SOLAR POWER BACKUP: GENERATOR BUYER'S GUIDE

ReNew

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One of four flexible solar panels

(see page 7 for details

Make a greywater recycling system

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Energy X-files: phantom power thieves

GST and renewables

Energy efficient lighting

Maintaining a wind turbine

A house for $10,000

Meet a young woman who built her own home in the city

Issue 69 Oct–Dec '99
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Federal Solar Batteries

The Best Answer in 'Cost to Performance' Ratios

The vital ingredient of an efficient and economical Independent Power Supply System is the battery. The Federal Solar range offers 6 and 12 volt flooded cell and gel technology batteries which provide long life in continual discharge/recharge applications over a wide temperature range and with minimum maintenance.

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Long life and the elimination of short circuits are facilitated by new super-insulating, micro-porous, polyethylene envelope separators. The positive plates are further protected by a glass wrapping which reduces shedding. The optimised balance of crucial active material on the plates and the increased amount of active material on the positive plate add to performance and life.

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These valve regulated, gelled electrolyte batteries are designed to offer reliable, maintenance free power for renewable energy applications where frequent deep cycles are required. They are non spillable, lead acid storage batteries, pressurised and sealed using special valves (never to be opended). Gel-Tech batteries will provide up to three times the cycle life of traditional wet cell batteries.

Whatever your battery needs are, there's no better 'cost to performance' solution than the Federal Solar range. Call us for your nearest agent in NSW, Victoria, Queensland and Tasmania.

SPECIFICATIONS

PART NO	VOLTS	AMP HR CAPACITIES* 20HR	100HR	APPROX WEIGHT KG	OVERALL DIMENSIONS MM LENGTH	WIDTH	HEIGHT
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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URL: www.federalbatteries.com.au
Email: contact@federalbatteries.com.au

Also available from selected Solar shops and specialist battery outlets.

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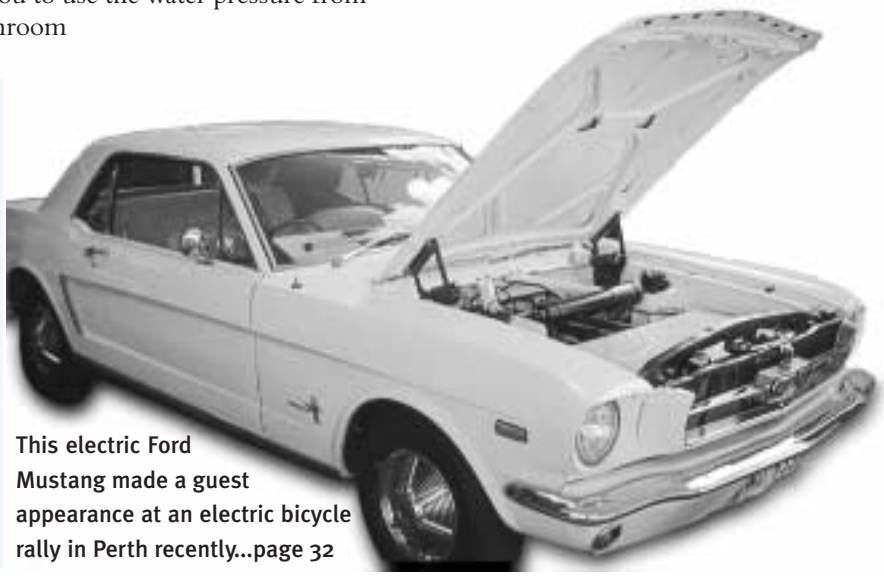
The future of lighting? LEDS are set to take over the night...page 65

COVER STORY: Meet Asphyxia, a young woman who didn't let a lack of experience stop her from building her own house for under $10,000. Cover photo and photo this page: David Johns

Maintaining a farm-scale wind turbine...page 34

Generator to go: Choosing the right backup generator for your renewable energy system

regulars



This electric Ford Mustang made a guest appearance at an electric bicycle rally in Perth recently...page 32

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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Contributions are welcome, guidelines available on request.

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editorial

Technical Editor Lance Turner celebrates a milestone

This issue is something of a milestone for me. I have worked for the ATA for over five years now, and this issue is my 21st. I have seen many changes around here over these past years, both in the production of the magazine, and in the ATA as a whole.

I joined the ATA way back when *ReNew* was known as *Soft Technology*. I was living in South Australia at the time, and noticed an advert for a vacant position in the *Sun Newsletter*. After a quick train trip to Melbourne, the staff decided I was the right person for the job, so I moved to Melbourne permanently the next week!

I came into the ATA when *Soft Technology* issue 49 was not far from going to the printers—talk about being thrown into the deep end! I had never done any magazine publishing, and had not even used a Windows computer before—I was a DOS dude, so the learning curve was a steep one indeed.

Back then the magazine was produced on some pretty slow computers using some not-so-fantastic software. The fastest computers in the office were 486s, machines that are now relegated to basic tasks like receiving faxes.

We had to print all of the pages on the office laser printer, cut and paste adverts and photo bromides into place, and send this conglomeration down to the printers to be photographically reproduced into film. Everything was done manually, and there were some pretty late nights, and some very long weeks worked back then.

Well, nowadays, we just scan everything into the computer, position it where we want it in each story, and convert the whole magazine into files called pdf files, which we then give to our printer on zip disk—a far cry from the old method. With these changes in technology, there has been a huge improvement in print quality of the magazine. We still have the occasional glitch, but all-in-all, *ReNew* looks a great deal better than it did five years ago. But despite the inprovements in technology, producing a magazine like *ReNew* still takes a long time. As I write this, it is now 6.30 pm, and Michael, Rachel (the advertising manager) and I are eagerly awaiting the arrival of dinner in the form of a pizza, soon to be delivered.

That is another thing I have seen change over the years—people (not pizza!). Since I have been here, I have worked with a great number of people, including three editors, three general managers, four admin people, and numerous volunteers. I have seen many changes over the years, including the building of two new mobile displays and the moving of the office into the Solar Workshop here in East Brunswick.

But it is not just the ATA that has changed over the years. The renewable energy industry as a whole seems to be undergoing some interesting developments, with many companies banding together to form groups with a much greater ability to promote the cause of renewable energy as a whole.

I can honestly say the last five years have been an interesting and enjoyable learning experience for me, and I hope to be involved with *ReNew* and the ATA for some time to come.

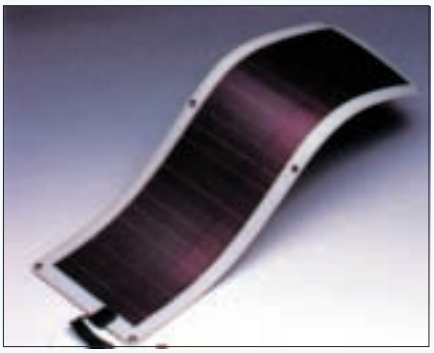
Happy reading,

Lance Turner

WIN! one of four UNI-SOLAR® flexible solar panels

in the ReNew/Uni-Solar subscriber draw

Total prize value: $2084



Unisolar flexible modules are ideal for marine, camping and other portable outdoor applications. These amorphous silicon modules have a vinyl backing, with a watertight polymer coating on the front, which means they can be attached to curved surfaces. Solar electricity affords us the ultimate in nomadic electricity generation—the Uni-Solar flexible module adds another dimension to solar portability.

Take out a *ReNew* subscription or ATA membership before 14 October 1999, and you could win one of four Uni-Solar flexible solar modules, valued at $521 each. See the conditions below, and get your subscription in today!

Features and benefits of the Uni-Solar flexible solar module, USF-32 *

- Amorphous silicon triple-junction technology
- Non-glass construction
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- Weight: 2.14 kilograms
- Polymer encapsulated, bonded to cushioned vinyl backing
- Bypass diodes across each cell for shadow tolerance
- Excellent high temperature performance
- Durable, no sharp edges

* The USF 11 is pictured

Conditions and how to enter

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

(2) The prize is not redeemable for cash.

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

(4) The competition runs from 25 May 1999 to 14 October 1999. Subscriptions/memberships must be paid by 5pm on 14 October 1999 to be eligible.

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

(6) ReNew subscriptions cost $22 per year. ATA membership costs $44 per year ($33 concession). Overseas subscriptions cost AUD$27 in NZ and PNG, AUD$34 elsewhere. Two year subscriptions and memberships are also eligible.

(7) To subscribe or join the ATA, use the subscription form on page 70 of this magazine (or a copy of it), or call the ATA on (03) 9388 9311 to pay by credit card.

(8) The competition is open to *ReNew* readers in any country, though a delivery surcharge may apply to winners outside Australia.

To help us speed the processing of postal entries, PLEASE print your name and address on the back of the envelope

The *ReNew*—Uni-Solar flexible solar panel subscriber competition is proudly sponsored by Canon Australia Pty Ltd, distributors of Canon solar electric power generation systems. For more information on Canon and Uni-Solar solar panels, contact Canon Australia, (02) 9805 2076 or visit their web site at www.canon.com

Canon Solar Power Products

REAP

Two issues ago in *Up Front* we published a rumour about a consortium of Australian companies who were negotiating with a European wind turbine manufacturer to make large wind turbines in Victoria. The negotiations have finally been made public, and we are pleased to say that the consortium, Renewable Energy Asia Pacific, is close to finalising an agreement with Dutch turbine manufacturer Lagerwey as *ReNew* goes to press.

If the deal is finalised, REAP will base their manufacturing in the LaTrobe Valley, ironically using manufacturing facilities that were built to make coal-fired generators.

REAP media release, 29 July

Keyboard power

Computer manufacturer Compaq recently filed a patent for a keyboard that uses the typing motion to recharge laptop computer batteries.

The keyboard converts the kinetic energy from typing into electrical energy. Adrian Crisan, a Compaq software engineer, came up with a conversion mechanism that uses tiny magnets that are attached to the shaft of each key. When keys are pressed, the magnets move through wire coils that surround them.

The motion of the magnets induces tiny currents which charge a capacitor. In turn, the capacitor builds up charge to recharge the laptop's battery.

***New York Times*, 29 July 1999**

SEDA wins US EPA award

New South Wales government agency, the Sustainable Energy Development Association (SEDA), has won a US Environmental Protection Agency award for its work on greenhouse gas reduction. The SEDA-initiated Greenpower scheme has involved 22,000 homes in a year.

Almost 1,700 residents in New South Wales have used a $500 incentive to purchase solar or heat pump hot water systems. Total savings are estimated at $300,000 annually.

***Trends in Renewable Energy*, 14 June 1999**

Putting a green spin on old growth forest destruction

One of the dumbest ideas we have heard in a long while is the recent proposal by the state government agency, Business Victoria, to try and get several wood-fired electricity generators operating in East Gippsland. The generators would be run on woodchipped old-growth forest, a product that is falling out of favour with overseas buyers.

The proposal called for the electricity generated to be sold as 'green' electricity, but this idea has been scoffed at by another government agency. In response to the proposal, Iain Buckland of Energy Efficiency Victoria told *The Age* newspaper that Greenpower consumers needed to be certain that they are paying for energy that is not environmentally damaging, or 'people would lose confidence in the scheme'.

***The Age*, 24 July 1999**

US wants 5 per cent of electricity from wind

Five percent of US electricity will be generated from wind by 2020, under a US Department of Energy (DoE) plan. Current capacity will double by 2005 and reach 10,000 MW by 2010.

Federal government funding will include $1.2 million in grants for turbine testing projects in ten states. DoE views wind as the renewable technology with the most potential, followed by solar electricity and biomass. The cost to generate electricity from wind in the US has dropped by US40 cents per kilowatt hour in 1980, to just 5 cents today.

***Trends in Renewable Energy*, 21 June 1999**

Tassie's grand wind plan

Tasmania could become Australia's wind energy capital, with plans to install up to 400 megawatts (MW) of wind generating capacity. Tasmania's state electricity generating authority, the Hydro Electric Corporation (HEC), announced plans for a multi-stage wind energy development in July. Arrangements have already been made to purchase land at the site of the first stage, at Wolnorth on the west coast. This 3,000 hectare site will host a 76MW wind farm built in three stages. The first 6MW stage will be completed by next year, followed by 35MW in 2002 and the remaining 35MW by 2004.

General wind monitoring has already taken place, and specific site monitoring has commenced, as has public consultation, heritage and environmental impact surveys.

Future developments will take place at sites further down the west coast, where the HEC says it has wind development rights.

In announcing the wind farm, the HEC's Chairman, Peter RAE, highlighted the success of the Huxley Hill wind farm on King Island, which he says has reduced the island's reliance on diesel fuel by 20 per cent, cutting annual costs by $400,000, and reducing carbon dioxide emissions by 1900 tonnes.

Mr Rae also pointed to the potential for a wind energy industry in Tasmania, 'As well as the development of wind farms, there is a great potential in the manufacture of wind technology in the State. This presents the opportunity for new industry in Tasmania in the form of plant assembly for wind turbines and the manufacture of towers.'

He also identified two critical factors in the future expansion of the project to 400MW: the completion of the Basslink project and the Federal Gov-

ernment's compliance with the Kyoto Protocol, 'It will be commercially viable only with the introduction of the Federal Government's Greenhouse credits trading system which will follow the ratification of the Kyoto Protocol.'

HEC media release, 29 July 1999

Huge wind farm in North Sea

The state of Schleswig-Holstein in northern Germany will allow private investors to build a 1,200 MW windfarm in the North Sea. It would become Europe's largest windfarm and a model for offshore wind installations. The investors will erect the initial 100 turbines in 2001, and hope to be completed by 2005. The cost would be more than 50 million Euros.

Currently, commercial offshore windfarms are generating in Danish waters with a collective capacity of

One of three Nordex 250 kilowatt wind turbines on King Island: these Turbines not only save Tasmania's Hydro Electric Corporation around $400,000 per year in diesel bills, but gave them experience in managing large wind turbine installations. The experience will come in handy as they embark on a 400MW wind project on Tasmania's west coast.

Media watch

While surfing the web recently, *ReNew* came across a startling 'cross fertilisation' between two web sites. The first is the federal Department of Industry, Science and Resources' *Net Energy* web site, which claims to be 'Australia's premier energy efficiency site'.

The second is the Uranium Information Centre web site, which does its best to convince us that the nuclear fuel cycle is completely safe, and that there's nothing to worry about at Jabiluka.

The excerpts below show that at the very least one of the two organisations responsible didn't have a very original copy writer—though a conspiracy theorist might be able to come up with something more colourful.

The graphics on the Uranium Information Centre web site are geared towards kids and strongly biased against renewable energy generation

In addition to the obvious plagiarism we were also disappointed with the focus on the barriers to the uptake of renewables—neither site mentioned the solid growth expected in the renewable energy industry in coming decades, and some of the information on the Net Energy site is seriously out of date—not a good sign for 'Australia's premier energy efficiency site'.

We will alert both organisations and wait for a response, but not before our readers have had a browse for themselves.

Federal government Net Energy web site www.dpie.gov.au/netenergy/info.html

Uranium Information Centre web site http://www.uic.com.au/whyu.htm

Gas has been seen in the same way as oil, as being too valuable to squander for uses such as electricity generation...It is also a valuable chemical feedstock.

Gas has been seen in the same way as oil, as being too valuable to squander for uses such as electricity generation...It is also a valuable chemical feedstock.

SOLAR & PHOTOVOLTAICS FACT SHEET

Solar energy has considerable logical and popular appeal. Many people see it as free, but it must be harnessed and it has some important disadvantages...

...So while it is true that sunlight itself is free, the capital costs of conversion, maintenance and storage are extremely high.

Solar energy in particular has considerable logical and popular appeal. However, for electricity generation solar power has limited potential, as it is too diffuse and too intermittent... While it is true that sunlight itself is free, the capital costs of conversion, maintenance and storage are extremely high.

Like other forms of solar energy, the wind can be considered to be free. However, special equipment is needed to extract the energy from the wind, and because wind is intermittent some means is required to store energy or provide substitute capacity for windless periods. Therefore, although the energy supply may be free, the cost of using wind energy isn't.

Wind, like the sun, is 'free' and is increasingly harnessed for electricity. Over 5000 megawatts capacity is now installed around the world. However, similar storage and back-up issues arise as for solar. It is not always available when needed, and some means is required to store energy or provide substitute capacity for windless periods.

11MW. German wind development is concentrated in the northern states of Schleswig-Holstein and Lower Saxony, both of which have adopted a goal of 1,000MW of wind capacity.

***Trends in Renewable Energy*, 21 June 1999**

You *are* buying more power than you think!

Following the feature on voltage supply published in the last issue of *ReNew*, the media has shown considerable interest in the story. *ReNew*'s publisher, the Alternative Technology Association, has been invited by the Victorian Regulator General to present the environmental and customer perspectives on the supply voltage question. The author of the voltage feature, Michael Gunter, told *ReNew* 'refined measurements on customer loads and analysis of published data suggest that millions of dollars and millions of tonnes of greenhouse gas emissions are at stake'.

Michael has provides additional information on the issue in his web site: www.suburbia.com.au/~mickgg

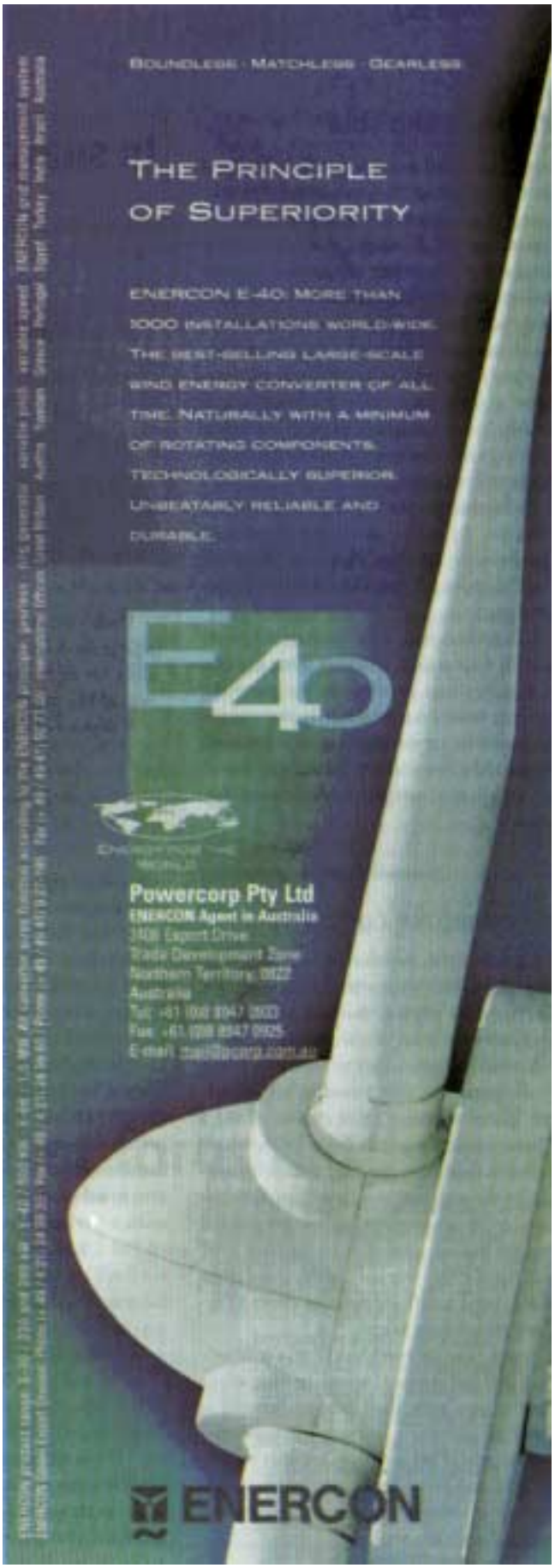
Powerlines kill, but don't worry...

