WIN a Solahart Black Chrome XII solar water heater

ReNew

Technology for a sustainable future

Valued at $4,200

details page 7

Solar power your shed

Wind turbine buyer's guide

Solar in Nepal

Mudbricks for the homeless

Make a solar water heater

Choosing a wind turbine tower

Anyone for a solar BBQ?

ISSN 1327-1918 02

Issue 63
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FLOODED							
7G	6	190	210	26.9	260	181	276
9G	6	215	239	28.8	260	181	276
8C6V	6	330	366	44.2	298	178	365
8L16	6	370	420	51.2	298	178	419
8KFS	12	135	150	35.8	346	171	292
9C12	12	228	253	57.5	394	178	362
GELTECH							
8G27	12	86.4	98	28.9	324	171	251
8G310T	12	97.6	108	32.0	329	171	240
8G4D	12	183	210	58.9	527	216	254
8G8D	12	225	265	72.9	527	279	254
8GGC2	6	180	198	31	260	181	276

* NOMINAL

FOR GELTECH ALL RATINGS ARE AFTER 15 CYCLES AND CONFORM TO B.C.I. SPECIFICATIONS.

IMPORTANT CHARGING INSTRUCTIONS: WARRANTY VOID IF OPENED OR IMPROPERLY CHARGED. Constant under or overcharging will damage any battery and shorten its life! Use a good constant potential, voltage-regulated charger. **For 12-volt, batteries, charge to at least 13.8 volts but no more than 14.1 volts at 68°F (20°C). For 6-volt batteries, charge to at least 6.9 volts but no more than 7.05 volts at 68°F (20°C).** Do not charge in a sealed container.

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Also available from selected Solar shops and specialist battery outlets.

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A simple solar water heater that you can make yourself for under $100...page 60.

Photo: David Johns

The cover: Using solar panels to provide electricity to your shed for lights can be a cheap way to extend your working hours, and a good introduction to renewable energy systems. We took some artistic license with the photo—you wouldn't need this many panels to set up a small lighting system.
The cover shows four 75 watt BP Solar panels (one courtesy of Going Solar in North Melbourne) on top of a Spanbilt shed. Spanbilt are an Australian owned and operated shed manufacturer, and have a range of sheds in kit form with sloping roofs suitable for mounting solar panels. Spanbilt sheds are available from hardware stores.
Cover model: Cliff Rayner.

Photo: Audrey Van Onselen

Designing harmful chemicals out of your house...page 34.

regulars

About ReNew

Formerly titled *Soft Technology*, *ReNew* is published by the (Australian) Alternative Technology Association, a non-profit community group involved in promoting and using appropriate technology. *ReNew* features solar, wind, micro-hydro and other renewable energy sources. It provides practical information to people who live with these energy sources, and demonstrates real-life applications to those who would like to.

ReNew also deals with sustainable transportation and housing, conserving resources, recycling and broader environmental issues.

ReNew is available from newsagencies, by subscription, and as part of ATA membership. ATA membership costs $40 per year, and offers a range of other benefits.

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Libby Anthony ph: (03) 9650 7883 fax: (03) 9650 8574

Contributions are welcome, guidelines available on request.

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editorial

It would be impossible to summarise all the reasons why our government has let us down in terms of the greenhouse targets established at Kyoto. A few of them are covered in this issue, by Alan Pears in his column (page 38), and by Michael Gunter in the revisited 'Parting shot' column (see page 82). Unfortunately, there were no real surprises in the outcome, though many Australians and overseas observers had hoped that we would not be allowed to get away with raising our emissions so easily. It is increasingly difficult to be optimistic if you hope for a sustainable future in Australia.

Still, as one reader points out in a letter to the editor, *ReNew* is at its best when reporting positive news. Fiona Tito gives us a glimmer of hope about some sense prevailing in the ACT government, the first in Australia to set a greenhouse gas reduction target.

As always there are many examples of people taking sustainability into their own hands. We visit Bill Parker's grid-interactive solar house in Western Australia (page 20). Many people put a lot of thought into making their house energy efficient, but Bill went one step further and also considered the energy used to make the building materials.

Audrey Van Onselen's 'clean' house is equally interesting. She became mysteriously ill several years ago, with allergic reactions to many common household chemicals. Her solution was to design and build a home that minimised the number of harmful chemicals built into it (see page 34).

Our buyer's guide for this issue covers wind turbines. We have tracked down all the domestic wind turbines available in Australia, as well as some of the larger ones (why not start a wind energy collective?). We tell you where they're available, how much they cost, and give you a bit of advice about selecting one for your needs. If one thing has given wind turbines a reputation for poor performance, it would be a poor choice of tower. Linda White caps off the buyer's guide with a great article on choosing a tower, and explains that big is beautiful.

This issue's cover story is a great introduction to do-it-yourself solar power. Colin Goodwin explains how he installed a panel, battery and some basic control equipment to bring light to his sacred haven, the shed.

On the other side of the world, we visit a company in Nepal who are helping to improve the lives of rural villagers, using solar power systems similar to Colin's. This story beautifully illustrates the role that renewable energy systems can have in the developing world—reducing the need for dirty liquid fuel lamps and helping children to gain an education by giving them light to read by.

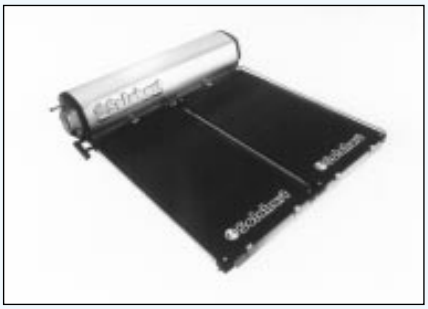
Happy reading.

Michael Linke
Editor

WIN a Solahart Black Chrome XII solar water heater valued at $4,200

Just by subscribing to ReNew

Installing a solar water heater is one of the easiest ways to help the environment, and also a great way of saving money. Imagine showering every day in the warmth of the sun, knowing that you're helping to reduce greenhouse gas emissions...



All you have to do is subscribe to ReNew for 12 months, a cost of just $20, or become a member of the Alternative Technology Association. Not only do you get Australia's biggest sustainable technology magazine delivered to your door, but you also go into the draw for the Solahart Black Chrome XII, valued at $4,200.

Features

Solahart Black Chrome XII

- Long life ceramic lined tank
- 300 litre capacity
- Two Multiflow collector panels
- Optimiser
- Gas heat boosting
- 12 year warranty
- Australian made

Conditions and how to enter

(1) The competition is open to any eligible person who subscribes to *ReNew* or joins the Alternative Technology Association (ATA) during the competition period.

(2) The competition is open to existing subscribers and ATA members who renew or extend their subscription/membership during the competition period.

(3) In all cases except for that outlined in condition (8), the prize is not redeemable for cash.

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

(5) Postal entries should include the entrant's name, address and phone number on the back of the envelope.

(6) The competition is open to individuals only: businesses, collectives and other organisations are ineligible.

(7) The competition runs from 1 December 1997 to 18 April 1998. Subscriptions/memberships must be paid by 5pm on 18 April to be eligible.

(8) A subscriber/ATA member who has purchased a Solahart water heater during the course of the promotion will have the option of receiving cash to the value of the prize if they win the competition.

(9) ReNew subscription costs $20 per year, ATA membership costs $40 per year ($30 concession).

(10) To subscribe or join the ATA, use the forms on page 70-71 of this magazine (or a copy), or call the ATA on (03) 9650 7883 to pay by credit card.

(11) The competition is open to eligible ATA members and ReNew subscribers in Australia only.

The ReNew—Solahart subscriber competition is proudly sponsored by Solahart Australia

Unmasking the phantoms

Congratulations on your article about phantom loads in *ReNew* issue 61. As an electrician I was aware of their existence, but did not think they were significant. How wrong I was! I did the check and found to my surprise that I had a phantom load of 60w—the equivalent of an incandescent light left on day and night! This adds up to 1.44 kilowatt hours a day. My house is pretty energy efficient—or so I thought. By using gas appliances and compact fluoros throughout I had my electricity consumption down to just under 4kWhrs a day—and more than a third of that was phantom load. I instantly switched some of them off: two battery chargers, two VCRs, but left the sensor light and the bell on.

Your suggestion for exorcism—switch them off—is a bit problematic, where stereo, TV and VCRs are plugged in at a power point or board hidden somewhere behind a wall unit or otherwise hard to access. My suggestion is to get a multiple power board that supplies all your TVs, stereos and VCRs with power and connect it to a long lead plugged into an easily accessible powerpoint.

Dieter Liebrich
West Footscray, Vic

Solar car racing

I am writing in response to Conrad Mackenzie's letter in *ReNew* issue 62.

Australian Major Events now own and manage the World Solar Challenge and World Solar Cycle Challenge. The first stand-alone solar cycle race took place in September—October this year. The second AME event will take place in October 1999, though final dates and route will not be finalised until February 1998.

Michael was correct in letting you know about Solar Racing Cars. It's a great book and features a chapter on the streamlined solar cycles that took part in the 1996 demonstration run from Darwin to Adelaide. I also have some additional technical information resources.

Feel free to phone (08 8303 2337) or email (wsc@saugov.sa.gov.au) if you would like an information package.

Rob Moore
Australian Major Events

Letter of the month

The staff at *ReNew* award a solar battery charger to the letter judged most interesting in each issue. Send your letters to *ReNew*, 247 Flinders Lane, Melbourne 3000.

Ode to an oft' forgotten sustainable technology

It is late Spring and you can actually see the grass growing. Tomorrow being Saturday, the suburbs will echo to the roar of lawnmowers and the odour of fumes will mingle with the fresh aroma of cut grass. If you were to look closer into backyards, you would often see people cursing as they pulled starter cords with only a repetitive splutter resulting, or frowning in frustration over dirty sparkplugs, or staring indignantly over fences as noise and exhaust disturbed more peaceful weekend pastimes.

Ten years ago you would have seen me almost taking to a recalcitrant non-startable mower with an axe! But then my kind neighbour offered me use of his push-mower. Initially I was sceptical. Could this thing spin fast enough to cut thick grass? Well not only could it, but it could do it better! Modern gearing and light-weight alloy framework made it just as efficient and easy to push (if a fraction harder then that was good exercise anyway) as a machine mower.

When we moved back to South Australia I went and bought my own push-mower for $98. That was 10 years ago. It is still going strong and it has cost me a total of $2 in all that time (for a nut and bolt). I mow a largish and uneven, difficult lawn quite easily, quietly, with no smell but that of cut grass, and it starts first time every time! I don't need to worry about noise for my neighbours and I can mow late in the cool of the evenings as a result.

With such a wonder product you'd think the machine mowers would be superceeded and gone the way of T-Rex, but no, I am still the only person I know in the neighbourhood with a push-mower. Why do market forces not prevail? Well, when I visit a lawnmower store I see why. All the emphasis, advertising and sales pitch is on $500 or more machine mowers that are going to need servicing, spare parts, fuel and oil till they konk out and then one can start over again. I suppose there is not much profit in $98 + $2 over 10 years! Cousins of my push-mower are there, but kind of tucked away as though some sort of an embarrassment.

We don't live in a free market, or at least not an intelligent and truly beneficial one. Commercial interests, dependent on the hegemony of consumerism, prevail. But maybe one day things will change. I'll know it when my neighbourhood resounds to the soft sweet smelling chatter of push-mowers on spring weekends.

Peter Parry
Westbourne Park, SA

Untapped energy sources

I am writing to say how great your magazine is! I was introduced to *ReNew* late last year and have since developed a keen interest in a sustainable and self-sufficient lifestyle.

I feel one area that has not been discussed is the use of energy sources that

are under utilized. An example of this is to run a loop of pipe from the cold water tap of the shower into the ceiling to power an exhaust fan. A 'mini'-micro-hydro could be designed which would turn on and off with the taps at each shower and cost nothing to run. You would never get into the shower and forget to turn it on, and more importantly, it could never be left on!

Keep up the good work.

Martin Kemp
Clayton, Vic

We had heard about a product like the one you have described, and after we got your letter were inspired to track it down. You can read about it in the 'Products' section of this issue.

—Michael Linke

Deficient food

I feel that most of us do not know of the relationship of our food supply to our cells and therefore to our health.

Our soils and pastures are often mineral deficient. As a veterinary surgeon I have been treating farm animals with mineral deficiencies for 40 years. Examples include calcium, phosphorus, selenium, copper, cobalt, magnesium, and boron. It is generally accepted, for instance, that land that has been farmed for more than 20 years is usually selenium deficient.

We treat our animals but nobody treats humans! The vast majority of doctors are not interested, have had no training in nutrition, and are guided by the drug firms with their superficial 'quick fix' cures.

Due to ill health I studied human nutrition and found our food supply lacking in vitamins and minerals and full of chemicals (now over 4000 in our food supply). This caused a tenfold increase over the last 30 to 40 years in chronic disease and cancer in parallel to the increase in chemicals.

It is obvious from the research that we need a vitamin and mineral supplement to cover every possibility and after much searching found a broad spectrum one that was not only scientifically balanced but was the only one of its kind registered by the government on the therapeutic index. It also actually worked and was used by several doctors.

Due to the Therapeutic Goods Act one can't claim its ability to cure any disease and print the name. For further details contact me by phone on (03)5520 2250.

Peter M. Couttie,
couttie@iconnect.net.au

Oil *is* plentiful

Being a committed ATA member and a petroleum geologist I thought I should respond when I read Alan A. Parker's article 'What happens to the world when the oil runs out' in *ReNew* issue 61. The article was a quite thorough and caring coverage of what could be a very serious problem for our society, with one or two minor flaws, such as we are *not* running out of oil.

Stories of impending doom due to declining oil stocks have been pedalled all of the 20th Century by the big oil companies so they can increase their prices and get people to buy oil to hoard. To make sense of the statistics bandied about in this argument you must understand some terms:

- *Reserves*—resources profitably recoverable at present oil prices with present technology.
- *Non-economic reserves*—resources which cannot be profitably extracted at present prices with present technology (technology will improve with time and prices will increase if oil supplies become short).
- *Resources*—oil known to exist.
- *Inferred resources*—oil believed to exist but not yet found.
- *Oil province*—region at least 100km across with numerous oilfields.

Reserves are the smallest category by a large margin, non-economic reserves which are not usually mentioned in public and are approximately six times as large will gradually become reserves. As prices rise and technology improves, resources 10 times as large as this are available if needed, and the inferred resources are much larger, extrapolating from the present large discovery rate.

Most of our oil now comes from Arabia (a quarter of Arabia's oil is in Iraq which at present is not used) but Russia-Azerbaijan is a bigger oil province and Mexico is nearly as big as Arabia. All these provinces were discovered before or just after the turn of the century but large new oilfields are still being found within them. As these provinces were discovered long ago all oil found in them can be listed as old discoveries.

Ian McPherson
Victoria

Solar hot water concerns #1

Congratulations on Ross Horman's article on solar water heating (*ReNew* 62) which gave a generally good overview of the issues of interest to the consumer.

I am concerned, however, over the continuing publication of solar contributions denominated only in percentages of hot water demand as was done in the inset on page 16.

My concern is on two levels. Firstly, it is unhelpful to the consumer who will not usually know the energy quantity that is used in a conventional (fossil-fuelled) water heater and is therefore unable to convert the figure into energy units, let alone dollars. Secondly, and in my view more importantly, when the percentage values are tabled for a full range of urban locations the reader is given the misleading impression that solar water heaters are most beneficial in the tropics (for example, Darwin 90 to 95 per cent) and rather poorer energy sources in the temperate zone (for example, Sydney 60 to 65 per cent).

David Keevers, the winner of the Bergey 850 wind turbine subscriber prize, with partner Mim. The closing date for the current subscriber prize, a Solahart Black Chrome XII water heater, is April 18.

In fact the standard recommended systems produce essentially the same annual amount of energy saving in any capital city in the country—around 12.5 to 13.5 GJ of delivered heat (18,000 to 19,300 MJ of gas or 3,500 to 3,750 kWh of electricity)—with the exception of Darwin where they save only 11.5 GJ. This result, which still surprises many, emerged from my own work of a decade ago (Lee, 1987). It was first widely published in AS 2002—1987 and is still around in the current edition of AS 3500—the 'Water Heating Code'.

The common knowledge that the northern locations are sunnier is deceptive. The key factor that levels the performances is the temperature of the cold water (also, the standard system for Hobart and Melbourne has 5m^2 of collector while most others have the more commercially common4 m^2). Put simply, there is more water heating work to be done in the southern climes because the cold water starts out colder. And 60 per cent of a big heating job can be, and is, bigger than 95 per cent of a little one.

The example I like is for a standard 4m^2 system installed at the ideal orientation and tilt serving the archetypal family of four in cold Canberra and balmy Brisbane. According to the standard, the Canberra family saves 'only' 67 per cent (13.46 GJ) while the Brisbane family saves an 'impressive' 81 per cent (12.65 GJ). But the Canberra family saves 6.4 per cent more energy with their solar water heater than do their compatriots in Brisbane!

Sunniness isn't everything in solar water heating performance.

For the studious:

• Lee T R, 'Effects of Sub-Optimal Collector Geometry on Domestic Solar Water Heater Performance', in *Creating the Future*, proceedings of the Solar '87 Conference, ANZSES, Canberra, November 1987

• AS 2002–1987, *The Installation of Household Type Solar Hot Water Supply Systems*, Standards Association of Australia, Sydney, 1987

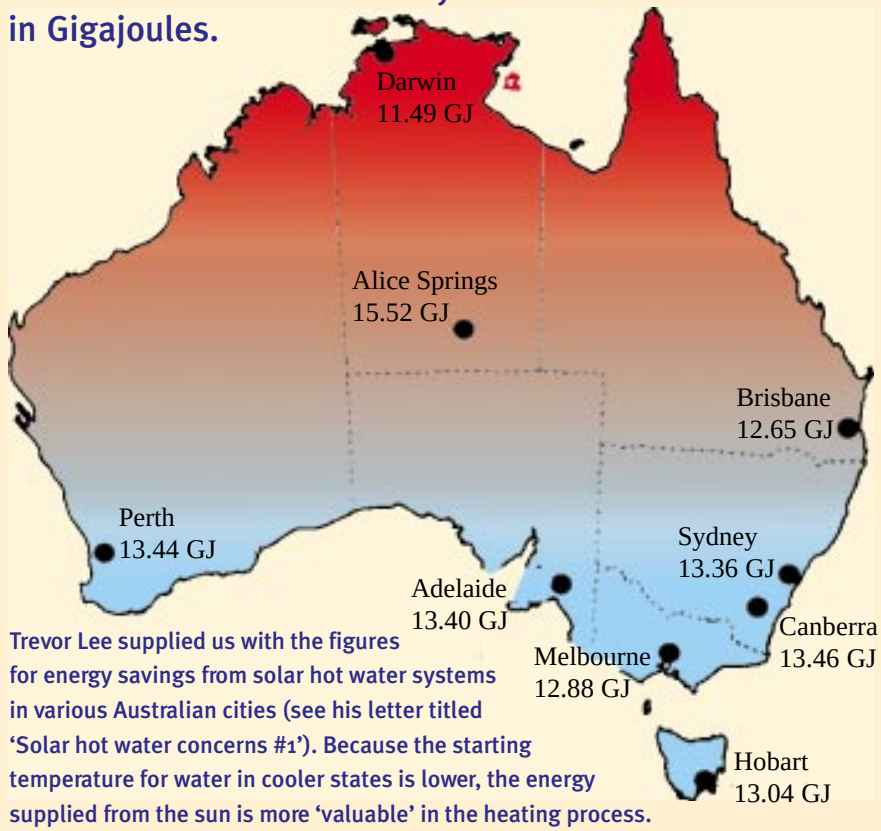
Trevor Lee

Chairman, Australian and New Zealand Solar Energy Society

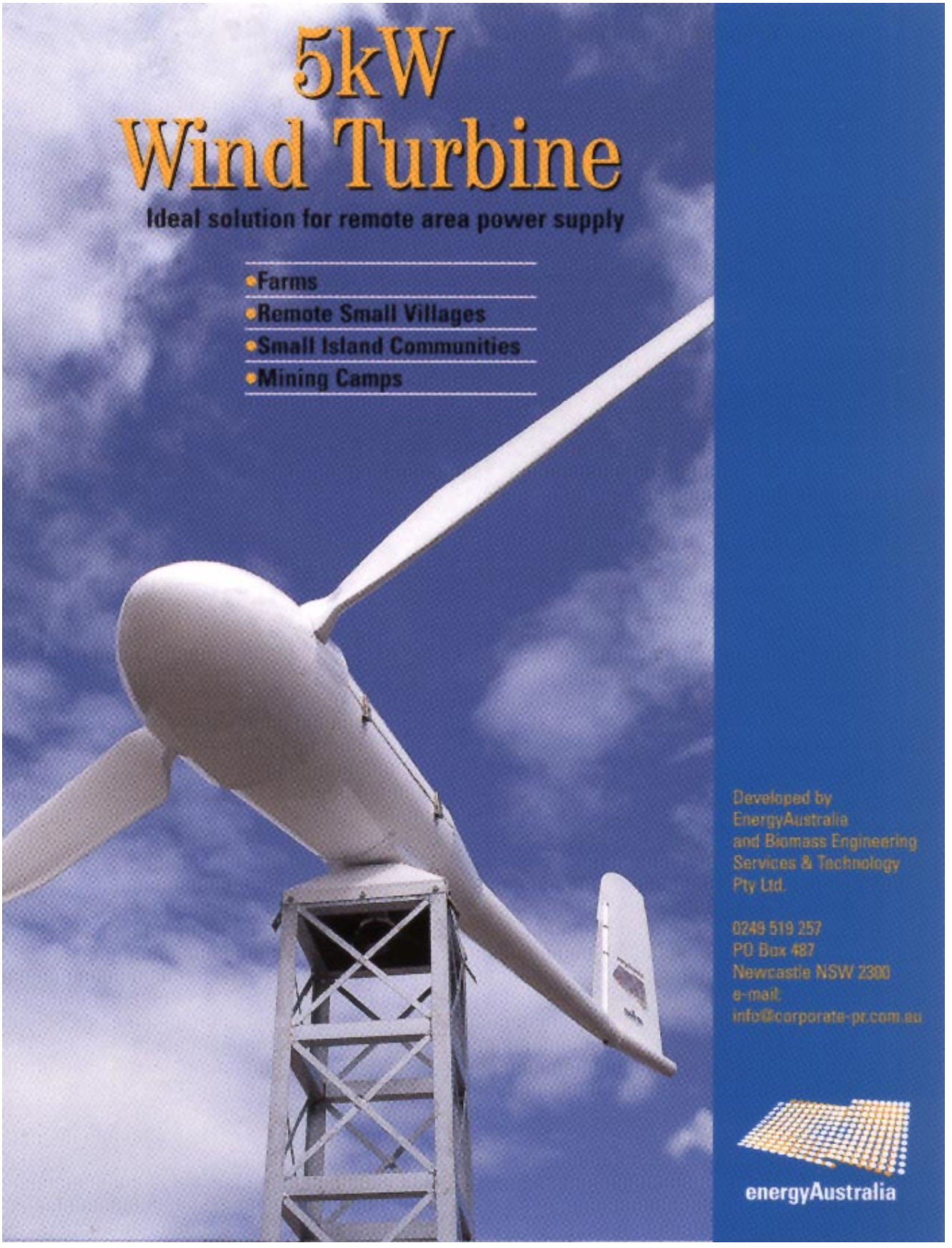
Solar hot water concerns #2

I must state my disappointment at a part of the article by Ross Horman (*ReNew* issue 62), on solar hot water systems. The statement of my concern is in the section 'Roof angle', in which he wrote, '...for most parts of Australia... ...the maximum

Anticipated annual energy savings for four person household solar hot water systems in Australian cities in Gigajoules.



Trevor Lee supplied us with the figures for energy savings from solar hot water systems in various Australian cities (see his letter titled 'Solar hot water concerns #1'). Because the starting temperature for water in cooler states is lower, the energy supplied from the sun is more 'valuable' in the heating process. This results in the surprising situation of a Hobart solar hot water system saving more energy than a Brisbane one.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input will be gained from an angle shallower than the latitude' (angle).

Though I must concede that the statement is correct (only) regards the total amount of heat (possibly) collected on an annual basis, I must refute it as misleading, if you are looking to optimise a system to match your normal usage of hot water. Why heat (or overheat) water that you don't need or use, or use a booster when it may not be needed?

With the normal usage of hot water you use more hot water during winter than during summer. As the sun is lower in the sky (and the days are shorter and cloudier) during winter, less heat can be collected with a panel on a shallow angle. The resultant shortfall inevitably leads to use of the booster.

Conversely, during the summer with the sun high in the sky (and longer, clearer days) there is greater input of heat than is used or required. This can lead to a point called 'stagnation', where the whole system has reached such a temperature that no circulation takes place. High stagnation temperatures can shorten the effective life of the system as a result of chemical reactions that can be enhanced at these higher temperatures.

If anyone is considering getting a mounting frame made for their system, it is far better (though not aesthetically) for both the life of the system and to get a better return on their investment, to optimise for winter with a steeper than latitude angle. This will result in higher input during winter, as the higher angle makes the thermal syphon more efficient, with less reliance on the booster. Plus, during summer the lower input will match the usage pattern closer and reach the stagnation point less, resulting in less stress on the system and therefore a longer lasting system.

For commercial reasons the 'slap it on the roof' approach is expedient, but does not help when systems fail, short of their possible life expectancy, after also spending far too long relying on the booster. After all didn't you buy that solar hot water system to save energy.

Even though solar hot water system are a good investment, they can be a better investment when they are optimised for the job at hand.

Stephen Grabham
Western Australia

Standards and red tape

The letter from Mr John Allott, headed 'Standards=red tape' in *ReNew* issue 62 has been brought to my attention and it is felt that an explanation of how Standards are used would help your readers understand their purpose.

Standards by themselves have no legal status. A Standard only becomes a legal document when a government organisation or a purchaser requires that a product be produced to the requirements of that Standard. Thus State electrical safety regulators require that all 240 volt AC power points comply with *AS/NZS 3112 Approval and test specification—Plugs and socket-outlets*, so that any Australian 240V plug will work safely in any Australian 240V socket.

On the other hand, solar modules do not have to comply with Australian Standard AS 2915—1987 *Solar photovoltaic modules—Performance requirements* unless the purchaser of the solar modules requires that the modules conform with this Standard, as this Standard is not called up in any government legislation.

Mr Allott infers that the proposed Standards on stand-alone power systems would not permit him to do his own extra low voltage (ELV) wiring, but in DR 97352, Clause 2.1.2, it states 'All ELV wiring shall be installed and maintained by a suitably qualified person'. Mr Allott's experience with Telecom would probably be suitable experience.

On the other hand, each state government has its own regulations covering the installation and maintenance of 240V wiring and hence the draft refers to the appropriate state based legislation for requirements on who can perform 240V wiring. It is suggested that Mr Allott discuss his situation with his State electrical regulator as this may resolve his problem.

Constructive criticism of drafts and published standards is welcome and Standards Australia acknowledges the help the public in reviewing and commenting on draft Standards, as this improves the final published document.

Geoff Webb, Projects Manager
Committee EL/42-Remote Area Power Supply Systems.

On the right track

You are a good sport for printing Robert E. Pearson's critical letter in *ReNew* issue 58. To me, he says a lot more about the writer than about your magazine. This is a letter written by someone whose old ideals have become boring but haven't been replaced by anything else new and exciting.

Mr Pearson is not alone. We live in a society where meaning has been lost, and millions of others suffer in the same vacuum. I suggest he reads a wonderful book: *Man's Search for Meaning* by Viktor Frankl.

Certainly, *ReNew* can be improved—what can't? A technical magazine should above all be accurate, and yet each issue has some incorrect claims of fact. Also, it would be a help if the issue number and date were more visible on the cover. However, on the whole, I approve of the ATA in general and *ReNew* in particular, enough so that my cheque for membership renewal is attached.

I personally get hardly any benefit from membership, but my subscription is one way I can keep a very commendable organisation alive, and doing its best to push this world of lemmings away from mass suicide.

The best part of the magazine is 'Noel's Treasures from Trash', which is an example of playful ingenuity, and education as it should be. I hope that Noel stays active and inventive for a long time.

A couple of years ago, when I wanted to buy a small inverter, an informed choice was possible because I dug out my back issues of *Soft Technology*. Your regular comparisons of what is available is an excellent feature.

For the rest, you capture the spirit of people doing a variety of planet-friendly things, and inspire others to follow this example. When I read *ReNew*, I get inspired and entertained.

Keep it up.

Bob Rich
Moora Moora, Victoria

Solar hot water features

Your article on solar hot water in issue 62 of *ReNew* was useful, but you now need another discussing the advantages and disadvantages of different models.

I purchased a machine a year or so ago and have noticed a couple of features that I would have liked.

One is a remote switch to turn off the electric booster. At present, I have to go outside to the power box to turn the booster on and off. During summer, I can turn it off and rely 100 per cent on solar. Admittedly, the off peak boosting it uses doesn't amount to much, but it is a saving all the same.

