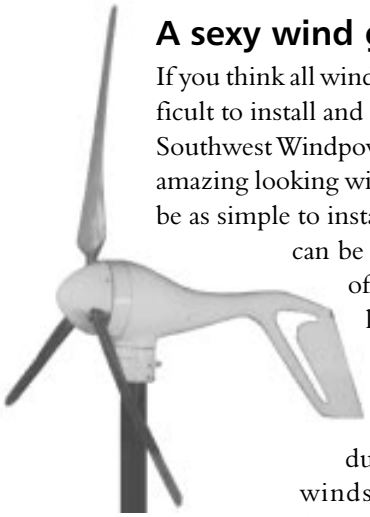
Double glazing

Keeping heat in the room in winter or out in summer can be a real problem. Double glazing offers an effective means of insulation, particularly in conjunction with other methods. Miglas Windows by Absolutely Solar provide double glazing, in an attractive aluminium and timber or all timber frame.

The external frame is maintenance-free extruded aluminium while the interior is kiln-dried hardwood. High-performance glass is used to maximise insulation while maintaining good lighting levels. For higher heat protection, Azurlite glass absorbs 90 percent of solar infrared while still allowing high levels of daylight to pass through.

rrp depends on the application and style required.
For further information contact Clency Bernard of Absolutely Solar on ph/fax:(03)9439 4829 or write to 16 Arcadia Way, Eltham North VIC 3095.

A sexy wind generator?



If you think all wind generators are complex and difficult to install and maintain, then the Air 303 from Southwest Windpower may change your mind. This amazing looking wind turbine has been designed to be as simple to install and operate as solar panels. It can be mounted directly onto the roof of a house, without the need for a large tower.

The Air 303 has been designed to provide up to 375 watts of power, with 300 watts being produced at 12.5m/s. It can operate in winds of up to 110 knots (nearly 200km/h) without any attention required.

Two output voltages are available to suit both 12 and 24 volt systems. As the generator contains its own adjustable voltage regulator, the turbine can be connected directly to the battery via a fuse without the need for a separate regulator.

The Air 303 has only two moving parts, is designed never to need maintenance, and is also available in a fully marinised version.

rrp $1195 or $1495 for the marine version.
For more information, contact Precision Wind Technology, PO Box 147, Tugun QLD 4224, ph:0411 224 807, fax:(07)5598 1710.

RAPS battery

The Sunlyte 12-5000x battery is a sealed-lead-acid battery designed for solar applications. It has a nominal rating of 12 volts, 100 amp-hours at the 100-hour rate.

As the battery is sealed, it never requires addition of water, is spillproof and leakproof, can be operated horizontally or vertically, operates at low internal pressure and produces no gases under normal charging. The battery is tolerant to freezing, can be deep discharged and has a life of 600 cycles at a 50 percent depth of discharge.

The Sunlyte measures 307L x 175W x 221H and weighs 27kg.

rlp $310 plus tax if applicable.
For further information contact GNB Battery Technologies on ph:(02)9722 5700, fax:(02)9774 2966, or ph:(03)9763 7700, fax:(03)9763 0900.

Stand-alone power

When connection to the mains grid is too expensive or simply not desired, the PowerOn independent energy system from Energy Australia makes a great alternative. It is a solar/diesel hybrid integrated system, designed to use solar power as the primary energy source.

Energy from solar panels is stored in a bank of batteries and supplemented, if needed, by power from a relatively quiet, automatic diesel generator. An inverter converts the battery power into 240 volt AC power.

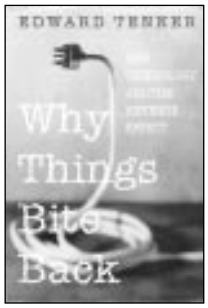
Households using an average of about six kilowatt hours a day can typically expect the generator to run for one hour per day in summer and three hours per day in winter, with diesel costing about $40 per month. The unit will accommodate short-term surge loads such as the washing machine or vacuum cleaner motor starting without the need to start the generator.

rrp is approximately $30,000 including installation and free energy audit and initial consultation. For further information contact Energy Australia on ph:(049)519 384, or contact Cox Inall Communications on 019 461 601.