There is a risk of cancer associated with power lines and electromagnetic fields, but a landmark US report says the risk is slight. The $50 million, six-year review found a statistical link with leukaemia, but was considered insufficient to warrant regulatory concern.

***Trends in Renewable Energy*, Issue 85, 21 June 1999**

Visit ReNew at the fair

An unashamed plug for *ReNew* and our publisher, the Alternative Technology Association, who will both be represented at the Going Solar Renewable Energy Fair at Hanging Rock in the Macedon Ranges, north of Melbourne, on 27 and 28 November. The ATA's mobile displays were a big success last year, with thousands of visitors learning about sustainable technologies first hand.



Heritage and solar

I was interested in your article in ReNew about the heritage houses and solar panels. I am a town planner, working for a private consultancy in Bendigo, and I have been involved in a number of heritage reviews and written a few planning schemes. I agree with you that the 'facadism' that directs much heritage planning is often contradictory and usually doesn't really assist to maintain the importance of older buildings, it usually just maintains high property prices (contrary to what most McDonalds developers will tell you).

As for this issue being important in inner suburbs, try doing the same in parts of Castlemaine, Maldon, Kyneton, Woodend and Daylesford and you'll probably get similar objections.

I think it is important to note a few issues in your article, however. One key one is that heritage overlays in the planning scheme would not necessarily prevent solar panels being installed on the front roof, even in Maldon where painting your house is enough to create a neighbourhood dispute.

Andrew Butt,
andrewb@castlemaine.net.au

In search of Stirling engines

I am currently working on developing a sustainable development education site in Brisbane, similar to CERES in Melbourne. By pure chance I came across a working model of a Stirling engine and managed to purchase it from the engineer (pictured), who had built several.

I believe this motor would be a great power source for dollar-poor countries and even possibly for developed countries. To that end I would like to set up a motor here as a power source for the education centre.

If anyone is working on industrial sized Stirling engines, please contact me.

Wayne Wadsworth,
52 Princess St, Fairfield QLD 4103,
ph/fax:(07)9481 8209.

Woodsmoke concerns

I am writing to express my concern over your recent article referring to wood smoke. Let me work my way through your article and point out your shortcomings.

I would be interested in how you arrive at the statement that 'wood heating worsens global warming'. You choose to use a *Choice* magazine article from 1993, which based its figures on pre 1987 tests. This article, by the way, was removed from distribution by *Choice* when our Association pointed out the inaccuracies of it. In the May 1997 and April 1999 issues of *Choice*, wood heaters showed a definite positive effect to reduce greenhouse gases.

Smoke can no more leak from a correctly installed and operated wood-heating appliance as you infer, than exhaust fumes can enter the cabin of a correctly operated motor vehicle. This is simply another misinformed and emotional statement based on little or no research into how a wood heating appliance is installed.

You then vigorously move on to another area of expertise that you undoubtedly contacted Ms. Robinson about for your total research data—PM2.5's. You boldly state that PM 2.5 particles cause so many extra deaths in Australia each year. I would be very interested to read your research data and test results on this matter. You see, recently in the United States a Supreme Court ruled *against* the US EPA initiating any use of regulations containing references to PM 2.5's because of insufficient worldwide research and test figures to substantiate US EPA claims. In Australia, no research at all has been carried out on PM 2.5. Most pollution control authorities here are struggling to obtain sufficient data on PM 10 and rely on overseas collection for their information.

The next report referred to, probably tops them all and completes the inept approach to the whole story. You refer to a South American survey of wood use for home cooking. These unfortunate people, in a small third world community, cook on open fires, with no fluing and no extraction systems, inside mud brick houses. How you can compare this to a certified AS-4013 wood heater installed in an Australian home to conform to five individual Australian standards is incomprehensible and irresponsible.

Your comments on AS-4013 show a complete lack of understanding of how the Standard was written and are applied to wood burning appliances. Some of your statements are not only erroneous but show a complete misunderstanding of how wood burning products are designed and perform. This standard is not only accepted by all State and Federal EPA's but is among the most stringent in the world. Unacknowledged by you, the Standard has also recently been lowered by 25 per cent. The Australian Standard is also being used as the model for the ISO world standard being created.

'Wanna be' renewable. Well, here we go again. A significant amount of guesswork used here. The National Fuelwood Study (Todd, Grey and King) indicated that about half the people interviewed in their research collected their own firewood. People in rural areas were much more likely to collect their own wood. Todd (1990) has estimated

the carbon dioxide impact of firewood use in Australia. The gross emission of CO_2 from the combustion of 4.4 million tonnes of wood is 8.3 million tonnes. But almost all this CO_2 would be released into the atmosphere anyway because most firewood in Australia results from land clearing (Todd, Gray and King) and the wood would be burnt as part of that operation if it were not collected as firewood.

If it is assumed that firewood used for domestic heating (5 million tonnes) has only minimal net CO_2 release and if all the firewood were replaced with gas (50 per cent) and electricity (50 per cent)(from thermal power stations), then the extra CO_2 release would be 4.9 million tonnes per year.

If we are not to use wood for home heating what are your suggestions? Your article offers no viable alternatives. Do you seriously suggest burning fossil fuels such as gas and coal as viable fuels for home heating based on the above figures? Are you aware that many European countries are looking at wood burning power stations to replace nuclear facilities?

The single most damning part of your presentation is, that while your office had no hesitation in contacting us to supply information and contacts for your 'Buying a wood heater' article, we were not even given the courtesy of being told of your misinformed article on wood smoke, let alone be asked to contribute to it.

I am sure your 1000 members and sponsors would be very disappointed to know that the information you have provided them with is seriously flawed and biased. If we do not receive an acceptable reply with the utmost urgency we will have no option but to contact these people, via the Internet, and supply them a copy of this letter.

B V Mogg, Chairperson,
Australian Home Heating Association

Thankyou for your letter. I hope my response comes in time to avoid your wrath, though I'm not sure how you intended to contact ReNew's readers via the internet, since you neither know who they are nor have their email addresses!

On to the less whimsical part of your letter. There is substantial debate about whether small particle pollution impacts on human health. Organisations like the American Lung Association, who are appealing against the US Court of Appeals' decision to disallow EPA enforcement of ozone and particulate matter standards argue that it does. You seem to imply in your letter that particle pollution is not a health concern because the US Court of Appeals ruled against regulating it, yet your own Home Heating Association's web site states 'The AHHA recommends the following control measures, which would reduce the emission of particles from wood heaters by over 80 per cent within ten years:' and follows with a list of recommendations. Why are you bothering, if you believe there is no health risk associated with particle pollution? Perhaps you need to clarify your own association's position.

You allege that I compare South American open fires with Australian Standard compliant wood heaters. I think you're being a bit paranoid here, I drew no link between the two.

A number of people have highlighted the innaccuracy of the greenhouse gas emission data that I used in the article. It seems the picture is rather more complex than the one I presented, though I dispute the position presented in the Choice articles you mention. These base the figure of 0.002 kg of CO_2 per MJ of heat from wood on firewood harvested from sustainably grown trees. This assumption, that all wood burnt will be replaced with new trees, is not explained—though there is a note explaining that if the burnt wood is not replaced the CO_2 figure will be 1.5kg per MJ. Where are the new forests that are replacing the wood burnt in 1.5 million Australian houses? As you highlight, a large amount of firewood is collected from land clearance: this process may not be a direct result of firewood demand, but it is hardly a sustainable practice. Wood might as well be a fossil fuel when used in this way.

I am aware of the use of biomass-fuelled electricity generation in Europe, and actually mentioned district scale biomass fuel plants in the article—you must have missed it. These have the advantage of being centrally operated, and not subject to misuse by ignorant individual operators or unscrupulous fuel merchants selling unseasoned wood. However, recent proposals to locate such plants in East Gippsland and feed them on old-growth forests are absurd—this highlights the need for the right fuel source if wood is to become a truly sustainable fuel.

We did contact your office about the wood heating buyer's guide, and offered you the opportunity to contribute editorial on correct use of a wood heater, which you declined in favour of sending a brochure. I have also contacted you about a new product made from compressed waste wood, featured in the products section of this issue of ReNew, but you have not yet responded. This product claims to generate less greenhouse gas and other

Wood heating internet forum

The wood heating buyer's guide and feature story on problems with wood heating in issue 68 of *ReNew* have sparked a flood of letters. Some are published here, though have been edited to fit, while there simply wasn't room for others that raise equally interesting points. To solve the space problem, we will be putting all correspondence up on our web site, along with links to relevant sites and other news on wood heating, at the address below.

Contributions are welcome, and updates will be published in *ReNew*.

www.netspace.net.au/~altec/heating.htm

A good thing that came out of our feature on wood heating was this flue extension on the CERES office wood heater. The original flue only extended as high as the wider bottom section, and caused choking smoke to enter both the CERES office and *ReNew*'s office next door, as it was not being dispersed adequately. After reading *ReNew*, the flue was extended and smoke dispersion is greatly improved.

pollutants in burning than conventional wood. We would still welcome your opinion on this and any other home heating product that has the potential to reduce greenhouse gas emissions.

A final note. When deciding to write about wood heating we recognised that people would continue to buy wood heaters, regardless of what we wrote about wood smoke or other environmental impacts. For that reason we elected to provide a wood heating buyer's guide in the same issue, including only those that met the Australian Standard for emissions—we recognise compliant heaters and continued reductions as the current best option for domestic wood heating in Australia. The reason why I did not include information about the new Australian emission standard is quite simple: it was not announced until July, we went to print in May.

—Michael Linke

A 'thumbs up' for wood fire articles

Excellent articles (*ReNew* 68) on woodfires and their associated problems. We are currently assembling ideas for construction of our future home on rainforest acreage near Dorrigo NSW and, with an abundance of tree-growing opportunities, are seriously considering wood-fire space-heating. Passive means are preferred over active, but active will be required to some degree for our frequent -4°C winters. The wood-fire option seems appropriate for us given that: The fuel is renewable (and we are growing trees for the purpose); it is as 'local' as fuel can get; production of the fuel requires only the sun and a chainsaw, not an infrastructure; and we like to sit by a wood-fire.

However it does pollute pretty badly. We look forward to further information using wood as a (cleaner) fuel.

I would also like *ReNew* to cover more on: house design, especially cheap, easy to build, highly efficient, small homes; concrete slab insulation techniques; use of the ecological footprint concept; currently-functioning sustainable communities; and what *ReNew* readers are doing in their own home and social situation. I realise that some of these are not technology-related, but they are certainly relevant to the 'employment' of technology.

Regarding home design, *ReNew* and the ATA is in a prime position to educate on truly sustainable technology and home design. Various home tours suggest to me that we have a *long* way to go and most passive-solar examples I've seen are very poor.

On a side note, am I the only one concerned over the 'fragmentation' of green thought and hence would-be policy? What about a national sustainability body (a new CSIRO division?) that could sift, consolidate and simplify the education material for the masses. There seems to be a lot of unnecessary and innacurate duplication occurring. Or is philoso-diversity a more sustainable approach? Anybody ?

PS *ReNew* is a great read every time.

Michael Meacham,
Raymond Terrace, NSW

Thanks for sharing your thoughts Michael. It helps us enormously to know what readers want from ReNew, and hopefully you'll see some of your suggestions addressed in upcoming issues. We have had more feedback on the wood heating articles than on any one topic in recent years, but unfortu-

nately we couldn't fit it all into the letters pages. For this reason we will be starting a page on our web site devoted to wood heating, and possibly other types of heating. You will find it at www.netspace.net.au/~altec/heating.htm. Contributions will be welcome, and we will publish updates in ReNew.

—Michael Linke

Pinpointing woodsmoke problems

I feel you've done a bit of a machine gun job in your well researched article on wood heating, when the real problems can be pinpointed more precisely.

Burning wood fuel creates trouble in two situations:

1. Urban situations where there are enough people or fires, and the wrong geographic conditions so that the smoke becomes a human health issue, and

2. Places where there is too much demand for the forest to supply the wood without being ecologically undermined.

Both of these conditions probably apply in Melbourne, but for the majority of people in rural Australia who use remote area power supplies, they do not.

In the forested areas of the country, fuel grade wood from land management and sawmill offcuts is being burnt to waste in huge quantities. Part of the problem in switching wood production onto farms and out of old growth forest is the lack of a market for thinnings.

Wood burning does not contribute to global warming except in a situation where the forest is not growing back. The natural cycle of a eucalypt forest (where most fuelwood comes from) returns the majority of wood to the atmosphere by termites, who convert it to carbon dioxide and methane, and bushfire, which burns the wood in the smokiest open fire possible. The forest needs fire and termites for its own ecology of course, but burning the wood in a stove produces neither more greenhouse gas nor more pollution than would be otherwise produced.

I am also uncomfortable to see gas again advocated as a 'green' fuel. LPG and 'natural' gas are both non-renewable petrochemicals, which contribute irreversibly to global warming both through leaking raw gas into the atmosphere and after combustion. They are also highly centralised monopoly products which we could well do to minimise our dependence on.

Wood is a precious energy resource which produces itself, can be stored cheaply for long periods, can cook dinner and warm a house even when it's raining outside. If we take forest management seriously, it is one of our few truly renewable resources.

Bruce Teakle, Mt. Glorious, QLD

Ed's note: Bruce has outlined several of his ideas about forest management to us, including firewood use, and we have asked him to contribute to a future issue of ReNew.

Solar panel warranties

I'd like to respond to the provocative but largely inaccurate claims made by Jose Campos' letter on 'Solar Panel Warranties' in the July edition of *ReNew*.

BP Solar's standard warranty on all its products is no different to most manufacturers, ie, it is voided when a product has been tampered with. However, we agreed to repair the junction boxes *free of charge* to Mr Campos.

The repairs were carried out by one of BP Solar's most senior solar module technicians. The repairs were performed competently and in accordance with BP Solar's very tough manufacturing standards, to overcome the mess left behind by the tampering.

Further, the letter contained many inaccuracies which were not only misleading but deceptive. I want to take the opportunity to clarify some of these misconceptions:

• **'the dealers comment: sorry sir we only warrant power output'** On reading the warranty statement which is included with all solar modules, it is clearly stated that defects caused by faulty workmanship (and thus power loss) are covered by warranty **unless** the modules have been modified.

• **'A 50 Millisecond flash of light in a 25 degrees C chamber is used to measure power output'.** At BP Solar when we

Continued on page 81

A house for $10,000

An inspiring story of how a young woman built her own solar powered mudbrick house in the suburbs

by Fiona Negrin

It's an ambition shared by many people—to one day be the owner of their own house. Still other people dream of one day building that house with their own labour, and some people take it one step further and want to build a more sustainable type of abode. Such a house might be built out of mudbricks or straw, maybe it would make its power from the sun, water or wind, it would probably include a vegetable or fruit garden and certainly a composting system; perhaps the toilet would also be some kind of recycling system and a few chooks would roam the yard. Most people who hold this ideal keep it as a goal for the longterm future, for a stage of their lives when they've settled down, can afford to buy some land and materials, and have the manual skills and free time to do it. I didn't think it was the sort of thing a young woman just a few years out of high school with no previous building skills did, especially if she still wanted to live in the inner city.

Photo: David Johns

Yesterday I was privileged to meet a woman who banished all my preconceptions. Asphyxia is a 24 year old acrobat with the Women's Circus, and until she designed and built her own house and garden, had had no experience in building and for most of her life had preferred being indoors to out. Now she lives in inner city Melbourne in a solar-powered mudbrick house that she built herself over a period of about two years and grows an abundance of fruit and vegetables in her garden.

> 'I didn't have any skills, but I thought building my own house would be a good way to learn.'

A friend of mine, Amy Williams, came with me to interview Asphyxia because Asphyxia is profoundly deaf and Amy knows how to sign. It transpired that Amy and Asphyxia already knew each other well, and Asphyxia was so welcoming and warm that it was more a conversation between friends than a 'formal' interview. As Asphyxia recounted the process of building her house, her story was illustrated by photographs which were taken at every stage of building the house and now fill two scrapbooks.

The first thing anyone would notice about the house is how uniquely beautiful it is. I'd been told beforehand that it was a one-room mudbrick house and I had pictured a squat, square-shaped structure, beige in colour and roughly textured. I was wrong! For a start, the house is relatively high because although it is just one room, it has a loft. The exterior walls are textured but appear smooth, and have been rendered with diluted bondcrete, while the guttering, door and window frames are painted fire-engine red. It's quite a striking colour combination and Asphyxia had to source the red paint from a shop specialising in paint for heritage houses, because the vibrant colour she was after isn't commonly available.

The windows, which take up most of the north-facing wall, are tall stained glass arches which were originally part of a church. Amy told me that everyone who visits the house comments on how amazing the windows are. From the outside the house looked gorgeous, and inside the light streaming in made the space seem more expansive than it is.

It was all the more interesting that Asphyxia was living in such a house considering that until she was in her late teens, her goal was to one day live

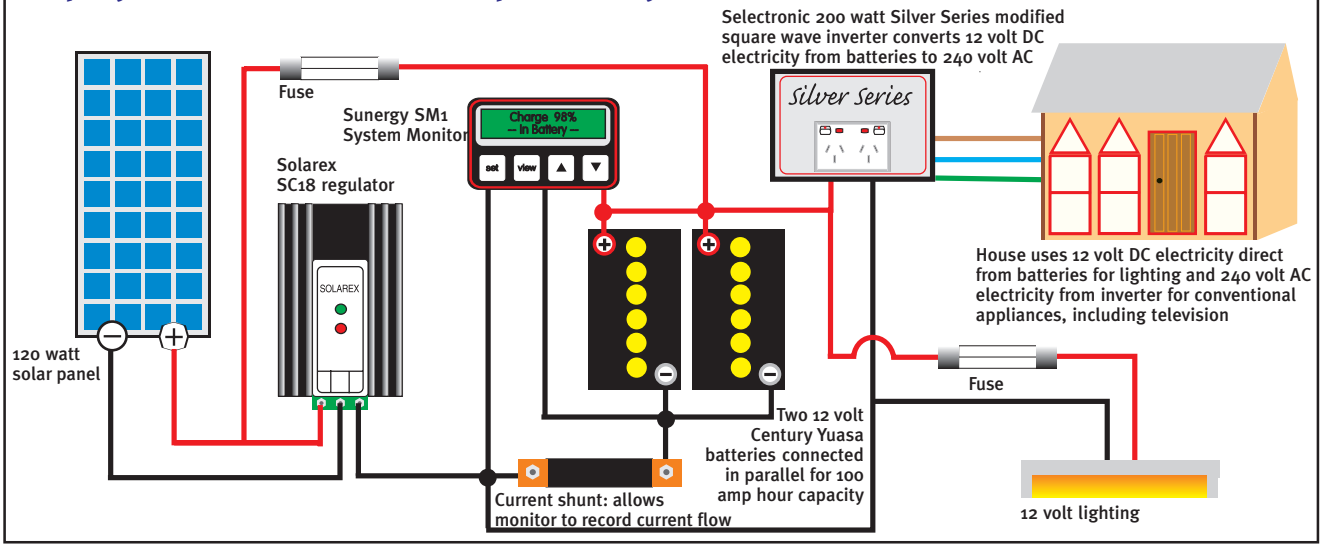
Asphyxia in her lounge, complete with TV powered by her solar electricity system. Photo: David Johns.