It would have been useful to have a monitor which tells me when the booster would be needed. In theory there is a system so that the solar power unit does not draw from the mains off peak if it is not needed. Frankly, though, I don't believe that it does. My comparison of the off peak power bill before we put in the solar and after shows little difference.

I should have bought the next size up. The 300 litre system was supposed to be fine for four people. We find it okay with just two. I should have gone for the 440. So people might wish to err on the side of an oversized system rather than the recommended one.

Michael T. Skully
Malvern East, Victoria

We didn't intend the article in issue 62 to be a buyer's guide, as we published a solar hot water buyer's guide only 12 months ago in issue 58. This issue is available from the Alternative Technology Association for $5, and lists all the features of the systems on the market.

—Michael Linke

King size turbines

King Island in Tasmania is best known for producing some of Australia's best cheese, but the locals will tell you that it also has some of the best wind in the country. Powered mainly by a diesel grid, the island's annual fuel bill in recent years has been around $2.5 million. Enter Rob Stewart, an employee of Tasmanian electricity distributor, The Hydro. Rob pushed for wind power at King Island, and The Hydro saw the light. The result is the installation of three Nordex 250 kilowatt turbines, which are estimated to save around $500,000 worth of diesel annually. The site has a 9 metre per second average wind speed.

PVC free credit cards

There is yet another toxic nasty lurking in our midst that many of us have probably not given much thought to: credit cards. Credit cards and ATM cards are made of PVC, one of the most toxic plastics manufactured, and the demand is growing every year.

A new card made of Biopol, a biodegradable plastic, is now being made in Europe. Biopol is made of sugar syrup derived from cereal plants. It breaks down in compost in around 12 weeks, but is perfectly stable in a wallet or purse.

Soon after the card was launched, the PVC industry responded with full page advertisements in British newspapers denying the damaging effects of PVC. One of the by-products of PVC, dioxin, is classified as a human carcinogen and a hormone disrupter. PVC also uses lead in its manufacture. The Danish EPA has banned PVC teething rings because they liberate dangerous phthalates when sucked by babies.

Although Biopol is manufactured by Monsanto—a chemical multinational that deals in genetic engineering and ecologically damaging herbicides—the product has been endorsed by Greenpeace, who say it has world-wide potential as an alternative to PVC.

***Appropriate Technology*, September 1997**

Congratulations STA

Canberra-based Sustainable Technologies Australia recently won a prestigious Eureka science prize for their work on SMART Windows and Titania solar cells. STA have also made a splash in the Sydney renewable energy scene, taking over SolarCorp from Andy Evans, who recently moved to Adelaide to be with his wife.

STA media release & rumour mill

Killer trucks

The most carcinogenic chemical ever discovered is found in truck exhaust fumes. In a study last year, the compound, 3-nitrobenzanthrone, was found in both diesel exhaust fumes and the air high above Tokyo.

Chemicals from diesel exhausts are estimated to cause 10,000 deaths each year in Britain, and 60,000 in the US. Scientists believe that 3-nitrobenzanthrone could account for the high proportion of lung cancer in cities.

Adelaide Advertiser, 24 October 1997

WA information hotline

Western Australia has a new energy information phone service. The Home Energy Line provides information about energy efficiency and renewable energy power systems. The freecall number is 1300 658 158.

Energy Matters, October 1997

Tidal power in Australia?

Western Australia could have the world's second largest tidal power plant if a project at Doctors Creek, north of Derby, goes ahead. The plant would cost $125 million and supply electricity to around 20,000 homes in Broome, Derby and Fitzroy Crossing.

An environmental assessment is currently under way. The environmental plusses are that it will displace fossil fuel generated electricity and reduce greenhouse gas emissions. The minuses are that it will potentially cause erosion, adversely affect marine animal migration, sedimentation patterns, water salinity and flooding regimes. It will certainly cause loss of mangrove vegetation, but may create new habitats suitable for mangroves.

The nature of the site means that the turbine could theoretically be producing power around the clock, for a total

of 200 gigawatt hours per year. The expected life of the turbine, which will utilise research work done at the Northern Territory University, is 120 years.

Energy Matters, October 1997

Motor giants team up on fuel cells

In the last issue of *ReNew* we featured the fuel cell bus that Daimler-Benz have been developing. The Benz's fuel cell vehicle project now has another new partner, Ford. Ford will be injecting around $646 million in cash, assets and technology into making commercial, road-going fuel cell vehicles.

In conjunction with Ballard Power Systems in Canada, the automotive companies hope to have the first fuel cells on sale in 2004.

The Australian 18 Dec 1997

Breamlea wind turbine 10 years old

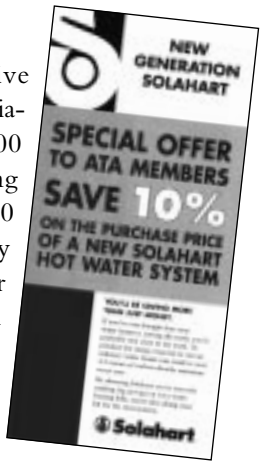
One of Australia's first non-domestic sized wind turbines recently reached an important milestone. The Breamlea wind turbine near Geelong in Victoria turned 10 years old in 1997, and a celebration was held on 16 November at the base of the turbine.

Electricity from the 60 kilowatt turbine is purchased by Melbourne electricity retailer, Citipower, who use it as part of their 'Eco Unit' scheme, where consumers buy shares in renewable energy generation plant.

Guest speakers included Australian Democrat Senator Lyn Allison and Victorian Shadow Minister for the Environment, Sherryl Garbutt. Senator Allison was sufficiently impressed by the Breamlea turbine that she mentioned it in a report to the Federal Senate the following week.

The turbine was originally part of an SEC Victoria foray into wind power, but was faced with being scrapped several years ago. The Alternative Technology Association purchased it from the SEC, re-established a grid connection and contract to buy the electricity and later sold it to a committed member, Michael Gunter. Michael and a group of members currently maintain the turbine, which remains the largest in Victoria.

Hot 100



The Alternative Technology Association's Hot 100 project is hotting up, with over 20 members already registering their intention to install solar hot water systems this year. The project aims to have at least 100 members install solar water heaters by the end of 1998.

So far, three members have gone ahead with installations, and several more are scheduled in the next few months. *ReNew* will profile some of these installations throughout the year.

Industry partners Solahart have offered a 10 per cent discount on their hot water systems to ATA members anywhere in Australia, and Absolutely Solar have offered a 10 per cent discount on Quantum Heat Pumps in the Melbourne area.

Photo: Michael Linke

Deafening, polluting Grand Prix racing cars won't be around for much longer, if this electric vehicle entry in the CitiPower Sunrace is any indication. *The Odyssey* averaged around 47.5kmh over the 1,215km from Sydney to Melbourne, with only small battery packs. The event was won by *Aurora 101*, a veteran of the World Solar Challenge, which also set a new world record of 100.9kmh average over a 100km stretch of open road.

A green fix for the unemployed and homeless

A project in the Blue Mountains, west of Sydney, set out four years ago with some lofty ambitions for teaching unemployed and homeless young people skills to help them deal with getting a job, and life in general. As Michael Linke discovered, the ambitions are translating to successes

For Donna, life had become a monotony of searching for jobs that either didn't exist, or she wasn't qualified for. 'We need someone with more experience,' came the mantra from one prospective employer after another.

All that changed soon after she found out about Mission Employment. A division of Sydney City Mission, a charity organisation focused on helping low income earners, unemployed and homeless people.

Donna entered Mission Employment training programs and learned secretarial and administration skills. It helped improve her CV, but also gave her the confidence to get a job.

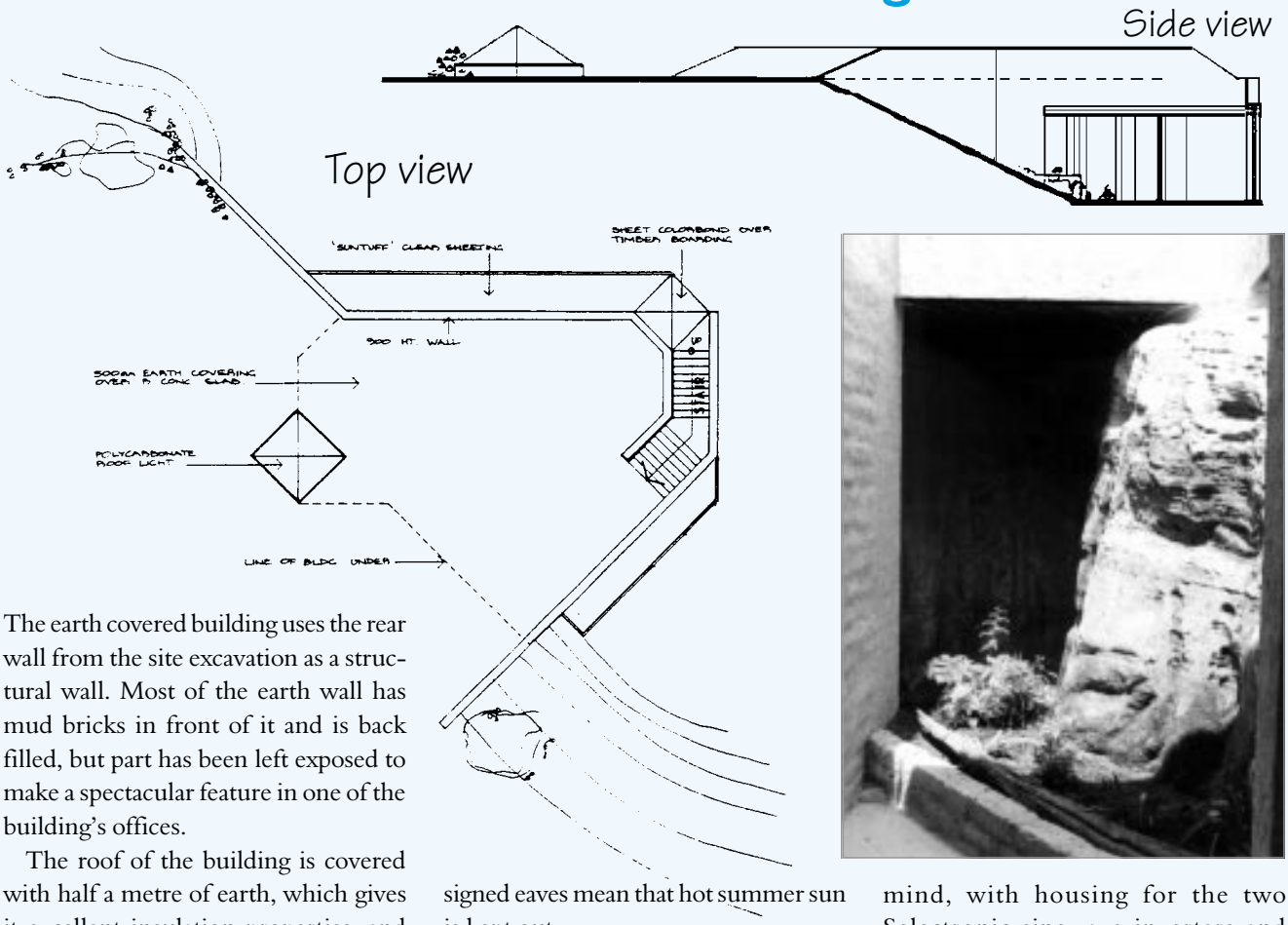
After some time in the workforce, Donna heard about an office assistant position available with Mission Employment. They had started some kind of project in the middle of the Blue Mountains, building an eco-centre to teach unemployed and homeless young people new skills. It sounded too good to pass up.

The project is called Intelife. It started in 1994 as acres of disused sandstone mine near Wentworth Falls in the Blue Mountains. The idea was to convert the barren, scarred earth into a centre for demonstrating environmentally sensitive building, technology and lifestyles. Intelife aims to incorporate crisis accommodation for homeless young people, as well as training facilities where long term unemployed people can learn new skills. Along the way, both unem-

Photo: Michael Linke

Ralph Knight, Building Manager at Intelife, inside the mudbrick building that he has helped young unemployed people to build. When complete, it will provide crisis accommodation to help homeless people learn life skills.

The Intelife earth covered building



Based on drawings by Penny Rosier Architects. ©Intelife

Photo: Michael Linke

The earth covered building uses the rear wall from the site excavation as a structural wall. Most of the earth wall has mud bricks in front of it and is back filled, but part has been left exposed to make a spectacular feature in one of the building's offices.

The roof of the building is covered with half a metre of earth, which gives it excellent insulation properties, and also doubles as a herb garden. The concrete floor, mud brick front wall and north facing windows mean that the sun's energy is stored in the building and radiated during the evening to keep the temperature even. Properly designed eaves mean that hot summer sun is kept out.

Daylight to the southern part of the building is provided by a 'Sky Pyramid' skylight, which protrudes from the earthen roof.

The building has also been designed with the renewable energy system in mind, with housing for the two Selectronic sinewave inverters and other control equipment built in. The separate battery room is adjacent to the control equipment.

The photograph shows the exposed sandstone feature inside the building, lit from above by a skylight.

ployed and homeless young people gain skills as they help create Intelife.

Currently there is a group of unemployed people at Intelife as part of a Greencorp scheme. Donna has the pleasure of watching them develop, and seeing the value they get from their new skills: 'They're having a ball. I get on the bus with them in the evening, and I hear them talking about the areas they work on. They take such pride in their work.'

The jobs at Intelife are many and varied, from making mud bricks to creating water gardens. Participants have more responsibility than similar programs afford, and are certainly not merely labourers doing all the hard and dirty work. At the start of each day a storeperson is given the task of handing out tools and equipment, and also has to make sure that everything comes back by night time. Supervising staff on site give skill training where possible, and qualified tradespeople are brought in to instruct on specialised tasks. One worker found himself cutting 10mm glass recycled from an office complex for an entire mudbrick building after a training session from a professional glazier.

The beginnings

The physical transformation of Intelife began in March 1994 after a lengthy planning period. It took Steve Fowler

from Mission Employment in nearby Katoomba and his associate Paul Curtis eighteen months to put the proposal together. The effort paid off though, and the board of Mission Employment Sydney voted to go ahead and purchase the land.

A number of major sponsors came to the party with large cash and in-kind donations. Levi Strauss were one of the first sponsors, donating $50,000. Sydney firm Penny Rosier Architects designed the buildings on the site free of charge, a service that would otherwise have cost $50,000. This kind of generosity not only made Intelife possible, but reflects the worth that others outside Sydney City Mission see in the project.

Although Intelife will not be fully open to the public as a demonstration site until 2001, there are already many

Photo: Michael Linke

Electricity at the site comes mainly from these solar panels donated by electricity retailer Integral Energy. Two Selectronic sinewave inverters convert DC electricity from the battery bank into AC electricity, which powers office equipment and tools in the workshop. Generators are used to power pumps, and to reduce their environmental impact these are run on petrahol, a blend of 80 per cent petrol and 20 percent ethanol. The ethanol is derived from the fermentation of agricultural waste.

Photo: Michael Linke

A view of Intelife from the sewage treatment pond. Sewage and greywater is collected in a septic tank near the buildings, where anaerobic decomposition occurs. It then drip filters through the two concrete, sand-filled tanks at the left of the photo. These feed into the reed and gravel bed, which uses up nutrients (the reeds are harvested and used as mulch). Finally, clean water enters the pond, where UV light from the sun kills any viruses which may have survived the process. The system was designed and is monitored by staff and students from the University of Western Sydney Water Research Laboratory.

working examples of sustainable technology. The site is powered by solar electric panels, and there is a reed bed system to treat sewage on site. Permaculture principles have been applied to regenerating the earth, and there are many swales and stepped slopes to make best use of water and prevent erosion.

All the mudbrick buildings have been designed using passive solar principles, and use recycled materials wherever possible. Fence posts are made of termite-resistent cypress pine, which means no hazardous wood preservatives are necessary.

In theory, Intelife seems idealistic—a showcase of environmentally sensitive development, set in an idyllic location, that is being built and will be run largely by young homeless and unemployed people. But the theory seems to be working in practice, and the proof is in the difference it has made to people like Donna, 'I love it. It's a pleasure to get up in the morning and come to work here'.

Visit or train at Intelife

Positions are available in Intelife programs for young unemployed people. If you are young, unemployed and are interested in working at Intelife, you can find out how to apply by writing to:
Intelife, Locked Bag 4, Wentworth Falls, NSW 2782, email: intelife@ozemail.com.au, or phone (02) 4757 2451.

Although not yet officially open to the public, tours are available if you can arrange a group of ten or more people. The Sydney branch of the Alternative Technology Association are visiting Intelife in September 1998. Phone Peter Vail on (02) 9419 7503 or Godfrey Davies on (02) 9436 0173 for details.

This stylish glasshouse is made from mud brick and recycled glass from city buildings, and fits in with surrounding mud brick buildings, using recycled timber wherever possible. Groups of young unemployed people learn skills in horticulture and permaculture under the instruction of expert tutors, then get to apply and practice the skills. They also learnt skills like carpentry, construction, glazing and mud-brick making while completing the glasshouse.

Grid connected solar in WA

Bill Parker takes us on a tour of his grid-connected solar powered home—only the second one in Western Australia

Bill's house uses the electricity grid like a battery, feeding in excess solar energy from the photovoltaic panels (left) and drawing it back as needed during the night. Hot water is provided by a Solahart solar water heater (right).

After some years of learning about and talking about the ideas and concepts of design for locality and climate I decided to put passive solar principles into practice. The decision was made in the winter of 1994, but getting from the decision to the present happy position was not so easy, and I'd suggest that anyone wanting to be an owner builder should first seek out psychiatric counselling. The easiest part in retrospect was finding a vacant block of land.

Adequate north-facing vacant blocks in the inner city area of Perth are rare. The city extends outwards from its nineteenth century grid some 30° off the east-west axis. Having walked, cycled or driven every street in the 'target zone', I found nothing. Later, I returned to a group of small streets near the East Perth interstate rail terminal and found a suitable vacant block. The site was on the edge of an old wetland near the Swan River, gently sloping to the north and east with excellent solar access—a perfect site. The architect (Zdenka Underwood) was consulted, and in due course the purchase made, and the agony began.

I think my wife and I have lived in something like fifteen houses separately or together, and we can readily list the faults that arise from a failure to look closer at the way people actually live, as well as the usual thermal shortcomings. We set out with a simple brief—the new home was to be passive solar and essentially contain one large room somewhere in which was to be a kitchen. (People now walk into this large room and say 'that's what we need' with an emphasis on the that). One wonders if the project home design industry is listening to this message, persisting instead with formal dining rooms.

Once a basic design had been derived, we chose to use the HERS (Home Energy Ratings Scheme) program in its first trials in WA to analyse the building, as well as to use Garry Baverstock's 'Tecto' program (see sidebar). The feeling from the consultant using the HERS program (on what is a fairly complex house from shading considerations) was that it required a lot of work to arrive at a meaningful result. However, both the HERS and the Tecto analyses came to the same essential conclusions. At first pass, we scored a four star rating and with some design modifications—window size reductions, the theoretical performance was improved.

No auxiliary heating?

From the outset, the design target was a home that would not require any auxiliary winter heating and that would use the afternoon sea breeze for cooling in summer. We talked about a wood stove, but have not installed one. The performance of the house during an exceptionally cold spell (night time minimum temperatures around zero for a week) in July following completion of glazing suggests that we may never need one. The feeling of walking into an otherwise empty house at 7.00am with the outside temperature around 1°C and feeling warm was very comforting and comfortable. It works!

The wall construction of the home is rammed limestone, built on a concrete pad within a series of stepped retaining walls. The lower floor internal walls are clay brick, and gypsum blocks are used for internal walls on the upper floor. We could have used rammed limestone internally, but at some loss of space. The two roofs are supported by engineered

trusses made from plantation pine sourced just south of Perth (the suppliers claim a 26 per cent reduction in timber requirement when trusses are used). Wherever possible, either plantation pine or recycled timber has been used. The staircase is made from wood found (by chance) in a local salvage yard, and re-milled after denailing—significantly cheaper than dressed new timber.

Low environmental impact

The challenge in trying to build a home that goes some way to minimising embodied energy and environmental impact is that getting accurate information about the source of materials and their pedigrees is often very hard or impossible. If a reputable company claims that its trusses are plantation grown, or that a rammed earth company can provide data on embodied energy, then reasonably, one can rely upon this.

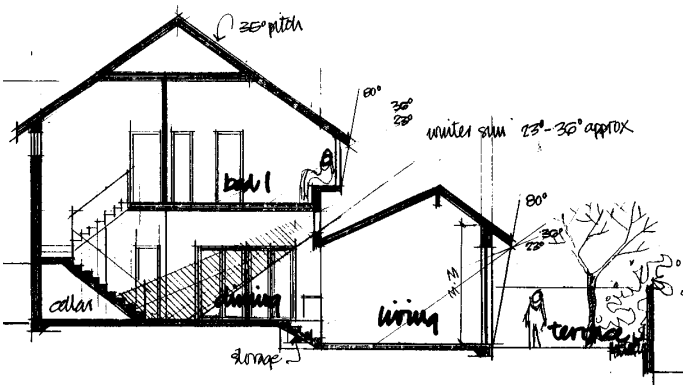
I knew for example, that some brick plants in Perth use landfill gas. But these facts are not exploited in mainstream marketing and the general public is unaware of these facts. Old growth Jarrah continues to be used for roof timbers, and the carpenters and fixers talk about the 'weakness' of pine. Such ignorance is appalling. Timber collected personally from a salvage yard is obvious, but what about the source of the crushed limestone for the walls? I could not discover whether the limestone we used was quarry waste or 'sawdust' or had to be specially crushed.

The process of being an owner builder is fraught with traps and pitfalls in trying to ensure that things are done the way one wants them. I have found no one who claims that building a house is an easy process. Another indictment on the building industry. But add to this an insistence on say, more insulation than a roofing plumber might be used to, and wait for the arguments. They know best, and architects are regarded with disdain, and you cannot be expected to understand what we know. In the choice of paving bricks, I let the guard slip and the bricks had been ordered. It turned out that they were in fact the product of the landfill gas fired plant.

Consult the stars or the kWh numbers?

Despite the difficulties, our overall strategy to build a low embodied energy and low consumed energy house has been successful so far. In general, the only item of high electricity consumption is a fridge-freezer. The selection of this item in itself was not as straightforward as it might seem. The slogan says 'consult the stars and save'. I'd suggest that consulting the predicted kWh data would be more useful. But there are limitations—many of the brochures we looked at contained no kWh data, nor did some of the products on display. With gas cooking, a gas boosted solar water heater and a strategy to minimise electricity consumption we then looked to the grid-connected PV system to become the second home to be connected in WA.

Using twelve 83 watt BP Solar modules and a Trace 4.5kVA grid-interactive inverter, (all of which are sales tax free) we are connected to the Western Power Grid and now participate in their renew-



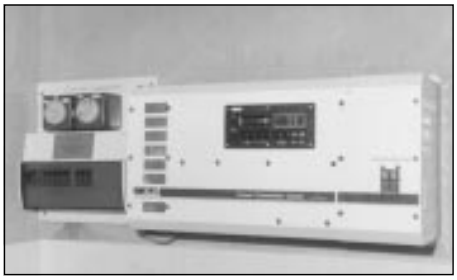
A cross section through the house shows the passive solar design features, such as north-facing windows that are shaded by eaves during summer.

Computers saving energy

Computer programs aid the predicted energy performance of homes. We have a precise idea of how particular building materials and construction methods perform with regard to heat loss and heat gain. We also know what the differences are between various climate zones around Australia. If we then combine these two sets of information and include such factors as orientation and shading, it is possible to arrive at a prediction of how a house (design stage or built) will respond. Or in other words, how much energy it will require to heat or cool. This approach has led to a rating system for houses that provides the potential owner with a 'star rating' (not unlike that used on white-goods). A five star house is better than a four star house and so on.

The advent of more user friendly computer analyses of designs has meant that the operator can vary such things as construction type, glass area, insulation, curtains, draught proofing and so on. In this way, the effect on energy efficiency of each of these can be measured.

It is important to stress that a house that scores a high rating for, say, Broome will not achieve the same score for Hobart—assuming the same materials and design were employed. Perhaps we could say that instinctively, but it is surprising how much home building has gone on in the past that merely relocated the same plan to a very different climatic location—to the comfort and cost disadvantage of the homeowner.



The Trace inverter converts the DC electricity from the solar panels to AC electricity for use in the house. It also feeds any excess electricity from the panels into the mains grid or provides the house with power from the grid when the sun isn't shining.

able energy buyback scheme. Western Power claim they are encouraging customers to install such systems with their buyback tariff, but I suggest that they are not actively discouraging renewable energy suppliers. They are not pro-active, and with such a small market, they may never reach 100 customers for the scheme. The buyback rates fall well short of net billing, and added to the fact that there is no subsidy, Western Power are getting capital-free generating capacity.

Their contribution is in the supply, (free of charge) of two digital meters. The whole process at present is wrapped up in engineering red tape, and life is made particularly difficult for the supplier. One hopes that with experience they will be able to make the process easier. Then we have the problem of the erratic grid voltage. We assume we get a 240 volt supply.

Now I have a means of monitoring this, the fluctuations become obvious. Apparently, the value should fall between 234 and 246 volts, and that 240 volts is a mean value. In fact, the system occasionally moves outside that to as high as 260, and as low as 182! The home is near a major switchyard, so the inverter will have to deal with some high voltage spikes.

As I write, we have passed the point in the year where the sun penetrates the home during the day and if we experience a cold night, one can feel slightly chilly at night, but the answer is to wear a jumper! Summer in Perth can reach fairly high temperatures, particularly when the night time can stay around 25°C with high thirties to forty plus degree days in sequence. The sea breeze can be very welcome. Windows in all rooms have been arranged so as to scoop the breeze, and already I have been experimenting with different openings and getting good results.

Now to deal with the building rubble in the garden…

Reprinted from *Solar Progress*, the journal of the Australia and New Zealand Solar Energy Society (ANZSES). Contact ANZSES by post: Box 1140, Maroubra NSW 2035. or email: anzses@unsw.edu.au

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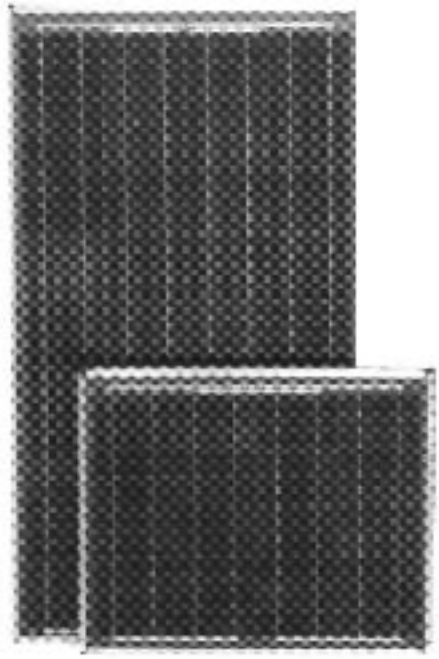

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Solar power your shed

A shed can be a safe haven from a harsh and uncaring world. It can also be a good place to learn some basics about setting up a renewable energy system. Colin Goodwin takes us on a tour of his pride and joy.

It goes without saying that a bloke needs a shed! After all, when a bloke has been around a while, and acquired life's essentials…like a barbie, a trailer, and a chainsaw…he needs somewhere to keep them all.

My problem was, you see, that my shed didn't have a light in it. In fact, it's just a simple garden shed, and didn't have any electrical power at all. Of course, being the enthusiastic Alternative Technology Association member that I am, I wanted a solar-powered shed.

My wife had given me a solar panel for Christmas. It was a ripper panel and gave me many hours of entertainment playing with motors and fans and lights and things. Eventually however, my good lady began asking questions, such as 'Why aren't you *using* your solar panel?' I explained that what I would really like to do was set up a small system to provide lighting for my shed, but that I needed a battery for the system. Well, blow me down, what do I get for my birthday but a battery. (Actually a deep-cycle, sealed-lead-acid battery—the good lady is also an ATA member.)

Obviously the time had come for action, so I started some serious research on what else I needed to produce the best solar-powered shed on the block!

Building Blocks

Clearly there are two basic elements to my little power system—using my solar panel to charge my battery, and then using the battery to power some lights. A more organised person than I would have started by first deciding what types of electrical services were required, and how many hours a day they would be used. From this it would be possible to calculate the battery size required and then what size solar panel would be needed to keep the battery adequately charged. I wanted sufficient power to provide light for working in the shed at night and to also use small power tools.

For background lighting, I felt that a large (36 watt) fluorescent light would be best, as this would provide ample light for the whole shed, while for detailed work I decided to use a halogen spotlight (20 watt).

For such small demands, a 12 volt system is ample, and bits and pieces for 12 volt systems are readily available from automotive and marine stores, so it was a 'no-brainer' to decide to stick with 12 volts. I also decided that I was unlikely to need more than two hours of lighting per night (on the nights when I did work in the shed). The lights should draw around 3 amps (36 watts divided by 12 volts) for the fluoro and 1.7 amps (20/12) for the halogen lamp, giving 4.7 amps if I use both.