Reviews

Why Things Bite Back: New Technology and the Revenge Effect

Edward Tenner
Fourth Estate, 1996
346 pp, RRP $39.95 (hardcover)
ISBN 1-85702-560-1



Edward Tenner's book will be of interest to anyone who is doubtful that new technology alone will be the panacea to the many problems facing our society.

Tenner asks the sorts of questions that will make even the most ardent techno-phile nervous (fortunately he also supplies answers). For example, given the great advances in computer technology, why are our offices still heavily reliant on paper? Or how has the use of antibiotics contributed to an increase in lethal bacteria? Or why does dieting result in some people gaining more weight than they originally started with?

The revenge effect occurs when there are unanticipated repercussions from the introduction of new forms of technology. Whilst one problem may be resolved, there is always the chance that another, maybe more serious one will replace it. Asbestos is an example of a technological product that bit back. Long renowned for its ability to offer protection from fire and heat, it took a long time to discover its darker side. It was only in the 1980s that asbestos was confirmed as the cause of mesothelioma (a particularly nasty type of cancer).

Parts of the book have been devoted to different aspects of modern life. Each of these sections contain detailed discussion about the backlashes brought about by technological advancements. There are chapters on medicine, environmental disasters, pests (both animal and vegetable), the computerised office, and sport. The book also contains copious notes, as well as a large number of references for further reading.

– Tony Stevenson

Eco-eating: a guide to balanced eating for health & vitality

Sapoty Brook
Lothian, Melbourne 1996
$19.95

Perpetual grazing is the way to eat according to Sapoty Brook, and the only healthy food to graze on is raw fruit plus small amounts of raw vegetables and meat.

Brook – who calls cooking 'mutilation' – says that all foods contain four primary minerals which he calls the CaPNaK minerals: calcium (Ca), phosphorus (P), sodium (Na) and potassium (K). He claims the concentration of these substances in the body affects the balance of the 'body-mind' causing tension or relaxation, warmth or cold, and so on.

Achieving this balance is supposed to be simple, using what the book blurb calls the 'easy-to-follow CaPNaK chart'. The idea is to eat something from one corner of the chart and then balance it by eating something from the other side. I found it very difficult to follow and, when I discovered information about *software* to help readers calculate their CaPNaK residues, I decided that I probably wasn't stupid – and it probably wasn't simple.

This book contradicts much of what the 'food experts' currently espouse, and usually without supporting evidence. Readers are expected to believe that meat, dairy products and grain are 'unhealthy foods' just because Brook says they are. *Eco-eating* is a strange mixture of unsubstantiated claims, new-age philosophy and scientific-looking charts and figures.

Among the claimed benefits of the 'fruitarian' diet is beauty: 'It is no secret that most of the beautiful people we see in film and print eat large amounts of raw food.' (He doesn't mention cosmetic surgery, personal trainers or body doubles.) Another supposed benefit is 'additional longevity of 10 to 40 years'; without an anecdote about even one ancient fruitarian.

The daily food bulk for this lifestyle is *enormous*. Here's the diet recommended for an *inactive* day (add another 28 pieces of fruit if you want to exercise): 4 bananas, 3 oranges, 250g broccoli, 3 kiwi fruit, 1¼ avocado, 1 peach, 500g green-leaf vegetables, 2 plums, 300g grapes, 1 rockmelon, 25g nuts. Those with higher calcium requirements need an extra kilo of green leaf vegetables daily.

The Australian recommended daily intake is between 8,000-13,000 kilojoules per day for an adult, (depending on age, sex, weight and height) but Brook recommends 6300-8500 kilojoules. He calls this 'undernutrition, not malnutrition', but points out that missed periods are quite common for women on a fruitarian diet, and even suggests this as 'an excellent substitute for contraception'. It's also a common symptom of insufficient kilojoule intake.