Photo: David Johns

In the kitchen. Asphyxia designed it herself, including a gas fridge hidden inside a cupboard.

in a flat. A few key experiences changed her mind, including a stay at a friend's house in country NSW which was a one-room house with a loft, no hot water and a vegetable garden. While helping her friend fix his insulation, it struck her that if he could build his own house for around $10,000, so could she. 'I hadn't realised that people really lived like this. I didn't have any skills, but I thought building my own house would be a good way to learn', Asphyxia says.

Asphyxia's solar electric power system: small is beautiful!



She started scouting around for land in the country and read books on how to build your own house, all the while feeling like it was a bit of a 'weird dream' that she was really going through with this. Also, she felt ambivalent about moving to the country as she had commitments in the city, and in the end she decided she wanted to stay in Melbourne. She located a block of land in an inner suburb and continued to work full time until she had saved $30,000. She then left her computer-programming job in order to devote her time to building the house.

Asphyxia's first task was to clear the land on which she would build her house. This in itself was a big job as the land was covered in chest-high weeds and had been used as a virtual rubbish tip. After receiving Council approval for her plans she spent two weeks and $7,000 buying materials for the house. She paid for the foundations to be laid and then a friend with carpentry skills helped her to make the frame for the house. A temporary shed was set up to store tools and for shelter—this shed was indispensable during the building of the house, and has since been converted it into a cosy little bungalow for human habitation! After building the frame and putting the roof trusses up, the windows were placed and the roof laid. These procedures weren't without error: despite painstaking measuring, the windows initially didn't fit, the roof was one sheet of corrugated iron short, and the supporting posts for the roof were cut wrongly. The latter turned out to be a blessing of sorts as it left an ideal place to put a verandah. The loft floor was measured and built, the guttering and storm water plumbing was taken care of by the same friend who helped with the carpentry, Andrew Cahill. The mudbricks were then delivered.

The process of bricklaying took over five weeks of full-time work, often in the worst of Melbourne's winter weather. Looking back on that period, Asphyxia says, 'people told me I was crazy to build a house during winter but I was too impatient to wait for good weather. After working in the rain and wind every day, I began to enjoy it.' Friends dropped by now and again to help with jobs like mixing mortar and carrying bricks, and Asphyxia appreciated their prescence 'because it enabled me to share the process of decision making.' At this time she was paying rent on a flat while working every day on the house, and she felt the compulsion to finish the house as quickly as possible.

Once the walls were completed, the process of washing mud to make the floor began. There's a photo in one of her scrapbooks of Asphyxia sitting on a wooden seat outside in the rain, her gloved fingers squishing mud around in a small bowl, her clothes completely mudspattered. Underneath the photo is a caption: 'This was the *worst* day in the entire process of building. It rained all day and I was soaked right through to my undies. I had to sit there mushing mud for the floor for hours with no shelter. I tried to think positive, and told myself I was communing with nature, but I found nature to be very cold and wet.' Ultimately the mud floor got flooded some months later, and has since been dug out and replaced by floor boards.

Ashphyxia moved into the house in February 1997, about a year after work had begun. She felt a great sense of relief upon moving in and her pace of work slowed down now that the pressure had been lifted. Since moving in, she has sometimes had to work hard to upkeep the house and other times not at all. Last year Asphyxia spent most of her time replenishing her garden after it had been bulldozed and destroyed during renovations to a property on adjoining land, an experience which she still recalls with sadness. Now the plentiful garden which surrounds the house bears carrots, leeks, radishes, silverbeets, cabbages, peas, oranges, loquats, nectarines, apricots, grapefruits,

Photo: David Johns

The loft bedroom, with bathtub in the background. The ceiling is finished with papier mache made from recycled newspaper stuck to chicken wire.

With a little help from friends: Paper mache is applied to the ceiling (top), the windows get the final coat of paint (right), and a 12 volt fluorescent light is wired into place (far right).

Asphyxia at work: laying the top course of mudbricks (left), fixing clear roof sheeting for skylights (below), and trial and error as the mud floor goes down: this would later be covered with a timber floor after it flooded and turned to slush (below left).

pears, gnashies, hazelnuts, cherries, berries, mandarins, figs, asparagus, artichokes, strawberries and more. The garden receives its nourishment in a myriad of ways including a greywater system whereby water used inside the house is recycled into the garden through pipes laid under the ground.

The house is essentially one large room, which is used as a loungeroom, study and kitchen. The kitchen contains an LPG stove, wooden benchtops and cabinets which Asphyxia designed herself, and a gas fridge tucked away out of view in one of the cabinets. While buying materials for the cabinets Asphyxia had to deal with patronising attitudes from sales attendants who were incredulous that a young woman was building her own house. One shop assistant told her to ask her father to do the measurements for her, and then he could help her with the kitchen cabinets. 'The only times I got respect were when I walked in with my workclothes, completely covered in mud and dirt.'

The upstairs of the house is a loft room with a bed and a deep bath. There's still some work to do on the loft, as the north-facing skylight lets in too much sun. As a temporary measure Asphyxia has laid some styrofoam boards over the inside of the windows and in time she plans to double-glaze half of the windows and cover the other half with papier mache, a material with which the walls and ceiling of the loft are rendered. Asphyxia's reasons for using papier mache were partly aesthetic and partly pragmatic: 'I like the look of it, but also I wanted to re-use a material, and papier mache provides good insulation.'

When considering how to provide power for her house, Asphyxia wanted to use solar but was uncertain whether she would be able to afford it. She worked out how much electricity she would need and decided that if she got a gas fridge and cut out on luxuries like a hairdryer and toaster, she would only need about 250 watt hours of electricity on average per day, plus batteries with 10 days' worth of storage for a worst case scenario during winter. Again she had to contend with unhelpful and patronising shopkeepers until she found Solar Charge in Brighton, where Technical Director Richard Potter was 'very lovely, helpful and respectful' and helped her in choosing the right sort of panel and batteries for her needs. Now Asphyxia has more than enough solar-generated electricity to run her computer, TTY telephone, stereo equipment and kitchen blender. She also has an Edwards solar

water heater, which provides enough hot water for regular showers and the occasional bath.

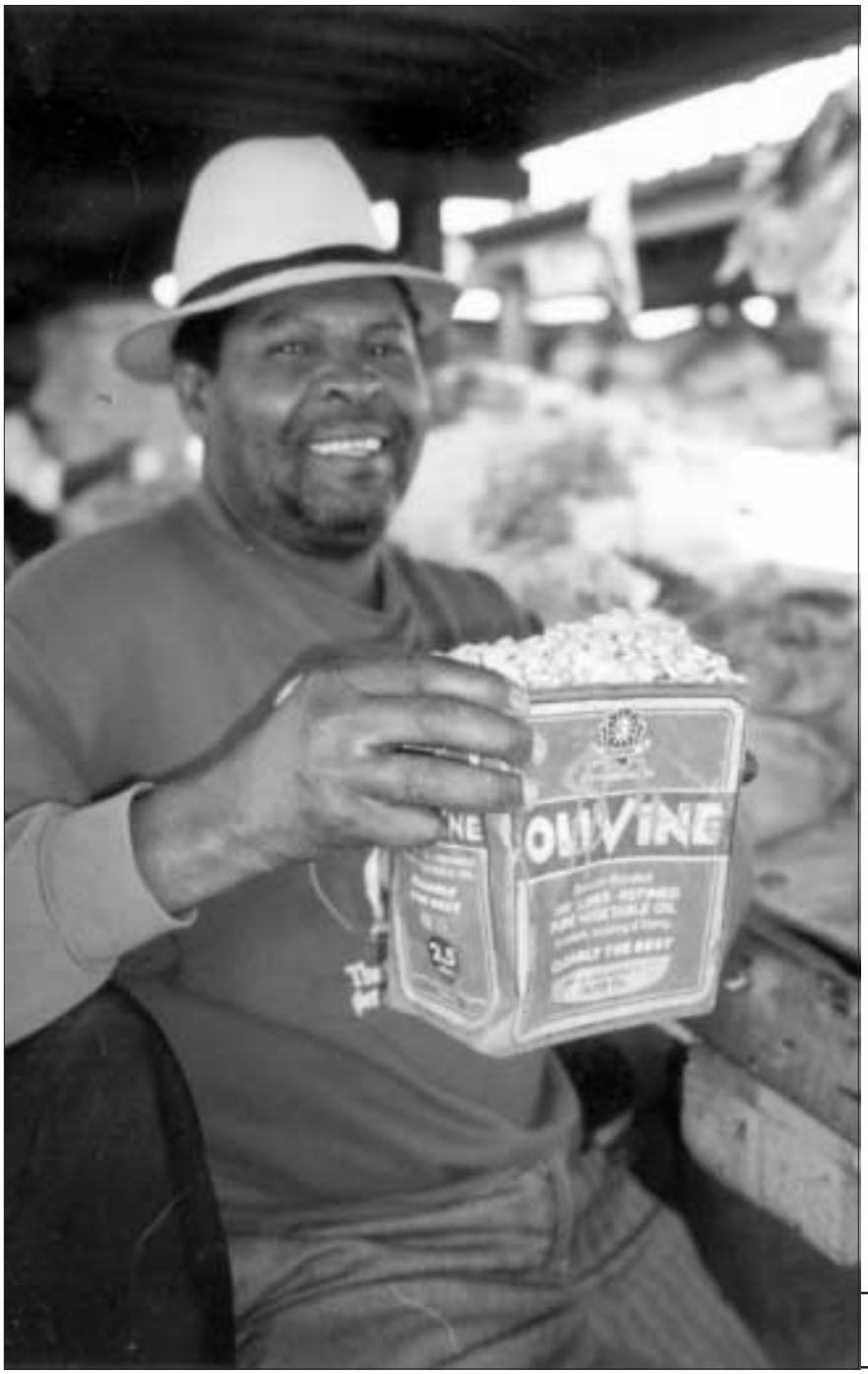
Outside, under the verandah, is the rudimentary and ingenious toilet. Having been told that it was a worm farm, I was expecting it to be a heaving pen of slithering worms above which one gingerly squatted. In fact it was more like the composting toilets located in national parks. Essentially a large wooden box with two holes on top to sit on, the fecal waste, toilet paper and urine which drop into the box are all eagerly devoured by the worms inside and end up being used to feed the garden. Certainly it is the most sensible outdoor toilet I've come across in any house I've been to, and the most appealing, with lovely views of the garden and the chookshed (which, incidentally, was made for Asphyxia by a friend and is painted in colours to match the house).

Meeting Asphyxia and seeing her home and garden showed me that a person doesn't have to wait until some magical time when they already possess the skills to build their house. Apart from money and time, it seems that confidence, tenacity, and the strong desire to do it are the vital components, and the skills are learned in the process. Asphyxia recalls that she was learning all the time, reading books and making many mistakes. Even now she feels that she gained particular skills in areas such as the electrical wiring of the house, but does not feel fully confident in carpentry. I can't help thinking what a quiet thrill it must be for her when she remembers the period when it was just a 'weird dream' to live in a house built with her own hands and those of her closest friends, and to reflect that now the house is built and it's strong, dependable, and hers for life. ✲

In high spirits: checking that the house's timber framing is all square

Avoiding the genetic engineering menace

Michel and Jude Fanton explain how the potential health and environmental dangers of genetically engineered food can be avoided by saving the seeds of traditional food crop varieties



Hybrid maize variety for sale at the Harare market in Zimbabwe

Genetically engineered crops, whose derivatives are proliferating in fast food outlets, school canteens and supermarkets, are the biological equivalent of the nuclear menace. Radioactivity depletes over time, but genetically engineered (GE) plants have the potential to multiply exponentially, as well as to cross fertilise with their naturally bred cousins. Just like nuclear waste, these stray genes cannot be recalled once unleashed onto the earth's surface.

Mandatory labelling

European Union traders are now compelled by law to label GE food no matter how small the component. In Australia and new Zealand mandatory GE labelling has so far been postponed and at this stage of negotiations it looks set to favour the corporate sector. A lot more public pressure must be brought to bear for there to be labelling laws of consequence implemented in Australia.

Australians are already eating GE foods containing higher doses of the weedicide Roundup because of the new varieties that are Roundup resistant, for example:

- Corn used in animal feeds and for processed food sweeteners such as dextrose and fructose;
- Cotton, the seeds of which are used in cooking oil and cattle feed;
- Canola, a major ingredient in vegetable oils, margarine, soaps and detergents;

• Soya beans, whose by-products such as lecithin are used in countless health products, and 75 per cent of processed foods such as ice cream, bread and baby food.

The hazards of GE

GE is a test tube science applied to food production and prematurely released onto consumers. The study of a gene in a test tube can tell only what that gene does in that particular situation but does not predict what it might do if released into the environment. Salmon genetically altered with a growth hormone gene not only grew extremely fast but unfortunately also had green flesh. These unpredictable side effects are called 'pleiotropic effects'. Other examples are:

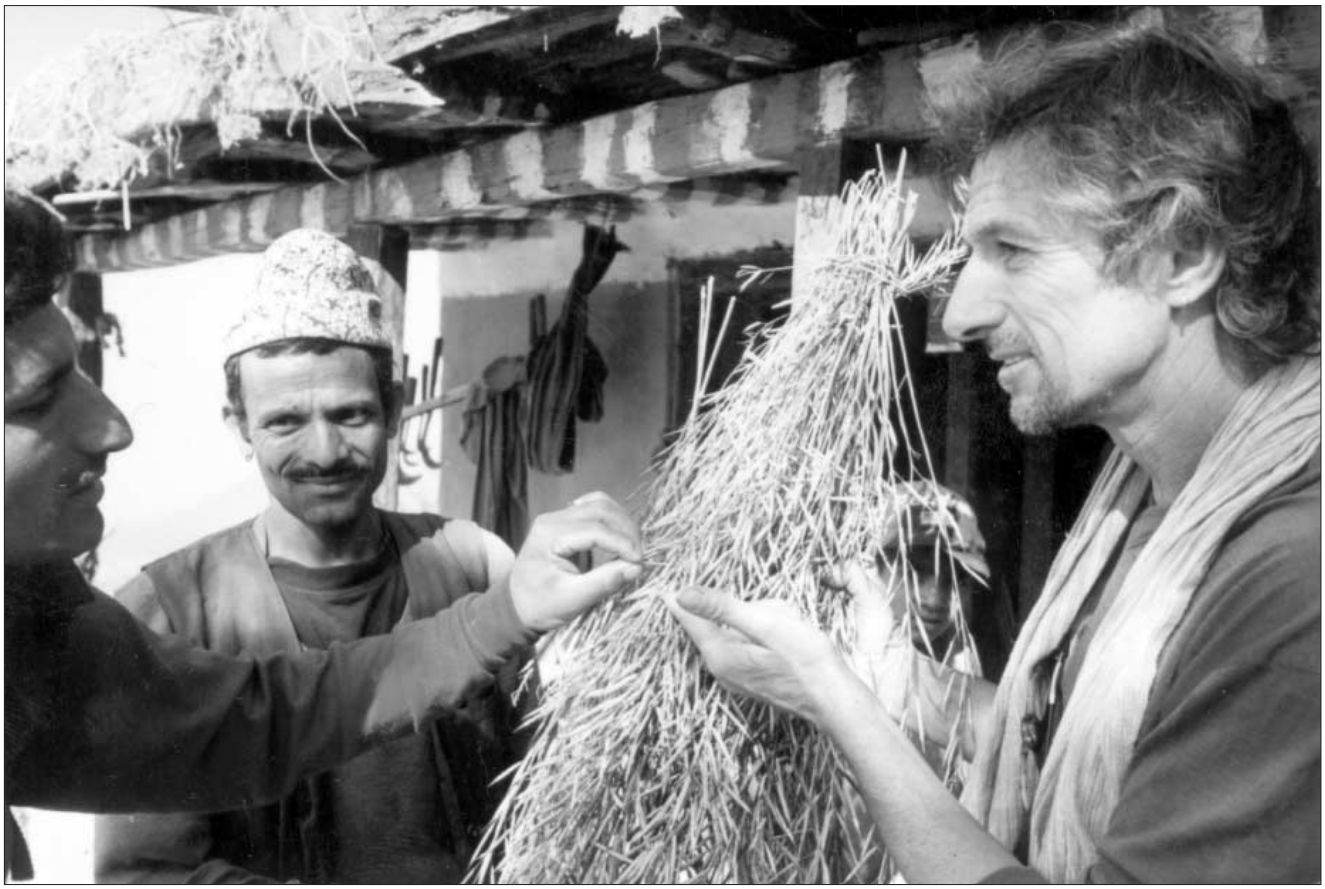
• Antibiotics such as kanamycin are used at the laboratory stage as convenient gene markers to track the uptake of modified genes. This can only decrease the effectiveness of antibiotics.

• Airborne pollen from GE crops invaded organic crops up to 10 km away - in the UK this caused the deregistration of one large organic grower. Similarly, organically grown blue corn chips had to be destroyed when they tested positive for gene contamination.

• Insects are developing immunity to Bacillus thuringiensis (Bt), a naturally occuring soil bacterium, used as a pesticide by organic and biodynamic farmers for 50 years. Because of its usefulness Bt genes are now being genetically spliced into many new potato, cotton and corn varieties, resulting in a loss of its effectiveness as insects become accustomed to such broadscale use. The giant seed merchant, Novartis which hotly denied this loss of resistance two years ago, now not only recognises the resistance problem, but stipulates in its GE growers' contracts that 20 per cent of the fields *must* be planted with equivalent non-GE crops! This is to provide refuges for pest populations, in an attempt to slow down their inevitable resistance through overexposure to Bt.

Marketing GE

Although GE technology is being presented as a solution to world hunger through hugely increased yields, the bulk of GE crops, for example corn and soya, are produced mostly for animal fodder and industrial uses. The corporate giants involved in GE demand substantial royalties for their seeds and insist on, and systematically enforce, contracts stipulating no portion of the seeds are for regrowing. Rather than



Michel Fanton with an extentionist from the Nepalese Jajarkot Permaculture Project translating, talks to a farmer about his mustard crop. This is a traditional highland variety used for making cooking oil.

benefitting from GE products, our farmers and developing countries will be further indebted.

Although proponents claim that GE will reduce environmental degradation, through a reduction in agrotoxins, the opposite is true. Monsanto crops are not bred for pest resistance but for pesticide resistance, for example, Roundup Ready® soya beans, corn, cotton and canola which tolerate excessive doses of the weedicide glyphosate, the active ingredient in Monsanto Roundup®.

Monsanto, who introduced Agent Orange and the highly polluting PCB chemicals, ironically coined 'Food, Health, Hope' as their marketing line. Monsanto has acquired the largest seed and biotechnology interests in the world and now controls the production and sale of the bulk of the world's processed food. Twenty per cent of all crops grown worldwide are now GE. Their marketing success depends on public ignorance of the subject.

Sowing the seeds of hope

The Seed Savers' Network, comprising gardeners and farmers, conserves varieties of useful crops that are neither chemically dependent nor genetically engineered. These seeds are regenerated every year, continuing to evolve in a dynamic relationship with the environment, unlike the frozen seeds from gene banks. Traditional crops have a been safe to eat and grown well without pesticides for centuries.