As it's undesirable to cycle any battery too low, since this reduces battery life, a rule-of-thumb I had found was to choose battery capacity so that a normal day's consumption consumed no more than 20 per cent of the battery capacity. This meant that for a daily usage of 9.4 amp-hours (4.7 amps x two hours), I should have a battery with five times the capacity (ie 47 amp-hours). My wife had in fact bought me a 42 amp-hour battery, providing a fair approximation to the to the battery required. So far so good!

Now, I also need to supply each day the 9.4 amp-hours from the solar panel to the battery to replace the power used overnight. Assuming that I get four hours decent sunlight each day (easily done in Melbourne's summer, but probably marginal for Melbourne's winter), I would need 2.35 amps (9.4 amp-hours/4 hours) from the solar panel.

My wife had bought me a 15 watt (peak) panel, which should provide 1.25 amps in full sun (15/12). So this suggests that my solar panel is undersized if I want to light my shed for two hours every night. In retrospect, I concluded that I would be satisfied if the battery was recharged over a few days, as I was most unlikely to be using the shed for two hours a night for many nights in a row.

So, my rough analysis suggested that the missus had indeed made reasonable choices of battery and solar panel. (Purists will point out that I haven't allowed for losses in wiring and other components, and self-discharge in the battery. However, since this is *my* shed, no purists are allowed!)

The battery

The battery my wife had selected was a Panasonic 42 amp-hour sealed-lead-acid battery. For a shed—where there may be many weeks when the power system is unused and left to its own devices—a sealed battery is a great choice. A flooded cell, which can vent gas to the atmosphere, would need oc-

casional topping up with water, and would also need to be kept in a vented space to avoid a buildup of explosive hydrogen. My sealed cell has none of these problems.

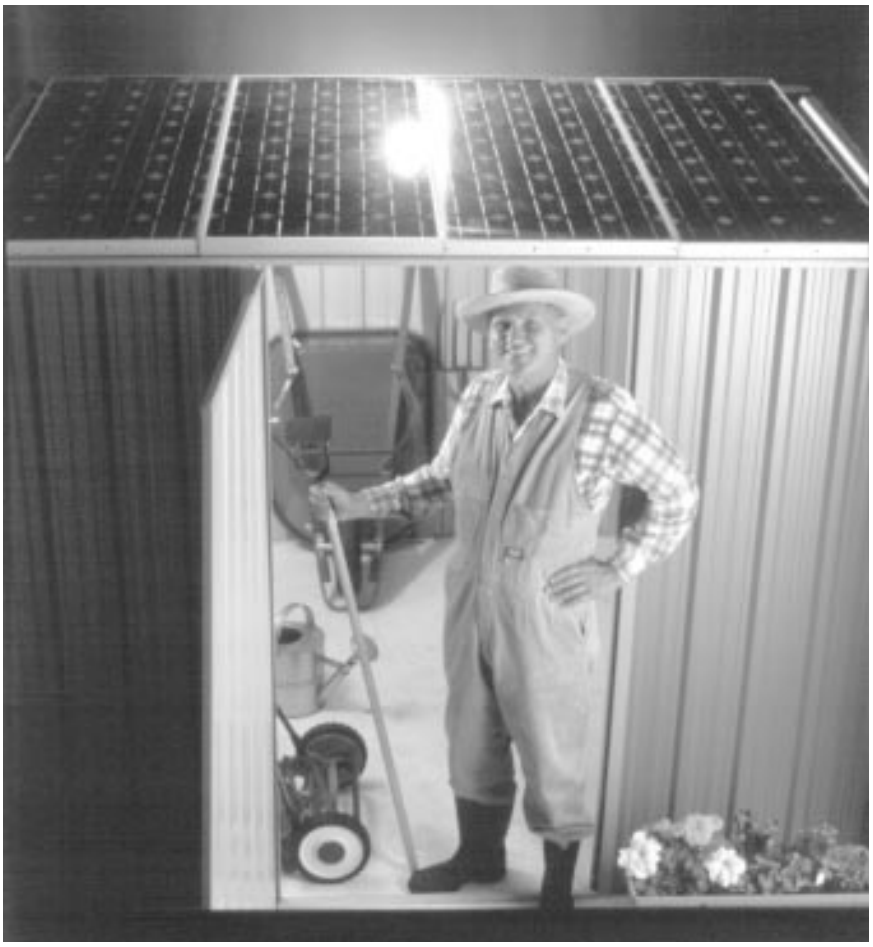
Printed on the side of my battery are two ranges of voltages, 'Cycle Use 14.5 to 14.9V' and 'Standby Use 13.6V to 13.8V'. The first is (I'm told) the desired range for charging a battery which has frequent daily use, while the second range is appropriate for a battery which has occasional or intermittent usage. For use in a shed, which is somewhat between the two, I decided to try and charge the battery to 14 volts, and then keep it at that level (that is, 'float' it at 14 volts). Although it's a 12 volt battery, you need to charge batteries to a higher level—when a load is applied, the battery voltage drops closer to 12 volts. Try it with a voltmeter, you'll see.

Solar panel

The solar panel is a BP SR1215 (which appears to mean self-regulating 12 volt, 15 watt). My experiments with this panel showed that it does give around 1.25 amps in full sun, as expected. However, because the panel is 'self-regulating' it is actually constructed with fewer silicon cells than a 'normal' panel, and reaches about 16 volts in full sun instead of the significantly higher voltage that a normal panel would reach.

While 16 volts in full sun is enough to charge the battery, it does mean that when it is overcast, the panel often gives only 12 to 13 volts, which is likely to be lower than the battery voltage, and thus cannot force charge into the battery. Consequently, the panel may take quite a long time to charge the battery if the weather is overcast.

It seems that 'self-regulating' panels are made to avoid the need for a voltage regulator for flooded-cell batteries. An occasional over-voltage just causes a little gassing (like an equalising charge), and at worst would mean that the batteries would have to be topped up more often, and may have a reduced life.



However, sealed lead-acid batteries should not be allowed to gas, as this can eventually destroy them. Consequently, it is important to ensure that the batteries are never subjected to overvoltage, and as the so-called 'self regulating' panels do not truly regulate, a voltage regulator is required.

For my shed, a self-regulating panel is not a good choice, since I still need a regulator to protect the sealed lead-acid battery, and the system suffers from poor performance on overcast days. A normal solar panel in conjunction with a regulator would have been a better choice.

Voltage regulator

I have found that most voltage regulators are actually designed for flooded-cell batteries—understandably since these are the most common. (You can tell because they have provision for 'equalising', which allows a deliberate overvoltage to be used to get the batteries to gas, and charge them to their maximum level.)

However, there are some voltage regulators which are explicitly designed for sealed batteries (absorbed-glass-mat and gel cells), and this is what I needed. I priced a commercial unit at over $100 before I decided to search out a kit instead. Some electronic hobbyist's stores carry kits which are appropriate.

I eventually chose a kit from Oatley Electronics, which cost $29, is quite ef-

ficient and is capable of handling up to 15 amps charging current (kit K09). My son and I assembled the kit—both of us enjoy simple electronics projects—and then purchased a case in which to mount it.

The voltage regulator worked first time. It required a simple adjustment to set the float level to my desired 14 volts, which was easily done by connecting up the panel, regulator and battery in full sun, measuring the regulator output with a voltmeter, and tweaking the setting until the regulator disconnected when the battery floated to 14 volts.

In use, the regulator will drive the battery voltage up to the float level, and then disconnects the panel from the battery, after which the battery voltage will take a few minutes to slowly drift down to 13.7 volts, at which time the regulator will reconnect the panel to the battery, and recommence charging.

The regulator has a LED which shows whether the panel is connected to the battery or not, and allows you to monitor the charging process. Incidentally, this type of regulator is called a 'series switching' regulator, and cannot be used for sources of power which require a steady load, such as a wind generator or a micro-hydro generator. These devices need a load to deliver energy to, and if disconnected from a load will run very fast and may destroy themselves.

An appropriate regulator for such devices is called a 'shunt' regulator. Solar panels however don't mind simply being disconnected from a load, and so a simpler switching regulator is quite satisfactory.

Lighting

I could have purchased a 12 volt fluorescent light—these are readily available in 8 and 16 watt units. However, I felt that these would not provide adequate light, and decided that I needed a larger 36 watt fluoro. These do not seem to be readily available in 12 volt units, and so I was obliged again to purchase a kit and assemble it. I was also fortunate in having an old 240 volt fluoro that I could cannibalise.

The kit I selected was also from Oatley Electronics, and cost $30 (kit K57). The same kit can be used to drive a compact fluoro with a built-in electronic ballast, or a fluoro tube via a separate electronic ballast. I chose the variant of the kit that is supplied with a separate 240 volt electronic ballast.

I first tested the existing fluoro on 240 volts to ensure it still worked. Then I pulled out the old wiring and fitted the new electronic ballast. This did not work at first, as I had used multi-strand wire and there must have been some bad connections. When I re-wired it with solid core wire it worked satisfactorily. My son and I then assembled the kit, wired it in front of the electronic ballast and connected it to the battery—it worked! So we finished up by fitting all the electronics into the fluoro housing.

For detail work at a bench I thought I would like to have a halogen desklamp. I looked at ordinary 240 volt halogen desklamps in hardware and lighting stores, but concluded that most of the $50 to $80 would be spent unnecessarily on the internal transformer, which I would have to remove anyway to run the halogen lamp from 12 volts.

Instead, I bought a conventional 240 volt desklamp for around $20 and a ceramic halogen lamp socket from an electronics store for $3. I then set about mounting the socket in the lamp. My first approach involved soldering the socket into the bayonet light fitting, and then gluing the socket onto a plastic cap which could be pushed into the light fitting.

I was busy reading by the light of the desklamp, and congratulating myself on my simple conversion, when I found that the halogen lamp had slumped inside the desklamp—the light was so hot it had melted the plastic cap. The lesson I learnt was that halogen lights get *very* hot, which explains why real halogen light fittings are made of metal and ceramic. So I'm still looking for a convenient safe way of fixing the hot socket onto my desklamp. *(I use mortar mix—Ed.)*

Setup and test

Installing the various components of my power system on the shed actually took very little time. First I decided where I wanted to install the lights and battery and measured the lengths of the cable runs. Then I bought some heavy twin-core power cable from my neighbourhood hardware store, as well as a light switch for the fluoro, and some cable fasteners to attach the cable to the walls. I bought some 'spade' connectors from an electronics store so that I could crimp them onto the end of the cables to ensure a good electrical connection to the battery and to the solar panel.

Finally, I ran the cables, crimped on the connectors, and attached the lights, battery and solar panel, and then invited my better half down for the ceremonial switch-on!

Our little system has run now for a few months (in Spring and Summer) with no problems. The battery is always fully charged with the regulator showing the 'float' state. The fluoro starts up gently but promptly, and the desklamp provides a brilliant work light immediately.

How I'd do it better

There are a few more things I should and could do to improve the system. These are:

Distribution panel with meters—I could set up a little distribution board,

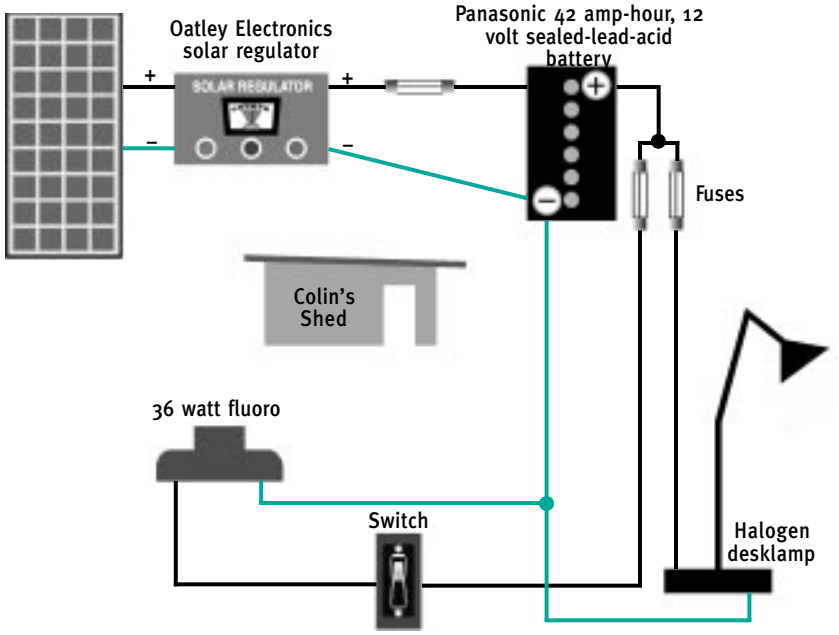


Diagram: Chris Mueller

This is the wiring diagram for the solar power system in Colin's shed. As you can see, it is quite a simple system.

with a permanent voltmeter to show the state of charge of the battery, and perhaps an ammeter to show current usage. Currently I'm in no hurry, as I suspect it'll cost around $100 to setup a decent distribution board.

Inverter—of course, when I want to use power tools, I'll need an inverter. There is a wide range of these, and the small ones (sufficient for a single power tool) are affordable.

Low-voltage protection—and finally, if I'm going to be using lots of lights and tools there's the danger that I'll accidentally use more of the battery power than is appropriate (that is, more than 20 per cent of rated capacity). Ideally I'd have a low-voltage protection cut-out to guard against this. I suspect I may need another electronics kit to do the job.

Conclusion

You may have wondered whether there are simpler ways to provide a couple of lights in a shed. I guess that, if all I ever wanted was occasional low-level lighting, so that I could find things in the shed at night, a simpler cheaper system would have been adequate. An 8 or 16 watt fluoro with a smaller sealed battery and a smaller solar panel and regulator would do the job. I could even have investigated the inexpensive solar powered garden lights that are available to see if I could disassemble one and use the components to build a micro power system.

Alternatively, I could have assembled a much larger system, and purchased commercially available voltage regulators and fluorescent lights instead of assembling these from kits. Then I would also have had the benefit of warranties and good quality assembly.

However, I (and my wife) are happy with our little power system! It has sufficient capacity to allow me to work at night in the shed for a couple of hours. It's also easily expanded with further battery or panels to allow longer and more frequent periods of work. And of course, with a shed, the sky's the limit! There's tools, beer fridge's, TV's—I've heard that some blokes have such demanding schedules that they are obliged to virtually live in their shed! So it's just as well to be prepared, right?

(My thanks to my friends in the ATA for advice and ideas.)

Where to get the parts

A 15 watt solar panel will cost anywhere from $140 to $250, depending on the supplier and brand of panel. Solar panels are available from renewable energy installers and suppliers, as well as some automotive and marine stores.

Some cheaper panels have phenolic resin backing boards, and will distort as they age, breaking the silicon wafers inside them. Avoid these, and go for known brands like Solarex, BP Solar, Canon, Siemens and Kyocera.

Panasonic sealed-lead-acid batteries are available from RF Industries, toll free: 1800 773 511. Other renewable energy dealers may stock similar batteries. Do not use car batteries, unless you want your system to fail very quickly—they are not designed to withstand deep discharges!

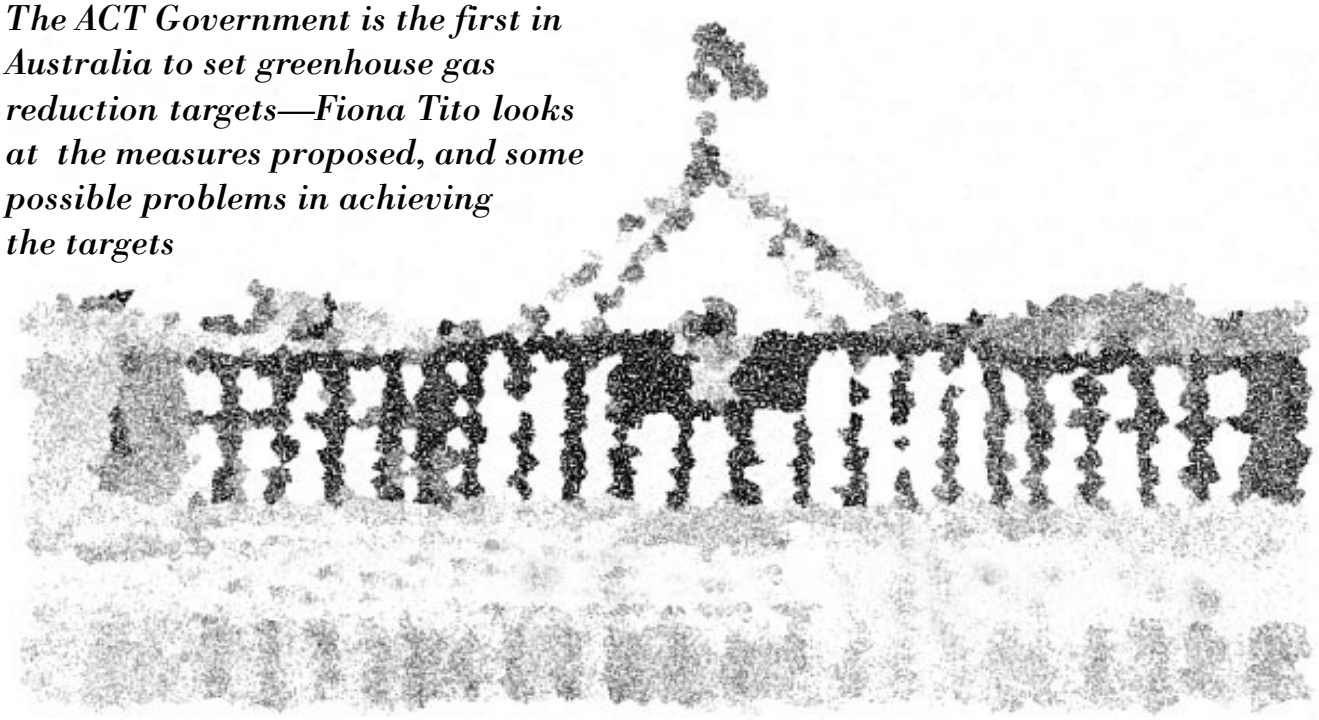
The regulator can be bought from Oatley Electronics, PO Box 89, Oatley NSW 2223, ph:(02) 9584 3563, fax:(02) 9584 3561, email: oatley@world.net. Renewable energy installers also sell low-power regulators.

Wiring, fuses, switches and terminals can all be bought from renewable energy equipment suppliers. See the Local Suppliers' Directory at the back of this magazine for a list of suppliers.

Greenhouse and the ACT

the mouse that roared (or at least squeaked loudly)

The ACT Government is the first in Australia to set greenhouse gas reduction targets—Fiona Tito looks at the measures proposed, and some possible problems in achieving the targets



Setting the agenda

In the last weeks of 1997, everyone heard about the Australian Government's embarrassing international stand on greenhouse gas reductions. The press was full of it for weeks, as our national leaders argued in international circles that we shouldn't have to reduce our emissions because we were 'special'. Well, there is one small, much maligned jurisdiction in Australia which is standing on its own against the tide of economic rationalist-driven, ecological irresponsibility.

The ACT announced greenhouse emission reduction targets at the World Local Government Leader's Summit on Climate Protection in Nagoya at the end of November 1997—the first government in Australia to do so. The ACT also became the first Australian capital city to join the Cities for Climate Protection Program and will use the formulas for that program to measure its progress. The ACT's targets are:

- to stabilise emissions to the 1990 level by 2008.
- to reduce emissions from that level by 20 per cent by 2018.

Emission levels for 1990 have been calculated at around three million tonnes—the second lowest of all states and territories overall and the second lowest per capita in Australia. However, the period 1990-95 saw ACT emission levels rise by nine per cent—three per cent faster than average national levels. This gives some urgency to the ACT's task.

Because of the small industrial and agricultural base in the ACT, the profile of carbon dioxide emissions is somewhat different from the national picture. Our two key contributing areas are domestic energy consumption and fuel used in transport. The ACT has a very high rate of motor vehicle usage and a relatively poor bus-based public transport system, and it has a climate with significant temperature extremes. Space heating and cooling and hot water heating are some of the biggest users of power in the domestic sphere. Only six per cent of ACT households have solar water heaters.

Achieving the reductions

The Government indicated that they have already introduced a range of energy efficiency measures, including:

- establishing an energy research and development trust fund.
- improving the energy efficiency of Government assets, including public housing.
- introducing the ACT Home Energy Rating Scheme (which requires new homes to meet a minimum of four out of five energy rating before development approval).
- establishing an optional 'green tariff' on electricity bills for the development of sustainable energy options.

The last of these measures has thus far been unsuccessful, because of the

size of the tariff (almost double the bill) and the lack of apparent commitment to use the money for sustainable energy production.

The ACT Government has proposed ten additional measures to be progressively introduced to assist with the development of greenhouse emission reduction plans. Some of these seem to overlap with a number of the existing ones listed above, while some are clearly new initiatives:

- the requirement for roof insulation in all new houses.
- the development of a practice of mandatory disclosure of energy rating of all homes when they are sold (the ACT Greens introduced legislation to do this in 1997).
- allowing existing homeowners access to the Home Energy Rating Scheme to allow them to take advantage of energy efficiency upgrades.
- an investigation into significant energy efficiency in Government buildings, including seeking the co-operation of the Commonwealth Government in relation to their buildings in Canberra.
- a cash-back or subsidy program for the installation of low-flow shower heads.
- a study of Australian best practice to determine the best ways of offsetting the high capital costs of some energy efficiency measures around the house.
- a 'Greenfleet' program, where car owners can pay $25 or $50 per year for the planting of 7 or 14 trees—the Government claims that planting 7 trees per year offsets the greenhouse emissions from an average car.
- the introduction of environmental criteria for the ACT Business Incentive Scheme.
- establishment of an independent Energy Advisory Service.
- the release of an Integrated Transport and Land Use Strategy for the ACT—which will look at the public transport future for the ACT, as well as the freeway construction program.

Photo: Colin Goodwin

The ACT is at the forefront of renewable energy research, but like most of Australia, has very little installed capacity. This solar thermal concentrator dish at the Australian National University works by heating a liquid salt which is pumped through the focal point, in turn producing steam to drive a turbine which generates electricity.

Further measures are supposed to be developed and community consultation undertaken, with the intention that the ACT will have a full Greenhouse Reduction Strategy by mid-1998.

Problems for the strategy

Critics within the ACT have said that the currently proposed strategies are unlikely to lead to reductions, and that the Government's announcements thus far are extremely 'low impact'. The current Government acknowledged that another part of their strategy was not to disrupt the 'ordinary lives of Canberrans' in achieving any reduction.

The immediate question then must be whether these two aims—of effective reduction and no disruption—can coexist. There are significant concerns that the announced strategies are either window-dressing or a re-announcement of existing policies. There is a degree of frustration also about the 'Let's hold another study' approach on the important issue of high cost capital en-

ergy efficiency items, such as solar hot water and insulation. The ACT Greens MLA Kerrie Tucker commented at the time that 'We know these schemes work, and how, and it's time to get on and introduce such a scheme, not have another study.'

There is also a degree of cynicism about the ACT Government's commitment to greenhouse gas reductions, given the recent 'hedging contract' entered into by the local Government-owned electricity supply agency ACTEW, with Yallourn Energy. Yallourn Energy uses brown coal, which is one of the highest producers of carbon dioxide emissions per unit of energy produced. When questioned about it, both the Minister and ACTEW have claimed that such a contract has no environmental impact or relevance to ecological sustainability—'it is just about price'. This seems a conveniently oblique way of avoiding uncomfortable questions about the impact of this on Greenhouse gas targets.

It ignores the fact that a hedging contract with any supplier to the national electricity grid helps to support and maintain their production of electricity. The approach of the advisers to the ACT Government on this issues was 'If we don't buy it, someone else will, so there is no overall environmental impact of the contract'—a somewhat narrow, if convenient way, of interpreting the real effect of such a contract.

An important first step

So there is an argument that the mouse is only squeaking loudly, rather than roaring! Nonetheless, having at least one government in Australia setting such targets is an important symbolic step. With the ACT's elections occurring as this issue of *ReNew* goes to print, there may be some delays in the completion of the Greenhouse Reduction Strategy. There is also the vague possibility that a new Government will not follow through with completion of the plan. However, with the strong presence of environmental activists and the environmental commitments of some of the existing political parties and independents, this seems unlikely.

Let's all hope that the ACT government, in the geographical midst of an antagonistic and apathetic federal government, has the continued courage to set the tempo for Australia. Let's also hope that the people of the ACT and the Government work to ensure that the means of achieving the reductions are real, not political 'smoke and mirrors' illusions.

Welcome to Coal World

I don't believe it! That *can't* be true! These were typical of our reactions in the *ReNew* office after we heard about the proposal for a new theme park in the Latrobe Valley, home of Victoria's coal-fired power stations.

The $42.5 million project came to our attention a few days after the Australian government scored its 'victory' at Kyoto. The theme? Fossil fuel: coal, oil, black gold.

Incredulous, we did some investigation. It seems that around half the money ($20 million) and the impetus is coming from an industry consortium, mainly involved in electricity generation or distribution in the Latrobe Valley. Most of the rest ($16 million) is coming from the Victorian Government, and the Federal Government has promised $9 million for an 'Industrial Hall of Fame', along the lines of the Stockman's Hall of Fame. The Latrobe Shire is also considering a $1 million investment in the project.

The theme park, which has been named 'Energy Ridge', is yet to get the final okay for government funding, but Victorian Premier Jeff Kennett has publicly endorsed it, and with heavyweight companies like BHP, ESSO, Edison Electric and AMCOR investing, the Premier is unlikely to withdraw his support.

The park will include a demonstration oil rig, which will have a helicopter landing on it to take tours of real Bass Strait oil rigs. It will also incorporate the existing visitor's centre, which runs tours of coal mines and power plants.

Some 'environmental' displays are also included in the plan. There will be a tree plantation, wind power, solar and wave power displays, but the proportion of the total budget will likely be tiny compared with the fossil fuel displays, given the interests of the commercial investors.

While high profile renewable energy displays are valuable, large scale, working, installed renewable energy generators are more valuable. A wind farm in a good site that cost $42.5 million would attract tourists, create jobs, and do a lot more for the environment than a (mostly fossil fuel) energy theme park.

If it goes ahead, Energy Ridge is scheduled to open its doors in late 1999, so there is plenty of time to lobby the government and companies involved for a large share of renewables.

On the opposite page we have outlined our vision of how a fictitious energy theme park run by the fossil fuel lobby, *Coal World,* might attract visitors.

-Michael Linke

Drawing: Shannon Sproule

Clean architecture

Most of us think nothing of the thousands of chemicals we come into contact with every day, but for some people the effects are severe. Audrey Van Onselen explains how she overcame debilitating illness by building a chemical-free house

In 1992 I became so debilitated by a stomach virus that I had to resign from my profession as a solicitor. I thought I would recover after a couple of months' rest at home, having rationalised the symptoms as the result of a heavy workload, part time university study and a poor diet. But my growing list of symptoms got worse and would not subside. In short, I was a wreck, with diarrhoea after most foods, increased urinary frequency, skin rashes, respiratory problems, muscle fatigue and a general lack of energy, short-term memory problems and difficulty concentrating, chronic ear infection, hair loss, severe menstrual disorders and a constant low grade fever.

Depression set in as I realised I had lost my career and my health, and was spending most of my life either sleeping, resting or on the toilet. I had no idea what was happening to me, and neither did two different doctors. One declared that I had irritable bowel syndrome and that she could not help me, while the other hinted that I had anorexia, as by this stage my weight had dropped some 25 per cent. I lost my life as I had known it—my work, financial independence, my hobbies, recreation, the ability to socialise and to exist in a 'normal' environment with a 'normal' diet.

I became determined to help myself. Deleting processed foods from my diet led to minor improvements, and was an important clue in pinpointing the cause of my symptoms—the thousands of chemicals that I was eating, breathing and touching every day.

A generic term for my condition is multiple chemical sensitivity (MCS), but orthodox medicine is not yet able to find a definitive cause, history or cure for the condition. Recognising this, I consulted a naturopath who was able to administer herbs that helped me deal with my condition. I became so intrigued by these 'unorthodox' remedies that I am now studying herbal medicine myself.

There are numerous theories as to why chemical sensitivities occur. The symptoms have been attributed to virus, bacteria, genetic weakness, toxic chemical overload, an immune system debilitated by childhood disease immunisations: the list is endless. The medical profession is geared to diagnostic markers, but currently there is no clear marker for the cause of multiple chemical sensitivity.

Why reduce the chemical load in buildings?

A number of chemicals in the average home are associated with ill-health effects. Besides my list of symptoms,

Audrey Van Onselen's house in Burrum Heads, Queensland, demonstrates that a chemical-free house does not have to look other-worldly, and can incorporate passive solar energy-saving features.

some of these chemicals have also been linked to potentially fatal illnesses like asthma and cancer. There is good reason to review the items we build our homes with, the furnishings and goods we fill them with, and the foods we eat.

As a solicitor I had persuaded myself that regulations must be there to ensure every-day products are safe. I had a rude awakening however, as the history of chemical additives unfolded before me. I discovered numerous examples of use before adequate testing and wide variations in 'safe' levels between countries. Products, once 'safe,' can be banned from the market-place after decades of use. Products previously used in and around the home like DDT (pesticide), organochlorines (termite-proofing) and asbestos (insulation) were all widely used once, but have been outlawed after being reclassified as dangerous.