A potential fruitarian problem which does get a mention is vitamin B12 deficiency which can produce brain damage similar to alcoholism. (Brook recommends eating the bugs, slugs and weevils in your vegies to prevent this.)

Many books have been written about healthy nutrition. Readers who are interested in becoming fruitarians would do well to read some other publications on balanced eating rather than relying on this – or any other single – theory.

– Claire Beaumont

Building a Domestic Windpump

James Barr
£4.99, 50 pp
ISBN 1 870653 29 7
Available by mail from the Centre for Alternative Technology, Machynlleth, Powys, SY20 9AZ, England.
Web site:
http://www.foe.co.uk/CAT

This book details the construction of a wind-powered water pump suitable for low volume uses.

Building a Domestic Windpump covers the construction of the apparatus step-by-step, giving detailed

descriptions of the individual parts required to make the wind pump, from the turbine assembly to the water pump itself, all using cheap and easily obtained parts.

There are plenty of clear, well-drawn diagrams, although I found some of them a little busy until I broke them down into individual sections. The descriptions and instructions are also fairly clear, although some paragraphs take a couple of reads to clarify some of the ideas and designs.

The book progresses from basic design and siting principles to design specifics, such as the turbine blades, turbine head, drive shaft and pump. It concludes with sections on water storage and general maintenance of the system.

The pump described in this book would make an ideal pump for a garden water feature, or as detailed in the book, could be used for pumping greywater from storage tanks onto gardens for irrigation.

I found this an interesting and potentially useful publication. While parts are a little hard to follow at first, with perseverance the average 'tinkerer' should be able to construct a useful piece of equipment for little cost.

– Lance Turner

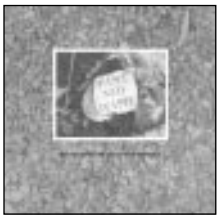
Waste Not Waste

Tony Fry & Anne-Marie Willis (eds)
EcoDesign Foundation 1996
96pp. $19.95 from bookshops
$17.96 from EcoDesign Foundation: PO Box 369, Rozelle, NSW, 2039 (+ $2.00 post in Aust, $6.00 o/s)
ISBN 0 646 27604 2

'The "waste problem" is one of thought and cultural categorisation rather than of materiality.'
— Tony Fry

Somewhat philosophical in nature, this book looks at recognising waste in all its forms, from the material to the conceptual. The six essays within this book are sure to provoke thought on what waste is and how we (ab)use it.

Waste, according to co-editor Tony Fry, is a cultural problem. In part he argues that whilst waste management is a good short term measure, in the long-run this mode of thinking creates its own form of economy. This in turn leads to the production of waste in order for it to be recycled, thus perpetuating a 'false' economy.



By challenging the way that we look at objects, our culture and our lives, *Waste Not Waste* asks us to look at the cliche 'One person's trash is another person's treasure' and asks us to redefine just what we mean by trash and treasure.

Though not overly practical in nature *Waste Not Waste* will help to generate ideas and concepts about how we define waste and in turn manage our resources.

The book includes black and white photographs of sculptures made as a response to the first two essays in the book.

– Neil Blenkiron

Reviews

How to build your own ferrocement water tanks

Instructional video + book
$39.95 + $3 POST
JOHN GILPIN
BOX 727G, Maleny, Qld 4552

For those of us not connected to a public water supply, a water storage tank is a vital part of life, and a very expensive item! But John Gilpin explains a method whereby you can build your own water tank for a cost as low as 40 percent of a commercially built one, and gain skills, confidence and a lot of satisfaction.

John Gilpin has produced a well tested video of the actual construction of a 20,000 litre tank. (About 4,500 gallons.)

The production is certainly not slick TV documentary style with a glamourous presenter rabbiting on about something they have never actually done. John does a great job of his own commentary, making the video more personal and authentic.

Ferrocement is an ideal material for the amateur. Basically it is a waterproof sand and cement mortar manually applied onto a wire framework. It is easy, cheap, strong and permanent. Ordinary tools and handyman skills are all that is required, and once you have been alerted to a few potential traps for the beginner and have understood the process you are ready to sail into the project. You will probably think of many other applications for ferrocement around the property. The technique can be used for walls and roofs of outbuildings, or even for house construction.