Origins of Seed Savers

Seed Savers was started in 1986 in response to plant patenting legislation; corporate takeovers of family seed companies and the resultant flooding of the market with hybrids. We then began collecting Australia's best garden and farm open-pollinated varieties through a novel seed exchange system.

Learning seed cleaning and sorting in Cambodia with Jude Fanton

Responding to our appeals in numerous articles and radio and television interviews, gardeners have sent seeds they had in their family for generations. Some examples are watermelon, corn, and bean varieties arriving in Australia in the mid 1800s and grown with seeds saved since then. This selection from strong survivors over many generations results in varieties naturally resistant to prevalent pests and diseases.

Seeds contain the genetic basis of tomorrow's food. This is what we attempt to preserve from extinction.

The seed saver centre

The Seed Savers' Network has a permanent base in Byron Bay, northern NSW. It is on one acre of land, with spring-fed water, wetlands and a terraced hillside. The Seed Centre is a repository for varieties of under-utilised fruits, nuts, original vegetables as well as plants producing fibre, medicine and oil. This includes plants like edible Asian water plants, a large range of salad and cooking greens and a collection of ancient grain and root crops. A heritage orchard is being planted. The seeds of thousands of non-hybrid vegetable varieties are stored in our seed bank with their details carefully recorded in a database. Everything is progressively tested for germination, some grown for observation and some sent to caretakers for multiplication.

The Centre has a fine ethnobotanical library, networking and information dissemination facilities, a room to process seed parcels and space to condition seeds from the garden. It is intended that in time a range of renewable energy technologies such as wind and solar power will be utilised and displayed at The Seed Centre.

Training programmes

The Centre attracts an increasing number of masters and students of traditional farming practices including natural pest management and effective microorganisms. We accept long term trainees and interns, such as Masami Sakaban, a Japanese teacher who stayed for three months, and Neary Kosal, a permaculture trainer with the Cambodian government who was with us recently for six weeks.

We provide one-to-one training for aid workers and each April and October the Centre holds courses for people who plan to work overseas in permaculture related projects.

Since 1995 we have been invited by international agencies to provide community seed bank training and consultancy. In Cuba the brief was to boost urban food production with seeds produced locally; in Cambodia to work towards restoration of traditional seed practices lost during Pol Pot's regime; in Tonga it was to reduce agricultural pollution from pesticide usage and in Borneo UNESCO engaged us to train Southeast Asian ethno-biologists and villagers in preserving endangered forest food species. As a result of these and

similar programs, our network has been replicated in Asia, Africa and the Pacific.

The seed bank

After due selection and harvest, storage is the most important factor in quality seed production. Valuable seed stock can easily be lost through poor storage—heat and humidity being the main culprits. Vegetable seeds and grains are best stored at low and constant ambient temperatures and low humidity.

Currently we store most of the seeds in the collection at room temperature, laboriously sealed in small air proof packs with sachets of oxygen absorbing material and silica gel that keeps humidity as low as five per cent.

Germination tests are conducted on an ongoing basis to determine the seeds' viability rate. This system has proved satisfactory but very time-consuming. To ensure increased seed longevity we are now in the process of planning a partly underground storage room, the challenge being to design a prototype which can be replicated in Third World villages so people can keep their seeds for a few years if they need to.

It should comprise a seed storage room with natural air conditioning and dehumidifying as well as an adjacent seed drying section, with a system to draw warm dry air (possibly solar-powered) through seed drying racks.

We would be delighted to hear from anybody with creative suggestions for the design of the seed storage and drying rooms. We experience high humidity in the hot months (up to 99 per cent) and the designated area has a good slope of about eight metres at 15 degrees with flat areas above and below. The main access would be from below or the sides.

What you can do

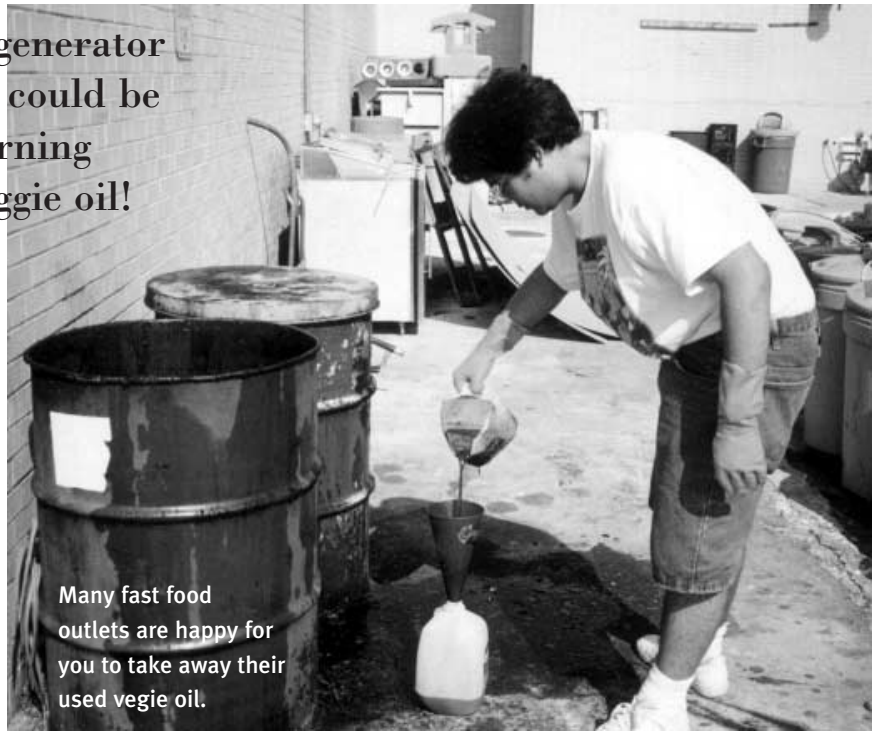
Whether you write to politicians on the need to ban GE crops and foods, or at least to label the products; form a lobby group or go our way and preserve old varieties, your efforts are very much needed. To get more information on current GE issues you could contact the Australian GeneEthics Network in Melbourne, ph: (03) 9416 2222.

The efforts of everyone who sends seeds to Seed Savers, renew stocks, contribute their various skills and subscribe to the network are essential to preserving a chance for healthy food tomorrow.

Michel and Jude Fanton are Directors of The Seed Savers' Network. Contact them at Box 975, Byron Bay, NSW 2481, ph/fax: (02) 6685 6624, ph (02) 6685 7560 email: info@seedsavers.net web site: www.seedsavers.net

Making your own fuel

If you have a vehicle or generator with a diesel engine, you could be running it on a clean-burning fuel made from waste veggie oil!



Many fast food outlets are happy for you to take away their used vegie oil.

Making your own fuel from vegetable oil can be easy, cost-effective, and environmentally beneficial. What makes this fuel even more attractive is that you can make it from the vast quantities of waste vegetable oil produced in Australia each year. With a bit of know-how and persistence, you can run any diesel engine on vegetable oil.

Only diesel engines can run on vegetable oil-based fuels. This means that any engine that has spark plugs and is made for leaded or unleaded petrol cannot use vegetable oil fuel. If you want a practical home-made fuel for a petrol engine, you might consider making ethanol, methane, or wood gas.

Grow Your Fuel

We produce a large quantity of used vegetable oil in Australia, but there are oilseed crops you can grow no matter where you live. The possibilities include coconut, soybean, canola (rapeseed), sunflower, safflower, corn, palm kernel, peanut, jatropha, and hundreds more. To learn which vegetable oil crop is best suited for your area, contact your state's office of agriculture, the agriculture department of a local university, or talk to local farmers.

One of the crops with the highest yield of oil per acre is canola. From just one acre of canola, you can produce 379 litres of vegetable oil. The most common oilseed crop in the US is soybeans, which produce 189 litres of vegetable oil per acre.

Growing your own oilseed crop has an added bonus. The meal that is separated from the oil is an excellent source of protein. This meal can be used as animal feed or in breads, spreads, and other food products. Pressing the oil from the seed does not require a large, expensive press. TabbyPressen of Sweden makes a tabletop press for around $1,500. The press usually comes with a 240 volt, 50Hz electric motor, so you can use it here without modification. The press looks like a powerful juicer.

To operate it, pour the oilseed into the funnel and wait for the vegetable oil to pour out of the bottom. The meal oozes out of the side of the press.

The engines that are found in cars, trucks, generators, boats, buses, trains, planes, pumping stations, tractors, and agricultural equipment can all run on fuel from vegetable oil. Pure vegetable oil, lard, and used cooking oil work just as well as diesel fuel.

Biodiesel

The most conventional method of running a diesel engine on vegetable oil fuel is to produce a fuel called biodiesel. Biodiesel is made by combining 10 to 20 per cent methanol (an alcohol) with 0.35 to 0.75 per cent sodium hydroxide (also known as caustic soda, or lye) and 80 to 90 per cent vegetable oil. A very reliable reaction can be made with 80 parts new vegetable oil, 20 parts methanol, and 0.35 parts caustic soda. These ingredients are mixed together for an hour and left to settle for eight hours.

After the chemical reaction is complete and the new products settle out, you have biodiesel fuel and glycerin soap. The fuel is yellow to amber in

colour and flows like water. The soap is brown in colour and has the consistency of gelatine. The soap settles to the bottom, allowing you to pump, siphon, or pour off the biodiesel.

Vegie oil and kerosene mix

The second method for using vegetable oil in a diesel engine is to simply 'cut' the oil with kerosene. This method is best suited for emergencies, heavy duty engines, and warm temperatures. Although it is possible to mix other petroleum products with vegetable oil, kerosene is most suited for the diesel engine.

Depending on ambient temperature, the blend of kerosene to vegetable oil will be anywhere from 10 per cent kerosene and 90 per cent vegetable oil to 40 per cent kerosene and 60 per cent vegetable oil. A fairly reliable blend is 20 per cent kerosene to 80 per cent vegetable oil.

The effectiveness and reliability of the vegie oil and kero method is increased by starting and cooling down the diesel engine on diesel fuel or biodiesel fuel. This can be accomplished by installing an extra fuel tank and switching to the vegie oil and kero mix when the engine is warmed up.

Straight vegetable oil

The third method for running a diesel engine on vegetable oil is to use straight vegetable oil. As with the other methods, you can use either pure vegetable oil or used cooking oil. To ensure the reliability and longevity of your diesel engine, the engine must be started and cooled down on diesel or biodiesel fuel. This also requires the use of an extra fuel tank and a valve to switch between the tank of diesel or biodiesel fuel and the tank of vegetable oil. Think of it as a startup tank and a running tank.

The key to running a diesel on straight vegetable oil is to heat the vegetable oil at every stage—in the fuel tank, fuel hose, and fuel filter. The vegetable oil must be heated to at least 70°C.

Most diesel engines have hoses that carry hot coolant. This coolant can be channelled to heat the vegetable oil hoses, tank, and filter. You can make simple modifications to the coolant hoses. These modifications combined with some extra fuel and oil hoses, an extra fuel tank, and an electrically operated switch will allow you to run your diesel engine on straight vegetable oil.

Fuel comparison

Biodiesel is a good substitute or additive fuel for diesel fuel. Vegie oil and kero mix is decent for use as an emergency fuel, and using straight vegetable oil is good if you have the time and know-how to properly modify your engine's heating and fuel tank systems. Diesel engines are used in many different situations. For each situation, there is a way to make fuel from vegetable oil.

How to make biodiesel

This fuel can be made in a blender or in a larger, homebuilt mixer. The materials you'll need are vegetable oil, methanol, and caustic soda.

If you are using new vegetable oil, always use 3.5 grams of caustic soda per litre of oil. Since each batch of used cooking oil is different, the amount of caustic soda in each batch of biodiesel will be different. To ensure that you are using the correct amount of caustic soda, make a small test batch of biodiesel in a blender before attempting a reaction in a large mixing tank. For the test batch, use 100 millilitres of vegetable oil and 20 millilitres of methanol. Then you must determine how much caustic soda to use.

If you are using used vegetable oil, use 0.45 grams of caustic soda for the first test batch. If this batch makes biodiesel and glycerin, use the same proportions for the large batch reaction. If the test batch does not form two distinct layers, increase the amount of caustic soda to 0.55 grams and make another test batch. If this batch is unsuccessful, make another batch and increase the amount of caustic soda to 0.65 grams. If that batch is unsuccessful, make another batch with 0.75 grams of caustic soda. Make sure you can make biodiesel on a small scale before attempting a large reaction.

Once you have made a successful small test batch of biodiesel, multiply the number of grams of caustic soda you used by ten to see how much caustic soda you will need for each litre of oil in the large reaction. For example, if you used 0.55 grams of caustic soda in the test batch, you will need to use 5.5 grams of caustic soda per litre of used cooking oil for a large reaction.

Here is the basic procedure for making biodiesel fuel. Read the safety information at the end of this article before you begin.

1. Purchase or collect new or used vegetable oil.

2. If the oil is used cooking oil, use a restaurant fryer filter to remove burned food bits.

3. Purchase some methanol from a local racetrack or chemical supply store. Ethanol can also be used, but the process is different.

Yum! Who would think that you could run your car on a bucket of lard?

4. Purchase some granulated caustic soda or caustic soda sold as a drain cleaner from the hardware store or supermarket. It must be pure sodium hydroxide (NaOH).

5. Measure the amount of vegetable oil you want to use in litres. We will call this number V. Pour the vegetable oil into the mixing container.

6. When the temperature is below 21°C, or when the vegetable oil is solid or lumpy, it will be necessary to heat the reactants before, during, and possibly after the mixing. The ideal temperature to attain is 49°C. A fish tank heater will heat 40 to 120 litres of reactants. For larger batches of biodiesel, a water heater element can be mounted in a steel biodiesel mixing tank. Make sure that you follow the manufacturer's directions and safety precautions when adding any electrical device to the system. Be careful when heating vegetable oil in a plastic container. Polyethylene cannot withstand temperatures above 60°C.

7. Multiply V x 0.2. The result will be the amount of methanol you will need in litres. We will call this number M.

8. To determine how much caustic soda you will need to use for new vegetable oil, multiply V times 3.5 grams. For used vegetable oil, use the number of grams of caustic soda you got in the small test batch. For example, if you used 0.55 grams of caustic soda in the test batch, you will multiply V times 5.5 grams of caustic soda. Call this number L.

9. Carefully pour L grams of caustic soda into M litres of methanol. Stir until the caustic soda is dissolved in the methanol. Be careful, this creates a toxic substance called sodium methoxide.

10. Pour the sodium methoxide into the vegetable oil right away. Stir vigorously for one hour.

11. Let the mixture settle for eight hours.

12. Pump the biodiesel from the top, or siphon it off with a hand siphon. Or if you are lucky enough to have a container with a spigot, open the spigot and drain the bottom layer of glycerin. The glycerin will be much thicker and darker than the top layer of biodiesel.

13. Allow the glycerin to sit in the sun for a week. After that, the trace methanol will be evaporated. You have made a nice glycerin soap. You can scent it with the fragrance of your choice, add other soap agents as desired, or just use it as it is. This soap is especially good for cleaning grease off your hands and cleaning greasy equipment!

14. Make sure your biodiesel goes through a 5 micron filter before entering your diesel engine.

A simple biodiesel processor

The simplest way to make a biodiesel processor is to use a 44 gallon (200 litre) steel drum and some sort of mixer. The mixer can be a circulating pump, such as a sump pump, or it can be an electric mixer for chemicals, specially made for drum stirring.

A pump or stirrer will cost about $250 if you buy it new, but you can build your own instead. With a bit of ingenuity, you can build a biodiesel processor that is inexpensive and effective. Tim Garrits of Kelseyville, California built such a processor from mostly recycled parts for under $80. A simple biodiesel processor can be built from the following parts:

- a 44 gallon metal drum
- a ½ hp electric motor
- two pulleys that give about 250 to 400 rpm at the mixer blade
- a belt that goes around both pulleys.
- a rolled 2 inch (50mm) rod for the mixer shaft
- a propeller made from two shelf brackets, welded to either side of the rolled 2 inch rod. The shelf brackets look like two opposed 'L's and form a propeller about 14 inches (36 cm) in diameter. Basically any propeller-shaped metal would do, if it is made from about 12 or 14 gauge steel
- a ¾ inch (19 mm) brass ball valve for draining the glycerin
- a hinge and piece of wood acting as a belt tensioner
- a 2,000 watt electric water heater element
- a water heater thermostat
- wood, screws, bolts, and other assorted mounting hardware.

A note of caution

You are dealing with dangerous chemicals when you make biodiesel. Both methanol and caustic soda are strong bases. They can deaden nerve endings and cause permanent damage. For this reason, chemical resistant gloves, aprons, and eye wear should be worn when dealing with methanol and caustic soda. Shoes, long sleeve shirts, and long pants are a must.

Keep both methanol and caustic soda in clearly marked containers. We recommend putting a skull and crossbones on them and writing something to the tune of 'Danger! Toxic! Do Not Eat!' in addition to the contents.

Sodium methoxide, the chemical combination of caustic soda and methanol, is even more toxic than the separate components. Keep this stuff away from any exposed skin. Do not let children play in or around biodiesel equipment. Remember, although you are creating two chemically benign substances when you make biodiesel, you are using dangerous chemicals in the process.

Always keep safety in mind when preparing a biodiesel reaction. Have a tap or hose nearby. Keep some vinegar handy to neutralise any methanol or caustic soda that may spill. If you take the time to prepare and follow safety

guidelines, your biodiesel reaction will go smoothly and you should have no problems.

Engine specifications

You are responsible for any damage that may result to your engine if you use a fuel that does not meet your engine manufacturer's specifications.

Disclaimers aside, biodiesel is used all over the world. Island people are making biodiesel from coconut oil, some countries are experimenting with biodiesel from hemp seed oil, and many others are using canola oil. Millions of miles of road tests have been done with this fuel. Tests have shown less wear on the internal components of engines using biodiesel.

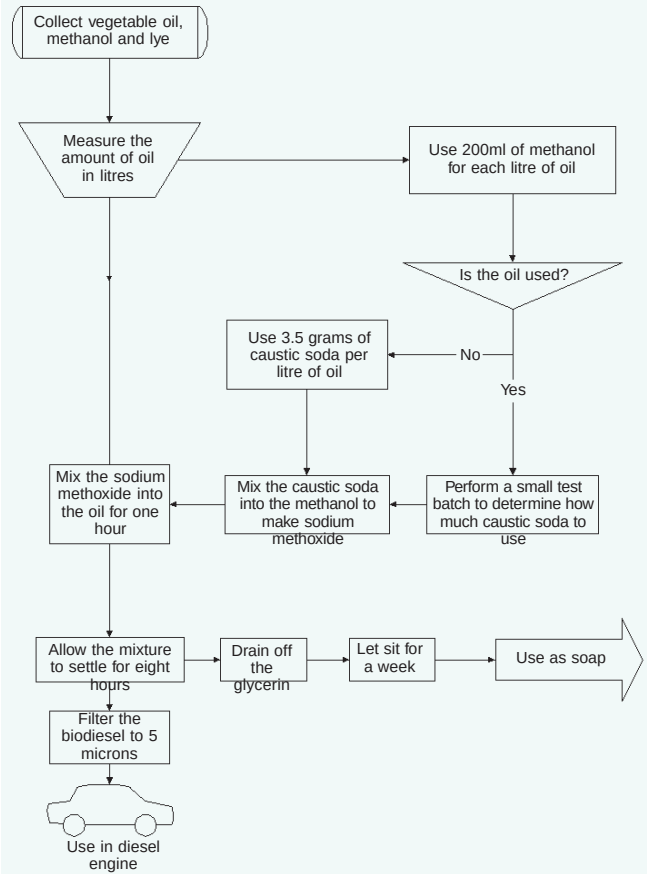
Biodiesel is a reliable, exciting fuel that you can make. If you are worried about your diesel engine, you can install an extra fuel filter system from an aftermarket parts manufacturer. After travelling over 25,000 miles (40,000 km) on biodiesel made from used cooking oil, we continue to choose and recommend biodiesel over toxic, carcinogenic petroleum diesel fuel.