Indoor pollutants

There are hundreds of common chemicals which are best avoided (see box for a short list), but perhaps the most ubiquitous is formeldehyde. Formaldehyde is contained in wood products bonded with urea, formaldehyde resins, urea-formaldehyde, foam insulation, urea-formaldehyde wood finishes, hardwood plywood, particle board, medium density fibreboard (MDF), carpets, fabrics, paints, foods and plastics.

Symptoms of exposure to formaldehyde can vary, ranging from burning eyes, tightness in the chest, headaches, asthmatic attacks, depression, menstrual disorders and even death. Formaldehyde levels decrease over time, but once an individual is sensitised to it there will be no decrease in symptoms.

A healthy house formula

I became interested in building a low-toxic home soon after identifying every day chemicals as the cause of my symptoms. I progressed from being housebound for four years, barely managing on a severely restricted diet, to feeling almost 'normal' again after moving into a new healthy house which my husband Nikolaus and I designed and completed in December 1996.

Standard architectural principles and materials entail air-tight buildings filled with synthetic materials which off-gas contaminants from chemically unstable materials like plastic, rubber, paint, adhesives and synthetic fabrics. The healthiest choice comes from a selection of products which cannot absorb or outgas chemicals.

Materials chosen for my clean house include: fired clay block, glass bricks, metal and glass external and internal doors, ceramic tiled floors throughout, Zincalume roofing, custom mini-orb ceilings, metal shelving, checkerplate steel (the staircase) and galvanised storage lockers. There is no wood, plaster board, vinyl, synthetic fabrics, carpet, resin, solvents or synthetic paints.

The roof insulation is a pure aluminium product, 'Silverline' which contains no glues, paper or insect proofing. Roof insulation is a key material as the roof is subjected to intense heat, and under such conditions any chemical additives off-gas at a higher rate.

Water purifiers used in the house include a micron reverse-osmosis filter for the kitchen tap and a chlorine filter attached to the shower head.

Good ventilation is important, providing a continual flow of fresh air to reduce any contaminants such as those created by out-gassing from books, electronic apparatus and dyes in clothes. The house has five Whirlybird air extractors to vent each of the second storey rooms.

A recent air sample test of our house, undertaken by Dr Greg Miller of Enviro-Test, has proven that there is no formaldehyde present. This was achieved by a positive selection of non-toxic products.

A clean building site

Selecting a building site for our house was an exercise in itself. The location at Burrum Heads (40kms north of Hervey Bay, Queensland) fulfilled the requirements of no close proximity to primary or secondary industries, no contami-

The illness

Multiple Chemical Sensitivity, Sick Building Syndrome or 20th century syndrome

The sufferer

Audrey Van Onselen, who was working as a solicitor in Brisbane when she first experienced the symptoms of MCS.

The symptoms

Diarrhoea, increased urinary frequency, skin rashes, respiratory problems, muscle fatigue and a general lack of energy, short-term memory loss, chronic ear infection, hair loss, severe menstrual disorders, an inability to concentrate, palpitations, constant fever.

The cause

The cause of MCS is not known, though exposure to chemicals in food, drinking water, polluted air and many household materials has been blamed.

The solution

In Audrey's case, life has become liveable again after reducing chemical intake from her diet by eating organic food, moving to an area with clean air and building and furnishing a house using materials that do not contain harmful chemicals.

Where are the chemical nasties around your home?

Chemical/material	Where found	Effects
Formaldehyde	Foam, wood finishes plywood, carpets, paints, plastics, cleaners, fibre board, insulation, particle board, shampoo	Burning eyes, tight chest, headaches, asthma attacks, menstrual disorders, depression, cancer, death
Fibre glass	Bulk insulation batts	Minor irriatations to eyes, respitory tract, dermititis, allergies
Carbon monoxide	Gas cooking stoves, kerosene, heaters, car-exhaust, cigarettes	Diminishes the ability of the blood to carry oxygen to organs. Headaches, nausea, coma, loss of consciousness, cessation of breathing
Solvents, pigments, cadmium, barium	Paints	Some paints are non-toxic, but many contain harmful chemicals like cadmium, which can cause loss of appetite, vomiting, lesions, kindey stones, cancer and death
Copper chrome arsenic (copper sulfate, sodium diochromate and arsenic pentoxide)	Wood perservatives, fences, furniture, wooden buildings, 'treated pine'	CCA products leach arsenic into the ground. They have been banned in Germany where people or animals can come into contact with it

nated land history and constant fresh ocean breezes—the beach is thirty metres from our backyard.

If you are interested in clean architecture, an ideal starting point is a clean building site. Selection involves thoroughly researching the location for activities that indicate past or present chemical contamination.

Including energy efficiency

Many of the materials we used in our house have a high level of embodied energy, that is, they use a lot of energy in their production. However, we estimate that due to the choice of materials, our house will require no maintenance for the next 40 years, which will result in energy savings over the life of the building.

We also designed for energy efficiency, and as a result the house has no heating or cooling requirements other than natural ventilation and sunlight. The building has standard passive solar design features like large north-facing windows protected against summer sun by eaves, high thermal mass, large sliding doors which catch the prevailing summer breeze for natural ventilation and internal surfaces are good heat emitters (concrete slab and ceramic tiles). We have also installed a solar water heater as an energy saving feature.

Testing your home

Independent environmental chemistry laboratories exist in every state of Australia. In Brisbane, Enviro-Test will test dust samples of a house and we obtained such a test of our former Brisbane home. The chemical classes included in the test were organochlorine insecticides and trace elements. These were offered as a standard test by that company.

Our current house was tested for total volatile organic compounds (TVOC). The finding was less than 25 micrograms per cubic metre of air. The National Health and Medical Research Council interim recommended limit for TVOCs in indoor air is 500 micrograms per cubic metre of air.

Buying a new block of land

It is prudent to do a contaminated lands search prior to signing a contract for the purchase of a block of land. It is easier to check first, rather than expend the effort and time entering a contract and trying to terminate it later.

In Queensland, where I live, a search can be done in via the Department of Environment and Heritage, at the Contaminated Sites Register.

Some sites will be registered as reclaimed contaminated sites and caution is recommended here as the level of contamination after 'reclamation' may still not be suitable for a sensitive person.

Building specifications

Building specifications outline in detail the building materials and techniques. Your comprehensive specifications can be included, by way of a special condition noted on the building contract, to be part of the building contract.

The low toxic chemical products specified (including an exclusion list of chemicals outlined) thereby form part of the contract and the specifications become a clear and indisputable legal venue for litigation should the specifications not be followed.

Specifications should also include a statement that in the case of any change of materials outlined, your consent must be obtained first.

The use of poorly tested and unsafe chemical materials in our environment is a problem in the short term for the chemically sensitive and in the long term for more robust individuals. The good news is that healthy choices can be made. The Queensland Master Builders' Association gave its stamp of approval for our house in the July 1997 QMBA awards in the category of 'innovative use of technology', based on the sourcing of nontoxic materials.

Resources

• *Contaminated Lands Register.* A service run by State Governments, offered by the Department of Environment and Heritage in Queensland).

• An independent laboratory which will test soil samples of land or dust in a house for analysis of chemicals.

• Rousseau, D., Rea, W.J. & Enwright,J. (1990) *Your Home. Your Health, and Well-being*, Berkeley, California, Ten Speed Press.

Includes in-depth tables of standard building materials and their health effects.

• Bower, J. (1993) *The Healthy House: How to buy one, how to cure a 'sick' one, how to build one*, New York, Carol Publishing Group.

• Godish, T. (1990) *Indoor Air Pollution Control*, Michigan, Louis Publishing, p.111.

• *Toxic Treatments: Wood preservative hazards at work and in the home*, A London Hazards Centre Handbook, 1989, London.

• National Centre for Epidemiology and Population Health (1994) *Trends in Mortality: by causes of death in Australia, the states and territories during 1971-92, and in statistical divisions and sub-divisions during 1991-92,* No. 3313.0 , Canberra, Australian Bureau of Statistics. Geographic delineation of areas with high mortality rates and causes of death.

• *A-Z of Chemicals in the Home*, Total Environment Centre and Australian Consumers' Association, Sydney, 1990.

Support groups

• ACTA (Australian Chemical Trauma Alliance Inc.)

• Allergy groups in each state (see phone directory listing under 'allergy').

Australia's first real steps towards greenhouse response?

It is tempting to use this column to review the processes leading up to, and outcomes of, the Kyoto conference on global warming. But it's too early in the New Year to get depressed. Instead, this column looks at some underlying changes in attitudes to greenhouse response within business and government.

In the lead-up to Kyoto, the Australian Government has been forced to make substantial public commitments to greenhouse emission reduction strategies (summarised in the Department of Primary Industries and Energy's *Australian Energy News, Dec 1997*), while the Labor Opposition (which increasingly looks like being the post-1999 government) has committed itself to stabilisation of emissions at 1990 levels or better. Other parties to the Convention—who are acutely aware that Australia was let off very lightly at Kyoto in the interests of achieving global consensus—will carefully monitor Australia's performance, and apply pressure if we don't deliver.

Of course, cynics might note that many of the Government's commitments simply replace programs it cut in previous budgets. We have seen many times how effectively entrenched interests can delay and block implementation of programs they perceive to be threatening to them, regardless of the benefits to the Australian community and the environment.

But there are some important shifts in the balance of the game, which may provide grounds for a reduction in the level of pessimism.

The resource industries, which are international businesses, recognise that Australia must be seen to play its part in greenhouse response if their businesses are to minimise the risk of trade sanctions and maintain investment. Yet they do not want to carry the burden of response. So they are actively supporting introduction of interventionist strategies such as best practice performance standards for buildings, appliances, equipment and vehicles: they want households and small business to do their bit.

"...cynics might note that many of the Government's commitments simply replace programs it cut in previous budgets".

There are also some splits in traditional political alliances. The cogeneration industry and the gas industry see themselves as potential winners from greenhouse response, so they are distancing themselves from the coal industry. Within the electricity industry, the increasing political strength of distributors and retailers relative to power generators (mostly coal-fired) is opening a gap: distributors and retailers are happy to sell 'greener' power—as long as it is profitable. The expected emergence of 'multi-utilities' which will sell electricity, gas and anything else that customers want, will further open up scope for greenhouse emission reduction—if the market rules are set appropriately.

Entrenched interest groups in the building industry, who have successfully blocked most past efforts to improve building energy efficiency, now have experience of using tools such as House Energy Rating systems. They have found the reality of energy efficient building design to be much less traumatic than they expected: indeed, the smart builders and developers now use such tools to enhance profits. Development of improved window systems (and window energy rating systems), improved insulation systems and new materials means builders have much more flexibility to achieve energy efficiency.

Passing the buck

The appliance and equipment industries have realised that large trading blocs, particularly Europe, are introducing energy performance standards: if Australia does not match them, our markets will be swamped by cheap, substandard product—and local industry will suffer. So the buzz word is 'harmonisation'. And energy labelling has proved itself as an effective marketing tool: environmental performance is becoming a key requirement for sales success.

Lastly, the community—and many within business—have signalled that they want action on global warming. There is widespread embarrassment at Australia's international position, and recognition that there is a fundamental contradiction between this position, Australia's abundant renewable resource endowment and a vision of Australia as a 'smart country'.

The outcome of these shifts is that governments and the bureaucrats that advise them are reassessing the state of the game. Governments and bureaucrats are very risk-averse. When they see a conflict between green groups and business, or even between the broad

community and big business, they are less than enthusiastic in progressing new policies and programs: they would rather be seen to support 'the economy' than community benefit. And they know how effectively big business can use the media.

When powerful business groups begin to split, it is safer for government to respond to community concerns. For example, now the support of the resource industries for building performance standards can be used to balance resistance from the building industry. Cautious bureaucrats and politicians will now try to position themselves in a new 'safe' area—this means support for programs and policies that were previously see as 'risky'. Of course, a 'safe' strategy still involves trying to find compromises that will offer something to each of the powerful groups, so it doesn't mean we'll see aggressive pursuit of radical policies. But it does mean that we can expect the debate within government to shift from *whether* we pursue emission reduction strategies to *how*, *when* and *how far* we drive them.

Supporting renewables and energy efficiency

A really big challenge is to focus governments on supporting development of industries that will underpin our future success, such as renewable energy and energy efficiency. Part of the problem here is the belief that support for these industries will somehow hurt existing resource-based industries—and anything that hurts the powerful resource industries cannot be actively supported by government. This seems to be based on the assumption that we have a pie of fixed size, so giving a larger piece of the pie to sustainable energy industries will leave a smaller slice for the resource industries. To overcome this blockage, we need to identify areas where development of sustainable energy options helps these powerful industries, does not adversely affect them, or helps them reposition themselves for future success. Shell, BP, BHP and others are beginning to identify such opportunities, so we are already progressing on this front.

Alan Pears

The Kyoto Protocol

The Protocol prepared at Kyoto commits developed countries to achieve an overall 5 per cent reduction in greenhouse gas emissions relative to 1990 levels by 2010 (actually the average for 2008 to 2012). Gases included in the agreement are the major gases, carbon dioxide, methane and nitrous oxide; and the less significant gases hydrofluorocarbons (replacements for CFCs), perfluorocarbons (mainly from aluminium production) and sulphur hexafluoride. A key clause for Australia is that countries for whom land use change and forestry emissions were a net source of emissions in 1990 can include these emissions in their baseline year amount, and reductions in these net emissions can be included in calculations of future emissions levels.

Each developed country has its own emission limitation commitment, with European Union countries being required to achieve an eight per cent cut, the USA seven per cent and the Russian Federation zero per cent. Australia, which is allowed an eight per cent increase (plus a bonus allowance because of the land use change clause) is one of three countries allowed to increase emissions: the others are Iceland (ten per cent) and New Zealand (one per cent).

The Protocol includes scope for trading of emissions between countries, and joint achievement of requirements where agreements exist (for example, the European Union 'bubble'). A limited framework for developed countries to assist developing countries to reduce emissions—with credits going to the developed country—is also included.

Many of the details and operational arrangements remain to be specified in detail in future negotiations.

Australia's 1990 greenhouse gas emissions (including forestry and land-use change) were just under 500 million tonnes of carbon dioxide equivalent, of which almost a fifth (93 Mt) was the net effect of forestry and land-use change. By 1995, forestry and land-use change net emissions had already declined by 36 Mt. If Australia managed to achieve net zero emissions from forestry and land-use change, while achieving its Kyoto requirement of an overall 10 per cent increase from 1990 emission levels, emissions from sources other than forestry and land-use change could rise by around 28 per cent, while almost every other developed country will have to achieve reductions. It is difficult to understand how the Australian Government can portray this outcome as a victory for the environment!

Wind generator buyers' guide

Wind generators can be the primary power source in a renewable energy system, providing you have a suitable site and select the right machine. Lance Turner takes a look at what is on the market.

For many people, the idea of wind energy is limited to images of rusty Southern Cross windmills pumping water. But modern wind turbines have come of age, and can play a key role in generating electricity for independent power systems.

There are many different names for wind turbines: wind generators, wind machines, and wind-power devices. No one is particularly right, but the important distinction is between electricity generating devices that can be used for home power, and water pumping windmills.

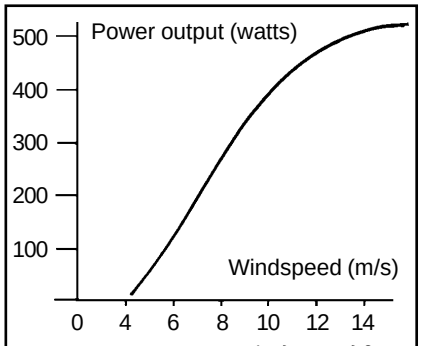
All wind turbines are designed and perform differently, and so some are more suited to particular situations than others.

What makes a good site?

Many people think they have a site that would be great for a wind generator, because there is always a wind blowing. However, even a site that has a constant wind is useless if the wind speed is less than is required to get a generator to start producing usable power. While manufacturers may use a low 'cut in' wind speed (the speed where the turbine starts generating electricity) as a selling point, there simply isn't much energy to be derived from slow winds.

There is very little energy available from the wind at speeds below three metres per second (m/s) and most wind turbines do not produce power below this speed. Sure, they may be spinning, even quite quickly, but they won't be producing electricity. The power curve below demonstrates the lack of power production below this wind speed.

The energy contained in the wind is not directly proportional to the wind speed. It increases with the cube of the wind speed. This means that a 6m/s wind has eight times (2 x 2 x 2) the energy of a 3m/s, so getting the turbine into the spot with the highest wind speed is of prime



Power output versus wind speed for the Soma 400. Note that no power is produced below 4m/s.

importance, though there are a couple of other factors that have to be considered.

There are two schools of thought on measuring wind speed prior to installing a turbine. The 'don't bother' school says gather approximate information about your area from the Bureau of Meteorology, nearby airports and the Batelle Wind Atlas, and if it is likely you have a windy site, put up the turbine.

The 'do bother' school says put up a tower at the height you will be installing your turbine with a datalogging anemometer on it and wait four months—the minimum period for getting meaningful results.

The don't bother school prevails in Australia for domestic wind turbines. Installing an anemometer on a test tower for up to a year costs time and money, but minimises the risk of buying a machine that won't produce power. On the other hand, most of the populated coastal areas of Australia have fairly good wind regimes.

The turbine killer

Perhaps the biggest enemy of a wind turbine is turbulence. Turbulence is basically rapid changes in wind speed and direction caused by nearby obstacles such as buildings, trees or land formations. A highly turbulent site will result in a much faster rate of wear and tear on the turbine, and early failure will be inevitable. What you need is a site with a nice smooth flow of air that won't beat your turbine to a pulp in six months.

A simple way to determine whether you have a turbulent site is to fly a kite with a long tail. If the tail flutters, you most likely have turbulence.

Overspeed control

If you have sited your turbine correctly, then there will be times when it will be subject to very high winds. To stop the turbine spinning too fast, some form of overspeed protection is required.

There are several methods that turbine manufacturers employ to control the speed of their machines in high winds. Some of the smaller machines, like the Rutland and Ampair, are built very sturdily and don't need any mechanisms for speed control.

In most older machines, and many current models, some form of furling is used. This involves turning the turbine out of the wind to reduce the swept area of the blades that faces the wind, thus reducing the amount of energy imparted to them. This causes the turbine to limit its speed and stops it from self-destructing. Furling has been used for many years and has proved to be reliable, effective and easy to implement. The Bergey is an example of a furling wind turbine, as is the AWP machine.

Suppliers' details

Air turbines are available from Precision Wind Technology, PO Box 147, Tugun QLD 4224, ph: 0411 224 807, fax:(07) 5527 1878; Rainbow Power Company, PO Box 240, Nimbin NSW 2480, ph:(02)6689 1430, fax:(02)6689 1109, email: rpcltd@nor.com.au; Air Marine Australia, 43 St Hellier St, Heidelberg Heights VIC 3081, ph:(03)9459 2888, fax:(03)9459 4327; Sustainable Technologies Australia, ph:(02)6299 1250, fax:(02)6299 1698.

Ampair turbines are available from Quirks Victory Light Co. P/L, PO Box 440, Rose Bay NSW 2029, ph:(02)9371 6600, fax:(02)9371 6623.

AWP turbines are available from Australian Windpower, 6 Malabar Cres, Eltham VIC 3095, ph:(03) 9439 1665.

Bergey turbines are available through Adtech, 37 Isabella St, Moorabin VIC 3189, ph/fax:(03) 5341 8232.

BEST turbines are available from Biomass Energy Services and Technology, 1 Davids Close, Somersby NSW 2250, ph:(02) 4340 4911, fax:(02)4340 4878, email: biomass@fastlink.com.au.

Enercon turbines are available through Powercorp, 3406 Export Drive, Trade Development Zone, NT 0822, ph:(08) 8947 0933, fax:(08) 8947 0925, email: powercor@ozemail.com.au.

PowerOn turbines are available from energyAustralia, ph:(02) 4951 9555, fax:(02) 4951 9988.

Rutland wind turbines are available from Solar Charge, 115 Martin St, Brighton VIC 3186, ph:(03) 9596 1974, fax:(03) 9596 1389.

Soma turbines are manufactured by: Sunrise Solar, 49 Vista Avenue Nth, Copacabana NSW 2251, ph:(02)4381 1531, fax:(02)4382 1880. They are also available from Rainbow Power Company, PO Box 240, Nimbin NSW 2480, ph:(02)6689 1430, fax:(02)6689 1109, email: rpcltd@nor.com.au

TAAWIN turbines are available from TAAWIN Australia, PO Box 26, Melton VIC 3339, ph/fax:(03) 9743 0786.

Vestas wind turbines are available through JB AS & SJS Tingate, 2 Victoria Crs, Mont Albert VIC 3127, ph:(03) 9890 9789, fax:(03) 9890 5370.

Westwind turbines are available from GP & GF Hill, 29 Owen Rd, Kelmscott WA 6111, ph:(08) 9399 5265 fax:(08) 9497 1335.

Windseeker turbines are available from Rainbow Power Company, PO Box 240, Nimbin NSW 2480, ph:(02)6689 1430, fax:(02)6689 1109, email: rpcltd@nor.com.au

Table 1. Small wind turbines (up to 10kW)

Brand/ Made in	Model	Power/ at speed	Cut-in speed	Voltages available	Overspeed protection	Slip rings	No. of blades	Blade Material	Rotor dia.	Weig
Air USA	303	300W 12.5m/s	2.6m/s	12, 24VDC	Variable pitch flexible blades	Yes	3	Carbon composite	1140mm	6k
LVM UK	Ampair	100W	2.2m/s	12, 24VDC	Not used	Yes	6	Glass filled polypropylene	915mm	13k
Australian Wind Power	AWP 400	400W 10m/s	3-4m/s	12, 24, 32 48V	Furling	Yes	3	Fibreglass	1.8m	—
Australian Wind Power	AWP 1000	1000W 10m/s	3-4m/s	12, 24, 32 48V	Furling	Yes	3	Fibreglass	2.9m	—
Bergey USA	BWC850	850W 12.5m/s	3.6m/s	12, 24, 48V	Pitch control, furling	Yes	3	Kevlar/fibreglass	2.4m	39k
Bergey USA	BWC1500	1500W 12.5m/s	3.6m/s	12, 24, 36, 48, 120V	Pitch control, furling	Yes	3	Kevlar/fibreglass	3m	75k
Bergey USA	BWC Excel 10000	10000W 13m/s	3.1m/s	48, 120, 240V	Pitch control, furling	Yes	3	Kevlar/fibreglass	7m	477
BEST	5kW	5kW 13m/s	3.6m/s	25, 48, 64, 100V	Blade stall governor	No	2	Epoxy fibreglass	5.1m	160
LVM UK	Aerogen 25	0.75 amps	3m/s	12, 24VDC	Thermal cut-out	—	5	Glass-filled polypropylene	572mm	4.5k
LVM UK	Aero3gen	4 amps	3m/s	12, 24VDC	Thermal cut-out	—	6	Glass-filled nylon	860mm	6.7
LVM UK	Aero3gen-F	5 amps	3m/s	12, 24VDC	Thermal cut-out and furling	—	6	Glass-filled nylon	860mm	9.2
LVM UK	Aero5gen	16 amps	3m/s	12, 24VDC	Furling	—	3	Laminated wood	1550mm	14.4
PowerOn Australia	5 kW	5kW 10m/s	2m/s	48, 100VAC	Stall governor	—	2	Fibreglass	5m	—
Rutland UK	WG913	90W 10m/s	2.6m/s	12, 24VDC	Thermal trip switch	Yes	6	Fibreglass reinforced nylon	910mm	10.5
Rutland UK	FM1800	480W 12.5m/s	2.2m/s	12, 24, 48VDC	Furling	Yes	3	Resin injected composite	1.8m	58k
Soma Australia	400	400W 10m/s	4m/s	12, 24, 32, 48VDC	Tilt-up feathering	Yes	2	Carbon fibre/ fibreglass	2m	35k
Soma Australia	1000	1000W 10m/s	3.5m/s	24, 32, 48, 110V	Tilt-up feathering	Yes	2	Carbon fibre/ fibreglass	2.7m	40k
TAAWIN Czech Rep.	3500	3.5kW 10m/s	2m/s	24VDC	Pitch control, brake	Yes	3	Fibreglass /steel	5.25m	385
TAAWIN Czech Rep.	5000	5kW 11m/s	2m/s	90-220VDC	Pitch control, brake	Yes	3	Fibreglass /steel	5.25m	385
Westwind Australia	2.5kW	2.5kW 13.5m/s	3m/s	24, 48, 96 120VDC	Auto tail furl	Yes	3	Fibreglass	3.6m	170
Westwind Australia	10kW	10kW 14m/s	3m/s	96, 120VDC	Auto tail furl	Yes	3	Fibreglass	7m	380
Windseeker USA	502, 503	500W 14m/s	2.6m/s	12, 24, 32, 36, 48VDC	Tilt-back furling	Yes	2, 3	Wood	1.5m	10.2

Table 2. Large wind turbines (over 10kW)

Brand/ Made in	Model	Power/ at speed	Cut-in speed	Voltages available	Overspeed protection	Slip rings	No. of blades	Blade Material	Rotor dia.	Weig
Enercon Germany	E30	230/280kw 13/14m/s	2.5m/s	400VAC	Pitch control	—	3	Epoxy fibreglass	30/26m	—
Enercon Germany	E40	500kw 12.5m/s	2.5m/s	10-20 kV	Pitch control	—	3	Epoxy fibreglass	40.3m	—
Lagerwey Holland	LW30/250	250kW 12m/s	3m/s	380VAC, 50Hz	Passive blade angle adjustment	—	2	Carbon fibre epoxy	30m	—
TAAWIN Czech Rep.	15000	15kW 12m/s	—	380/400VAC, 50Hz	Pitch control, brake	Yes	3	Fibreglass /steel	8m	650
Vestas Denmark	660kW	660kw 15m/s	4m/s	690VAC, 50/60Hz	Pitch control, air brake	—	3	—	47m	—

Note: In the tables above, some information for some of the turbines was unavailable or not supplied by the manufacturers/distributors. The

ght	Generator type	Comments	RRP	Warranty
g	Brushless alternator	Also available in a marine model	$1,195	3 years
kg	Permanent magnet alternator	Marine or harsh land uses	$1,295	1 year
-	Rare earth permanent magnet 3-phase alternator	Currently unavailable due to development, but will be soon	$1,990	2 years
-	Rare earth permanent magnet 3-phase alternator	Currently unavailable due to development, but will be soon	—	2 years
kg	3-phase permanent magnet alternator	No servicing required Includes regulator	$4,400	2 to 4 years
kg	3-phase permanent magnet alternator	No servicing required Includes regulator	$8,800	2 to 4 years
kg	3-phase permanent magnet alternator	No servicing required Includes regulator	$27,800	2 to 4 years
kg	Fully enclosed 4-pole, 3-phase Induction	Very low starting torque	—	3 yrs tower 1 yr other
kg	Permanent magnet, 8-pole single phase alternator	Made for marine applications	—	—
kg	Permanent magnet, 12-pole 3-phase alternator	Made for marine applications	—	—
kg	Permanent magnet, 12-pole 3-phase alternator	Made for marine applications	—	—
kg	Permanent magnet, 12-pole 3-phase alternator	Made for marine applications	—	—
-	4-pole, 3-phase alternator		—	—
kg	Brushless alternator with encapsulated windings	Land or marine use	$900	1 year
kg	Brushless alternator with encapsulated windings	High voltage transmitted	$4,250	1 year
kg	Permanent magnet 3-phase alternator		$3,080	1 year
kg	Permanent magnet 3-phase alternator		$4,390	1 year
kg	Permanent magnet 3-phase 6-pole alternator	Locking/shutdown from base of unit Price includes controls and inverter	$11,500	2 years
kg	Permanent magnet 3-phase 6-pole alternator	Locking/shutdown from base of unit Price includes controls and inverter	$11,900	2 years
kg	Permanent magnet 22-pole 3-phase alternator	Also available in a light-wind model Direct drive alternator—no gearbox	$7025	2 years
kg	Permanent magnet 32-pole 3-phase alternator	Also available in a light-wind model Direct drive alternator—no gearbox	$21,250	2 years
kg	Brushless alternator		—	2 years

ght	Generator type	Comments	RRP	Warranty
-	Enercon direct drive ring generator	Normal/light wind versions available	—	—
-	Enercon direct drive ring generator		—	—
-	4-pole asynchronous	Uses AC-DC-AC system, allowing blades to vary in speed	—	—
kg	3 phase alternator	Locking/shutdown from base of unit	—	2 years
-	3 phase asynchronous alternator with Optislip	Available in twin generator version	—	—

Survivor turbine was not included in the table as no information was supplied.

About the table

Below are explanations for a number of headings in the table that may need clarification.

Power at speed

This is the rated power output, and the wind speed at which it produces this power. Power is in watts (W) or kilowatts (kW) and wind speed is in metres per second (m/s). One m/s equals 3.6 km/h.

Cut-in speed

The wind speed at which the turbine starts producing electricity.

Voltages available

These are the nominal system voltages that the turbine is available in. The actual output voltage may be considerably higher than this to allow for voltage losses in the system wiring.