The tank design, selection of materials, site preparation, and method and sequence of building are carefully described. I particularly like the part on how to recognise good and bad materials, the design of the clean-out drain, and the method of keeping dirt and unwanted animal visitors out.

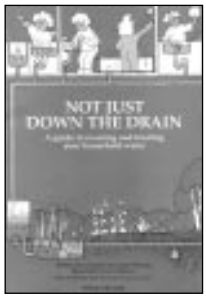
If you have not worked much with concrete before, you will find this a large and challenging project. There is quite a lot of labour involved, a lot of material to be handled, and some skills to be acquired.

With the help of this excellent video you should end up with a better quality tank, more features, and cleaner water than is possible with any commercially built tank I have seen.

– Monty Russell

Not Just Down The Drain: A Guide To Re-using And Treating Your Household Water

Stuart McQuire
Friends of the Earth, 1995
59 pp $11.60
ISBN 0 646 22478 6



This concise publication contains a wealth of information about better water management around the home. It was published with funding from Melbourne Water, and the goal is to educate people about water consumption and the associated health issues, risks, and benefits to be gained from re-using water.

Not Just Down the Drain is based on seven steps aimed at developing a personal water strategy. The steps are divided into chapters, and each chapter gives simple and practical instructions on calculating various aspects of water usage. For instance, chapter one helps you determine where your used household water goes, chapter two explains how to work out the amount of waste water your household produces, while other chapters deal with reducing, safely purifying and reusing water used in and around the home.

The final chapter lists organisations that can offer advice about water conservation. It is a somewhat localised list (the book is sponsored by Melbourne Water), but many of the contacts listed should be able to direct interstate callers.

The book concludes with a section devoted to case studies and management issues, and includes valuable references for further reading. *Not Just Down the Drain* is suitable for anyone interested in water management, whether they live in a house or a flat, in the suburbs or the country.

– Tony Stevenson

Food With a Future

Gladys Roach
Aird Books, Melbourne, 1996
$12.95

Food With a Future is a delightful cookbook, full of tempting recipes and based on a refreshingly sensible food philosophy. In a foreword to the book, author Gladys Roach writes, 'When I was young we used to say, "eat, drink and be merry – for tomorrow you may die." Nowadays we mostly hear, "Don't eat this and don't eat that – or tomorrow you will die." Being merry seems to have gone off the menu altogether!...The aim of this book is to bring back pleasure to eating and interest and satisfaction to cooking...'

The recipes are drawn mainly from Asian and Mediterranean 'peasant' cultures, using lots of rice, pasta, fruit, vegies and pulses combined with small quantities of dairy products, meat and fish. There is plenty of inspiration here for both omnivores and vegetarians.

My only quibbles with this book are that serving quantities are not indicated (the recipes I tried fed three to four people happily), and 'exotic' ingredients such as *sambal oelek* (a Malaysian chilli paste) are not always explained.

Fortunately, most ingredients are easily identified and obtained. I was pleased to also see that the author is not against the odd pre-prepared item (eg frozen puff pastry, tinned tomato puree) to save time or effort.

At $12.95 this collection of delicious, imaginative recipes is excellent value and well worth having on your kitchen shelf.

– Claire Beaumont

Noel's treasures from trash

fun things for clever kids to make

To make this **simple electric motor** you will need:

- a D-size battery
- two plain paper clips
- a strong rubber band
- a small flat magnet
- 3.5 metres of enamelled copper wire, about 0.5mm thick
- some sticky tape
- two match boxes
- a pair of long-nose pliers

How it works

As the current from the battery flows through the coil, it produces a magnetic field that pushes the coil away from the magnet. Once the coil has rotated far enough, the insulation left on the wire cuts off the power. The coil freewheels until it has rotated to the point where current starts flowing again and the whole cycle repeats.