Complete instructions, diagrams, photos, and parts lists for the three methods of running a diesel engine on vegetable oil and building a biodiesel processor are included in the new, second edition of the book *From the Fryer to the Fuel Tank*.

Authors: Joshua and Kaia Tickell, biofuel@best.com This article originally appeared in theAugust/September issue of *Homepower* magazine (www.homepower.com).

Further reading:
The Biodiesel Newsletter is a free email newsletter covering homemade fuel and more: www.veggievan.org

Biodiesel procedure flow chart



***From the Fryer to the Fuel Tank: The Complete Guide to Using Vegetable Oil as an Alternative Fuel* by Joshua and Kaia Tickell, new second edition. Book website: http://www.veggievan.org/book US order number (24hrs) +1 419 281 1802.**
Available from the ATA for $39.90 plus $6 postage. See page 56 for details.

A vegie oil powered tractor

by Cassandra Patrick

Brian Barrett has found an innovative way to make use of a waste product that many have trouble giving away—used vegetable oil. Using a very simple process, Brian has used recycled cooking oil to power his diesel tractor. The idea sprang from another renewable energy project that Brian was already involved in, the practice of making organic compost from restaurant food waste. The materials for both the tractor fuel and the compost are derived from this waste.

In Australia, restaurants, cafes and takeaway food outlets are required by law to install grease traps to collect their used cooking oil and prevent it from being released into the sewerage system. What many of us perhaps don't realise is how this oil is actually disposed of thereafter.

The oil is collected by a tanker and carried off to a factory to be treated. The oil is separated into three component parts, as Brian explains. 'They heat the material in tall towers and the fat all goes to the surface, they take that off and that's sold into the tallow industry for soaps and candles and that sort of thing. The water fraction is released into the sewerage system after they test it, but they're left with a forty percent component which is just food.'

The company that treats the oil was more than happy for him to take away this apparently useless byproduct, which Brian then used to make his own organic compost, on his farm in Kyneton, Victoria.

One day Brian received a phone call from a factory owner who was distressed that he could not get rid of the tallow he made from the oil treatment process. Prices had fallen from fifty or sixty cents a litre to five or ten cents a litre and the factory owner confessed, 'It's not worth handling and I don't know any answers to it.'

It was at this point that Brian had the idea of using the oil for some kind of fuel—'Then I remembered back to the war years when I was a child, how the farmers who couldn't get diesel for their tractors ran their tractors on olive oil and canola oil or castor oil, or any sort of vegetable oil they could lay their hands on, and they ran very well.'

The factory owner was happy to give the oil to Brian for free. The only treatment the oil required before being used as fuel was to be heated and filtered. The consistency of the oil, Brian says, is like margarine at room temperature, it's not liquid, but it's not very solid. Brian describes his first experiment with the oil: 'I heated it up and filtered it down to a very fine degree, down to about five microns, got rid of all the rubbish and the crumbs and stuff like that and tried it out on the front end loader that we've got as part of our composting operation and it ran very well and went with less exhaust, less smoke, just as much power, and it just went beautifully, with no problems.'

Encouraged by this success, Brian went on to try the oil in an irrigation pump and an ordinary diesel fuel pump, even using it to run his car, a Mercedes with a diesel engine, for a while.

The next step was to try a more long-term project. Brian bought a tractor and after thoroughly checking it out to see that everything was in good working order he filled it with the vegetable oil fuel and waited to see the result. The experiment was a success and the tractor has run on the fuel for two years with no problems, performing general farm work.

I asked Brian whether he had to make any modifications to the tractor before adding the vegetable oil. 'The only modification I've done has been to divert some of the heat from the radiator with pipes and run the pipes into the fuel tank so that the hot water melts the fat. And I've added a little auxiliary diesel

tank at the back of the main tank so that we can start the machine on that, run it for five or ten minutes until the water's hot and it's melted the fat and just switch the thing over and it just runs on pure fat all day.'

Brian has done nothing to alter the vegetable oil itself, apart from a simple filtration process using a pump and some filter paper, which gets rid of any remaining debris.

The fuel can also be made using a mixture of varying proportions of vegetable oil with ordinary diesel. Using twenty five to thirty percent fat and the rest diesel means the fuel remains liquid at room temperature and thus won't have to be heated. Another source of fuel for Brian's project is the hospital where he works as a surgeon during the week. He collects large drums of cooking oil from the hospital. This mixture is liquid at room temperature and can be mixed with the fat. The ratio of fat to liquid oil to diesel varies depending on what Brian has available at the time. At the end of each day Brian turns the engine back to diesel in order to run the fat out of the fuel lines to prevent it from cooling and setting hard overnight.

I asked Brian whether he had heard of any other farmers who had attempted similar projects. 'Not recently, no. Only during those war years. But there were old tractors many years ago that would run on just about anything, on kerosene as well.' I also enquired whether he thought others would be able to get access to free recycled oil if they did wish to attempt to use it as fuel, 'Well, it's still pretty experimental but I guess anyone can do it if they want to and I know during the war years many farmers did just that.'

Whilst farmers during the war were driven to the use of vegetable oil as an alternative fuel by necessity, today the choice is motivated by different issues. Diesel is costly both in terms of its effects on the environment and in terms of its sale price to the purchaser. Using vegetable oil instead of diesel frees the user from dependence on an environmentally damaging fuel whose reserves are being depleted rapidly worldwide.

In addition to this the financial benefits to the farmer could well prove to be the primary motivation for experimenting with the fuel. As Brian affirms, probably the biggest single expense for a farmer is diesel accounts. Before switching to vegie fuel, diesel fuel was costing Brian about $1200 a month. With the combined ecological and financial incentives it offers, Brian's vegie fuel may well prove a growing trend.

The great electric cycle rally

Phillip Calais reports on Australia's first annual electric cycle rally

'An *electric* bike. Kinda defeats the purpose of a bike, doesn't it?' This is typical of the responses I got from people when I mentioned that I was organising an electric bicycle rally. It is a fair question—if you assume that the only purpose of a bike is as a form of exercise. But for those who want to use bikes as a form of transport then different values must be applied.

I work in an office and sometimes I have business meetings around the city. As a result I am expected to turn up wearing a suit and tie, and under these circumstances an electric bike is ideal. Turning up at a meeting wearing fluoro green lycra and dripping with sweat on a Perth summer day tends to leave a bad impression. Turning up on an electric bike wearing a suit and tie and helmet does quite the opposite.

Electric power assisted bicycles can also make one of the healthiest forms of transport available to the elderly and disabled. A trike can be fitted with an electric motor, and offers greater stability than a conventional bicycle, and range that would be impossible in a wheelchair.

The Western Australian branch is one of the newest branches of the Alternative Technology Association, having only formed last year. Our first big public event was Western Australia's first electric bike rally which was held in May in the grounds of Bentley Technology Park near Curtin University. Jonathon, my work colleague at the time, and I were members of the Alternative Technology Association (ATA), and as there was no WA branch, we decided that we should get the ball rolling and start one up. So late last year we organised the first branch meeting.

At this first meeting, various ideas were thrown around about what members wanted to do, and what events we could stage. I had brought along my half finished (but rideable) electric bike. After doing burn-outs down the corridor, Jonathon suggested that we should organise an electric bike rally.

We selected a venue in Perth. Technology Park is a research and industrial state with about 60 companies spread over ten hectares. The Park was an almost ideal location for the rally and several bike clubs already use it as a race venue. The internal roads are very smooth and in good condition and have nice sweeping curves. There are also some nice lawned and landscaped areas with trees.

The Zeta II uses a small motor drive rolling on the front or back wheel to provide electric boosting to pedal power

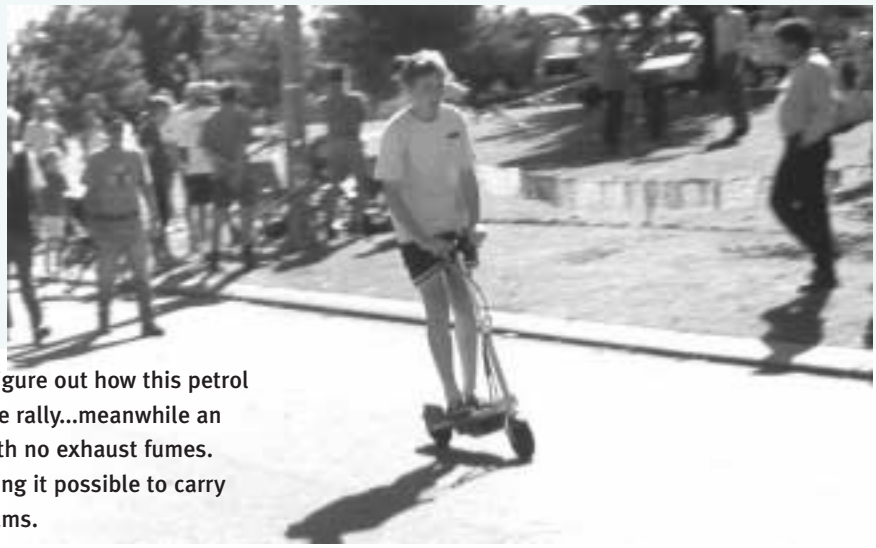
To prepare for the event we contacted bike shops and left leaflets and posters with them, borrowed road signs from the local council, contacted the 'World of Energy' museum which is run by the Western Australian electricity utility, Western Power, and borrowed their E-bike.

The big day finally came and Jonathon turned up at my house just after I had managed to crawl out of bed. I had been up until 2 am preparing my two bikes.

Overall, about 150 people turned up that day, together with an electric Ford Mustang (very nice!), a Toyota Ute and a Mitsubishi Colt as well as about 20 electric bikes and trikes and a number of recumbents and other x-bikes (experimentals).

Jonathon had his bike as well as the Western Power bike, I brought along my home-made bike which uses a Black and Decker electric lawn mower motor and my wife's bike which has a commercially made hub motor that I imported. Jonathon's bike also uses the same motor and controller.

A selection of participants at the rally



Perhaps this observer (above) is trying to figure out how this petrol driven scooter came to be at an electric bike rally...meanwhile an electric scooter (right) glides by silently with no exhaust fumes. These scooters can fold down quickly, making it possible to carry them on public transport like buses and trams.

Other bikes there included several from Balmoral Cycles (who helped sponsor the event) and included a Mitsubishi E-bike which was a very neat piece of work, as well as two motorised scooters, one electric and one petrol. Basically these two can be described as folding motorised and steerable skateboards. The petrol powered one could also be described as a deformed whipper-snipper!

Powered Cycles, another Western Australian-based retailer of electric bikes, also attended. They had the Sinclair Zeta power assistance kit installed on some bikes and trikes. This is basically a battery pack and motor that sits above the front or back wheel of a conventional bicycle and drives it directly with a belt drive.

As well as e-bikes and e-cars, there were a few other interesting technologies on display. Sunny Miller, an ATA member and President of the Perth Solar Cooking Interest Group had a solar cooker on display. I brought along my three foot diameter WWII searchlight reflector, which is useful for setting bits of wood on fire (in bright sun, a piece of softwood held at the focus almost explodes!).

After a lot of talk and people going for rides, it was time for the official rally to start. However by this time many bikes had already done laps up and down and batteries were beginning to fade. Despite this almost everyone with a bike participated. Even the little scooters went around the two kilometre circuit without any problems, keeping up with all but the fastest bikes.

Overall the day was a great success, having generated quite a lot of interest in alternative and appropriate transport. It allowed many people to see that electric vehicles are viable modes of transport and that electric bikes and cars are real and practical transport alternatives.

Next year's event should attract even more e-bikes and a lot more participants and spectators—although it's pretty hard to just be a passive spectator when there are electric bikes to be ridden! ✲

To get involved in next year's Electric Bike Rally, contact Phillip Calais by phone on (08) 9470 6798 or by email pcalais@energy.wa.gov.au

No, it's not pedal powered, but it produces no emissions on the road. This electric Ford Mustang didn't participate in the bicycle rally, but was a popular display on the day.

Maintaining a farm-sized wind turbine

A wind turbine may be an ideal choice for electricity generation if you're a farmer, tourism operator or part of a remote community. But what's involved once it's installed?

The old saying 'if it aint broke, don't fix it' could certainly be applied to modern wind turbines, which are becoming more reliable every year. However, periodic maintenance can help to extend the life of a turbine, and reduce repair costs considerably. If the turbine is in the five to 20 kilowatt range, the savings from yearly maintenance are likely to be well worth the time spent, considering the price of the turbine can be upwards of $20,000.

Lowering the tower

There are two broad categories of wind turbine tower to consider: fixed towers and hinged towers. Both types are pictured here, and in both cases the turbines are 10 kilowatt Westwind turbines that were undergoing repairs. The fixed tower is located at the CERES Environment Park in Melbourne, while the hinged tower is on French Island at the Tortoise Head Guesthouse (see the cover story in the previous issue of *ReNew).* In terms of maintenance, a fixed tower will be significantly more expensive and inconvenient. It will require a crane, cherry picker and experienced riggers to get the turbine to the ground. For example, to remove the 10 kilowatt Westwind turbine from the fixed tower pictured on the opposite page cost over $1,000, and will cost another $1,000 to reinstall once maintenance is carried out.

A hinged tower for a larger turbine will have a gin pole and can be lowered with a length of cable and a four wheel drive or winch. The gin pole protrudes from the base of the tower at close to right angles, and provides the leverage to lower the tower safely.

Using a gin pole to lower a one tonne turbine on top of a 30 metre tower is an easy task, but can be dangerous if done incorrectly. Before lowering the tower the turbine's manual brake should be applied, and if possible do the work on a windless day. The cabling that connects the gin pole to the 4WD must be rigged correctly to maximise the lever-

Maintenance tips

- Compile a list of checkpoints for periodic maintenance with the installer or company you purchase the turbine from, and scour the manual that comes with the turbine for maintenance advice.
- Schedule an annual inspection and stick to it strictly. Allow a full day to carry out the inspection and maintenance—it may only take half a day if there is nothing wrong with the turbine.
- Make a list of low cost parts that may need replacing and ensure that you have them in your tool box. Order any missing items well in advance of the date you set to lower the tower. These may include nuts and bolts, leading edge tape, cable shackles (special U-bolts for tethering cables) and cable swivels.
- Be sure that you can lower or climb the tower safely: ask your installer to show you how to rig the pulleys if you have a gin pole. Take photos of the rigging and make notes for future reference.
- Invite your friends! You will need a person on each guy cable, one to operate the winch or drive the 4WD, and one to give intructions to the driver.

Lowering the 10 kilowatt Westwind turbine at the Tortoise Head Guesthouse on French Island, Victoria.
Above: An oval ring is held in place on each of the guys with a pair of shackles. A rope is tied to the guy anchor and passed through the ring to increase the leverage on the guys as the tower is lowered—tension is maintained on each guy by a person holding each rope. Centre: a 4WD ready to take the weight of the tower. Right: Rigging the gin pole.

There is no space to lower a hinged tower at the CERES environment park in Melbourne, so this Westwind turbine was installed on a fixed tower. When a magnet in the turbine came loose recently, a cherry picker was hired to inspect it (left) followed by a taller cherry picker and crane (centre) to bring it to the ground to be repaired (right). By the time it is reinstalled the whole process will have cost over $2,000, not including repairs.

age available. If it is not done right, the result can be a turbine that hits the ground at speed, and a 4WD left dangling in the air! This actually happened to the previous owners of the French Island wind turbine pictured in this article, and while the driver of the 4WD got a nasty fright, the turbine and tower escaped serious damage.

Maintenance tasks:

The focus of the maintenance will be on the turbine itself, but there are a few things to check at ground level first. All turnbuckles on the guy wires should be greased and rust free, and the guy wires should be reasonably tight (check this again once the tower is back up). Pivot pins and split pins should also be greased. Also check that cable ends are not frayed, and that all shackles are firmly in place. At least two shackles should be used to loop the ends of cables.

Once the tower is down, inspection of the turbine can begin. Check all the exposed screws and bolts for rust, and replace any that are on the way out.

Unscrew the nacel cover and remove it. If there are any gaps in the cover, expect to find bird nests, and if it's spring expect to find baby birds! The nest shouldn't do any damage to the turbine, however, apart from making it look messy.

Each blade should be inspected thoroughly along its length for cracks. If the blade is constructed in layers, there may

Above and left: lowering the tower on French Island

be fairly straight hairline cracks along the lamination where the layers have flexed, and as long as they are fine they shouldn't be a problem. Of more concern are jagged cracks that run across the blades; these are probably indicative of structural problems.

The edge of the blade that cuts through the wind is called the leading edge, and should be protected with special leading edge tape, as used for helicopter blades. This tape protects the blades against gradual wear and tear from insects, ice and salt crystals and grit that they continually strike as they spin. It may come unstuck with time, or may start to tear away. It should be replaced if it is showing any signs of wear. It will cost around $8 per metre for 50mm wide tape from the manufacturer of your turbine. The amount of tape required will, of course, depend on the length of your turbine's blades.

If the turbine has a brake cable this should be checked. There should be an inspection plate near the top of the tower to do this. To avoid tangles as the turbine turns to face the wind, the bottom of this cable is connected to the top with a swivel. Keeping this swivel greased and ensuring that it is not worn is essential for fast emergency shutdowns.

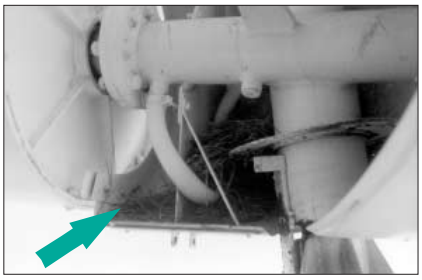
If any of the nuts used on the turbine are 'Nyloc' nuts—those with a nylon ring inside them to stop the nuts from slipping once on—dispose of them and use new ones. The nylon can become damaged and lose its grip.

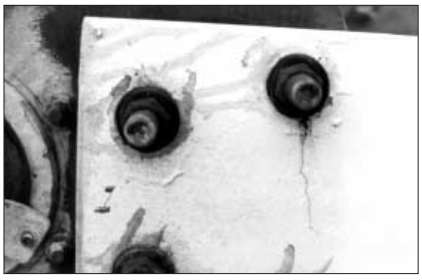
Other maintenance tasks will depend on the turbine. If it has a gearbox, this should be checked for oil leaks and filled with oil, though most turbines available in Australia up to 20kW in size do not have gearboxes.

The braking system should also be checked, for instance the bearings in the yawing mechanism (where the turbine tail bends to turn the turbine out of extreme high winds) should be in good working order. This may not be obvious on the ground, and may require some observation on high wind days prior to dropping the tower.

Why choose wind?