Overspeed protection

This is the method that the turbine employs to protect itself in excessively high winds.

Slip Rings

Slip rings transfer electricity down the tower to avoid having cables twisting as the generator moves around to face into the wind.

Rotor diameter

This is the diameter of the swept area of the turbine's rotor.

Weight

The weight of the turbine itself, not including any control gear or tower components.

Generator type

The part of the turbine that actually produces electricity. Older machines used brushes, which required regular replacement, but these have been eliminated in newer designs with self-exciting or permanent magnet alternators.

RRP

The price given by the manufacturer or distributor. Prices will vary depending on where you buy your turbine.

Warranty

Generally only covers a turbine for defects in components and manufacturing.

A variation on the furling system is the 'tilt' method of overspeed control. With this method the generator is mounted on a pivot that allows the machine to tilt back as forces increase on the blades.

A relatively new turbine on the market, The Air, has a novel form of overspeed protection. The blades are made from a flexible carbon-fibre composite material that can change pitch, depending on the wind speed. At a certain speed, the blades will start to 'flutter', thus disrupting the airflow across them and slowing the turbine down.

Which voltage?

Like solar panels, the output voltage of a wind generator is higher than the battery voltage to allow for losses in the long cable runs and the regulator. If you are planning to produce most of your power from the wind, you will do best with a higher system voltage, as the wiring losses are lower at higher voltages. Alternatively, a wind generator with a slightly higher output voltage may be available.

Some systems transmit the power from the wind turbine at a high voltage, say 100 volts, and then convert this to a more usable voltage with a controller at the battery bank, thus greatly reducing power losses and cables sizes required.

Power requirements

You need to know how much power your wind generator will need to produce so that you can buy the right unit.

This requires that you calculate the total load on the battery bank each day in amp-hours, and then allow for some losses caused by battery charging inefficiencies.

Once you have this figure, and know the amount of wind you can expect at your site, you can use performance graphs to determine the generator most suitable for you. These graphs can usually be obtained from the turbine manufacturers, and are often part of their brochures.

Regulation

When a battery bank is fully charged, a wind turbine connected to it will have no work to do. With no resistance, it will begin spinning faster, like a car in neutral going sown hill, and could destroy itself.

What you need in this case is a regulator which diverts the excess current from the batteries away to another load, (such as an element in your water heater tank). This is called a shunt regulator.

Costs

The cost of the turbine is the only price listed in our buyers guide table, but there are many others associated with installing a wind turbine. The cost of the tower can be up to half the total installed cost of a wind turbine. Electronic control equipment also adds to costs, as does the labour for the installer.

Then, of course, you will need a battery bank to store the electricity from the turbine.

Wind or solar power?

The answer to this one, if you want a reliable energy system, is both! A hybrid system is the way to go, getting power from one energy source when the other may not be producing too well.

Wind turbines can generally produce power at a lower cost per watt than solar panels, and can be a viable option if you have a good site.

Maintenance

Well built modern wind generators require little more than an annual inspection. Make sure that you get a comprehensive manual when you buy the turbine, so you know what to look out for.

References

Gipe, P. (1993). ***Wind Power for Home and Business*****. Chelsea Green Publishing Company. 414pp. ISBN 0-930031-64-4. Contains the Batelle Wind Atlas.**

Piggott, H. (1995). ***It's a Breeze—a guide to choosing windpower.*** **Centre for Alternative Technology Publications, Wales. 36pp. ISBN 1 898049 19 X.**

Readers and their turbines

Tortoise Head Resort has a Westwind 10kVA which was professionally installed in the late '80s. There have been few problems and it is yet to be serviced, though it now has noisy bearings. They are pleased with the power output, appearance and reliability.

Paul and Sylvia have a Bergey 850 on a 30 metre tower. It was professionally installed around September 1997, and to date they have had no problems with the unit, though they feel they should have bought a larger model. The turbine recently survived a direct lightning hit unscathed, due to correct earthing of the tower, proving the importance of a proper installation.

Keith Morahan, of Whittlesea, had a Soma 1000 and 14 metre tower professionally installed in 1995. While he is happy with power output, appearance and noise issues, Keith has experienced some reliability problems with the turbine, which is serviced on a yearly basis.

Michael, from New Zealand, has an Air 303 which was professionally installed in 1996. He is very happy with the turbines power output and appearance, but is not so pleased with the noise it produces.

Peter and Clare Averill, of Coburg, Victoria, have a Rutland Windcharger that they installed themselves on a 5.7 metre tower. They are very pleased with the reliability, appearance and noise aspects of the machine, though it does suffer from low output due to the low tower.

Theresa Lim of Parkside, SA, has a Flowtrack 5kW that was professionally installed on a 22 metre tower in 1996. Theresa is happy with the power output, appearance and noise levels of her turbine, but has had one or two reliability problems, including a dragging brake.

The right tower for your turbine

There is no point in spending big money on a new wind turbine if you don't have the right tower. Linda White shows us what to look for

Now, you've finally decided to take the plunge and buy a wind generator—a household sized one, say 850 to 2500 watts. You can just see yourself, lying back in your banana lounge gazing up at the miracle of it all…but hang on, what's keeping it up there? What you need is a wind generator tower!

There are many things in life that well, aren't what you would call sexy, but without them, things just wouldn't function. When was the last time you overheard a conversation that went 'Oh mate, you should have seen the stumps under his house! Beautiful they were, all straight and set…', you know what I mean!

Wind generators do have the sex appeal genes, but the poor old tower was behind the door when they were handed out.

When we bought our first wind generator the people who supplied it told us that 'Almost anything would do for a tower.'

'Like what?' we asked.

'Oh a light pole…or a windmill tower.'

'Isn't there a special tower for this thing?'

'Oh not really.'

'How tall should it be?'

'Oh, 20 feet, 30 feet, 40 feet, whatever.'

This was not the sound advice that we were looking for. We wanted to do the job once, and do it properly. After all, why buy a wind machine and only get half the power it is capable of producing because it isn't on the right tower? The power you produce from your home power system is going to cost significantly more per kilowatt-hour than mains power, so you would have to be a bit thick to pass up the opportunity to wring every last drop out of your invested dollars.

Above: Linda White and friend with a turbine lowered for inspection. Note the rest for the tower to sit on when lowered.

Worse still, how would you feel finding it isn't covered by warranty because the tower you chose to use didn't afford the machine proper protection in gale-force winds?

We did our research into various types of towers, including the effect of tower height on performance, and decided on the 'tilting' or 'lay down' style of tower as being the best solution for us. This style is not new, it's been around for decades, but after building one to a design that we had seen, we felt it could be improved substantially.

In conjunction with a major group of consulting engineers, we came up with a design which is elegant, practical and economical, as well as exceeding all Australian standards which apply to these structures.

What makes a good tower?

Let's look at what a tower must do.

- In 99 per cent of locations, it must be very tall. Don't kid yourself with the vision of your wind generator ticking over just above the top of the chimney. Well, that's all your machine will ever do, just tick over. A very expensive wind vane.
- It must be strong. Your tower should be able to handle the loading of your wind generator being hit by a gust that exceeds your wind generator's maximum rated windspeed by 50 per cent (this can be in the region of 250 to 300km/h. Not only this, but it should be able to continue safely in service for decades, without a deterioration in safety margins after occasional winds like this.
- Your tower should be rigid. It should remain perpendicular under any wind

loadings within the ratings of your wind generator. The high wind protection devices employed by most wind generator manufacturers rely on stiffness in the tower to operate properly and in a timely manner to prevent damage.

As well as this, metal fatigue can result from excessive continuous flexing. Another problem with today's non-rigid blades can occur at high wind speeds with the blades striking the tower.

• Be minimally resonant. Resonance is when a 'live' device (motor, wind generator or the like) produces vibrations that, when transmitted into the material they are mounted on, cause it to vibrate at or near its 'fundamental' frequency. That is, the frequency for that particular material that takes the least energy to keep it vibrating. This can be harmless, or it can be destructive. Proper tower design takes these factors into account, and ensures that any harmful resonance is designed out.

• Ensure that the wind generator is easily serviceable. The tower exists purely to serve the wind generator in all its requirements. A good wind generator should need virtually no service. However, should you wish to inspect the machine for any reason, the tower design should facilitate this safely and with no risk to life and limb, and preferably without you leaving the ground.

• Good value for money. The tower has a number of important functions to perform. It should be able to provide all of them competently, but at the same time provide value for your hard-earned dollar. If you can contribute labour and not compromise your safety, without requiring any special machinery (like mobile cranes) then all the better.

• It should provide all of the above qualities, but without being a mechanical monstrosity. Beauty is in the eye of the beholder, and one person's pride and joy is another's nightmare. We must all treat the visual landscape with sensitivity.

What towers are available?

We have seen a number of things used to support wind generators, and all but two are ineffective or potentially unsafe and are not worth considering in detail. Briefly, windmill towers are almost always too short, (do not consider using anything under 18 metres) and many modern ones are not robust enough—they simply are not designed for the wind loadings involved.

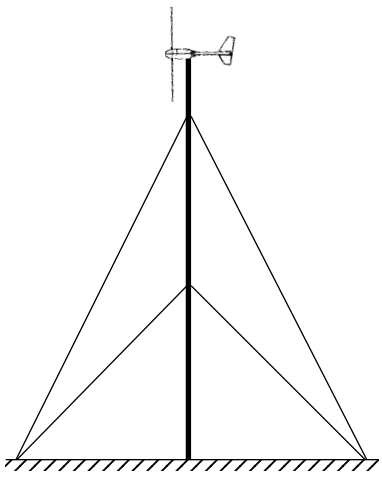
Steel light poles, unless specifically designed by their manufacturers to carry the loading of a wind turbine, flex too much, and have been known to fail at the base welds through crystalline metal fatigue. Try standing at a third floor window and watch them flex on a windy day (and this is with the relatively light wind loading of a couple of light fittings).

Only a fool would use a roadside light standard that has been replaced after being hit by a car, but I know of some fools. Roadside concrete light standards at the heights required will be extremely difficult to transport. They also may not be 'stiff' enough. As well as this, steel and concrete light standards will generally require a mobile crane to install the turbine or provide service.

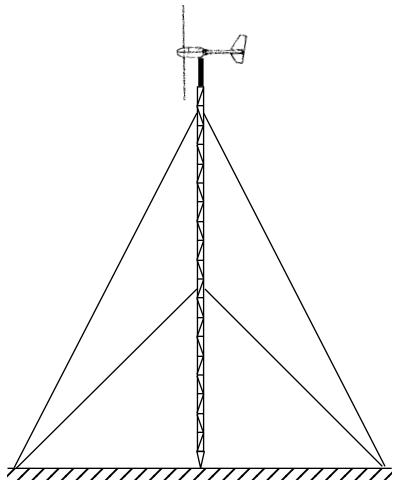
Two main types

Two types of tower are commonly used for professionally installed home and farm wind generators worldwide. These

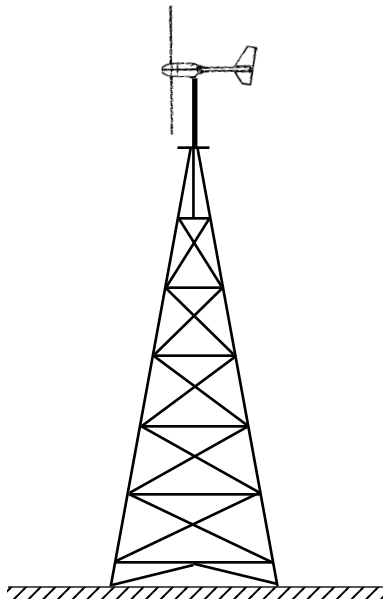
Figure 1. The three different types of tower. Because of their wider base, guyed towers are stronger than free-standing types.



A guyed pole tower



A guyed lattice tower



A free-standing lattice tower

are freestanding lattice or pole towers, and lay-down guyed lattice towers or lay-down guyed pole towers.

They all work if properly designed and constructed, but in our experience, the lay-down pole towers have several advantages over the others for home sized wind generators, including cost, ease of installation and maintenance, minimal visual impact, less steel in their material construction, and less energy required in their construction.

Free-standing towers

Most free standing towers which are designed for wind generators of rotor diameter between 1.5 and 6 metres are of the triangular type. They consist of a crisscross network of steel trusses which form a wide base and taper to a narrower support toward the top. They look a bit like a small high tension power pylon.

The height of the tower determines the size of the tower at the base, or its 'footprint'. Today they are mainly used where one has become available second hand, is of a useful height (18 metres or more) and is in good condition, or where ground space is at a premium.

Free-standing towers have the advantages that they require a narrower footprint on the ground than do guyed towers, and so can be installed in more confined spaces.

However, their disavantages are that they are the most expensive tower option, they use more steel in their construction and use more concrete in their base support structure due to their smaller footprint. They also require much more energy and time to construct, and are made from specially fabricated sections. They can be difficult to ship and handle on site without the right equipment. This type of tower requires rigging experience and a crane to erect. The tower must be climbed or a crane hired to inspect or service the turbine.

While some enthusiasts like to crow of their prowess at dangling from the top of a tower while trying to assemble a wind turbine, and proclaim with hairy-chested glee the joys thereof, this shouldn't be a prerequisite for the home owner to derive power from the wind.

Short freestanding towers designed for windmills are too short for getting the best power from a wind turbine. The old style Dunlite and similar wind turbines from earlier this century are often mounted on this type of tower. However, the ones generally available in Australia are less than 12 metres tall (although, the company stated 'The higher the tower, the greater the power' and some 18 metre towers later came into use) and do not put the turbine up high enough to take advantage of the higher wind speeds and lack of turbulence.

Lay-down towers

There are two commonly used types of construction for these wind turbine towers: lattice towers supported by steel guy wires, and tubular towers also supported by steel guy wires.

The advantages of a guyed tower include cost—these towers use much less steel and are therefore less expensive. Tubular towers are made from readily available structural steel pipe, and are therefore the cheapest option of the lot in terms of the height/cost/strength combination called for in these applications. Lattice tower sections are usually shipped in short sections that two people can handle easily.

Guyed towers are also easy to install, being able to be anchored into rock or soil, and because they are easily raised or lowered with a vehicle-mounted or hand winch, the turbine is easily lowered to the ground for inspection or service. An entire 26 metre tower, 100kg wind turbine and all the tools needed to erect it can be carried on a one-tonne utility, enabling access to remote sites at reasonable cost.

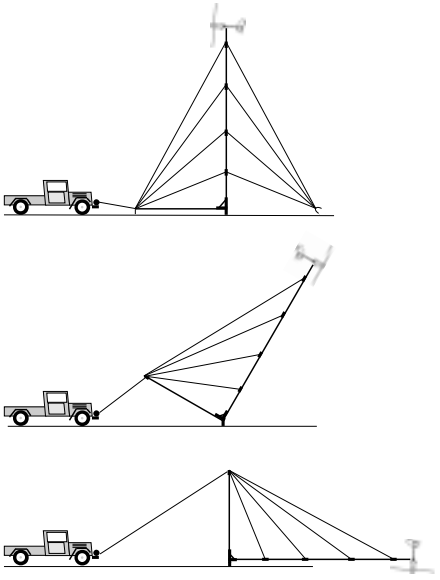


Figure 2. One way to raise or lower a guyed tower is by using a vehicle and winch.

Tubular guyed towers present a very narrow visual profile, and after weathering the guy wires are barely visible, being only 5mm to 6mm in diameter, and as a result have the least impact on the visual amenity of the landscape.

A properly designed and installed guyed tower will be much stronger than an equivalent self-supporting tower, and by its nature, has more resilience and rigidity. It can also be made perfectly perpendicular by adjusting the guys.

The only real disadvantage of a guyed tower is its footprint—they do not lend themselves to erection in suburban back yards or similar confined spaces—there just isn't the room to install the guy cables at the correct angle for maximum strength.

How tall should a tower be?

A wind turbine tower is often the most neglected part of a wind power installation, and yet probably the most important. You wouldn't put your solar panels in the shade, so it makes sense to put your turbine where the wind is.

As the air mass moves over the earth's surface (wind), the part closest to the ground is slowed down by the surface and obstructions such as buildings and trees. These obstructions also cause the air to tumble and swirl (turbulence).

Turbulent air may appear to be going fast, but it is swirling and is extremely inefficient in terms of the power that the turbine can derive from it. This has two consequences. Firstly, the turbine will perform very poorly (turbulence robs the turbine of power). Secondly, the turbine will be subjected to much more mechanical wear and tear. There is also much more airborne dust and debris close to the ground due to turbulence. Over time this can increase wear on the leading edges of the blades. Bird strikes are also much more likely closer to the ground.

It is generally accepted that the minimum requirements for wind turbine height 'is that the hub of the machine be 10 metres (33 feet) above any obstructions within 100 metres (330 feet).

The taller the tower, the less turbulent the air, and the faster the wind. Almost as importantly, the more consistent and smooth the flow. This allows the turbine to provide useful charging current over a significant time period, which results in useful power production.

As an example, if you had a 1500 watt wind turbine that, at 10 metres is producing 750 watts, if you go up to 25 metres you can get 1500 watts, which is what you are paying for.

The extra tower height is well worth the investment. With our tower installations, we almost never recommend a tower under 26 metres (85 feet), and in some cases we go up to 33 metres if our customer's site requires it. In the United States, 46 metre (150 foot) towers for home power wind turbines are quite common.

When thinking windpower, think 'how high can I afford to go' rather than 'what is the shortest tower I can get away with?' We don't have one client who feels their tower is too high, but we do have a couple who were adamant that short towers would be fine, and have had us double the height for them.

Choosing a tower

If ground space is at a premium, then select a free-standing tower. Bear in mind though that if space is that precious, it may force you to have your wind machine towering (pardon the pun!) over your humble abode—maybe you should think twice about that notion! If you have sufficient space, a lay-down (or 'tilting' tower) is going to be far more cost effective. Contact a tower manufacturer for the space required. Check with the turbine manufacturer to see what they specify in terms of tower top loadings for their machines, or check with the tower manufacturer to see whether they specify their towers for your particular wind generator.

Ask the tower manufacturer for locations that you can visit, to see what you are buying from an aesthetic point of view, and to help visualize an installation. If possible, measure the height of trees or other obstructions within 100 metres of your proposed location.

If you are buying a tower kit to assemble yourself, assess the quality of the components. For instance, can the supplier guarantee the specifications and strength of the components? Are you covered by product liability insurance? Are there comprehensive instructions? Are computations available for council applications?

If you opt for a guyed tower, whether a kit or installed, ensure that it is guyed under tension, ie that suitably rated turnbuckles or other devices maintain the guy wires under correct tension. Some shonky towers have appeared (particularly in Victoria) with no tensioning. These towers have led to damage of turbines as well as accelerated wear and tear on themselves.

Livestock problems

Just one final comment to answer a commonly asked query about guyed towers: guy wires do not present a problem for grazing stock. Horses, cows and sheep may want to rub against them, but the guy wires are tensioned to hold the tower steady and are anchored into the ground, usually to about two tonnes of concrete in a hole.

Professionally installed guyed towers are equipped with high tensile guy wire which has a normal load rating of 3.3 tonnes, which is not going to be exceeded by even a one-tonne horse if it sat on the wire. The lower portion of the guy wires can be coated with white plastic to act as sighters to prevent animals and children from accidentally tripping over them, if that is a perceived problem.

About the author

Linda White is the Technical Director of Adtech Australasia. She has an academic background including a BSc in mathematics, and lectures in electronics, physics and mathematics. She also has a native nursery in Western Victoria near Ballarat powered mainly by a wind generator with some small solar panel water pumping applications. The Adtech towers are now also made at this property using wind power.

Adtech (ph:(03)5341 8232) also distribute some useful windpower publications:

***Windpower for Home & Business* by Paul Gipe $54.95 +$5.00 post & packaging.**

***The Adtech Tilting Tower Instruction & Installation Manual* $50.00 +$5.00 post & packaging (refundable if you purchase an Adtech Tower or Tower Kit).**

Anyone for a solar BBQ?

What do you get when you cross an umbrella with a barbeque? Brett White has the answer.

While the idea of parabolic dishes for solar cooking is not a new one, Brett White's adaptation of a beach umbrella that can be used for shade, but also doubles as a reflective dish for cooking food is indeed original.

The Solar Barbeque works with a frypan or pot at the focal point (the area in front of the dish where the sun's rays are most concentrated). This allows almost all types of cooking to occur at similar rates to conventional household ovens. In summer, cooking times are almost equivalent to using a gas stove, though in winter cooking times are slower. This offers an advantage over box cookers where faster cooking times are desirable.

The Solar Barbeque is made from largely recycled material, specifically from old beach umbrella components and wine cask bladders. In 1997, Australians discarded roughly 40 million wine cask bladders. These bladders will last for several years in sunlight, retaining their reflective surface.

The solar cooker would be useful in areas where wood for cooking is in short supply, or constitutes a health problem. Practical places to use the Solar Barbeque are at the beach, camping trips, where fuel wood is in shortage, or for workers on roads or railways.

Brett White is hoping to commercialise his invention, and is interested in hearing from anyone who might want to help out. If you are thinking of building your own, the most difficult problem to overcome is getting a tight focal point. Normal umbrellas do not have the correct shape to focus the sun's rays accurately, so some modifications are necessary.

For more information, visit the website www.users.bigpond.com/solarbbq

By Cable Daniel-Dreyfus

One minute a beach umbrella, the next a solar cooker. The Solar Barbeque uses a modified beach umbrella design lined with recycled wine cask bladders to create a focal point which can boil, stew, fry and bake food almost as fast as a conventional gas burner. When you have finished cooking your meal, the umbrella provides a shady spot for you to enjoy it!

Appropriate technology

a key to human development

Bob Fuller outlines a movement whose time may almost have come

The appropriate technology movement was a product of the late 1960s and early 1970s. It was epitomised by small scale decentralised technologies, and the book, *Small is Beautiful*, by the economist Fritz Schumacher, became the guiding text. The movement arose from two global trends at the time.

There was the growing disillusionment by some in industrialised countries in the promises of 'high technology'. In the post-war period there was full employment and growing prosperity and consumerism. It was also a period of high idealism, particularly amongst young people. They envisaged world peace and fundamental social change. There was a growing realisation that material acquisition alone did not guarantee happiness. Disenchanted youth turned to communes and self sufficiency. Small-scale technologies and the philosophy of self reliance were rediscovered and developed by this movement.

At the same time, newly independent developing countries were seeking to establish themselves. Their immediate needs in the post-colonial world were to feed their populations and compete independently in the global market place. They lacked substantial reserves of capital, but had large populations that needed productive work.

Schumacher's idea was that technologies already existed that were more appropriate to their needs in terms of size and cost. These technologies had become redundant in the industrialised countries as they had developed. In capacity and complexity, these technologies lay somewhere between traditional rural implements and modern capital intensive techniques.

In response, appropriate technology organisations were set up all over the world, in both developing and industrialised countries. George McRobie listed over 100 organisations in *Small is Possible*, his sequel to Schumacher's book. The word appropriate was often invoked, and was probably as overworked as the word sustainable is today. This popularity before maturity led to the real meaning and implications being increasingly eroded and ignored.

The need

Today the need for appropriate technology seems more pressing than ever. In industrialised countries, there are now large permanent pools of jobless people, and social inequity is increasing.

In developing countries, the basic needs of a growing percentage of the world's population remain unchanged. Over one billion people live with inadequate supplies of fresh water, 2.5 billion people do not have access to

Evaluating appropriate technology

In making an informed choice about technology, the following five criteria for appropriateness can be evaluated by asking relevant questions, such as those listed below:

Technical

- is the technology built on locally known technologies?
- does it use local materials and energy?
- is the technology proven?
- does it produce acceptable quantities and quality?
- is it suitable for the local geography and climate?

Economic

- are initial and maintenance costs low?
- is hard currency investment minimised?
- is it competitive with other technology?
- is it compatible with overall development plans?
- are producers integrated into the national market?
- are benefits enjoyed locally?

Social

- are locals involved in decision making?
- are existing or easily acquired skills used?
- are meaningful jobs created?
- is local labour used?
- is the technology culturally sensitive?
- is the impact gradual?
- does it encourage rural development?

Environmental

- is local damage minimised?
- is global damage minimised?
- can renewable energy be used?
- is it environmentally sustainable?

Political

- does it rely on non-local support?
- does it strengthen the local area?
- are the poor the beneficiaries?

The technical, economic and social criteria included here are much abridged versions of those listed by Francis and Mansell (1988) *Appropriate Engineering Technology for Developing Countries*. Research Publications, Blackburn, Australia.

commercial forms of energy, and an estimated 800 million people go to bed hungry every night.

Overall, the gap between the world's rich and poor nations has not closed. For example, the gross domestic product per capita in North America has remained at approximately 20 times that of South Asia since 1960. The difference between the GDP of North Americans and those in Sub-Saharan Africa has increased from 12 to 18 times in the same period.

Defining technology

Any discussion of appropriate technology must begin with some definitions. The meaning and emphasis attached to the words will reflect one's values and priorities.

For the author, a good working definition for technology is as follows:

> 'Technology is more than jets and computers; it is a combination of knowledge, techniques and concepts; it is tools and machines, farms and factories. It is organisation, processes and people. The cultural and historical context in which technology is developed and applied is the key to success and failure. In short, it is the science and the art of getting things done—through the application of skills and knowledge'. (source unknown).

Two things need to be emphasised from the above definition.

Firstly, technology is not value free. It is developed and relates to a particular time and place. It is not automatically transferable and relevant to different cultural and historical settings.

Secondly, technology is clearly much more than 'hardware'. Imagine buying a new computer without an instruction manual. Technology involves a host of other processes and structures (training, management, credit, infrastructure) to make the 'hardware' work.

The classic example of the fishing net is still a powerful one. Giving a poor person a net (hardware) to catch fish to feed their family is not enough. You need to teach them how to use and mend the net, and where and when to fish (fishing net software). Unfortunately, there are too many examples of inadequate attention to the 'software' side of technology, particularly in the field of development.

Appropriate technology at work: simple solar drying of grapes is more economical and easier to use than Hi-tech heat pumps.

One of the contributing factors to the loss of meaning of the concept of appropriate technology was the over-focus of sections of the movement in industrialised countries on the artefacts of the technology, rather than on its totality.

Appropriate technology is, however, much more than a package of tools and knowledge. It represents a particular way of looking at society and technology, and demands the answers to the questions 'appropriate for whom?' and 'appropriate for what?'. In its broadest sense, the appropriate technology movement set out an alternative agenda for social and economic development.

AT in practice

As an attempt to demonstrate how an appropriate technology approach may be used in practice, two examples are taken from the author's own practice and offered for consideration.

In 1986, the author was funded to investigate ways in which solar technology might be used to improve the production of dried sultanas in northern Victoria. The resulting prototype system combined active and passive solar technologies to enhance the traditional rack drying method, and achieved benefits in terms of reduced drying time and improved quality.

During the same period, funding was sought by other researchers to build a centralised drying plant using heat pump technology. Such a facility, it was suggested, could be jointly owned and used by a number of growers.

A heat pump dryer is an excellent technology and can produce high quality dried products. However, when the two

technologies are evaluated for this particular target group and location using the criteria in Table 1, the 'inappropriateness' of the latter system is revealed.

Some vindication of the approach taken was the measurable uptake of aspects of the solar system by up to 10 per cent of growers in the first three years.

The second example involves project appraisal. Nearly everyone would agree that the classic cost-benefit analysis is a poor tool for this exercise. It fails because many important factors are either poorly quantified or ignored completely. No obvious substitute is available, yet we still have to make decisions about project viability.

One simple way of ensuring that all factors are considered is to use a check list, and to ascribe a score to each factor in turn. The list should include all the possible effects of the proposal as outlined in the five criteria described above.

The author used this technique to evaluate 18 commercial operations as the site for a demonstration solar drying plant in the South Pacific. While the technique is not perfect, and is open to the criticism of subjectivity, it at least attempts to include all factors. It is also transparent. The rankings were included in the consultant's report, and were accepted by the funding body.

This experience indicates the possibility that traditional funding agencies would be receptive to a method of project appraisal which poses the critical questions advocated by supporters of appropriate technology.

Barriers to appropriate technology

If appropriate technology makes so much sense, why then is it so marginalised as a methodology for choosing technology? What are the prevailing societal attitudes working against appropriate technology and what shifts do we need to make? These are summarised in Table 2.

Table 1: Comparison of solar and heat pump system for on-farm drying of sultana grapes

Criteria	Solar system	Heat pump system
Technical	existing knowledge of curtains proven materials simple	new knowledge required not proven in agricultural setting complex
Social	locally made local growers involved gradual change	externally made operated by experts step change
Economic	low cost competitive local area benefits	high cost not competitive external manufacturer benefits
Environmental	renewable energy	grid electricity

The credibility of some of the prevailing attitudes is now wearing thin. 'Experts' are no longer seen as infallible, and certainly not always unbiased. The view that we can continue to plunder nature ad infinitum would be rejected by most people. And the experience of many would be that technological advance has not brought greater equality, rather its opposite. The weakening of some prevailing attitudes presents the opportunity for the acceptance of alternative values and beliefs.