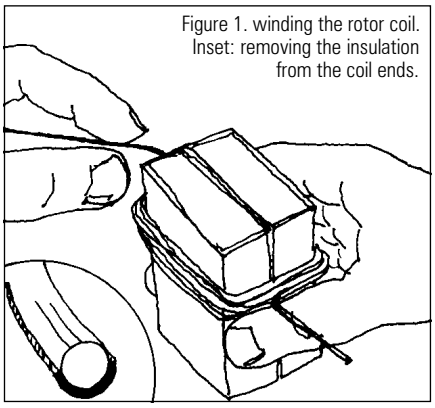


Figure 1. winding the rotor coil. Inset: removing the insulation from the coil ends.

The armature, or rotor of the motor is made of a single coil of wire, wound around two match boxes to create the required shape. Starting about three centimetres from the end of the wire, start winding the coil until all the wire is used. You will need to finish the coil with the other end of the wire on the opposite side of the coil to where you started. You can see how to do this from figure 1.

Now remove the match boxes and tape the coil in several places so it can't unwind. Scrape off the insulation halfway around each end of the wire, as shown in the inset in figure 1.

Tape the magnet to the centre of one side of the battery. Straighten out both paperclips, and using the long-nose pliers, make small circular loops at one end of each one, about 3mm in diameter. At the other end of each clip form a loop about 10mm in diameter.

Place the rubber band around the battery, running longwise so that it goes across each of the battery terminals. Slip the large loops of each of the paperclips under the rubber band so that there is one paperclip attached to each end of the battery.

Now slide the coil into place through the small loops in the paperclips and adjust the clips so that the coil is parallel to the battery and the magnet is directly beneath the centre of the coil. You should now be able to start the motor by giving it a gentle flick. If it stops, try flicking it in the other direction. You may also need to flip the magnet over so that the other pole is facing upwards. ☼

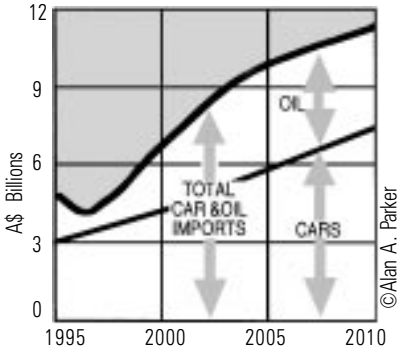
Running low on time and oil

The 'Cars of Tomorrow' article (*Soft Tech* Jul-Sept 96) was well timed, as the Australian car plan will soon be revised and people need to know just how practical it is to produce electric vehicles today. There are also compelling economic and environmental reasons for the mass production of a national electric car.

By the year 2002, car and oil imports together will add $8 a billion a year to the balance of payments problem. By 2005 this will increase to $10 billion, at which time our cities will be more congested and polluted. Furthermore, Australian oil reserves will only last another 13 years. The Federal government, while wrecking the public service in the name of economy, is doing nothing to reduce car and oil imports. A new car plan is needed that recognises the importance of energy efficient, clean cars to both the Australian economy and the urban environment.

Left to themselves, drivers will enjoy the free ride provided by tax perks for company cars and low fuel prices. This is why half a million new cars are bought every year and most of them are bigger, faster, dirtier and emit more carbon dioxide than necessary. The car industry makes cars that are environmentally obsolete. However, with some protection and restructuring the industry is capable of producing cleaner, more fuel efficient cars to slow oil imports and reduce car imports by around $4 billion per year by 2005. In the short term cars consuming only three to four litres of petrol per 100 kilometres are practical. In the longer term an unconventionally powered, virtually pollution free Australian car would be possible.

Cost of imported cars and petroleum: 1995 to 2010



Data Source: *Oil imports & prices from Oil and Australia forecasts 1996.2005* AIP supplement to Petroleum Gazette 1996/1. Car imports projected from assuming FOB average car cost of A$14,070

The false economies of the current and previous Governments have denied Australian car manufacturers a potential future at the cutting edge of new technology and have generated a large demand for imported cars. There are no policies that will put more people on public transport, on bicycles, or in shared cars.