The maintenance tasks outlined here may seem a little daunting if you have no experience with wind turbines. However, for the small amount of servicing required, wind can offer an excellent return for your investment. When the only other option for providing electricity for a farm or small community is a diesel generator, a wind turbine in the right site can pay its way in no time. At the Point Hicks lighthouse off the Victorian coast, for instance, diesel costs were $32,000 per year. After the installation of a 10 kilowatt Westwind turbine in 1998, diesel costs





Things to look out for. Left: leading edge tape is designed to protect the blades from air-borne particles as they spin, therefore it is designed to wear out and be replaced. This tape on the turbine at French Island has had to contend with high wind speeds and salt particles. Centre: birds will nest anywhere, including the nacelle of a wind turbine. The nests are harmless, but will need to be cleaned out to inspect inside the turbine. Right: a fine lateral crack is developing on this blade, it will need an expert opinion.

are down to $2,000 per year, and the payback period on the turbine, including installation and the tower, is around three years.

There is an argument that suggests renewables become uneconomic if located in remote areas of Australia. The argument goes that unless the owners are skilled in maintenance, the cost of flying in a specialist and spare parts will be prohibitive. Turbine maintenance costs may well be high in remote locations, but a system based on diesel generators will also require maintenance, on top of much higher running costs than systems based on renewable energy. Nonetheless, maintenance costs of your whole system should be estimated and budgeted for to avoid unpleasant surprises. ✲

Text and photos: Michael Linke

Further reading:

***ReNew* published a wind turbine buyers guide in issue 63. This lists most of the wind turbines currently available in Australia, from 100 watt output through to 660 kilowatt machines for large scale wind farms.**

An excellent reference book for wind power is *Wind Power for Home and Business* by Paul Gipe, Chelsea Green Publishing, 1993, ISBN 0-930031-64-4

Buying a back-up generator

What size and type of generator should you buy as a back-up for your renewable power system?

Most renewable energy systems have a backup generator, or gen set of one form or another. While it is possible to build a system that won't require one, the extra cost of renewable generating equipment will be higher than the cost of a gen set, so most people settle for the cheaper option.

The most common generating set found in remote area power supply (RAPS) systems is a petrol-powered portable 240 volt AC gen set rated around 5 kilovolt-amp (kVA) capacity. These are used in conjunction with a battery charger to provide backup charging to the battery bank, as well as to run large AC loads such as welders.

Portable problems

AC generators can be broken down into two main groups—portable sets, designed to be light enough to be moved around with relative ease, and stationary sets, which are mounted in one fixed location.

So, what is the difference? Generally, portable sets, being made quite lightweight, have small, high-speed petrol motors and two-pole alternators. These components, while making for a light gen set, also make for an inefficient one. While these gen sets are the ones most commonly available, the majority are not capable of putting out their rated power, especially into a load with a power factor much below 1 (see the section on power factor in this article). This means that when powering a large battery charger, as used in RAPS systems, these generators need to be much bigger than you would expect.

One renewable energy installer we talked to, who has designed his own battery charger, has done a lot of testing on several makes of gen set, and has found similar problems with virtually all of them when powering a large battery charger. At a charger load of around 1.5kVA, the 5kVA gen sets experienced such voltage drop from their alternators that they were incapable of driving the charger to its full capacity. This is obviously very poor performance, especially when you consider that the power factor for the charger at this load was around 0.8, which is not too bad.

His opinion is that the problems were due to several factors, including the use of two-pole alternators which are really quite small for their rated output. When you are producing power at 50Hz, you need plenty of magnetic material in the alternator, which you just can't get with a lightweight unit.

Stationary sets, on the other hand, have much more robust motors, are often diesel rather than petrol, and have heavier alternators that are much more capable of putting out their rated power.

They also have more complex motors which have such niceties as oil filters for the engine oil. Portable gen sets just don't have these and require that their oil be changed as often as every 20 hours. However, in practice it is rarely changed that often, resulting in prematurely worn out engines.

Petrol or diesel?

Both engine types have their advantages and disadvantages. Diesels are the more fuel-efficient of the two, and are generally more robust than petrol engines, so will last longer and require fewer overhauls.

A 450 watt portable unit. Don't expect too much from generators this size!

Petrol engines tend to wear out quicker, but have the advantage that they can be converted to run on fuels that are much cleaner to handle or burn than petrol or diesel, such as LP gas, natural gas or even biogas. Diesel engines can also be run on cleaner fuels, such as biodiesel made from waste cooking oil. However, you should also be aware that running your engine on fuels other than what the manufacturer specifies could void the warranty.

AC petrol gensets (and high-speed diesel sets) will generally use the less

A direct charging petrol gen set from Tasman Energy. It is also available with a diesel engine.

efficient two-pole alternators, while low-speed diesels, with their slower rotational speeds, use four-pole units. Lower rpm also means less wear and tear, so a low-speed diesel gen set will generally live longer than a petrol one.

If you decide on a diesel, you should try to get a direct-injection engine, as these are generally more efficient than indirect units. Also, a large external fuel tank is better than a smaller on-board tank, as it means less trips to the shed to fill the tank, and so less handling of potentially toxic fuels.

Gensets and chargers

As mentioned earlier, many gensets will not run battery chargers that are anywhere near their rated power output, so you will need to be very conservative when looking for a generator.

Your battery charger needs to be of the correct size for your battery bank. The general rule is that the charger should be able to put out a C/10 charge into the batteries. You can find more information on battery ratings in the battery buyer's guide in *ReNew* issue 59. The 'C' ratings of your battery bank should be included in the battery literature or written on the battery.

So, if you have a 500AH battery bank, you will need a charger capable of putting out 50 amps continuously (not peak, some chargers are rated this way, and will only manage much less current continuously without overheating).

A 24 volt, 50 amp battery charger might require almost 2kVA from the gen set. While you might think that a 3kVA gen set would be more than adequate, trying to pull this much power from a cheaper gen set will result in such a high output voltage drop that the charger will never be able to put 50 amps into the battery bank. A 5kVA gen set would be the minimum machine required in this situation.

Note that the above example assumes the gen set is of the common portable type. Better quality stationary gensets will produce more power, and a 4kVA unit should be suitable.

It should also be noted that charger sizing is done on the C/10 charge rate (the charge rate that would charge the battery in 10 hours), while many battery banks are specified by their C/100 rate (the rate that would discharge the battery in 100 hours). As battery capacity diminishes with higher discharge rates, the 500AH (C/10 rate) battery bank mentioned above may actually carry a 650 to 700AH rating at the C/100 rate.

Power factor?

Earlier we mentioned power factor in relation to AC loads. The term AC stands for alternating current, and this is the type of power that comes from the mains and an AC generator. Instead of the voltage remaining constant, like that from a battery, the voltage swings first positive, then negative, then back to positive again. This full cycle happens 50 times per second, and is expressed as 50Hz or Hertz.

For a purely resistive load, such as a heating element, the power factor is always 1, or unity. This means that the current through the load is always synchronised with the voltage—when voltage hits zero, so does the current.

However, when the current flow lags behind the voltage, as it does when the load is inductive, such as the transformer inside a battery charger, the power factor is reduced.

This is quite a difficult concept to grasp, but it means that the generator needs to be rated not in kilowatts, as is a DC generator, but in kilovolt-amps, which is only equal to kilowatts when the power factor is equal to one.

For loads with power factors less than one, the real output of the gen set in kilowatts will always be less than the kilovolt-amp rating of the gen set.

Noise

There are two types of noise associated with generators—electrical noise and physical noise.

Physical noise is obvious. If you can hear the thing clattering away in the background when you are trying to watch the TV, then the generator is way too noisy.

There are several ways to reduce this form of pollution, including housing the generator in a well insulated, well ventilated shed, and mounting the generator on rubber mounts instead of having it sitting on the concrete floor.

The diesel Twin Spinner gen set from Adtech has both AC alternator and direct charging DC generator, so you can have the best of both systems.

When shopping for a generator, check out the noise rating, usually found on the gen set somewhere, or in the brochure, and then ask to listen to one running. This is the best way to compare machines.

Electrical noise refers to inconsistencies in the output AC waveform (including harmonics) of the gen set. This can be caused by poor alternator design or by loads attached to the generator itself. One common battery charger used in RAPS systems, the Woods, is known to produce quite a high level of harmonics and noise.

A 12.5kVA low-speed diesel gen set from Denyo.

Voltage and frequency regulation

Most portable generators are not voltage regulated, the output voltage being dependent on such things as engine speed and what loads are attached to the generator.

Frequency is a direct function of speed, and while most appliances will operate with slight fluctuations in frequency, some equipment is more susceptible than others.

At least one manufacturer (Honda) has addressed these problems. Some of their new generators have fully regulated sinewave inverters built into them. They are capable of regulating the output voltage and frequency quite accurately, and Honda claim they produce an output waveform that is a very clean sinewave.

As mentioned earlier, stationary gen sets generally have four-pole alternators, which usually hold their voltage better under load, so if this is a concern to you, then it may be worth spending the extra money on this type of generator.

Starting systems

There are four common starting systems available. Most people will be familiar with pull-start engines, and many generators use this system. Before buying one of these you should ensure that everyone in your household who will ever need to start it can manage to pull out the rip-cord.

Another, slightly less strenuous method is the recoil method, whereby a strong spring is wound up using a crank handle or pull cord, and the rapidly unwinding spring turns the motor over.

The third method is electric starting, using an electric motor to start the engine, just like a car. This method is a prerequisite if the generator is to be started remotely, either by the user or a generator controller. This method is used on larger machines, and on many diesels, as their higher compression ratios make pull starting very hard.

Automatic starting

The fourth method of starting is a feature of larger gensets that are designed as auxiliary backup generators specifically. It a variation on the electric start that allows them to automatically start should the battery voltage fall below a preset level. Most people think this option unnecessary, but a correctly set up autostart/stop generator can greatly reduce running time, and hence pollution. It is not unknown for generator owners to start a gen set to charge their batteries, and just let the thing run until it is out of fuel, rather than monitoring battery charging and shutting the machine off at the correct time.

Some inverters and battery chargers now have generator starting circuits built into them, allowing them to control electric start gensets directly. Alternatively, some generators can be upgraded to an autostart generator by fitting a separate generator controller at a later date, though this can be difficult and potentially dangerous on many petrol engines, due to the starting sequence required for these engines, including accurate setting of the choke.

Direct charging

Direct charging of (RAPS) batteries is often more efficient than using an AC gen set with a battery charger, but is rarely found in RAPS systems in Australia. Direct charging uses a petrol or diesel motor to drive a high-output DC generator, sometimes a car or truck alternator, to charge the battery bank directly without the need for a separate battery charger.

If you have an inverter and battery system capable of running all of your appliances, and still require a backup gen set, you might be best investing in a direct charging gen set, as they usually have

a regulated output voltage (but not always) and they do away with the need to purchase a separate battery charger.

There are very few DC gensets available in Australia, although they are easily made from a petrol or diesel motor and heavy-duty vehicle alternator. However, many car and truck alternators have inbuilt regulators that cannot be adjusted, and will only put out up to 14.4 volts on a 12 volt system, which is often not adequate to fully charge a battery bank.

A unit with an external regulator, or even better, a purpose-built generator, is the better option. Of course, if the generator has an auto stop function that cuts in when the battery is charged, then the alternator doesn't need a regulator at all. The Adtech range of gensets are configured in this way, providing a constant current source to the batteries. However, auto-shut down is an option on these units, so unless you use an external controller, such as from your solar regulator or inverter, then you should opt for the automatic model.

Another issue to consider with direct charging gensets is location. While an AC unit can be situated a fair distance from the battery charger without suffering voltage drop, a DC unit needs to be very close, typically only a few metres away, or the voltage drop through the cables will be significant. This requires careful planning so that the generator is close enough to the battery bank, without being in the same shed or compartment. This is necessary due to the flammable nature of the fuels used, and the possibility of them being ignited by sparks from switching or other power control equipment. Putting a gen set next to your battery bank can be a dangerous practice.

Another direct charging gen set, this unit, made by Vital Earth Company, has an output of 550 watts at 12 volts, and shuts down when the battery is charged.

Some renewable energy installers will make up DC gensets as required, to suit individual systems, but you need to make sure they use a suitable alternator.

A possible problem with DC gensets is that they only backup the renewable power system, and can provide no AC power should a power system component, such as the inverter, fail. Also, if you need to run an appliance that is too big for your inverter, then you are out of luck. However, many new inverters can now sustain higher output for short periods than a 5kVA generator, with better voltage regulation and no power factor limitations, so large loads are generally not a problem with a properly sized system.

Maintenance

As mentioned earlier, the low-cost petrol gensets have quite simple motors, without oil filters, and so need regular maintenance. Oil changes can be as often as every 20 hours of running time, which can be almost every week in times of low input from the renewable energy components.

However, it is very rare that anyone ever changes the oil in their gensets this often, and most people are unlikely to even keep track of how long the generator has run since its last oil change.

However, changing the oil in this type of engine is very important, as the oil quickly becomes dirty with carbon and metal particles which, if not removed by changing the oil, will result in greatly accelerated engine wear.

Another important service requirement is the air filter. An engine breathing dirty air will suffer greatly increased cylinder and piston ring wear. Dirty air cleaners also lead to richer running, more pollution, greater fuel usage and poor speed regulation.

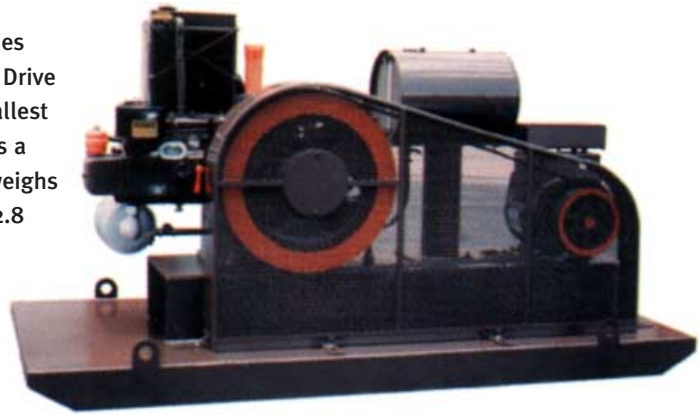
Alternative fuels

Both petrol and diesel contain components that are highly toxic and carcinogenic. This reason alone is enough to put some people off buying a generator. However, there is no reason why a generator can't use a more environmentally friendly fuel, such as LP gas, natural gas or biogas in a petrol motor, or biodiesel in a diesel engine.

There are not many companies able to do gas conversions on small motors, but one company that does is WG&B Manufacturing, Factory 9, 10 Elonery Rd, Noble Park VIC 3174, ph:(03)9790 0458. The cost of a conversion is around $260 plus $35 to $60 for the LPG hose. A standard LPG bottle is used as the tank. Some motors over 18 horsepower may require different valves, increasing the cost of the conversion.

Gas Drive Systems has some interesting gas-powered engines, including some very heavy-duty, slow-revving units. They have motors starting from 10 horsepower (7.5kW), and complete gensets from 6kVA. They can be powered from many gases, including LPG, natural gas, and biogas.

John Deere also manufacture LP gas-powered Kohler engined gensets, starting at 7.5kVA.



One of the 'C' series gensets from Gas Drive Systems. The smallest unit, the C-46, has a 6kVA rating and weighs in at a whopping 2.8 tonnes!

Running costs

These will vary greatly from gen set to gen set, but diesels are the cheaper to run, due to their higher efficiency, unless you have an LP gas or natural gas unit.

Fuel consumption figures can be seen in the tables accompanying this article, and running costs can be calculated from these. To calculate the litres per hour used, just divide the fuel tank capacity by the running time.

The high-speed engines generally wear out quite rapidly, often requiring overhauls every 1000 hours or so. In contrast, a low-speed diesel will only require overhauling every 10,000 to 20,000 hours. So, while the diesel may be expensive initially, the savings on maintenance will make it a cheaper proposition in the long run, unless you use your gen set quite rarely.

Conclusion

There are many different engine types and sizes, options and features to choose from when buying a generator.

AC charging is the least efficient, but the most versatile method, while DC charging will make much better use of your expensive fuel.

Correct sizing of the generator is important, otherwise you will end up with a backup system that just doesn't perform.

The cheaper portable sets, while they may be adequate, are really not designed as permanent backup power supplies. You are better off spending the extra money and buying one of the heavier duty stationary gensets. Reliability will be higher, and maintenance costs and inconvenience will be lower. ✱

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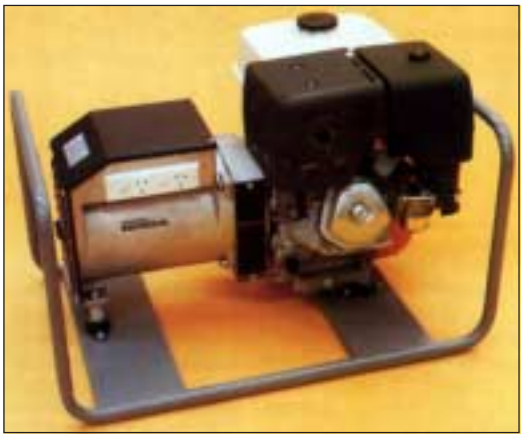

A typical high-speed 5.5kVA unit found in many RAPS sytems. While they have a 5.5kVA rating, most of them are hard pushed to deliver half that into the average battery charger setup.

Where to buy them

AC Power: Scan Hi, 45 Church St, Abbotsford VIC 3067, ph:(03)9428 1429, fax:(03)9429 4526.

Adtech, R950, Durham Lead VIC 3352, ph:(03)5341 8232, fax:(03)5341 8232, email: adtech@compuserve.com

Advanced Power, 33 Shepherd St, Liverpool NSW 2170, ph:(02)9600 6555, fax:(02)9821 1936, email: apower@ans.com.au

Arrow: Gas Drive Systems, PO Box 250A, Ermington NSW 2115, ph:(02)9748 7100, fax:(02)9748 7114.

Deere: John Deere P/L, 2/21 Blackmore Rd, Narellan NSW 2567, ph:(02)4647 4857, fax:(02)4646 1236.

Denyo: Co Quip, 376 Sydney Rd, Coburg VIC 3058, ph:(03)9353 4474, fax:(03)9350 4842.

Dunlite: Diesel and Machinery P/L, PO Box 585, South Melbourne VIC 3205, ph:(03)9699 1655, fax:(03)9696 4183.

Gentech: Godings, Cnr Yea Rd and Forest St, Whittlesea VIC 3757, ph:(03)9716 2468; Welling and Crossley, 50-58 New St, Spotswood VIC, ph:(03)9398 0855.

Honda, Private Bag 19, Somerton DC VIC 3062, ph:(03)9270 1111, fax:(03)9270 1122.

Kawasaki, PO Box 25, Tullamarine VIC 3043, ph:(03)9338 5855, fax:(03)9338 0772.

Kubota, 9-23 King William St, Broadmeadows VIC 3047, ph:1800 334 653, fax:(03)9309 1343.

Lister: Diesel and Machinery P/L, PO Box 585, South Melbourne VIC 3205, ph:(03)9699 1655, fax:(03)9696 4183.

Macfarlane Generators: a large range of rebuilt second-hand generators: 99-121 Carinish Road, Clayton VIC 3168, ph: (03)9544 4222, fax:(03)9543 7138, www.ozemail.com.au/~macgen

Onan: Cummins Engine Company, 1800 Hume Hwy, Campbellfield VIC, ph:(03)9357 9200, ph:(02)9616 5300 (NSW)

Power King: Engineered Products Group, 27 Vella Drive, Sunshine VIC 3020, ph:(03)9312 7999, fax:(03)9312 7987, Perth: (08)9353 5077.