Opportunities for AT

Two of the most pressing issues both globally and nationally are the environment and employment. Advocates of appropriate technology have consistently argued that there are a number of activities where 'technologies' exist to simultaneously mitigate environmental damage and create meaningful jobs.

A report to the Department of Employment Education and Training in 1994 on 'green jobs' confirmed this possibility. Over 2000 employers in five target industries were surveyed to determine recent trends and likely short-term prospects for employment. The industries targeted were energy efficiency and renewable energy, waste management and clean production, recycling, water and waste water, and ecotourism.

The survey found that green jobs grew in all categories, except water, by over 80 per cent. This was against a backdrop of a recession when overall employment shrank. Further growth of 20 per cent was expected by all industries, again with the exception of water. Green job growth was strongest in the private sector, rising from 4000 in 1988 to just under 7000 in 1993, an increase of 70 per cent.

Looking in more detail at one of those industries provides an even more encouraging picture. The renewable energy industry in Australia was found in 1995/96 to have had total sales of goods and services worth $846 million, and employed 6,300 people. While the report draws attention to the huge potential for growth by exporting into the growing energy markets of the Asia-Pacific economies, a look closer to home provides a powerful example of an opportunity waiting to be seized.

A solar vision

The current penetration of solar water heating systems on Australian homes is

about five per cent, which is low considering our favourable climate. Israel is a country of similar latitudes to Australia, but has a penetration rate of 70 to 80 per cent. If 75 per cent of the households in Australia heated their water with solar energy, then an additional 4.5 million systems would be required.

On average a solar water heating system requires 4m^2 of glazed collector area. In 1994, 140,000m^2 of glazed collector area were produced. Assuming the installation took place over 20 years, the extra collector area required would represent a 6.5 times increase on current annual production levels. Currently it is estimated that the solar water heating industry employs 570 people in manufacturing and sales. Assuming employment is directly proportional to the number of units sold, then an additional 3000 jobs would be created.

Primary energy savings would be approximately 36.4 Petajoules per annum in electricity and gas combined. Carbon dioxide savings per annum would be 6.6Mt which represents over two per cent of energy related emissions in Australia.

The opportunity illustrated by the above exercise is particularly pertinent because it neatly provides a part of the solution to two current problems—reducing greenhouse gas emissions and creating useful jobs. The exercise could be applied to a number of other technologies, such as house insulation and remote area power systems. The 'Green Jobs in Industry' report estimates that 100,000 net new jobs could be created in the energy efficiency and renewables over the next two decades.

Strategies for appropriate technologists

The concepts and technologies that characterise appropriate technology still have relevance today despite the decline in acceptance in mainstream engineering, planning and development professions. Whether appropriate technology as a concept and practice can be revived so that it is seriously considered is unclear.

Perhaps what is required is a re-imaging so that appropriate technology industries sit comfortably alongside 'Hitech' industries in people's minds. It is perhaps worthwhile reflecting on the mental image that has been created in mainstream culture by the microelectronics and information sector, namely 'progress, growth, jobs and wealth'? Could an image of 'green jobs and self reliance' be created for the 'Aptech' industries?

One appropriate technologist, H. Knudsen, believes that technologies need a 'social carrier' to be successful. He argues the private sector may not take up this role since many of the technologies advocated by the appropriate technology movement are labour intensive and may not be considered 'profitable'. He therefore suggests that either governments or NGOs must perform the role of the 'social carrier'. Whether governments would seriously consider this to be their role in this era of privatisation is doubtful.

There is evidence to suggest that a 'window of opportunity' for appropriate technology may be opening. A majority of Australians now feel that their quality of life has not improved in the last 20 years, despite the advances of technology (*The Age*, March 5, 1997).

Whereas in the late 60s it was predominantly idealistic middle class youth in industrialised countries who questioned the ability of technology to continuously improve the quality of life, it now appears that much larger sections of society are equivocal. The advent of a new millennium will produce widespread reflection about our society, its goals and visions. Appropriate technology must press for its place in that vision. ✲

Bob Fuller is a Senior Associate with the International Development Technologies Centre, Faculty of Engineering, University of Melbourne Victoria 3052. This article was taken from a longer paper presented at the 1997 ANZAAS Congress in Adelaide. (The original paper contains extensive references).

Table 2: Prevailing societal attitudes to technology compared to those of the appropriate technology movement

Prevailing attitudes		Appropriate technology approach
Economic development	→	Human development
Technological dependence	→	Technological self-reliance
Transfer of technology	→	Indigenous technology
Technological determinism	→	Technological choice
Technology as politically neutral and value free	→	Technology in social, cultural and political context
Inequality producing technology	→	Inequality reducing technology
Province of experts	→	Public participation
Factory view of nature	→	Ecological view of nature
Once-through process	→	Sustainable technology

(source: Barns, I. (1984). Challenges for Einstein's Children—Keith Roby's Vision of Science in Community Life. Murdoch University Press, 208p.)

A solar revolution in Nepal

Photo: Yogi Kayastha

Chris Greacen

Five years ago Adam Friedensohn and Jeevan Goff left the US and came to Nepal with the dream of starting a business providing solar electricity to remote villagers. Eighteen million of Nepal's twenty million people have no electricity. They want electrical power to replace kerosene for lights at night and perhaps to power a radio or TV to hear news from the outside world. Electrification by utility line extension is a distant dream, made difficult and expensive by Nepal's rough mountainous terrain. For many villagers, photovoltaic (PV) or micro-hydro offers the best hope for household electrification.

Jeevan and Adam started their solar village electrification efforts with only one laptop computer and very little cash. Their business plan was based on the following:

Cost of extending the electric grid in Nepal: $30,000 to $60,000 per kilometre. Cost of a 35 watt stand-alone solar photovoltaic (PV) system: $600. How many households could be electrified with solar for the price of a kilometre line extension? Answer: 50 to 100 for the cost of the line extension alone! With these numbers in hand, they figured it was worth risking several years of their lives to find out if they had a business. Today their company, Lotus Energy, has a staff of over 50 and a three-storey office/factory in Kathmandu. The business includes a manufacturing division that makes MOSFET-based charge controllers and 12 volt DC compact fluorescent ballasts.

They have installed over 1000 solar electric systems and components in rural Nepal, mostly for home lighting, but also for solar pumping and powering remote medical clinics, development project offices, and Tibetan Buddhist monasteries. They train and employ Nepalese for all the jobs in the company, including electronics design and prototyping, system installation and repair, sales, and marketing.

A typical village system

Lotus Energy mainly sells small 36 watt PV systems for village lighting. Fortunately, many traditional Nepali village homes have similar floor plans. Downstairs is a cooking area and a room for animals at night. Upstairs are one or two 500 square foot bedrooms. This similarity means that Lotus can create and sell standardised solar electric systems, including pre-cut wire lengths. This makes the solar electric systems easier to build, repair, and finance. Each village household system is powered by a single 36 watt Siemens PC2-JF PV module. This module provides several hours of power to three compact fluorescent lights and a black and white, 12 volt DC television.

Above: Siemens PC2-JF panels soak up the sun in a field at Bhakunde village. This was Lotus Energy's first village installation and batteries were brought to the site dry. At the site, acid was added, and each battery was given its initial charge using ten 36 watt Siemens PV panels in parallel. It took three days to charge forty batteries! Now Lotus Energy adds the acid and charges batteries in their factory in Kathmandu.

Tending the seeds

Well built solar electric systems are crucial for the long-term success of solar village electrification. In developing countries there are a number of challenges that renewable energy companies face that have little to do with engineering. They're policy problems and financing problems. How will the systems be paid for? Nepalese villagers have very little cash. While a solar electric system may pay for itself in the long term, in the short term even a small system can cost more than a year's wages. How will they be maintained? Solar electricity requires little maintenance compared to, say, a petrol generator. But batteries need distilled water, electrical contacts need to be kept clean, and bulbs need replacing. Often this maintenance isn't intuitive to villagers. But if it's not done, then the system may die a premature death.

These are issues that many renewable energy development projects ignore entirely, by dropping a foreign technology in an exotic, needy area, taking photos, writing up an impressive report for the donor organization, and leaving. It all looks good on paper, but often six months or a year later, all that's left in the village is a pile of expensive junk, and a growing bad name for renewable energy (and 'development projects').

To address how to pay for village PV systems, Lotus Energy worked with the Nepalese government and Nepalese banks to put in place a program called LEVEL-UP, the 'Lotus Energy Village Electrification and Lighting Utility Program.' The Nepalese government provides a 50 per cent subsidy for solar electric systems available through the Agricultural Development Bank of Nepal (ADB/N). ADB/N offers the same subsidy to village micro-hydro systems, but for the past several years this subsidy has not been fully claimed. Traditional grid extension electrification is also subsidized, as is kerosene and other fuels.

To cover the remaining unsubsidised costs, Lotus Energy worked with ADB/N to create a revolving loan fund. Villagers pay 5,000 rupees (about US $100) downpayment, and pay the remaining 10,000 rupees at 16 per cent interest to the local branch of ADB/N. The bank pays Lotus in batches of 50 systems. Via a combination of subsidy and long-term loan, the villagers finally have what they have long been promised by politicians, but never got: electricity in their homes.

The first installations

After an extensive survey, Lotus Energy chose the Kabhre district in central Nepal to be the first site for LEVEL-UP. The area was within a day's travel of Kathmandu (facilitating easy monitoring of the project) and had adequate sunlight. In some villages, mountains cast substantial shadows both in the morning and late afternoon hours. Lotus Energy installed a sample system at the health clinic with the help of a local 12 year old boy. After explaining the operation and maintenance of the system to the selected caretaker they left the system in the responsible hands of the village chief.

The villagers of Kabhre used the system every night for a few months. When Lotus Energy returned villagers lined up to buy systems for their homes. Lotus decided to offer 40 systems for the first round. Once the banking paperwork was completed for these systems, Lotus Energy returned and installed them all within a week or two. They began on Earth Day just before the monsoon rains started. The roads wash out every year at that time, so Lotus technicians could not return until a few months later. During monsoon, sunlight hours are at their low-

Photo: Yogi Kayastha

Lotus Energy technician Lekhnath Aryal helps customer Mr Chakra Dwoj Lama of Kamere village, Kanpur, pack a complete solar electric system into a doko (traditional bamboo basket) to be carried to his village.

Photo: Bhumi Baral

Transportation to villages during the rainy monsoon season is very difficult. This truck carrying ten solar electric systems (as well as bags of rice and people) is stuck up to its axles.

Charge controller

Lotus Energy's 10 amp MOSFET based controller regulates the battery and loads. Lotus Energy designed the package with international symbols so that even an illiterate person can operate the system. The shunting-type controller has two low voltage disconnect (LVD) modes to prevent the battery from discharging too deeply. This feature is essential since batteries that are frequently run until they are flat will last only a fraction as long as those that are moderately discharged. The first LVD (usually set at 11.5 volts) triggers a blinking red light and shuts off power to the loads, but will allow the villager to turn on the power for two more minutes if the controller's 'ON' button is pressed. This allows users a few more minutes of light to put away things for the night.

The second LVD (usually set at 11.0 volts) is not as generous. At this low-battery voltage, lights are out. Period. The power is allowed to be turned on to the loads when the battery's voltage has climbed above 12.0 volts. The load controller also has built-in 12 amp over-current protection, triggered by measuring the voltage drop across the controller's (50 amp rated) MOSFET. Electricity from the solar panel is stored in a 70 amp-hour, 12 volt deep-cycle battery manufactured by a company called Industrial Batteries Ltd in Bangladesh. The battery has tubular positive plates for long life and recombination caps to reduce the amount of water that escapes from the cells. Each system is provided with one litre of distilled water, enough to last for several years.

Compact fluorescent ballast

For home solar electric systems, reliable, efficient lighting is essential. Unfortunately, most 12 volt compact fluorescent light ballasts have poorly designed starting circuits that lead to premature bulb failure. Lotus Energy designed and produces their own high efficiency electronic ballast for four-pin Philips 'PL' bulbs that appears to last for several years of frequent cycling. The ballast uses a special heating circuit that warms the tube for about half a second before starting. A 20kHz, filtered, bipolar transistor-driven sinewave generating circuit drives the bulb. The ballast is around 80 per cent efficient.

The circuits that Lotus makes are easily serviceable in the factory. Lotus makes the housing of the SYSCON 10 amp controller and the fluorescent light ballast out of durable fibreglass and the back plate from sheet aluminium. Circuit boards for the controller and ballast are printed in-house using silk-screening, then loaded, soldered, and tested by Lotus employees.

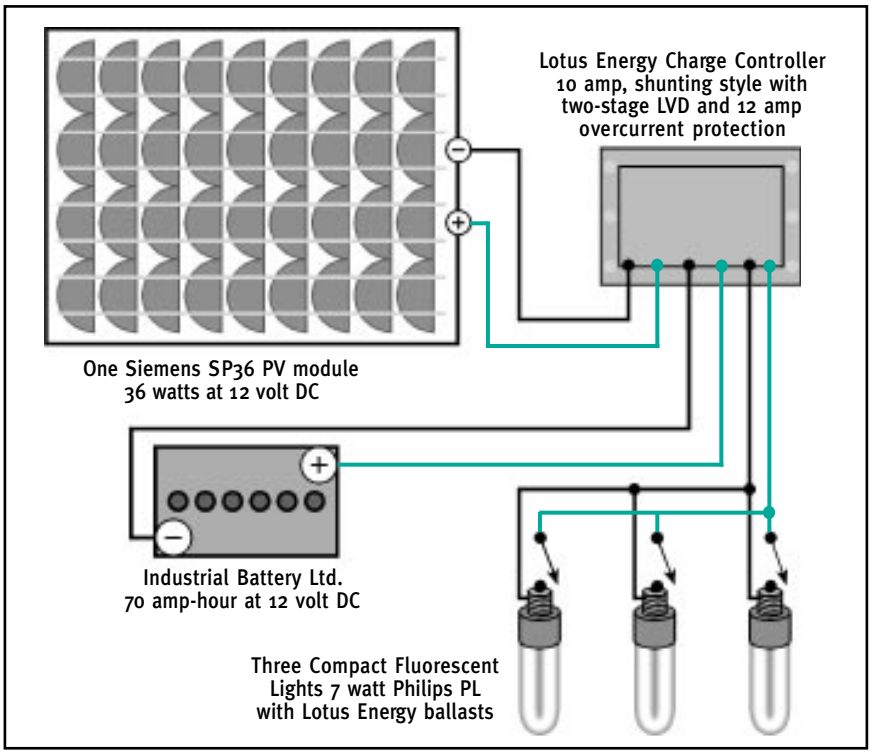
est, only four sun-hours per day average. When Lotus Energy returned after monsoon, the villagers were happy with their systems and said they rarely saw the system controller's low-battery indicator light come on. They used three compact fluorescent lights for three to four hours a night. They also connected their cassette radios and stopped buying the flashlight batteries that used to litter the countryside.

At the end of monsoon there were over 200 more villagers waiting for their chance to buy systems. Lotus has since done similar projects in several other districts. In each, a local person is trained and hired to maintain the systems. This maintenance person ensures that the systems are operated properly, and that the batteries have sufficient water. They also install new wiring, lights, and respond to warranty claims. The PV panel is warranted for ten years, the electronics for two years, and the battery has a three year pro-rated warranty. For an area with extreme transportation difficulties, this kind of network of local repairmen and promoters is crucial for the success of a renewable energy electrification program.

Making money, saving money

Many of the villages in which Lotus Energy works have resident thanka painters. Thankas are a beautiful intricate type of Tantric Buddhist painting. The artists earned their income from painting thankas and selling them in the capital city, Kathmandu. Previously they complained about the smoke, soot and noise from the Petro-max mantle type lanterns and about how much money and time they spent buying kerosene. The light from the Petro-max was of a poor quality. Now with solar systems they have clean, bright light and much more cash in their hands (about 500 Nepali Rupees extra or $10 per month). They can paint later into the night and sell more paintings!

Tailors and weavers in the village are able to continue working later into the night and make more money. Store owners can stay open later. Women are happy not to have to wake up



and struggle with kerosene lanterns for half an hour in the dark before their families wake up. They have more time for other things and can handle food without it smelling like kerosene. In homes with solar electric lights, headaches and eye irritations caused by dim light, soot, and fumes from kerosene lamps are a thing of the past. Best of all, children are better able to see at night to study. This is especially important during busy agricultural times when work in the fields consumes all the daylight hours.

A brighter life

Life in the Himalayas is extremely rugged. The villagers wake before the sun rises to get ready for the field work of the day. Women are faced with many hours of gruelling work just to bring enough water to their homes for cooking and washing. This water supply requirement is an issue that Lotus Energy hopes to address in some communities in the coming year. Remote village electricity requirements are too small to attract the Nepal Electricity Authority (NEA) who could never justify running lines to these areas for only a few pennies a month. The NEA has a hard enough time as it is collecting the small amounts from remote areas since the villagers are never home in the daytime when the bill collectors come by.

The systems Lotus Energy provides can't solve all the villagers' energy problems. They can't cook with solar PV, and in many areas forests are being cut down for fuel wood much more quickly than they can grow back.

Villagers cannot operate heavy machinery or water pumps using PV, except in a few cases with larger systems installed by Lotus Energy, and they still have to mill their rice with diesel engines every year.

What the systems can offer is to cut back significantly on their imported non-renewable kerosene use for lighting, the costs and risks of kerosene, and the time spent carrying kerosene (usually on their backs) from the cities. The systems may reduce the number of disposable mercury-containing flashlight batteries littered all over the countryside. Radio and TV, powered by the solar electricity, provides valuable information and entertainment,

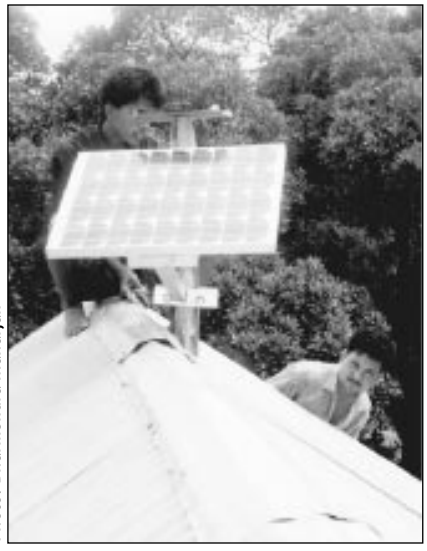


Photo: Dharmendra Maharjan

Photo: Nanda Raj Lama

Right: Lighting is the biggest demand on village solar electric systems. Here Bhumi Baral and Yogi Kayastha install a 7 watt CFL outdoor lighting fixture and Lotus Energy 12 volt electronic ballast under the eve of a house in Bhakunde village.

Left: Installing the PV panel is the most dangerous part of the installation in typical Nepali village homes. Here Lotus Energy technician Ramji Khanal installs a PV panel on the roof of a three-story house in Bohre village.

though it also introduces 'culture pollution' of urban pop-culture. Finally, solar powered radio-telephone systems provide crucial emergency communications in many remote areas. All of these make life in the villages a little easier, cleaner, safer, and brighter. ✶

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Help a Himalayan Buddhist monastery have solar light

Lotus Energy has recently opened up a new program called 'Himalayan Lotus Lights'. The program offers solar PV lighting systems to Buddhist monasteries and retreat centres throughout the remote Himalayas. Contact: lotuslights@lotusnrg.com.np for further details.

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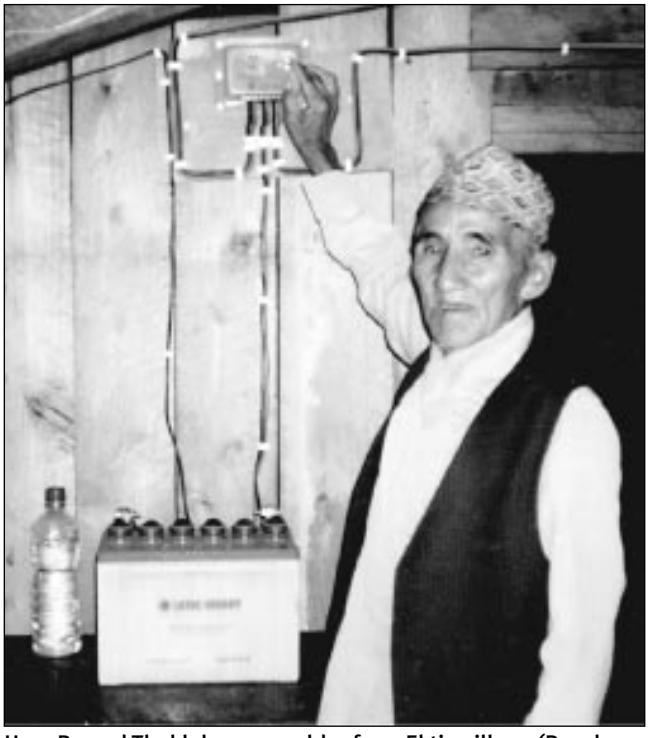

Photo: Ramu Khatri

Hom Prasad Thoklehang, an elder from Ektin village (Panchthar District), presses the 'ON' button of the system controller for his new solar electric system. Notice the bottle of distilled water and the recombination caps supplied with the battery.

The village or the house...that is the question

There are two different perspectives on renewable energy rural electrification. One school of thought believes that village-large-scale power production is the best option. Because of low cost, comparatively low-tech manufacturing requirements, and economies of scale, micro-hydroelectricity is commonly chosen. Village micro-hydro plants are installed by a number of companies in Nepal, often using Nepalese-manufactured turbines and controllers. Projects usually involve working closely with a village to develop a managerial system, maintain the installation, collect fees from villagers, and address conflicts that arise when villagers don't pay. Equipment usually consists of Pelton or cross-flow turbines powering induction or synchronous generators. These generators vary in size from 100 watts up to hundreds of kilowatts. Electronic load controllers (ELCs) keep the voltage regulated by diverting excess electricity into resistive heating loads when households aren't using the hydro's full capacity (in the middle of the night, for example). In some installations there is no ELC, and the hydro plant is manually regulated by a man with a hand on the water valve, and his eye on the voltmeter! In the past 20 years, some 300 micro-hydroelectric systems have been installed in Nepal. Another 1,000 produce mechanical power for grain milling and hulling or oil expelling.

A second school of thought focuses on decentralized home-based systems. This is the area where Lotus Energy has worked so far. It turned out to be much more difficult than expected to get an entire village to organise and follow through with hydroelectric projects. By contrast, household scale PV systems seem to be doing well. With stand-alone PV, each household gets its own system, each its own responsibility, and it alone enjoys the benefits. There's no social problem or headache! On the other hand, with individual systems, there's less opportunity for the village to work together on a common goal. In practice there is plenty of need for both PV and small hydro in Nepal, and the best technology for electrification depends on local geography and the goals and aspirations of villagers.

EV public transportation in Kathmandu

What else is Lotus Energy working on? They have opened up an electric vehicle company called EVCO which has several three-wheeled vehicles running on fixed routes that can take nine passengers each. The vehicles run on two battery exchanges per day, which occur at a central station in Kathmandu. Lotus Energy's aim is to replace 2,000 three-wheeled diesel 'Vikrams' with non-polluting electric vehicles.

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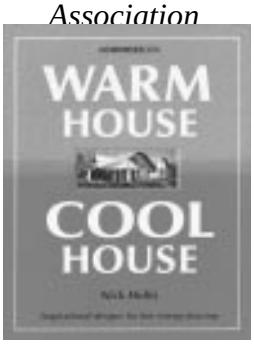

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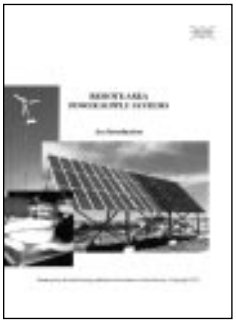

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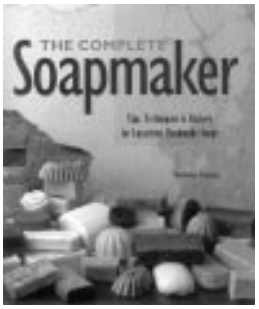

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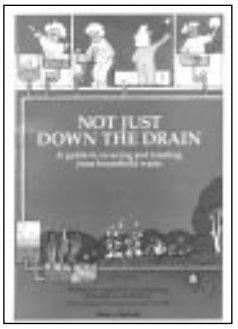

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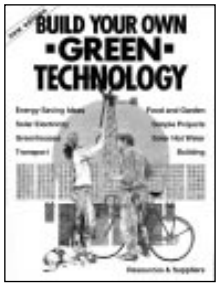

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Mass transit beyond 2000

Will we all be riding bicycles powered by fermented sugar cane?

What stands between a city that is clogged with cars and pollution and one that maximises clean transport options like public transport and low emission vehicles? The answer is complex, but the big problems manifest themselves as a lack of infrastructure and individual attitudes. Each is influenced by the other, creating a vicious cycle of car dependence.

Cycling advocates have long promoted the bicycle as an essential part of the solution to our transport problems. But the two big barriers apply to cycling in cities across the world: a lack of infrastructure (on and off road cycleways), and individual attitudes (a perception that cycling is both too dangerous and too much effort).

One area which may help establish the bicycle as a significant transport mode is the development of power assisted bicycles, or PABs. PABs have been around a long time, and are at the dawn of a new era of technological improvement. There is a growing range of electric PABs on the market today, but advances in the cheap production of a clean and sustainable liquid fuel, ethanol, represents another area of great potential for the PAB.

Ethanol is an alcohol that can be produced from agricultural waste and specially grown crops. Burnt in an efficient motor, it produces mainly water vapour and carbon dioxide (CO_2), and even when used inefficiently it is still far cleaner than petrol or diesel. The carbon dioxide that is removed from the air by growing ethanol feed stock greatly offsets the CO_2 emitted from biofueled engines.

In cities built on hills like Sydney the PAB could enable people to cycle as much as the Dutch do in their flat cities, provided there was a Dutch-style bikeway network to encourage them. If just two million Australians used PABs instead of cars for trips of less than 8 kms then the reduction in greenhouse gas emissions would be enormous.

There is an opportunity for Australian industry to both produce ethanol and to manufacture PABs to run on it. Apart from the use of PABs locally there is a huge export market in developing countries like China right now. It is a market that will continue to grow as fossil fuel alternatives become less environmentally and economically viable. Japan, for instance, is likely to be producing 100,000 electric PABs a year by the year 2000.

A brief history

The nearest relative to the modern PAB is the Singer motorised bicycle back wheel of 1900, which anticipated the design of the 1952 BSA motorised back wheel (see photograph 1). Around 1965 there were thought to be 15 million PABs and mopeds in Europe. How many of each is not known because they were all classified as mopeds.

In 1984 Honda introduced the 'People,' a PAB with a 24cc petrol engine weighing 26kg. Meanwhile several Taiwanese companies where making PABs with 30cc petrol engines mainly for the Chinese market. In 1989 Yamaha intro-

The state of the art is illustrated by the jointly developed Yamaha/Bridgestone 'cross framed' bicycle with aluminium parts and 26" wheels with sprung front forks. This PAB weighs 26kg, will travel 28km on a single battery charge, has power output of 235 watts and is recharged in 3.5 hours from mains electricity.

duced the second generation of electric bicycle. The 'PAS Prototype' was a major design breakthrough with torque sensors in the cranks linked to the motor controls for automatic power assistance when it is actually needed. From that time many major companies became involved in electric PAB design and production.

In 1997 there were ten Taiwanese companies producing electric bicycles. There are 12 companies in Japan selling 35 models of electric PABs and two electric tricycles. Yamaha power units, batteries and controls are being built into European electric PABs.

One of the main constraints to both Japanese and Taiwanese electric PAB sales in Europe in 1997 is the legacy of the 1970s moped legislation. PABs are still classified as mopeds in some European countries. Outside Europe in Japan, Taiwan, Australia and New Zealand, power assisted bicycles with a power output of 200 or 250 watts are classed as bicycles but in most other countries they are classed as mopeds or motor cycles.

Australian state regulations stipulate a maximum power output of 200 watts which would exclude 23 of the 35 Japanese models of electric PABs. Considering how hilly some parts of Australian cities are, that Australians on average are heavier than the Japanese and recent Japanese experience in the safe operation of PABs, there is a very good case for increasing the output limit from 200 to 250 watts (0.33 Horsepower).

The modern Power Assisted Bicycle has a power output between 100 and 250 watts (0.33 horsepower). The Sachs 30cc motorised back wheel has 500 watt output, but is sold in Australia with a 25 kph speed limiter.

Developing countries

For the future the largest potential market for PABs is in China. China has an under-developed road system with poor surfaces and relatively few cars. Potential Chinese PAB buyers mostly want a low priced, sturdy and reliable PAB with the option of being able to make long trips. The restricted range of the electric PABs is a big factor in why they are not selling well in China. In developing countries generally this will be a problem.

Cheap PABs with poor quality two stroke engines running on poor quality petrol are very polluting, even if they only have tiny 30cc to 40cc engines. It is not surprising that in congested cities like Shanghai, with 500,000 petrol driven PABs, the authorities want to regulate to limit sales. In cities like Shanghai, with better road surfaces and battery recharging facilities, a better approach would be to have national regulations and incentives that boosted the sales of electric PABs, which are being manufactured under license in China.