By 2007 world oil supplies will have peaked and the price of imported oil will greatly increase. For fifteen years this country has been driven down the gas guzzling road that leads to economic suicide in the long term. The time has come to 'green' the car industry and demand that renewable energy technologies are taken seriously.

– Alan A Parker

Government halts EnergyCard promotion

The Sustainable Energy Industries Council of Australia (SEICA) is lobbying the Federal Government to continue promotion of EnergyCard, a low interest credit scheme to help individuals purchase renewable energy products.

The Howard Federal Government ceased funding of EnergyCard promotion in June, even though there is still between $1-$2 million left in the 1995-96 promotional budget.

The scheme, which is backed by the Macquarie Bank and AGC, makes renewable energy systems and energy-saving products affordable. It also has the potential to reduce our domestic pollution problems. As SEICA executive officer Carrie Sonneborn explains, 'If these campaigns ran nonstop, Australia could easily achieve a massive reduction in greenhouse gas emissions.'

Australia's international reputation has suffered recently as our government drags its feet on committing to greenhouse gas reductions. The EnergyCard represents a low cost method (both politically and financially) for tackling our huge greenhouse problem.

Sixty percent of EnergyCard purchases to date have been for insulation, with solar hot water making up the majority of the remainder. Publicity for the launch of the EnergyCard in mid 1995 generated record sales of solar hot water systems.

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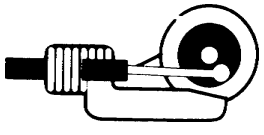

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What's on

Send your *What's on* event listings to *ReNew* (formerly Soft Technology), 247 Flinders Lane, Melbourne 3000, or Fax:(03) 9650 8574

Eco-village Design Workshop

☼ 16 – 22 September, 1996

Permaculture Village, Maleny QLD

Focuses on projects such as land trusts, co-housing, group title or multiple occupancy housing.

Contact: Green Harvest, 52 Crystal Waters Permaculture Village, MS16, Maleny QLD 4552, ph:(074)94 4676, fax:(074)94 4578.

World Solar Summit

☼ 16 – 17 September, 1996

Harare, Zimbabwe

This year's summit will focus attention on solar energy, with particular emphasis on its possibilities for supplying energy to rural areas of developing countries.

Contact: World Solar Summit Secretariat: UNESCO Engineering and Technology Division, att. Boris Berkovski & Richard Wyhn, 1 rue Miollis, 75732 Paris Cedex 15, France, fax:+33 1 4065 9535, ph:+33 1 4568 3900.

SRD Talk

☼ 6.30pm, Thursday 19 September

Institute of Engineers Australia, Ground floor, 118 Alfred St, Milsons Point NSW

This talk, 'Revolutionary Furniture and Textiles – Reforming the manufacture and design of office furniture and textiles by utilising new processes and recycled materials.'

$10 SRD members, $5 concession, $20 non-members, $10 concessions.

Contact: SRD on ph:(02)564 0721, fax:(02)564 1611.

Electric Vehicle Field Day

☼ 20 September, 1996

Amaroo Park, Anangrove, NSW

Demonstrations of road-going cars, suppliers' displays and more.

Contact: Pat Berry on ph:(02)488 8423.

Permaculture Conference

☼ 28 September – 7 October, 1996

Perth, WA

The theme is 'Designing for a Sustainable Future', with a focus on 'Earth care', 'People care' and 'New economic strategies'.

Contact: International Permaculture Conference, PO Box 568, Kalamunda WA 6076, ph:(09)291 9306, fax:(09)291 9978 or email:ipc6-1996@iinet.net.au.

Renewable Energy Asia Pacific '96

☼ 7 – 9 October, 1996

Manila, Philippines

This conference provides a forum for renewable energy manufacturers to showcase their latest products.

Contact: Alternative Development Asia Ltd, 5F 3 Wood Rd, Wanchai, Hong Kong, ph:+852 2574 9133, fax:+852 2574 1997.

Open House Day

☼ Sunday 13 October

Briagolong Mechanics Hall, VIC.