Robin: Crommelins Machinery Sales, 139 Welshpool Road, Welshpool WA 6106, ph:(08)9350 5588, fax:(08)9451 6381, email: email@crommelins.com.au, www.business.com.au/crommelins

Tasman Energy, PO Box 266, Deloraine TAS 7304, freecall: 1800 226 626, fax:(03)6362 3054.

Vital Earth Company, freecall 1800 243 626, email: vital.earth@hunterlink.net.au

Yamaha, Locked Bag 48, Wetherill Park 2164, ph:(02)9757 0011, fax:(02)9757 1384.

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Brand	Model	Power output (kVA)	Output voltage	Engine type	Cooling system	Starting system	Fuel tank size	Running time @ % load	Running speed (RPM)	Weight (kg)	Cost $	Comments
AC Power (Scan Hi)		2.2	240VAC	Honda petrol	air	recoil	3.6	2.5 @ 100%	3000	36	see comm-ents	Prices vary greatly, depending on dealer. 2kVA start at around $598, 5kVA start at $1150. Automatic start/stop gensets with controllers start at $3100.
		4.1					6	2.8 @ 100%		58		
		5.5					6	2.6 @ 100%		76		
		6.25				recoil/electric	6.5	2.25 @ 100%		76		
		11				electric	45	8.5 @ 100%		131		
		13.5	415VAC 3 phase				45	8.5 @ 100%		131		
		2.2	240VAC	Briggs & Stratton petrol		recoil	4	2.8 @ 100%		37		
		3.75					6	2.8 @ 100%		56		
		4.1					6	2.1 @ 100%		57		
		5.5					3.8	1.1 @ 100%		75		
		8				electric	8.1	2.4 @ 100%		83		
		11					45	8.6 @ 100%		132		
		13.5	415VAC 3 phase				45	8.6 @ 100%		133		
	Quietline	6.5	240VAC	Yanmar diesel	liquid	electric			1500			
Adtech	Battery charging gen set	110A	24	Kubota direct injection diesel	liquid	electric start manual stop	9.5	up to 7 hours	around 1800	115	$4914	Includes separate control panel. Also available as auto start/auto stop.
		60A	48								$5045	
		160A	24								POA	
		90A	48								POA	
	Twin Spinner	6.5kVA AC and 100A @ 24VDC or 50A @ 48VDC	240 or 415 VAC and 24 or 48 volt DC				12	4.5			9800	
Advanced Power		1.8	240VAC	Honda petrol	air	recoil	2.5	2 @ 100%	3000		POA	
		2.5					3.6	2.5 @ 100%				
		3.3					3.6	2 @ 100%				
		4.4					6.5	3 @ 100%				
		5.8					6.5	2.3 @ 100%				
		6.8				recoil/electric	6.5	2 @ 100%				
		7.5					6.5	1.7 @ 100%				
		12				electric	35	6.8 @ 100%				
		3.5		Honda diesel		recoil/electric	4.5	4 @ 100%				
		5.5					4.5	3.2 @ 100%				
Arrow	VRG220	20	240VAC	Natural gas	liquid	electric				675	25,000	Water-cooled exhaust can provide hot water as co-gen.
	C-46	6							600	2812	16,850	Low speed, runs on most fuels. Prices are guide only, are in US dollars and are plus freight from the US
	C-66	7.5								2939	18,950	
	C-96	15								3306	23,850	
Deere	8.5RMY	7.5	240VAC	Kohler LPG	air	electric	NA		3000	154	7,300	
	11RMY	9.6								154	9,200	
	10RZ	10	415VAC 3 phase	Ford	liquid				1500	286	10,296	
	12RZ	12.5								322	10,956	
	20RZ	20								504	12,558	
Denyo	DCA13SPK	10.5	3 phase 200 and 400VAC	Kubota diesel	liquid	electric start	62	26	1500	490	13,500	Includes full voltage, current and frequency metering and adjustable voltage regulator.
	DCA13SPY11	10.5		Yanmar diesel				31		463		
	DCA15SPK	12.5		Kubota diesel				23		509	14,500	
	DCA15SPY11	12.5		Yanmar diesel				26		505		
	DCA20SPK	17		Kubota diesel				17		579	15,500	
	DCA20SPY11	17		Yanmar diesel				19		554		
Dunlite	DGUH1.5	1.5	240VAC	Honda petrol	air	recoil	2.5	3.2	3000	33	1,060	2 year warranty.
	DGUH2	2					3.6	3.3 @ 80%		41	1,270	
	DGUH3	2.9					6	3.6		56	1,540	
	DGUH5	4.8					6.5	2.5		71	1,950	Electric start optional.
	DGUH7	6					6.5	2		73	2,220	
	DGUHD5	4.5		Honda diesel			4.6	3		104	4,240	
	DGUV1.5	1.5		Vanguard petrol			3	2.25		31	995	
	DGUV2	2					4	3.3		48	1,210	
	DGUV4	4.2					6	2.8		65	1,540	
	DGUV5	4.9					6	2.75		67	1,880	
	DGUV7	6.4					8.5	2		90	3,010	Electric start optional.
	DGUV8	7.2					8.5	2		90	3,370	
	DGUB2	2		Briggs & Stratton petrol			3.8	2		45	1,120	
	DGUB3	3					5.7	2.5		53	1,570	
	DGUY2	2.4		Yamaha petrol			4.5	4		47	1,260	
	DGUY3	3.1					6.5	3		62	1,530	
	DGUY5	4.9					6.5	2.25		69	1,930	
	DGUYD2	1.8		Yanmar diesel			2.5	2.75		52	3,050	Electric start optional.
	DGUYD5	4.5					5.5	3.3		93	4,850	

Brand	Model	Power output (kVA)	Output voltage	Engine type	Cooling system	Starting system	Fuel tank size	Running time @ % load	Running speed (RPM)	Weight (kg)	Cost $	Comments
Gentech	EP2000HSU	2	240VAC	Honda petrol	air	recoil	2	3 @ 80%	3000	30	POA	1 year warranty
	EP2500HSU	2.5					3.6	3.3 @ 80%		36		2 year warranty
	EP3400HSU	3.4					3.6	3 @ 80%		40		
	EP4400HSR	4.4					6	3 @ 80%		60		
	EP5900HSR	5.9					6.5	3 @ 80%		70		Electric start optional.
	EP6000HSR-3	6					6.5	3 @ 80%		78		
	EP7000HSR	7					6.5	2.8 @ 80%		75		
	EP8000HSR	8					6.5	2 @ 80%		80		
	EP9500HSRE	9.5				electric	27	12 @ 80%		100		
	EP11000HSRE	11					27	12 @ 80%		110		
	EP12000HSRE-3	12					27	12 @ 80%		130		
Honda	EX350	0.35	240VAC	petrol	air	recoil	0.79	1.6/2.5	3000	8.5	$840	
	EXD400	30A	12VDC				0.79	1.3/2		8.8	$1059	
	EX500	0.5	240VAC				0.79	1.5-2.3		8.8	$889	
	EG550	0.55					1.3	2.6		19	$799	
	EX7	0.7					2.3	4.5		—	$1251	
	EU10i	1					2.3	8		13	$1535	Built-in sinewave inverter
	EM1500X	1.5					11	11.5		41.5	$1751	
	EG2200X	2.2					3.7	2.8		39.5	$1674	
	EM2200X	2.2					11	9.4		44.5	$2013	
	EM3000X	3					17	10.1		62	$2806	
	EM4500SX	4.5				electric	17	6.8		80	$3390	
	EX5500	5.5				electric	16.5	5.5		189	$61889	
	EU26i	2.6				recoil	13	8.3 @ 25%		54	$3399	Built-in sinewave inverter
	EU30i	3				elec/recoil	13	7.1 @ 25%		59	$3849	
Kawasaki	GD700A/AS	0.51	240VAC	petrol	air	recoil/electric	2.5	4.5	3000	21	1,205	Prices include sales tax.
	GA1000A	0.75				recoil	4.5	4.5		26	1,311	
	GA1400	1.05				recoil	4.5	3.5		27	1,463	
	GE2200A	1.7				recoil	15	12.5		43	1,920	
Kubota	AV1600	1.4	240VAC	petrol	air	recoil	3.7	18	3000	40	1,662	Prices include sales tax.
	AA2000	2					4.1	3		37	1,168	
	AV2500	2.1				recoil	3.7	12.5		46	1,934	
	AA3500	3.5					20	9		61	1,904	
	AV3800	3.2				recoil	4.7	11		65	2,478	
	AV4500	3.6				recoil	4.7	10		68	2,633	
	AV5500B	4.8				recoil	5.3	8.5		89	3,332	
	AA5500	5.5					20	6		84	2,392	
	AV6500B	5.4				recoil	5.3	7.5		94	3,650	
Lister	HSL6	4/4.4	240/415VAC	Lister diesel	air	electric	1.3 litres per hour @ 100%		1500	320	POA	Full voltage regulation. Fuel tank in base frame. 12 month warranty. Many options available.
	HSL8	5/5.3					1.5 litres per hour @ 100%			350		
	HSL13	8.6/9.7					2.7 litres per hour @ 100%			390		
	HSL15	10/11.3					3.1 litres per hour @ 100%			400		
	HSL19	13.5/15.3					3.9 litres per hour @ 100%			430		
	HSL24	16.2/18.3					4.6 litres per hour @ 100%			460		
Onan	16DKAE50Hz	18	240VAC	diesel	liquid	electric			1500	532		Remote start and stop.
	20DKAF50Hz	23								575		
PowerKing	QFD650	0.55	240VAC	Yamaha petrol	air	pull start	4.2	8 @ 80%	3000	20	749	List prices.
	QFD950	0.78					4.2	5.8		22	849	
	G1C1.8YT	1.8				recoil	4.5	5		32	899	
	G1C2.8YT	2.8					4.5	4		39	999	
	G1C4.2YT	4.2					6.7	3.7		60	1,299	
	G1C5.8YT	5.8				recoil (electric option)	6.7	2.4		63	1,499	
	G1C6.8YT	6.8		Kohler petrol			6.7	2.2		70	1,799	
	G1C8CS	8				electric	4.7	1.2		86	2,499	
	G1C11CS	11					20	3.5		133	3,999	
	G1C13CS	13.5					20	3		150	4,799	
	G1C2RT	2		Ruggerini diesel		recoil	4	4		53	1,999	
	G1C5RS	5				electric	5	3		80	3,999	
	G1C8RE	8				electric	20	7.4		122	5,999	
	G1C10RE	10				electric	20	6.5		140	6,999	
	G1S5RE2	5				electric	30	19	1500	170	7,499	
	G1S6.5RE2	6.5				electric	30	16		180	7,999	
	G1S9RE	9				electric	30	11		225	8,399	
	G1S15RE	15				electric	30	8		265	9,999	
	WG130YT	3		Yamaha petrol		recoil	6.7	3.7	3000	100	2,499	
	WG180YS	6				elec/recoil	6.7	2.2		120	3,999	
	WG200CS	7.8		Kohler petrol		electric	4.7	1.2		125	4,299	
	WG130RE	3		Ruggerini diesel		electric	5	—		115	4,499	
	WG200RE	8				electric	—	—		150	7,699	
	WG240RE	9				electric	—	—		200	8,699	
	WG300RE	15				electric	—	—		435	11,999	
	WG400RE	20				electric	—	—		485	14,999	

Brand	Model	Power output (kVA)	Output voltage	Engine type	Cooling system	Starting system	Fuel tank size	Running time @ % load	Running speed (RPM)	Weight (kg)	Cost $	Comments
Robin	R650	450W	240VAC	petrol	air	recoil	2	3.4	3000	18.5	920	Trade prices listed.
	R1300	800W					4.1	4.9		27.5	1,260	
	S2	2.5					3.8			38	928	
	S22	2.75					3.6			39.5	1,068	
	RGX3510	3								56	1,928	
	S3	3.75					5.5			53	1,320	
	S35	4.37					6			56	1,496	
	RGX5510S	5				electric				78	2,904	
	S5	5.62				recoil (electric start option available)	6			71	1,640	
	S6	6.97					6			67	1,960	
	S7	8.75					10			75	2,268	
	S11ES	11				electric	30			154	4,800	
	RGD2500SII	2.3		diesel		electric				110	4,960	
	RGD3300SII	3								113	5,540	
	S3RD	3.12				recoil (electric start option available)	3.2			77	2,468	
	S35RD	4.37					4.5			103	2,940	
	S5RD	5.62					4.5			112	3,590	
	S6RD	6.87					4.5			112	3,792	
Tasman Power		60, 80, 120A @ 12V 55 or 80A @ 24V	12, 24VDC	petrol, diesel	air	recoil or electric	see comments		around 3000	around 40	from $1295	Custom built to customer requirements. Can also supply a kit of parts.
Vital Earth Co.		550W	12VDC	petrol	air						POA	Auto cutoff when battery full.
Yamaha	ET650	0.55	240VAC	petrol	air	pull start	4.2	8.1	3000	18.9	830	2-stroke engines.
	ET950	0.78					4.2	6.3		20.2	950	
	EF1000	0.8				recoil	3.8	5.5		24	1,299	
	EF1600	1.4					12	14		39	1,450	
	EF2600	2.3					12	10.6		41	1,695	
	EF4600	4					21	10.2		72	2,350	
	EF6600E	5.5					21	8		88.5	2,990	Optional remote control kit.

[build your own]

Backyard greywater recycling

Tired of dumping your waste water into the sewer when it could be watering your garden? Michael Linke explains how he built a greywater recycling system

I feel a bit guilty that I didn't get onto building a greywater system sooner. In the past four years that I've been thinking about it, our household has showered, clothes- and dish-washed away hundreds of thousands of litres of water. In the same time we have also drip fed and hosed thousands of litres of water directly from Melbourne's water supply onto the garden. The catalyst was visiting Asphyxia, the woman who appears on the cover of this issue of *ReNew*—she's a couple of years younger than I am, yet has achieved so much, including building a greywater recycling system in her back yard. So the time to act had finally come, and I set off into the garden armed with a shovel and snippets of information from reading about the subject over the years.

The aim of a greywater recycling system is to filter the goop from the kitchen, laundry and bathroom waste water and reuse the water wherever it is needed. The goop includes chemicals dissolved in the water from soap, detergent and shampoo, food scraps and oil. There are different ways of approaching the filtration, but three main elements are involved: mechanical separation, plants and bacteria.

Mechanical separation

This can catch solids, such as food scraps, by filtration or settling, and oil and 'scum' by exploiting the fact that it floats on water. In my system, there was a problem to overcome in that the garden is not much higher than the point where the water drains into the sewerage mains. I decided to overcome this by re-plumbing the pipes to flow into a 'settling tank', and pumping water out of there into the rest of the filtration system.

The settling tank is a 150 litre plastic barrel buried in the ground, and has a water pump in the bottom. A float switch detects greywater flowing into the tank and switches the pump on when it reaches a certain level, switching off again once all the water is pumped out. The float switch and pump are positioned so that there will always be some water left in the barrel, with scum and oil floating on top and sludge sitting on the bottom.

Plants and bacteria

Bacteria are what 'biodegrade' many of the soluble and insoluble chemicals in greywater. Like the bacteria in the human digestive system, they need a comfortable place to live. Decomposition of chemical compounds will be fastest where aerobic bacteria are at work—those that live in an oxygen environment rather than airless (anaerobic) environment. So in a greywater system, this means the water must pass through the bacteria's home and deposit chemicals along the way, but not stick around too long and drown them. The effective surface area of the filter must also be quite large. To meet these requirements, I filled a disused, open-ended compost bin with sand, and placed this in a lined pond. The water from the primary collection tank is pumped to the top of the compost bin and filters through the sand, where the bacteria can do their work on the chemicals.

The base of the pond is filled with more sand. The water level in the pond is kept below the sand level, but water rises up the sand by capillary action. This means the sand is moist but not saturated and the aerobic bacteria can do their work here too. The sand is planted with aquatic plants, which serve a number of purposes. They take up the nutrients that the bacteria have processed as part of their growth cycle, they transpire (evaporate) water, and their root systems provide habitat for anaerobic bacteria.

Water from the pond flows into 20 metres of perforated agricultural pipe buried around 500mm underground and surrounded with gravel screenings to promote water flow into surrounding soil. Further microbial work is done here, and plants on top of the trenches use up further nutrients and transpire more of the water.

Problems with the system

One problem is with the settling tank. It fills with scum and sludge quite rapidly, and I estimate that it will need to be emptied three or four times a year and sent to the compost heap. This is an unpleasant job, as it can get quite smelly inside the tank.

One possible solution that I'm considering is using matting products that are also used to clean oil spills to filter the oil. This works on the same idea as a sand filter, trapping the oil and allowing bacteria to eat away at it.

The kitchen sink is the source of the greatest volume of cooking oil, and solids in the form of food scraps that inevitably escape the plug-hole strainer. The other solution is to install a scum collector under the kitchen sink, which will stop the bulk of the floating scum from entering the primary collector tank in the first place. This won't reduce the need for cleaning, but a sump tap in such a collector would be easy to empty into the compost bucket—much simpler than emptying the main tank.

Safety

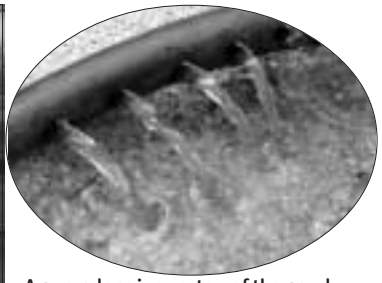
Many people assume that greywater is 'safe' in terms of pathogens, provided that it is separate from the toilet system. This is not the case, however, as faecal matter can enter from the shower, bath and nappy washing. If meat is prepared in the house, blood can also enter the system with nasties like salmonella. So any time you come in contact with greywater, such as when you're cleaning tanks, wash your hands thoroughly afterwards with hot soapy water.