The best way to deal with the millions of existing PABs with two stroke engines is to use a blend of 20 per cent ethanol with 80 per cent petrol as is done in the summer for cars in some polluted American cities. Government programs to ensure that engine tuning facilities are provided and encouraged would further reduce pollution from PAB engines.

Making engines to run on ethanol

The development of an ethanol powered PAB would require a new engine designed to take advantage of ethanol's unique qualities and to ensure that the engine works under the climatic conditions in the country in which it is sold. As 1.3 million cars run on ethanol in Brazil the technology is well understood and it would be a good place to trial an ethanol powered PAB because ethanol fuel is available everywhere. Exactly how a small 25cc PAB engine would perform and whether it would run better on pure ethanol or ethanol rich blends of petrol has yet to be researched.

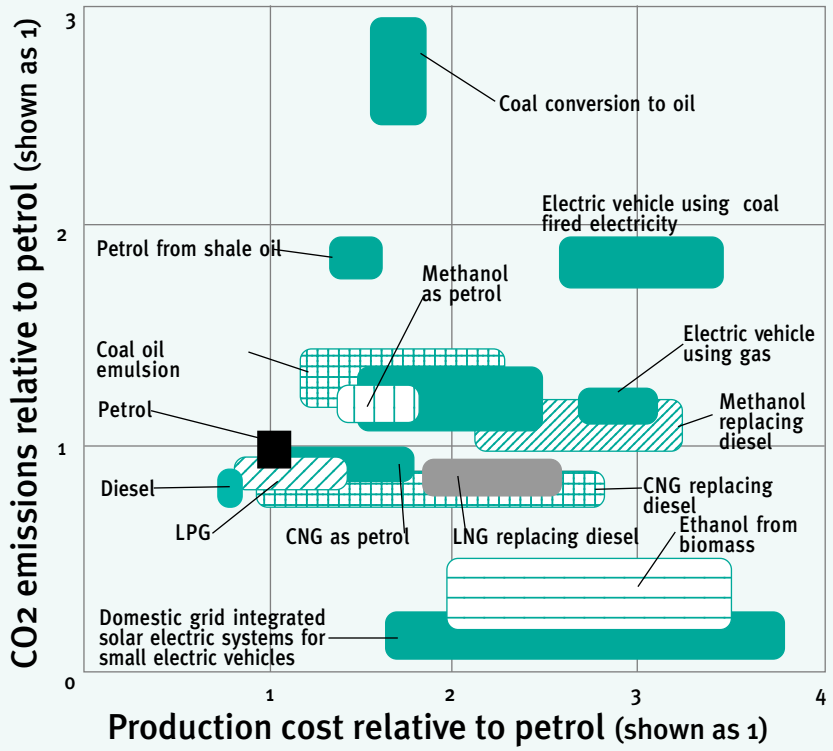
Ethanol—fuel for beyond 2000?

Ethanol is an alcohol created through fermentation of sugars. Ethanol can be made from timber harvest residues, agricultural waste, trees, and sugar cane. It can be used as a fuel to drive specially designed motors, or a percentage can be added to petrol or diesel for use in existing motors. Ethanol has advantages over petrol as a liquid fuel. The most important ones are that it produces far fewer toxic emissions when it is burnt, and provided the land for the base crop is properly managed, it is a sustainable fuel.

As a commercial fuel it will likely be made from plantations of specially selected shrubs or trees grown on marginal land with low value for anything else. In most countries there are practical limits to the amount of land that could be used to produce biomass from which to distil ethanol, but not in Australia. In Australia it is estimated that the manufacture of ethanol from Blue Mallee forests farmed on the 25 million hectares of land that has already been damaged by salination could, theoretically at least, produce 10 million tonnes of ethanol a year by 2010. This would displace fossil fuels, as well as helping to rehabilitate the bush, both ecologically and economically.

Ethanol fuel use would greatly reduce CO_2 emissions (Chart right edge of 'ethanol from biomass rectangle') but it can currently only be produced at a cost higher than petrol. New technology for producing ethanol from wood is likely to reduce the production cost substantially (left edge of the 'ethanol from biomass rectangle').

At present carbon dioxide emissions are high for electric vehicles, and today's electric cars charged from coal-powered mains electricity are not greenhouse friendly. Today the cost of domestic solar electric systems (right side of rectangle) are high. However, as grid integrated solar electric systems are introduced, and the cost of solar electric panels and rechargeable battery systems come down, the total cost will reduce (left side of the rectangle) Even so, electric PABs use far less electricity and should be used now and they will become more efficient as more renewable energy is used.



Sources: Le Comu, J 1989. *Greenhouse Gas Emissions from Production and Use of Alternative Transport Fuels*, Shell Australia. English, N. 1997 Alternative Transport Fuels: Opportunities and Constraints, DESTV564

Ethanol-powered motors don't like cold weather. When start-up temperatures are below minus 9°C, petrol must be added to the air intake until the engine warms up to allow firing on pure ethanol. In the language of motor mechanics, the compression ratio has to be raised from 8:1 to 12:1. In spark ignition engines specially designed carburettors are also required. Given the low temperatures of Chinese winters, determining the blend of ethanol and petrol will require some further research.

There is a manufacturing opportunity here because Australia has expertise in the design of small clean two stroke engines. The Millard group in Melbourne has designed a car with a 1.2 litre three cylinder orbital engine for Indonesia's second national car, the *Maleo*. This orbital engine technology came from the Orbital Engine Corporation (OEC) in Western Australia, which is one of the leading independent automotive research establishments in the world. The orbital two

Alternatives to oil

The chart uses research done by the Shell oil company in Australia and other sources to show exactly how much CO_2 will be produced by dirty alternative fuels currently capable of being produced in quantity. The environmental problem is that most of these alternatives greatly increase CO_2 emissions and most fuels that produce less CO_2 are, like diesel, only marginally better than petrol at this time. All costs and emissions are compared to petrol (scaled as 1) that is extracted from crude oil priced at $16 per barrel. The cost range is shown by the length of the rectangles, with the highest current costs at the right edge of the rectangle and the predicted lowest future costs at the left edge.

stroke direct injection system is also used in scooters, and motor cycles. A direct injection orbital engine using petrol produces far less pollutants than a standard engine. It seems likely that if these engines were designed to use ethanol they would be even cleaner, and a tiny orbital engine on a PAB would produce a very small volume of emissions.

The PAB has the potential to gradually reduce oil consumption in the world's congested cities. The demand for heavy duty PABS and power assisted tricycles is likely to be much greater in developing countries, where the cost of petrol relative to earnings is already high.

To create ecologically sustainable cities we must start building bikeways now on all main roads, so that continuous bikeway networks are in place to cater for bikes and PABs. During the next 50 years the PAB will take its place between the car and the bicycle as the in-between machine, the missing link in the sustainable transport chain.

Alan Parker

report reporter

new sustainable technology reports

Compendium of Funding Sources for Renewable Energy Projects

This compendium is published by the Australian Cooperative Research Centre for Renewable Energy (ACRE). It is packaged as a binder with around 100 pages of information to assist in obtaining finance for renewable energy projects. It also includes a three-monthly update service, where new sources are identified.

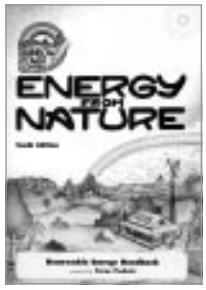
Intended for participants in ACRE programs, the compendium is divided into several sections, including State and Federal Government (which lists relevant grants and subsidies), International Programs, AusAID and other development agencies, and a list of resources for monitoring new business opportunities.

The market for The Compendium is fairly clear. Researchers involved in high technology development would benefit, as would a company with a product that is 'ready to go', but requires capital to get started. At $500 it is out of the reach of most back-yarders looking to develop their ideas, but for a small company looking to reach new markets or develop its product, the Compendium would be a valuable asset—there is no way the information it contains could be gathered for less than this price.

Price: $500. Send payment to Carrie Sonneborn, Australian Co-operative Research Centre for Renewable Energy, Murdoch University, Perth Western Australia, 6150. Phone (08) 9360 2876, fax (08) 9335 4909, email sonnebrn@central.murdoch.edu.au.

Energy from nature book 10th Edition

Rainbow Power Company
Compiled by Peter Pedals
PO Box 240, Nimbin NSW 2480,
email: rpcltd@nor.com.au



Rainbow Power Company's *Energy From Nature Book* has been around for many years, and the current edition is an excellent source of information on renewable systems and their components. It also contains a complete catalogue of products available from Rainbow Power.

The book starts off with a history of the Nimbin-based company. It follows with a discussion of why we should be using renewable energy in place of more common power sources. The next section deals with the basics of electrical systems: what electricity actually is, how it is measured, the differences between AC and DC, series and parallel connections and many other aspects, all illustrated with simple circuit diagrams.

Among the topics discussed in relation to remote power systems are: how to reduce the fuel consumption of backup generators, estimating your power needs, power system sizing, the effects of shading on solar power generation, wiring extra-low-voltage systems with safety, problems that may be encountered and how to fix or avoid them, and just about every other aspect of self-sufficient power generation that you could think of.

There is also a great section on how to use a multimeter to make the most common measurements you will likely have to while setting up a system, a brief section on lightning protection, and passive solar house design is also covered.

Being a catalogue, the book contains information and photos of many of Rainbow Power's appliances interspersed throughout its pages—all included in relevant sections. All in all, an excellent book, and one well worth looking at if you are thinking of delving into the world of renewable energy.

-Reviewed by Lance Turner

Music to Wake up to

Deep Green
Available from web site http://www.teagarden.org

A Minute or Less

Various artists Available from Friends of the Earth and Choozy Distribution, PO Box 4434, Melbourne Uni, Parkeville, 3052

No, *ReNew* hasn't become a music magazine. But while these two CD's may seem a little out of place in the *book* review

section, they both make interesting connections between popular culture and sustainable technology.

Music to Wake up to is a collection of ambient electronic music composed by Western Australian outfit, Deep Green. What makes it interesting is that it was recorded and mastered in the UK using a solar powered studio. The solar power was provided by Greenpeace's mobile solar array, a demonstration vehicle used to promote solar electricity. While the volume of greenhouse gas emissions saved by using solar to record one CD isn't staggering, it is great PR for renewables, and gives the music-buying public a tangible memento of solar electricity's viability. It will become increasingly difficult for cynics and vested interests to say 'solar doesn't work' in the face of public awareness heightened in this way.

Musically, *Music to Wake up to* lives up to its title. It is meditative, relaxing and well produced. It's also good to go to sleep to—but that's not a condemnation!

A Minute or Less is a fund-raising and publicity venture by the Friends of the Earth 'Streets for People' campaign, aimed at promoting walking, cycling and public transport. There are 78 tracks from 78 different artists, all one minute (or less) long. The flier accompanying the CD outlines the objectives of the campaign, and points out the environmental damage caused by cars, though only one song title addresses the purpose of the CD, *Catch the Tram Instead you Slack Bastard* by Prude.

The Collective, and most of the bands on the CD, are based in Melbourne, though some like The Fauves, Snout and P. Harness are better known across Australia. As you would expect with 78 artists contributing, the stylistic variation is enormous. There is acappella from Those Acapelicans, flippant pop from Tlot Tlot, and gentle accoustic music from Cuddlefish, who have been known to travel to gigs with amps and instruments in bicycle trailers. My favourite is a ridiculously fast techno track: *Lions and Tigers and Bears* by Trabampoline, which samples Judy Garland from *the Wizard of Oz*.

-Reviewed by Michael Linke

[Build your own]

Solar water heater system

Where do you get hot water when you are outside or in the shed? Get it heated straight from the sun with your own solar water heater! Lance Turner explains how he made a simple heater for very low cost.

There are many times when I am working in the shed that I need a small amount of hot water, such as making circuit boards, or when I want to get cleaned up before going back into the house.

For these reasons, I decided to make a small solar water heater system that I could have out at the shed, thus eliminating the need to go into the house to get hot water.

The water heater is a simple design, and uses a flat panel collector connected to a plastic water tank. There is also a header tank to replace the hot water as it is used.

A lot of the material used in the project was recycled. This included both of the water tanks and the metal sheet used in the collector.

The thermosyphon effect

Most solar water heating systems rely on the thermosyphon effect to cause the water to flow through the panel without the aid of a pumps.

This works because as the water heats up it becomes lighter, so heavier water flows into the bottom of the panel from the bottom of the tank and pushes the hot water out of the top of the panel into the top of the tank.

There are two main requirements for this system to work. Firstly, the solar collector panel must be mounted on an incline, and secondly, the tank must be mounted above the top of the panel.

A serpentine collector

There are two different options for arranging the pipes in a solar collector panel. The first is called runner and riser, where you have a number of vertical tubes, the risers, running between two horizontal tubes, the runners. This type of collector is hard to make because it requires the tubes to be accurately drilled and soldered together.

The other type, the serpentine collector, uses a single piece of pipe that winds back and forth across the collector as it rises. It is very simple and has no solder joints to fail at a later stage.

My collector used a length of 10mm outside diameter copper tube. This has an inner diameter of about 8mm, which

is a bit small, but seems to work in this system. If I were to make another collector, I would use 13mm tubing.

The pipe needs to be bent about 170° at each turn, giving a five degree rise to each horizontal section of the tube. This stops any air bubbles getting trapped in the tube and stopping the thermosyphon effect. I bent my tube using a simple wooden jig that had a grooved wheel at one end and a lever arm with another grooved wheel that rolled the pipe around the first one. If this sounds to hard to make, you can get a pipe bending tool at most hardware stores, but it may cost up to $100.

Once I had bent the pipe into its serpentine shape, I soldered it onto a sheet of 0.8mm thick copper, about 850 x 450mm. I started by tacking each bend into place so that it wouldn't move as I progressed toward the top of the sheet. This took quite a while, about an hour in fact, but the finished result was a tube completely sealed to the copper sheet. The sheet did buckle a bit, but this is not really a problem, as it does not affect the ability of the collector to transfer heat to the water.

An alternative to soldering would be to use small metal straps pop-riveted over the pipe. Silicone heat conducting paste, avail-

able from electronic component stores, could be used between the pipe and sheet to improve heat transfer.

Another way of making a serpentine collector would be to use lengths of polypipe, elbow fittings and clamps to form the shape. This would then be attached to the sheet using the method above.

Once this was done, I cleaned off the excess flux, scrubbed the whole sheet with a scotchbrite pad, and painted it flat black.

The case for the collector was made from 90 x 25mm pine for the sides, and a sheet of masonite for the back. This was painted inside and out for weather protection. The glazing of the collector is a sheet of 2.5mm thick PVC plastic.

I bought this a long time ago as a cheap alternative to glass, but have since discovered how toxic it is. I would now choose the polycarbonate alternative, or better still use recycled glass.

The clear sheet was held in place with a strip of wood beading, about 15 x 20mm, also painted brown, screwed down and sealed with silicone sealant. The pipes of the collector plate were also sealed into the box with silicone.

The water tanks

There are two tanks used in this design, the main storage tank, which holds the heated water, and a header tank that refills the main tank as water is drawn off. Both tanks are made from HDPE (high density polyethylene) plastic drums, the type often used for water and chemical storage. One is a 20 litre drum, and the other 18 litres.

As I was not sure of the history of these drums, I cleaned them thoroughly by soaking overnight with 'Excel', a biodegradable cleaner/disinfectant from Tri-nature.

The 20 litre drum was to be the main tank, but had a small hole in it that needed repairing. The sidebar explains how to weld HDPE plastic.

I also cut a hatch in the top of this drum, removing the original opening and most of the handle as well. I left a small amount of the handle in place so it would be easier to seal this hole by just heating the handle stub and squeezing the hole shut with a pair of pliers. However, this was not very successful, so I ended up using silicone sealant to fill the handle from inside the drum.

There are a number of ways to fit water inlets and outlets to these drums, but I made my own using a 13mm bolt drilled hollow along its length with a 8mm drill bit. I drilled a few millimetres into the head of the bolt with a 10mm drill so that I could push a short length of copper tube into it. This was then soldered into place. It should be noted here that I do not use the water from this system as potable water, so the use of lead solder and second-hand drums is acceptable, but if I had wanted to drink the water, I would have used silver solder and new materials.

I made two of these adapters, and then drilled two 13mm holes into the drum, one near the bottom and one near the top. I then fitted an O-ring to each adapter, inserted them into each hole in the drum, and fitted a large washer and brass nut to the back, tight-

Here you can clearly see the serpentine shape of the copper pipe in the solar collector panel.

Fixing a damaged water tank

The HDPE plastic drum that I used for the main water tank had a small hole in one side, fairly close to the bottom. While I could have attempted to seal it with silicone sealant, I have had little success in the past in repairing HDPE with any type of sealer—they just won't stick!

What was needed was a way of sealing the hole so that it wouldn't fail, so I decided to have a go at plastic welding instead. Using a blowtorch on a very low setting, I gently heated the damaged area. I then placed a small piece of scrap plastic over the hole and blended it into the surrounding plastic of the drum using a heated stainless steel spatula. I also placed an aluminium plate on the other side of the hole while I was doing the repair, to stop the plastic from distorting and pushing in while the heat was applied.

I found this method quite easy, once I realised that I needed to be patient. If you get the plastic too hot it will collapse or start to burn. It is just a matter of working at it slowly, and you should end up with a strong, watertight repair.

ening them enough to seal, but not enough to crush the O-rings too much.

The second tank, the header tank, does not need to be sealed, and also only needs one water outlet, at the bottom. This was done by drilling a 13mm hole in the drum and forcing a piece of polypipe into it and sealing it with silicone sealant.

I made a wooden box for the main tank from 18mm chipboard, making it big enough to fit about 40mm of insulation between the tank and the inside of the box. Two holes were also cut for the inlet and outlet.

The box was given three coats of paint to seal it against the weather and any spills. This is very important, as chipboard is easily damaged by water, swelling and disintegrating quite quickly.

The access hole in the top of the tank was sealed with a sheet of plastic cut to shape, screwed into place and sealed with silicone. Two 35mm thick bearers were mounted inside the tank box for the tank to sit on, and the tank was sealed inside the box. I didn't use insulation but I may add this later to improve performance in winter.

Assembling the components

I made a frame out of 42 x 35mm pine from the local hardware store. This consisted of eight 400mm lengths assembled into a base similar in shape to a stool or tiny table. I used 6mm diameter x 100mm long coach bolts to hold it all together.

From the legs of the base ran two horizontal lengths of the same material. This increased the base size enormously and allowed me to attach the collector to the frame at about a 30° angle, making it all one unit. The tank box mounts on top of the frame, with the header tank sitting on top of the box (see figure 1).

The tank was connected to the collector using 13mm polypipe and fittings. As the outlets from the tank and collector were 10mm pipe, I had to slide some 25mm lengths of clear plastic tube over them so the polypipe would be a snug fit. Use petroleum jelly on the fittings if they feel too tight. You will need to do this to the tank before you assemble it into its box!

The inlet and outlet on the tank both had a short length of polypipe attached, just long enough to bring it outside the box, and a T-fitting was inserted into each of these. The connections were then made using polypipe as follows:

The bottom outlet was connected to the bottom inlet of the collector panel, and also to the outlet of the header tank. This allows the main tank to fill with cold water from the bottom. The top tank connections went to the top of the collector panel, and also to a plastic tap mounted on the back of the frame.

All of the connections had a crimp-on hose clamp fitted so that they couldn't be pulled off. All right angles were achieved using polypipe angle connectors, as you can't bend polypipe very far without it kinking.

That is about all there was to it. The header tank was filled with water, and refilled until the main tank had filled. I then gently rocked the whole unit lightly to allow any trapped air to escape.

Performance

On the first day of testing, which was partly overcast and reached 24°C, I got over ten litres of warm to hot water from the system, despite only setting it up at about 11am. This is more than enough water for my uses, and on sunny summer days there is plenty of very hot water. Hot enough to scald, in fact, so be careful!

On cold, cloudy days, the performance of the heater is not so good, barely heating the water to body temperature. There are a couple of ways that performance could be improved on cloudy days, including insulating the tank and the hot water pipe from the top of the panel to the tank, as this probably radiates a reasonable amount of heat. ☼

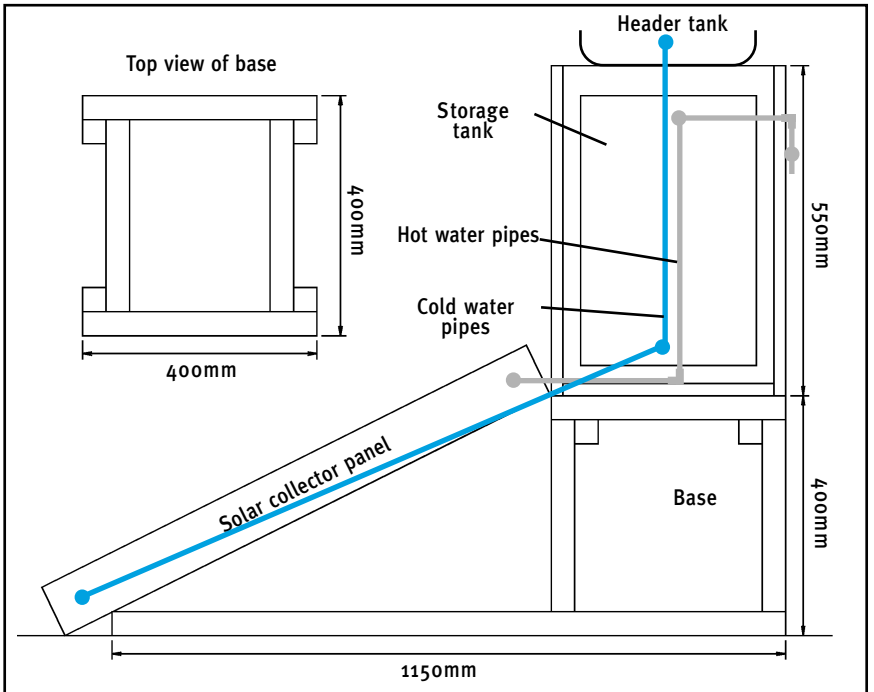


Figure 1. The dimensions and assembly of the solar water heater. Note that the cold water plumbing connections are shown in blue.

Send us your questions

If you have a problem you just can't solve, or want to know the answer to a general question about sustainable technology, drop us a line and we will do our best to answer your query.

Send your questions to: ReNew, 247 Flinders Lane, Melbourne VIC 3000.

Heat storage systems

In issue 61 (Oct-Dec 1997) in the Q & A section there was a letter titled 'Heat Storage System' by Peter Burger. In it he was looking for a heat storage setup using phase-change salts. I would like to pass on the title of a book I recently saw on the topic:

Solar Made Easy, first published November 1993, Copyright 1993, Simon Cope & Bob Riley, The Auckland Institute of Technology Press, PO Box 92006 Auckland 1020, ISBN 0-9583334-1-6.

In this book is an article called Solar Heat Store by Bob Riley that discusses the practical application of phase change salts for heat storage using sodium sulphate. I'm not sure if it is what Mr Burger is after but it may help.

Mark Caukill,
Palmerston North NZ

Solar computing

I am interested in information on whether it's possible to run a personal computer, printer, scanner or fax on solar or wind energy. I have recently been given the chance to work permanently from a remote location near the mid north coast of NSW, and am very keen to take up the opportunity! Any advice you can pass this way would be very appreciated.

Peter Minter,
p.minter@nepean.uws.edu.au

There are two options for computing on a renewable energy systems. One is to use 12 volts DC directly from your batteries to power a laptop. The other is to power 240 volt AC computers via an inverter. In either case, your system will need to be sized correctly

Computer monitors use a lot of power, as do laser printers, so you would need an inverter that could supply several hundred watts of sinewave power for these. The number of panels and size of battery you need will depend on how many hours a day you wish to run the computer, printer, and whatever else is attached.

Using one of the new (and currently expensive) flat-panel monitors instead of the old cathode ray tube type would reduce the power consumption considerably, as would using a bubblejet printer instead of a laser printer.

As with any renewable energy system, you would need to know your power consumption first—and that means measuring everything you expect to run and calculating the total power usage. You can then size the system from these figures.

—Lance Turner

Special switches

I would like some more information on the special switches mentioned by Martin Nichol from Sun Real in your October-December 1997 issue, as local enquiries have proved fruitless. Where does one get them, or can they be home made?

Peter Boyd, Redfern NSW

Peter, the special switches are actually quite simple, and contain a MOSFET to do the switching of the load current. As MOSFETs are a voltage controlled device, they cause no degradation of the switch contacts, unlike switching heavy DC loads directly. Sun Real, ph:(03)5768 2248, sell these switches for about $15.

Another option would be to use a suitably rated relay and switch its coil with the wall switch. The relay contacts would then switch the load current. However, the relay will be less reliable than the MOSFET, due to arcing and subsequent wear of its contacts.

Wondering about my wash

I use a Wonderwash (refer to Soft Technology #51 and #54) here in the Daintree Rainforest. I have set up my own power system with two Solarex MSX 77 panels, a Solarex 18 amp regulator and a battery bank giving me all the 12-volt electricity that I need.

I have noticed two write-ups of ceramic laundry disks (Cleantec in #60 and the Turbo Plus in #62).

The disks gained general approval for use in a washing machine but there was no mention whether they would work in a Wonderwash.

As I live in a rainforest I would prefer not to use soap at all, and the disks would appear to be a good proposition to me. I wrote to Wonderwash but did not get a reply.

Could you please check this for me?

Geoff Watson,
Cow Bay via Mossman, QLD

I have used the Cleantec disks in my Wonderwash, and they certainly work well at removing dirt and odour, though I find that tough stains may require a little spot cleaning with soap.

—Michael Linke

Have you had your poison today?

Can anybody advise where I can obtain a detergent which is safe for washing foodstuffs for the removal of pesticides and other toxic chemicals used in food production? If you reply to the magazine, others will possibly be interested too. Alternatively, my email address is gcollins@pronet.net.au.

Glenn Collins,
Wavell Heights, QLD

[Sustainable technology events]

Send details of events to *ReNew*, 247 Flinders Lane, Melbourne 3000, Fax:(03) 9650 8574, Email: ata@ata.org.au

For event updates, see our web site at http://www.ata.org.au/

Going Solar events

- **7 March—Solar for 4WD, camping and marine uses**
- **10 April—Going Solar's 20th birthday**

Contact: Liz or Pippa on ph:(03)9328 4123.

Landcare Open Day

Sunday 22 March, 1998
Creswick Landcare Centre, Midland Hwy, VIC
Theme will be 'water conservation'.
Contact: Cresweick Landcare Centre, PO Box 3, Creswick VIC 3363, ph:(03)5345 2200.

Global Small Hydro '98

23-25 March, 1998
Hangzhou, China
Aimed at promoting development of medium and small hydro power systems.
Contact: International Network on Small Hydro Power, PO Box 607, Hangzhou, 310006, China, ph:+86 571 705 5492, fax:+86 571 705 5491, email: hic@pub.zjpta.net.cn

NSW Power

24-26 March, 1998
Forum The Grace Hotel, York St, Sydney
Financial opportunities of buying into the electricity market. Workshop on drafting successful contracts with retailers'.
Contact: IBC Conferences, ph:(02)9319 3755, email: enquiries@ibcoz.com.au.

Moora Moora Festival

Saturday 28 March, 1998
Moora Moora Community, near Healesville, VIC
Market, buskers, organic food, music, & workshops on building, solar & wind energy.
Contact: Julee on ph:(03)5962 5878, the community centre on ph:(03)5962 4104, or write to Bob Rich, PO Box 214, Healesville VIC 3777.

HIA Home Ideas Show

11-19 April, 1998
Exhibition Centre, Melbourne
Showcasing many building and renovation products and services.
Contact: Australian Trade Exhibitions, PO Box 192, Camberwell VIC 3124, ph:(03) 9819 0211, fax:(03) 9818 8553, email: home@a-t-e.com.au

Tallangatta Expo

21 April, 1998
Tallangatta Showgrounds, VIC
Rural expo with emphasis on renewables.
Contact: Rotary Club of Tallangatta, PO Box 12, Tallangatta VIC 3700, ph:(02) 6071 0226.

Ecologue XXI Wind Energy Symposium

23-25 April, 1998
Narbonne, France
Theme: 'The wind and wind energy'.
Contact: Ecologue XXI, BP 8-11200 Fabrezan, France, ph:+33 468 43 54 74, fax:+33 468 43 54 75, email: ecologue@easynet.fr.

Renewable Energy Seminar

Friday 24 April, 1998, 2-9 pm
Brisbane, QLD
To be presented at the Institution of Engineers Conference. Cost approx $90.
Contact: John Stasyshyn, ph:(07)3832 3749, fax:(07)3832 2101.

EcoDesign short courses

May-October, 1998
Ecodesign Foundation, Rozelle, NSW
Aimed at introducing sustainability issues of construction and manufacturing materials.
Contact: EcoDesign Foundation, PO Box 369, Rozelle NSW 2039, ph:(02)9555 9412, fax:(02)9555 9564, email: edf@edf.edu.au, www: www.edf.edu.au

Alternative Farmvision Expo

1-3 May, 1998
Geelong Showgrounds, VIC
Lifestyle, leisure and agricultural expo.
Contact: John Jackson, AFV Event Management, PO Box 1656, Geelong VIC 3220, ph:(03)5221 1966, fax:(03)5221 1904.