Open house day, conducted by Briagalong Primary School and Maffra Avon Owner Builders Association, including a field day with displays relevant to owner builders.

Contact: Briagolong Primary School on ph:(051)45 5260, MAOBA on ph:(051)45 5551.

Ararat Alternative Farm Expo.

☼ 19 – 20 October, 9.30am – 5.00pm

Ararat Harness Racing Complex

Displays of alternative farming techniques and equipment.

Contact: Andrew Gubbins on ph:(053)52 1495.

Urban Living

☼ Sunday, 20 October, 9.30am

Randwick Community Centre, 33 Bundock Street, Randwick

Discussions on recycling, retrofitting, energy-efficient design, water conservation and re-use, plus demonstrations and hands-on workshops. Cost: $15 or $12 for members.

Contact: Godfrey Davies ph:(02)9436 0173.

Solar '96

☼ 22 – 25 October 1996

Darwin, NT

This conference includes a number of speakers from both Australia and overseas.

Contact: Conference Secretariat, GPO Box 1392, Darwin NT 0801, ph:+61 8 8999 5440, fax:+61 8 8999 5289.

1996 World Solar Challenge

☼ Sunday, 27 October, 1996

Darwin, NT

The world's most highly regarded solar vehicle race is on again. Six classes, with entries costing as little as $30,000 expected.

Contact: Hans Tholstrup, ph:(02)9988 4255 or Jo Pocklington, ph:(055)93 9277.

World Solar Cycle Challenge

☼ Sunday, 27 October 1996

Darwin, NT

To be held in conjunction with the World Solar Car Challenge. Includes recumbent cycles and production three and four wheel classes.

Contact: Energy Promotions on ph:(02)9988 4255, fax:(02)449 8767.

Velo Australis

☼ 28 October – 1 November 1996

Fremantle, WA

Features speakers from around the world, dealing with the theme of 'Bicycles: A global solution to local problems.'

Contact: Promaco Conventions, ph:(09)364 8311, fax:(09)316 1453, Email:promaco@cleo.murdoch.edu.au

Electric & Solar Vehicle Conference

☼ 4 – 5 November, 1996

Adelaide, SA

This conference is an opportunity to exchange ideas and information relating to sustainable vehicle energy solutions.

Contact: Myriad Conference Management, PO Box 8178, Hindley St, Adelaide SA 5000, ph:(08)387 3877, fax:(08)322 6290, email:myriad@adelaide.dialix.oz.au.

Low-tech Waste Management

☼ 27 November, 1996

Lismore, NSW

A seminar dealing with low-tech, on-site waste and waste water management systems.

Contact: Leigh Davison, Southern Cross University, PO Box 157, Lismore NSW 2480, ph:(066)20 3000, fax:(066)21 2669, email:ldavison@scu.edu.au

Solar Cooker Conference

☼ 6 – 10 January, 1997

Tamil Nadu, India

This third international conference is aimed at promoting the use of solar cookers in both Third and Western World countries.

Contact: Solar Cookers International, 1724 Eleventh St, Sacramento, CA 95814 USA, ph:+ 1 916 444 5379, fax:+1 916 444 6616, email: SBCI@igc.apc.org

Earthlinks '97

☼ 13 – 17 January

University of Tasmania, Hobart

Aimed at bringing together environmental educators to explore ways of reconnecting with the Earth, while giving participants the chance to experience Tasmania's unique environment.

Contact: Nel Smit, Education programs, Dept. of Education, GPO Box 919, Hobart TAS 7001, ph:(002)33 7725, fax:(002)33 6980, email:cs_nel@ecc.tased.edu.au.

Great Southern Sunrace

☼ 24 – 28 January, 1997

Adelaide to Melbourne

First annual solar car race from Adelaide to Melbourne via Elizabeth, Peterborough, Broken Hill, Mildura and Bendigo.

Contact: Sustainable Energy Enterprise Developments, phone:(03)9820 9032, fax:(03)9820 2027.

Pathways to Sustainability

☼ 2 – 6 June, 1997

Newcastle, NSW

Final phase in an international review of Local Agenda 21, with the outcomes presented to a special session of the UN in late June.

Contact: Conference Secretariat, Pathways to Sustainability, PO Box 489, Newcastle NSW 2300.

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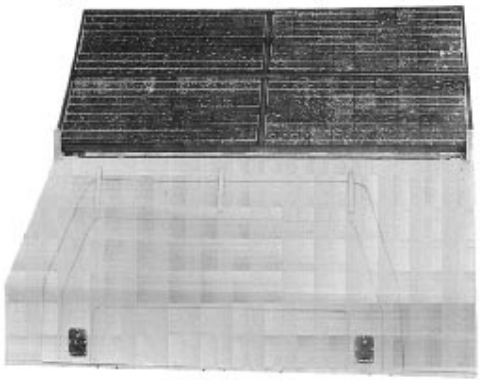

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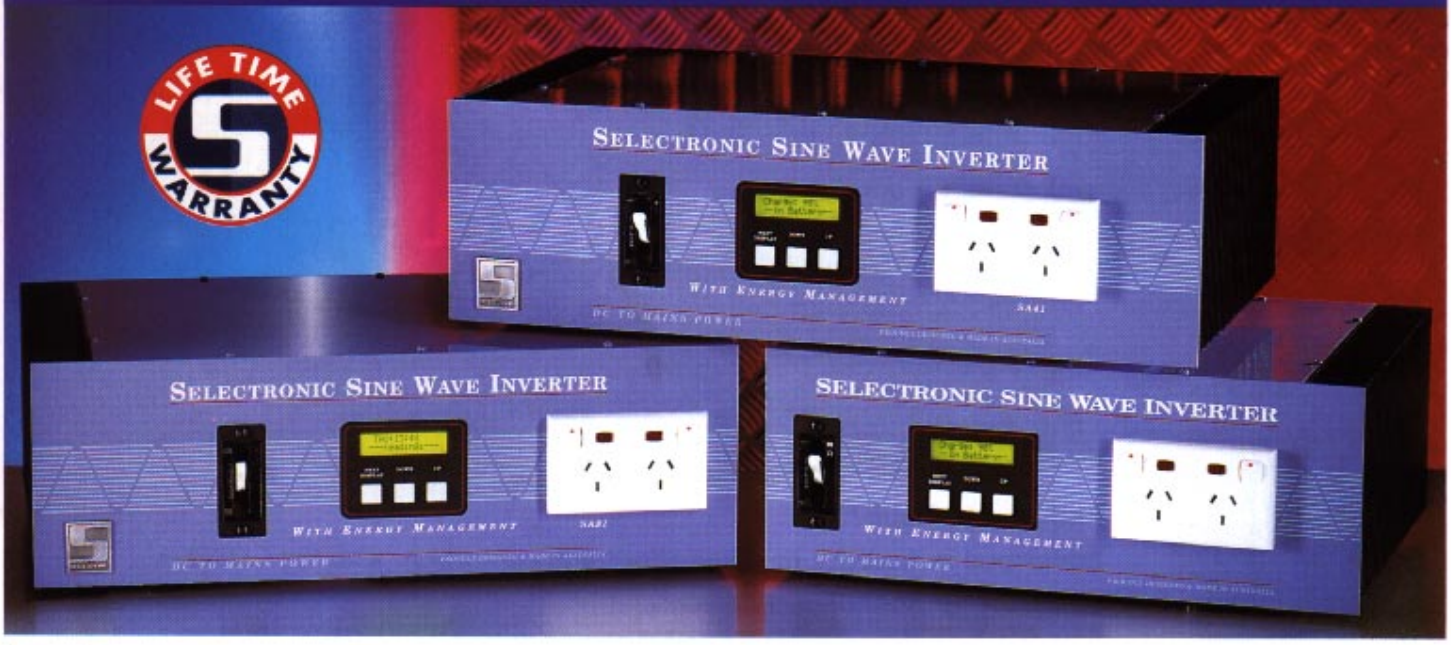

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