Solar Boat Race '98

Saturday 9 May, 1998
Lake Burley Griffin, Canberra
An exciting race for non-polluting craft.
Contact: Australian Science Festival (Advanced Technology Boat Race), PO Box 193, Civic Square ACT 2608, ph:(02)6205 0588, fax:(02)6205 0638, email: science.festival@anu.edu.au

Energy & Enviro. for Sustainable Dev'ment

May-June, 1998
University of Twente,
Enschede, The Netherlands.
Contact: TDG, Faculty of T&M, (CT 1799), University of Twente, PO Box 217, 7500AE Enschede, The Netherlands, ph:+31 53 4894377, fax:+31 53 4893087, email: J.R.M.Borghuis@tdg.utwente.nl

European Biomass Conference

8-11 June, 1998
Congress Centre, Würzburg, Germany
Contact: WIP, Enargy + Environment, Sylvensteinstr. 2, D-81369, München, Germany, ph+49 89 720 1235, fax:+49 89 720 1291, email: renewables@tnet.de

Sustainable Energy & Enviro. Technology

14-17 June, 1998
University of Queensland, Gold Coast
Contact: APCSEET '98 Secretariat, Intermedia, PO Box 1280, Milton QLD 4064, ph:(07)3369 0477, fax:(07)3369 1512, email: apc@cheque.uq.edu.au

Good Life Festival

26-28 June, 1998
Kilkivan Show Grounds, QLD
A celebration of all things rural, either traditional or alternative.
Contact: Kilkivan Landcare Group, PO Box 62, Kilkivan QLD 4600, ph:(07)5484 1261, fax:(07)5484 1409.

World Energy Council Congress

13-18 September, 1998
Houston, Texas, USA
'Energy and technology: sustaining world development into the next millenium'.
Contact: Register in the WEC database at: http://www.wec98congress.org/17regis.htm

World Renewable Energy Congress

20-25 September, 1998
Florence, Italy
Contact: Professor A. A. M. Sayigh, Chairman, 147 Hilmanton, Lower Earley, Reading RG6 4HN, UK, fax:+44 118 961 1365, www: http://www.netcom.net.uk/~asayigh/wren.html

Congress on the Environment

27-30 September, 1998
University of Tasmania
Will consider the sustainability of southern hemisphere marine and terestrial ecosystems.
Contact Professor Jim Reid, ph:(03)6226 2604.

World Solar Challenge

18-27 October, 1998
Darwin, NT to Adelaide, SA
Will now be held biennially to cater for increased interest in the event.
Contact: Cathie Holdich, Adelaide Event Office, ph:(08)8303 2021, email: wsc@saugov.sa.gov.au

Energy and Energy Conservation

20-22 October, 1998
Shanghai, China
Renewable energy, energy conservation for buildings and energy management.
Contact: Mr Zhou Shunzhi, Rm 1322, Bldg 3, 1486 Nanjing Rd (W), Shanghai 200040 P R China, fax:+86 21 6204 9481, email: wjyao@online.sh.cn

Electric & Solar Vehicle Conference

26-27 October, 1998
Adelaide, SA
Provides a forum for the exchange of ideas on sustainable vehicle energy solutions.
Contact: World Electric and Solar Vehicle Conference, PO Box 8178, Adelaide SA 5000, fax:(08)8322 6290, email: conference@wsc.org.au

Solar '98

25-27 November, 1998
Christchurch, New Zealand
Technology, commercialisation, education & policy in renewables and energy efficiency.
Contact: Solar '98, PO Box 1140, Maroubra NSW 2035, ph:(02)9311 0003, fax:(02)9311 0004, email: ANZSES@keystone.arch.unsw.edu.au

World Renewable Energy Congress

10-13 February, 1999
Murdoch University, Perth WA
Will highlight the role of renewable energy technology for the next century.
Contact: Dr Kuruvilla Mathew, Environmental Science, Murdoch University, Murdoch WA 6150, ph:(08)9360 2896, fax:(08)9310 4997, email: mathew@essun1.murdoch.edu.au

Noel's Treasures from Trash

To make this Periscope you will need:

- Two cardboard milk cartons
- Two mirrors, about 65 x 100mm
- Sticky tape
- A sharp knife
- A ruler and pencil

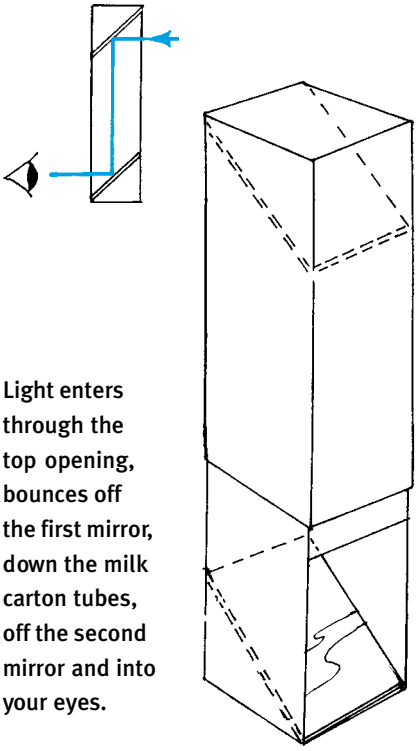
A periscope is used to bend light so that we can see around corners or over obstacles without being seen ourselves. Periscopes are used in machines such as submarines and tanks, but our periscope will be a lot more fun.

Start by cutting off the top part of the milk cartons with the knife so that you are left with two long cardboard tubes. Don't cut off the bottoms, though. Wash out the cartons and leave them to dry.

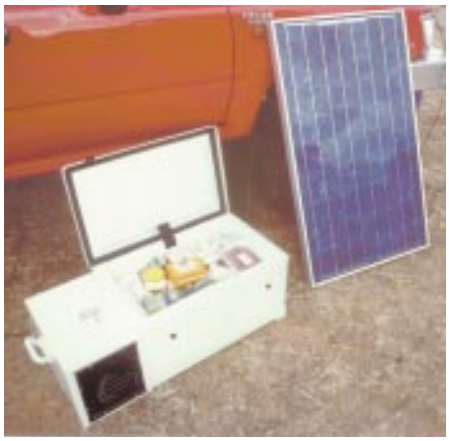
When they are dry, cut a straight line across one side of each carton about 100mm up from the bottom, and then down each edge to the bottom of the carton. Carefully push this flap in and tape it in place inside the carton so that it sits at a 45° angle.

Now tape a mirror in place on top of each of these flaps, so that the mirrors also sit at 45°. Cut down from the open end of one of the cartons about 30mm along two edges, so that this carton can be made to slide into the other one.

By sliding one carton inside the other, with the mirrors on opposite sides, you will have a periscope that allows you to see over objects and around corners. By having the two mirrors on the same side, you will be able to see what is happening behind you, although the image will be upside down.



Light enters through the top opening, bounces off the first mirror, down the milk carton tubes, off the second mirror and into your eyes.



Portable 12 volt fridge

This 45 litre portable 12 volt DC Frostbite fridge has a number of interesting features, including a rustproof fibreglass cabinet, pressure injected polyurethane foam insulation, and handles and drain plugs made from nylon.

The Frostbite uses the Eutectic system of refrigeration, which allows the fridge to use very little power even in high ambient temperatures. According to Davy Industries, the fridge will only need to run for 30 to 60 minutes every six hours once cold in a 35°C ambient temperature.

The fridge has a fully repairable diaphragm compressor that draws around 4 amps when running, and is capable of operating at any angle.

rrp $1200

Distributed by Davy Industries, RMB 1036, Barnawartha Nth, VIC 3688, ph/fax: (02) 6026 7711

750 watt micro-hydro turbine

The Platypus Power PM1000 micro-hydro turbine is designed to provide up to 750 watts of continuous power from a river or creek for battery charging in independent power systems.

The turbine features a marine grade 316 stainless steel casing and runner, a brushless permanent magnet alternator and heavy-duty bearings that are guaranteed for five years.

The turbine only has one nozzle that is easily changed to allow it to provide as much power as possible from different seasonal water flows.

The PM1000 comes with a constant-voltage taper-charging controller, which includes load dump elements, circuit breaker, voltage, charge and dump current meters.

The turbine requires a head of between five and 80 metres, and flow rates between 0.5 and 9 litres per second. It is available in three voltages: 12, 24 and 48 volts.

rrp $1942 for the 12 and 24 volt version, $2142 for the 48 volt model.

Distributed by: Integral Energy, Locked Bag 8849, South Coast Mail Centre NSW 2521, freecall: 1800 644 550, fax:(02) 4228 2890, email: iee@integral.com.au.

Recycling your bath water

When you think about it, sending 100 litres of bath or shower water straight down the plughole is a shocking waste of water. Flushing the toilet with clean potable water straight from the water mains is just ridiculous. The Wattworks water recycling system aims to help address both of these wasteful practices.

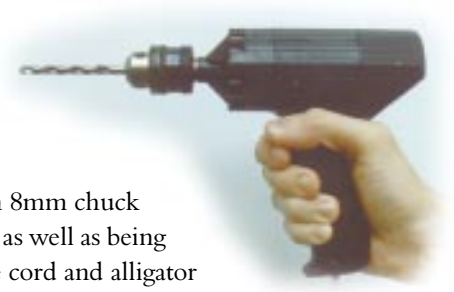
The system works by collecting bath and shower water in a 200 litre storage tank and then pumping it into the toilet cistern for flushing, thus using the water twice. Should the tank become full, excess water can be by directed to the sewer or onto the garden, depending on the model. If the tank runs empty, then a switch stops the pump from running.

The Wattworks system is supplied in kit form, and individual components are also available separately if required. The system carries a one year guarantee on all parts.

rrp: $920 for the single storey kit, $1145 for the double storey kit, and $1390 for the full irrigation kit.

Distributed by Wattworks P/L, PO Box 569, North Balwyn VIC 3104, mobile: 0419 580 640, ph/fax:(03) 9859 8688.

12 volt drill



A power drill is probably the most used power tool, but if you don't have mains power, then using a 240 volt drill is not always possible. LV Motors, the same company that makes Aerogen wind generators, also produces a nifty little 12 volt power drill for general duty work.

The drill is very simple and quite compact. While it only has one speed and an 8mm chuck capacity, it would undoubtedly have many uses in the 12 volt powered workshop, as well as being a handy tool aboard boats and motorhomes. The drill also comes with a 4 metre cord and alligator clip connectors, and, according to the manufacturer, the permanent magnet DC motor makes for a drill with a high output torque.

rrp $139.00

Distributed by Whitworth's Marine and Leisure, ph:(02) 9939 1055, fax:(02) 9905 4759.

Foiled again!

Another foil insulation product, but in a slightly different form, are foil batts from Wren industries. These look much like thin cardboard coated each side with aluminium foil, folded into a concertina shape. They are installed into ceilings in much the same way as convention fibre batts, but unlike glass batts, don't require protective clothing for the installation process.

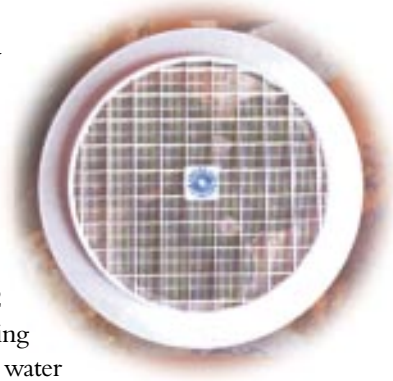
Foil batts can also be used in conjunction with other insulating materials, such as polyester batts, to provide insulation in ceilings, walls, and floors with R-values up to 2.5 or more, depending on the installation.

Foil batts also comply with the insulation specifications for the 'Breathe Easy' low allergy home program, run by the Asthma council of Victoria.

rrp around $3.95 per square metre. Available from hardware stores,

Distributed by Wren industries, 2A Bricker St Cheltenham VIC 3192, ph:(03) 9532 5855 or freecall: 1800 066 002.

Water-powered exhaust fan



Conventional exhaust fans have a number of problems, not the least of which is that they have to be situated at least 1.5 metres from the shower rose in the bathroom for electrical safety reasons.

The Envirofan eliminates this requirement by using the shower water to drive the fan. Water is taken from the pipe between the taps and the shower head, diverted through the fan and then fed back to the shower head. This means that the fan runs whenever the shower is running, and can be placed directly above the shower cubicle.

The Envirofan does have one drawback, though, and that is it requires a water flow of 12 litres per second or greater to operate properly, meaning it may not work well with water-saving shower heads. However, the fan does act as a water restriction device itself, thus reducing the water used with a high-flow shower rose. A low-flow version is also under development by the manufacturer.

rrp: $69.00

The Envirofan is Australian designed and manufactured by EPC Development Group P/L, PO Box 12, Babinda QLD 4861, ph:(070) 671 188, fax:(070) 671 622. It is also available from Rainbow Power Company, ph:(02) 6689 1430, fax:(02) 6689 1109.

Low power night light

The moon glow night light uses the new technology of electroluminescent plastic to produce a low level green light suitable for safety or comfort lighting in hallways, stairwells and children's bedrooms. The unit is quite small, and can be plugged into a double power point without obscuring the other socket. However, when plugged into some power points or switched power boards, it does prevent access to the switch itself, meaning it has to be plugged in and unplugged with the power switched on, which seems a bit odd.

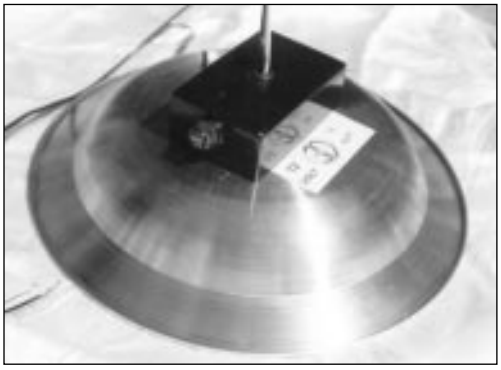
The moon glow light has a rated power consumption of 0.07 watts, which is very low indeed. This equates to just 613 watt-hours per year, or just five cents per year to run at 12 cents per kilowatt hour. This type of light is very efficient and generates no detectable heat, making it much safer than incandescent bulbs, and because no bulbs are used, it is also far more reliable.

rrp $9.98. Our sample was bought from McEwans.

Manufactured and distributed by HPM, ph:(03) 9764 8484, technical hotline: 1800 112 456.

Improved 3D fluoro

In Issue 58 of *ReNew* we reviewed the 3D fluorescent light from 3D lights. While the review was mostly favourable, we did have one or two concerns, such as the ballast not having any form of cover.



This has been addressed in the new version of this light, which now has a very neat black plastic cover over the ballast. Underneath the cover is a ballast which now has a larger transformer, as well as trimpot so that each light can be adjusted to give the same output. There is now also a 1.25 amp fuse fitted—an excellent improvement.

The new lamp has the same 16 watt 2D tube and stainless steel reflector as the previous unit, and with its even light caste would make an ideal light for a 'solar shed'.

rrp $50 plus $6.50 postage.

Distributed by 3D Lights, RSD Goongerah VIC 3888, ph:(03) 5154 0151.

Solar water pumping system

This complete water pumping system consists of a pair of 40 watt solar panels mounted on a fixed frame which drive a B/W Solar Poly-pump bore pump via a B/W Solar Universal pump drive and a maximiser.

The system is supplied with the pump and maximiser pre-wired to make installation easier, and is capable of pumping up to 3000 litres during a ten hour day, or 100 litres from a draw of 27 metres. The pump also features a variable stroke, from 50 to 100mm, according to the flow rate of the bore. And, in the unlikely event that the sun doesn't come up one morning, the pump also has provision for manual backup using a hand crank.

Other uses of the Poly-pump system include water transfer from dams to tanks, and aeration of ponds.

rrp $2490

Manufactured and distributed by B/W Solar, 9 Newborough St, Scarborough WA 6019, ph/fax:(08) 9341 8711, mobile:0417 931 316.

Foil insulation

Astro-foil is an American product that combines two layers of polyethylene closed air cells, much like bubblewrap, with a layer of aluminium foil on each side, to form an insulation product that is a direct replacement for bulk insulation batts.

According to the manufacturers, this allows the foil to stop heat transfer in all three ways that it occurs, convection, conduction and radiation. The foil is simple to install, and can be used under roofs or above ceiling joists, in walls or even under wood floors.

Astro-foil comes in two forms, the double air-spaced Astro-foil which has an R value of 2.6, and the single layer Astro-e, with an R value of 2.5. Astro-foil also exceeds Australian and New Zealand standards AS/NZS.4200.1:1994, is non-allergenic, non-toxic and acts as a vapour barrier.

rrp $7.43 per square metre for Astro-foil, and $5.76 for Astro-e, subject to variations in the Australian dollar.

Distributed by Astro-foil (Vic), PO Box 15, North Shore, Geelong Vic 3214, ph:(03) 5278 9374, fax:(03) 5272 1536.

Building with straw

One of the most common construction and furniture materials is particle-board or chipboard. This material consists of wood chips bound together using formaldehyde resin, not the most environmentally friendly or healthy of materials.

An alternative to chipboard is now available in the form of Ecopanel, which is made from wheat straw bound together with a polyurea resin binder. This makes for a less toxic material that also requires no trees to manufacture.

According to Envirocraft, the makers of Ecopanel, it also has a greater screw-holding capacity than chipboard, a greater resistance to swelling from water exposure, and exceeds Australian standards for chipboard manufacture.

Ecopanel is available directly from the manufacturer in bulk packs. For details, contact Envirocraft, 12/Factory 5, Malcolm Crt, Kealba VIC 3021, ph:(03) 9310 9311, fax:(03) 9310 9322.

High-efficiency car fridges

Portable fridges can be large users of power, and when you are on the move, you don't want a fridge that flattens your car battery after a few hours.

Boat and Caravan Accessories now have a new model from Waeco International, which is a 40 litre top loading unit using the latest compressor from Danfoss, the BD35F. Danfoss compressors are renowned for high efficiency and reliability. This new compressor features electronic control that allows it to run on either 12 or 24 volts, as well as reducing its overall consumption. For use at home, a 240 volt DC adapter is also available.

rrp $1,330 including tax.

Distributed by Boat and Caravan Accessories, PO Box 258, Proserpine QLD 4800, ph:(079) 476 209, fax:(079)476 214.

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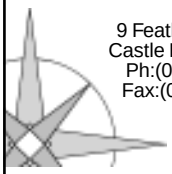

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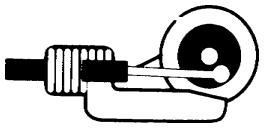

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Classifieds

Classified advertising is available in ReNew. The cost is $30 for up to 30 words. Classified advertising is free to Alternative Technology Association members. Send Your adverts to: ReNew, 247 Flinders Lane, Melbourne VIC 3000, ph:(03)9650 7883, fax:(03)9650 8574.

For Sale: Scania wood stove, 50W Solarex panel, 2 Solapak water panels, 5hp B & S engine running 100 amp alternator and water pump, Victa 4-stroke lawnmower, Homelite slasher, small wheelbarrow, miscellaneous tools and more. $1000 the lot. For more info call Bob on (03) 9528 5820 ah.

For Sale: Six BP SOLAR PVSTOR 2V cells. 779 amp-hour (C100). Includes joining cables, stainless steel bolts, nuts and washers, plastic terminal covers. $600 ono. Ph:(03)5986 2030 all hours.

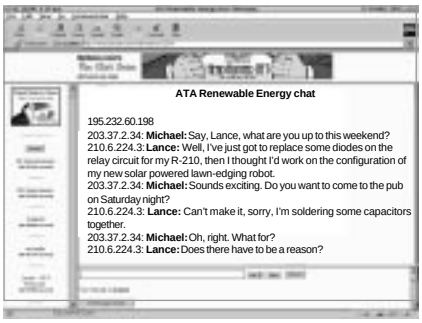
For Sale: Onga HJ 250 water pump. 240V AC, single phase power, Davey 3 litre pressure tank $150 ono. Ph:(03)5986 2030 all hours.

For Sale: Modern 14 square, two bedroom mudbrick home on 20 acres of Box-ironbark bush near Bendigo and Lake Eppalock (Strathfieldsaye) – $120,000. The house is of and open energy efficient architectural design with solar hot water and electricity (new 12 volt system with inverter; suitable for most domestic purposes), gas stove/fridge, open fire, combustion stove and telephone. Looking for a sympathetic new

Classifieds cont next page

Drop in for a chat

Ahh, the wonders of modern technology. *ReNew* readers who are web-enabled now have a friendly place to go when they feel like a chat. The ATA web site has a chat room devoted to discussions of renewable energy, energy efficiency and other sustainable technologies. You can find it by going to http://www.ata.org.au/ in your web browser and clicking on the 'ATA chat' button.



As far as we know, there are no other chat sites devoted to sustainable technologies.

For those who aren't up with the lingo, a chat room allows you to have a 'conversation' in text with anyone else who is in that 'room'. What you see on screen is people's names listed with their contribution to the conversation. The list is refreshed every 30 seconds, so new contributions appear in close-to-real time. Sometimes chat rooms are 'noisy', with lots of simultaneous conversations, and sometimes they're quiet. If you're new to the internet, a chat room can be a good place to get started.

Members of *ReNew*'s staff will be in the chat room at around 9pm on Sunday evenings (Melbourne time) during March to talk about the magazine, so come along with any grand ideas you have for feature articles.

Corrections

A couple of errors need clearing up from issue 62. Firstly, many people noted that our subscriber giveaway was technically impossible to enter, given that the advertised closing date (18 April *1997*) had passed some time ago. Fortunately, most people recognised this as an error, not an attempt to con the public. The correct date, 18 April *1998*, now appears in the competition details on page 7. Also on the matter of the subscriber prize, the information about the tank of the Black Chrome XII was incorrect, and should have read 'Long life ceramic lined tank' rather than 'durable stainless steel tank'.

On page 38, the article by Ron Jackson on fuel cells had the by-line at the base of the photo. Ron was the author, not the photographer—our apologies to him.

custodian committed to conservation. Call Paul on (03)9450 8620 (bh) or (03)9489 5545 (ah).

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[A parting shot]

Australian renewables after Kyoto

Michael Gunter re-launches this old *Soft Technology* column with a scathing appraisal of Australia's performance on greenhouse gases

On 12 December, an agreement was finally hammered out at Kyoto, which if ever ratified by enough signatory countries, will in theory reduce greenhouse gases by a paltry six per cent below 1990 levels by 2010. Chances of achieving that seem quite slim, given the attitude of the Republican dominated US Congress. They will point to Australia's eight per cent increase and use it as a powerful argument for not ratifying the Kyoto agreement. Thus Australia's stance at the Climate Conference may well have a much more serious impact on the Kyoto outcome than our 1.5 per cent share of global emissions would suggest.

Australia continues 'business as usual'

The nagging and hectoring by the Australian delegation at Kyoto, on their totally discredited interpretation of 'differentiation', got to the point where the other delegates said in effect 'we give in, if you'll just shut-up.' Great one, Meg McDonald, hatchet-woman extraordinaire. Maybe somebody should tell Alexander Downer that diplomacy is not about winning at any cost.

In this hostile political and economic environment, it is hardly surprising that a sustainable non-polluting energy source such as wind power is failing to make any significant headway in any state of Australia. Recent large wind farm projects announced for South Australia and Victoria do not seem assured of getting off the drawing board. The power companies would need a large group of customers to sign long term contracts for the supply of more expensive Green Power, before they could justify to their shareholders committing to a long term contract with the wind farm owners.

It is important to note that Australia is one of the cheapest places in the OECD to buy electricity. As the power stations fight it out in the new national electricity market, wholesale electricity is selling at rock-bottom prices, about 1.5 cents per kilowatt-hour on the spot market. Insiders' best guess of the price to distributors, after secret 'hedging' contracts are taken into account, is still only 4 to 5 cents per kilowatt-hour. Why would a power distribution company want to pay 9 cents a kilowatt-hour for power from the proposed Cape Bridgewater wind farm, when they would have the shareholders asking embarrassing questions about the extra cost? This is just one small example of how the National Electricity Market is being run in such a way that the environment always seems to come last on the list of priorities.

The wind energy industry is growing at a rapid rate in countries whose governments legislate in its favour.

Electricity, greenhouse, and bushfires

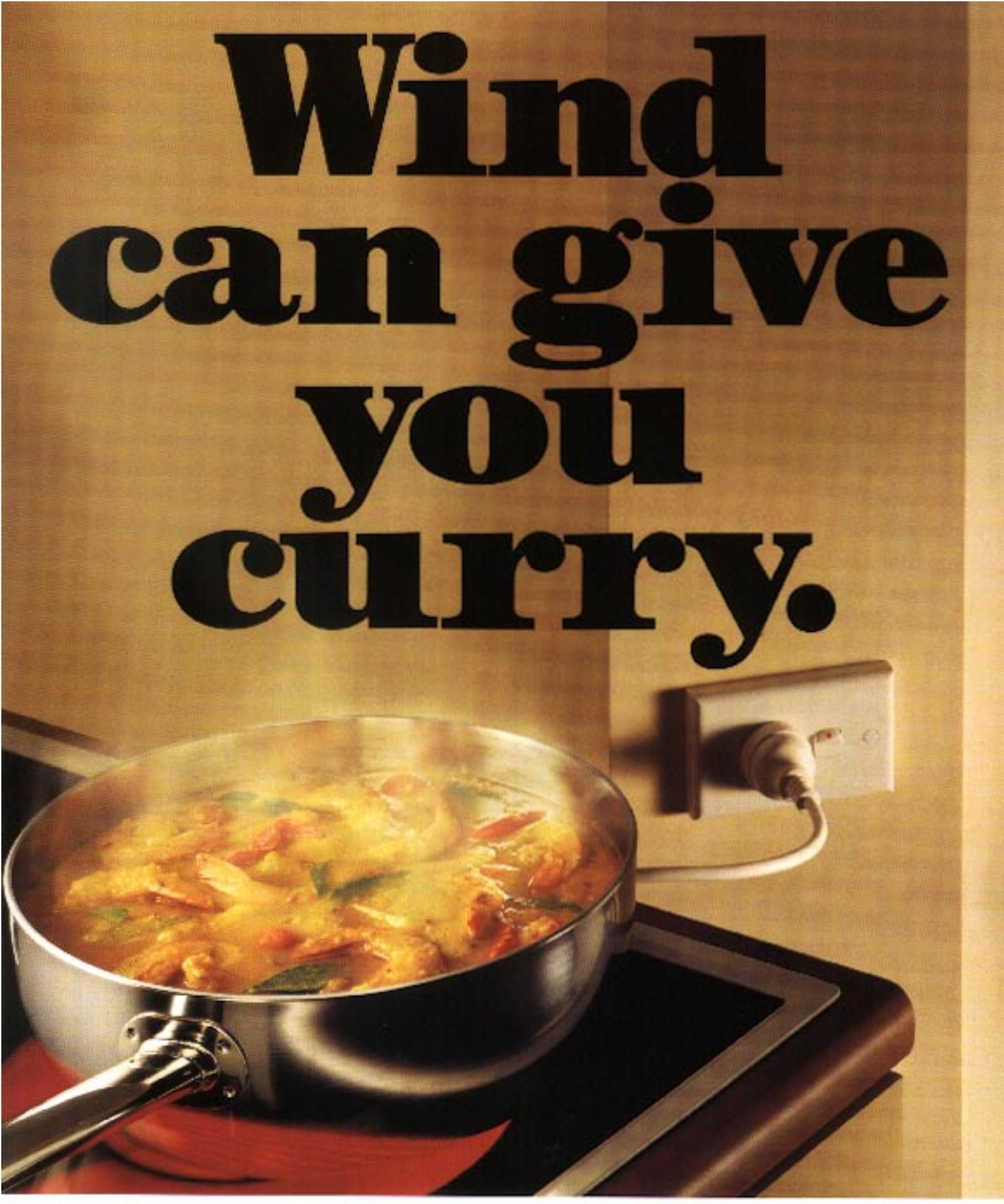
Atmospheric concentrations of carbon dioxide have increased 30 per cent in the last 100 years. This is a background, global level. In cities it is much more. Downwind of power stations it is also averaging much more. Much of Gippsland, including the Alpine National Park in Victoria is downwind of the Latrobe Valley.

During periods of normal rainfall, the forest is almost certainly soaking up the CO_2 at an increased rate. 'Normal' droughts brought on by the 'normal' El Nino phenomenon, then bring all this extra fuel to a highly flammable state. A careless campfire or a lightning strike then triggers a catastrophe, as recently occurred when 34,000 hectares of the Alpine National Park went up in smoke.

Maybe it is time the victims of these fires, or the insurance industry acting on their behalf, started a class action to recover a proportion of the cost from those, on the balance of probabilities, indirectly responsible for the intensity and severity of the recent fires. The internet site http://suburbia.net/~mickgg/bushfir2.htm contains more information on this hypothesis.

To be proven, it must be demonstrated that the CO_2 concentrations in Gippsland forests is indeed increased more than the background increase, and that type of forest grows faster and thicker as a consequence. Legal action is the sort of action markets, and shareholders, understand. We might even find that there is a tiny niche market for clean renewable energy!

Wind can give you curry.



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