Carbon and nitrogen

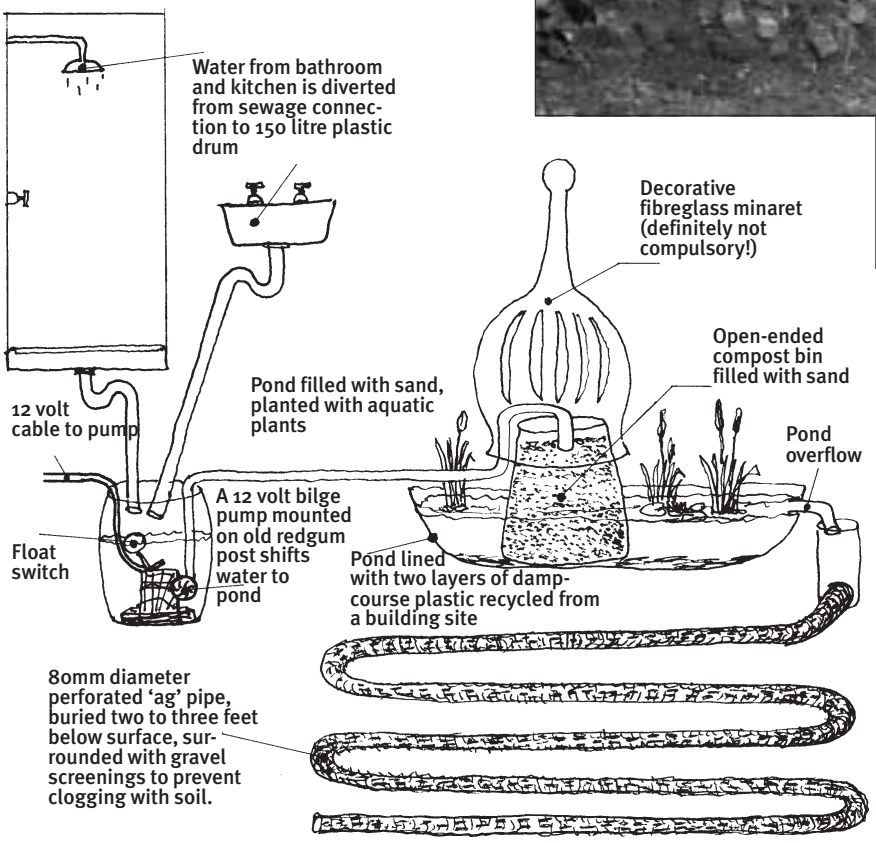
Most keen composters will have read about carbon:nitrogen ratios. Getting this ratio right is important for the health of the bac-

How the system fits together

The system diverts greywater that would otherwise flow to the sewer into a plastic drum, where scum floats on top and solids fall to the bottom. From there it is pumped into an open-ended compost bin full of sand that sits in a plastic-lined pond. The water flows through the sand, which acts as a filter, and down into the pond. Aquatic plant species in the pond act as a further filter, taking up some of the nutrients from the greywater. Water then flows out of the pond and into perforated transpiration pipes under ground.



A spreader pipe on top of the sand filter ensures even water distribution



The pond overflow: water flows through the pipe into the bucket, then into the buried ag pipe. The ag pipe is wrapped with plastic weave livestock feed bags at the inlet to prevent large volumes of water dripping out. The bucket is usually filtered with a flywire mesh to prevent small particles from entering the trenches.

The primary collection tank. A T-piece was connected in-line with the original greywater pipe to the sewer. Greywater is diverted into the tank, but in the case of a pump failure the water will back up into the T-piece and flow to the sewer. The two other pipes are 15mm poly pipe, one is for pumping water to the pond while the other houses the 12 volt cables to the pump.

The transpiration trenches: perforated 'agricultural', 'ag' or 'slot' pipe is buried around 500mm below the ground and surrounded by gravel screenings, which allow the water to flow out freely. The pipe used here was 80mm in diameter, and 40 metres was laid. This should allow for rainwater from the house roof to be diverted to the greywater system, which will give the garden extra water and flush out the sand filter .

Materials and costs

12 volt bilge pump	$20
150 litre plastic drum	$10
Recycled dampcourse plastic	—
Aquatic plants	$80
Disused compost bin	—
Sand and gravel	$60
Rule marine float switch*	$60
Ag pipe, 2 x 20 metre @ $26	$52
Total	$282

Projected annual water usage saving: $60

**I originally bought a 'Seaworld' float switch for $35, but it was pathetic and didn't work at all. Glad I wasn't relying on it to tell me my boat was sinking!*

teria that will be doing the decomposition work in your system. They like around 25 parts of carbon to one part of nitrogen. In a greywater system that uses only bathroom, kitchen and laundry water, there will usually be a nitrogen deficiency, so the high carbon content constituents like fats, oils, grease, soap, detergent and cellulose fibres will not be fully decomposed and may eventually clog the filtration systems.

Getting more nitrogen into the system is not difficult. Ammonia based cleaning products will help, as will adding nitrogen-rich fertilisers. But the most obvious (and cost-effective) additive is urine, which is what I am using for nitrogen in my system. While the current method for adding the urine might be a little unappealing for some people (via a bucket), I hope to have a urine-only toilet operating soon.

Salt and disinfectant

Salt (sodium chloride) and other sources of sodium are found in many cleaning products, and will stress and kill many plants. Cleaners that use potassium in place of sodium are preferable. Disinfectants are also best avoided, as they kill the microbes that greywater systems are reliant on.

Plants used

The right plants for different parts of a greywater system will depend on your location and the inputs to your system, though generally aquatic plants that like alkaline conditions are best. So far I have seven plant species in my pond: *Carex ripiara (blue sedge)*, *Restio tetraphyllus* (tassel rush), *Equisetum hyemale*, *Juncus spp*, *Marsilea drummondii* (Nardoo), an unidentified sedge from my mum's dam in Gippsland, and a grass from the same dam that I haven't identified. The grass isn't doing well, though the unknown sedge is thriving, as are most of the other species, which I bought from the CERES nursery (the Yellow Pages will list aquatic plant suppliers in your area). The Nardoo dies back in winter, and it would be a good idea to make sure that most of your plants are year-rounders as many natives are dormant in cold weather.

In the ground above the transpiration trench I have planted broad beans, broccoli,

leeks, artichokes and a range of other vegetables which are all thriving.

How big?

Sizing my system was a fair amount of guesswork, and after only three months I consider it a work in progress (there will be updates in future issues of *ReNew*). My small suburban backyard could accommodate more pond area, and this may be added if the system shows signs of distress in the future. There is currently 20 metres of transpiration trench, though I have another 20 metres of pipe to add. I may alternate between the two sections by blocking one off at the intake, thus giving each one time to fully process the greywater.

Can anyone treat their own greywater?

Some kind of greywater treatment or re-use is possible just about anywhere, but the system used will depend on local conditions. The ability of the soil to absorb water, for instance, will determine whether it is desirable to use trenches directly in the ground. If the soil is saturated at the wettest time of year, a trench system could well become anaerobic (without oxygen), which entails a slower rate of decomposition. This could lead to a clogged, smelly and unsuccessful system that actually pollutes local ground-water.

Similarly, a high water table could make a trench-in-ground greywater system inappropriate. After years of digging holes around the house, I have observed that the water table is a couple of feet below the clay during the wettest months, and the clay is covered by two to three feet of soil. The soil is never sodden, so I considered a trench system safe. There are many alternatives to using trenches, however, including fully lined systems large enough to transpire all the water through plants. ✳

Further reading

***The Composting Toilet System Book*, David Del Porto and Carol Steinfeld, The Centre for Ecological Pollution Prevention, 1999. ISBN 0-9666783-0-3. Covers mainly composting toilets, with a good section on greywater. It is available from the Alternative Technology Association (see page 57 for ordering details).**

***Create An Oasis with Greywater*, Art Ludwig. Available from Going Solar and other outlets. A supporting book is also available: *Building Professionals Greywater Guide*.**

The Sustainable House, Michael Mobbs. The information on water recycling is fairly specific to Michael's successful Dowmus installation, but very thorough. Available from the Alternative Technology Association (see page 56 for ordering details).

[The Pears Report]

The GST and sustainable energy

How badly have Meg Lees and the Democrats let down Australia's sustainable energy industry?

The Democrats' efforts to renegotiate the GST package have failed to redress the fundamental anti-sustainability bias of the GST. But the revised package does bring good news to some sections of the renewable energy industry. Specific packages for remote area power, rooftop PV systems and Green Power total around $75 million per year for four years—the biggest commitment to renewables, outside large scale hydro, we have seen. (There is also an extra $100 million per annum for greenhouse measures, but it is not clear what these involve.) When this is added to the 2 per cent renewables target and Green Power schemes, it really does look as though we are making genuine progress on renewables.

But a public commitment to apply incentive packages to renewable systems installed from July 1999 is needed urgently. Otherwise cash flows of renewable energy businesses could be slashed by customers delaying purchases to benefit from the package.

The impact of the GST on energy efficiency is a very serious issue. As I pointed out in my previous column, the so-called competitive energy markets have introduced seemingly overwhelming barriers to energy efficiency improvement. The GST package has raised the barriers even further. The Democrats seem to have failed to grasp the pervasive negative impact of the GST on energy efficiency, as their compensating programs focus on renewables, not energy efficiency. So, what are the adverse impacts?

First, the GST will disproportionately increase the up-front cost of energy efficiency measures. Pre GST, products with small sales volume and a large value-added component have a high proportion of their cost in marketing, installation and business overheads, which are not subject to existing wholesale sales tax (WST). Most energy efficient products fall into this category. When a 10 per cent GST replaces WST on these products, the cost increase is up to 9 per cent. In contrast, competing energy-inefficient products are often produced on a much larger scale, and have a much smaller installation, marketing and overhead component per unit, so a much higher proportion of their existing cost is subject to WST. Therefore removal of WST and application of GST has less net impact on their price. Further, when a sustainable energy option is higher priced, even if it experienced the same percentage impact from a GST, the actual dollar increase would be bigger, so the price gap would widen: for example, a $1200 high efficiency hot water service would pay $120 GST while a $700 standard HWS would pay $70 GST—$50 less. In practice, when both the effects above are included, the high efficiency hot water service could increase its price by around $100 with GST, while the standard product could increase by around $35.

Queensland plans to build four or five new coal-fired power stations, which will generate an additional 20 million tonnes of CO_2 each year. And the Victorian Government has called for expressions of interest from companies interested in building another brown coal-fired power station in the Latrobe Valley.

Also, tax cuts are much more likely to be spent on 'instant gratification' products and services than on long term investments in energy efficiency: a home buyer with extra money is more likely to spend it on a walk-in wardrobe or granite benchtop than invisible features like insulation. (For a more detailed discussion of the impacts of the GST, see my submission to the Senate GST Inquiry on behalf of the Sustainable Energy Industry Association, at www.seia.com.au).

These effects mean the revised GST package will increase Australia's greenhouse gas emissions overall. The impact of the additional renewable energy programs on emissions will be quite small in the medium term—one estimate puts the saving at 5.5 million tonnes per annum by 2010 (1 per cent of total emissions), because they are building from a very small base. Senator Hill has admitted (Four Corners, 28 June) that the GST package will increase transport greenhouse gas emissions by an extra 2.2 per cent by 2010. And the impact of proposed coal-fired power stations (see below) will swamp the effect of expanded renewables.

At a time when the Government is becoming increasingly nervous about the difficulty of meeting our Kyoto target, it is bizarre that it should make the task even more difficult. But that's politics, I guess.

The 'market solution'—creating a Kyoto crisis

The latest consultancy study for the Government on the greenhouse impact of creation of electricity markets shows

that, in 1998, the effect of markets was to increase Australia's greenhouse gas emissions by around eight million tonnes of CO_2 per year above previous expectations. Not a very impressive performance-based outcome from the centrepiece of our 1992 National Greenhouse Response Strategy. Of course, the consultants (the Allen Group and McLennan Magasanik) are true believers in the market: they predict that eventually it will reduce emissions—but not soon enough to help us meet our Kyoto target. It's not clear what logic has led them to conclude that a market focused on short term issues, and which places zero value on environmental impacts, will deliver environmental benefits.

In response to officially predicted electricity growth trends, we have seen some depressing proposals. Queensland plans to build four or five new coal-fired power stations, which will generate an additional 20 million tonnes of CO_2 each year. And the Victorian Government has called for expressions of interest from companies interested in building another brown coal-fired power station in the Latrobe Valley.

These proposed power stations will absorb over $5 billion of investment, and generate at least 500 million tonnes of additional greenhouse gas over their lives. What would a $5 billion investment in energy efficiency deliver? It would avoid the need for investment in more power stations, cut business and household overheads, create more employment and reduce greenhouse gas emissions.

But our leaders (in both politics and business) simply cannot grasp the principle of doing more with less energy—even though Canberra politicians work in a building which has halved its energy consumption and saves $2.5 million each year on energy bills. It's strange, really, because politicians are great supporters of labour productivity improvement—doing more with fewer workers, but they just can't apply this to energy.

Greenhouse emissions trading, which is supposed to solve all our problems by allowing us to balance energy growth by planting lots of trees and buying emission permits from other countries, is also showing a few holes.

Some energy-intensive industries have suddenly realised that emissions trading could be very expensive for them, so they are losing enthusiasm or trying to distort the trading rules in their favour. There is a touch of irony in this. A few years ago, energy intensive industries strongly supported economists' arguments against carbon taxes and in favour of emissions trading, without really understanding the issues. At the time, their main aim was to block carbon taxes. Now they are in a bind: their support for emissions trading is on the public record, yet it could be worse for them than a carbon tax (which would most likely have been levied at a lower rate, with exemptions for price-sensitive export industries).

Maybe there is justice in the world.

The GST is likely to discriminate against energy efficient products and result in increased energy demand

continues page 52>

Another not-so-minor problem with proposed emission trading schemes is that they focus on large emitters. Over half of Australia's energy-related greenhouse emissions are generated by small emitters, including households, small business, cars and trucks. The theory seems to be that large emitters such as power stations pressure users of their fuels to become more efficient or switch to less greenhouse-intensive energy sources. I will be pleasantly surprised to see the owners of a power station provide financial incentives for consumers to use less electricity.

To sum up, Australia's chances of achieving our Kyoto greenhouse commitment are rapidly slipping away. We are investing enormous amounts of money in polluting infrastructure that will lock-in increased greenhouse gas emissions, while market-based mechanisms and the GST are undermining the market positions of technologies that would reduce emissions. Emissions trading will have limited impacts, and will take some years to introduce.

And, if governments aggressively pursue energy efficiency improvement, they will provoke a financial crisis for the fragile 'competitive' energy industry they have just created. Australia is moving perilously close to a 'lose-lose' greenhouse strategy.

It will take a dramatic policy switch to salvage the situation. The kinds of actions needed include:

- A moratorium on any new fossil fuel power stations (other than cogeneration)
- A broad-based financial incentive system for householders and business to invest in energy efficient appliances, equipment, buildings and cars
- Strong regulatory action to block energy waste
- A major capital investment program to build public transport infrastructure and support development of the sustainable energy industry
- A process whereby for every emission-increasing project, specific actions for equivalent offsetting reductions must be identified and implemented. For example, closure of BHP's Newcastle steelworks balances increased emissions from its new Pilbara hot briquetted iron plant.

I'm not holding my breath.

Alan Pears is a principal of the energy and environmental consultancy firm, Sustainable Solutions.

Free showers from the sun

Hot 100 update

The Alternative Technology Association's Hot 100 program is still running, with two manufacturers currently offering ATA members a discount on solar water heaters. A 5 per cent discount is available from Solco, while Solahart will give 10 per cent on selected models.

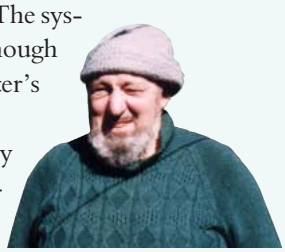
If you would like to participate in the Hot 100, contact the ATA, PO Box 2001, Lygon St North, Brunswick East VIC 3057, ph:(03)9388 9311, fax:(03)9388 9322, email: ata@ata.org.au

The Hot 100 is heating up, with 33 participants to date.

A keen hot 100 participant tells us about his system...

Keith Morris, from the Melbourne suburb of Moonee Ponds, had a Solahart 180 litre system installed in March 1998. The system has performed well, being able to provide enough hot water for a shower and a bath on a sunny winter's day, with no boosting at all needed in summer.

Keith's neighbours also like the Solahart, as they were able to have hot showers at Keith's house during Melbourne's gas crisis in June 1998.



Noel's Treasures from Trash

To build this Stirling engine you will need:

- a piece of wood 970 x 75 x 50mm
- a wooden base 200 x 200mm
- some small pieces of wood to support the tanks
- two 825g fruit tins (the tanks)
- two 375ml soft drink cans with the tops cut off (the pistons)
- two pieces of 6mm diameter wooden dowel 740mm long
- two 19mm copper elbows (from a hardware store)
- two pieces of copper pipe 19mm by 115mm long
- two pieces of 19mm copper pipe 60mm long
- one 19mm copper tee piece and plug to suit.
- one piece of metal flywire mesh 70 x 40mm
- one flywheel about 200mm diameter (an old bike wheel) or two pieces of heavy wood 70 x 19 x 200mm long
- two bike spokes
- soldering kit or heat resistant glue
- a piece of tin or galvanised iron 140 x 200mm
- pliers, screwdrivers, tinsnips, drill and 2mm and 5mm drill bits

This is probably the most challenging project that has ever appeared in Noel's Treasures from Trash. It is based on a design by Peter Tailer that appeared in *Scientific American*, January 1990.

Most motors, such as petrol, diesel and jet engines are known as internal combustion engines because they burn the fuel inside combustion chambers. A Stirling engine is an external combustion engine, because fuel is burnt outside the engine and used to heat part of the engine itself. Air inside the engine is heated, and expands, pushing a piston. The air is then pushed by a second piston, called a displacer, to another part of the engine, where it cools down and contracts. The displacer then moves the air back to the hot part of the engine, where it heats and expands once again.

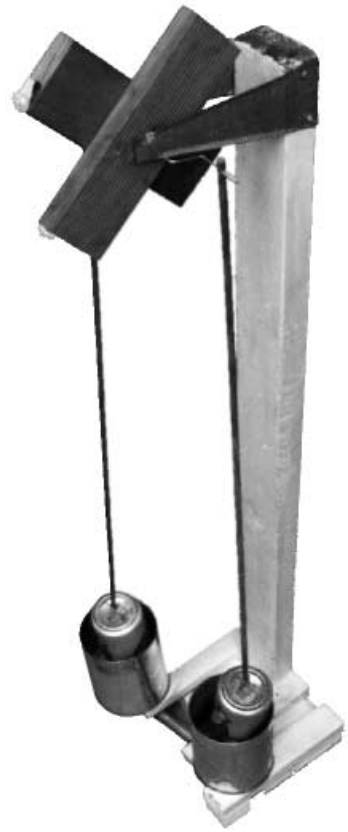
To build this Stirling engine, fix the stand securely to the base so that it stands vertically. To make the heating and cooling tanks, make a hole in the bottom of each of the large tins just big enough so that you can push one end of a copper elbow into each one.

Assemble the copper pipe pieces, referring to figure 2. Start with a 115mm piece of pipe and fit an elbow to one end. Insert a 60mm pipe into the other end of the elbow, and then one end of the tee piece to the end of that. Fit the remaining 60mm piece of pipe into the other end of the tee. Roll up the wire mesh lengthwise, and insert it into the open end of the 60mm pipe piece, pushing it in until it is roughly in the middle of the tee. This is called the regenerator. It is used to store some of the heat from the air as it passes from one cylinder to the other.

Now fit the remaining elbow to the 60mm pipe end, and the other 115mm length of pipe into the other end of the elbow. You need to solder the pipes and fittings together, or use heat-proof glue.

Insert each of the 115mm pipe ends into one of the large cans, right up to the tee piece, and solder or glue into place. Now, using some small wooden blocks as a support, fit the tank assembly to the base. You can use glue or small brackets to hold the tanks in place.

Drill a 2mm hole in one end of each of the dowels, about 10mm from the end. Glue the other end of each dowel to the bottom of one of the drink cans.



Now you need to make the flywheel and crank. This can either be a small bike wheel, or two pieces of heavy wood attached together to form a cross. Once this is done, drill a hole through the centre of the wooden flywheel and pass a bike spoke through it. To fix it to the flywheel, you can either use strong glue, or solder two small bits of metal to the spoke and nail them to the flywheel.

If you are using a bike wheel, push a plug of wood into the centre hole, and drill through the plug to take the spoke.

Next are the flywheel supports. These are made from a piece of sheet metal, as per figure 3. A notch is cut in the end of each one to support the crankshaft, and small flanges are folded along each side to increase the strength of the supports. Screw the supports to either side of the

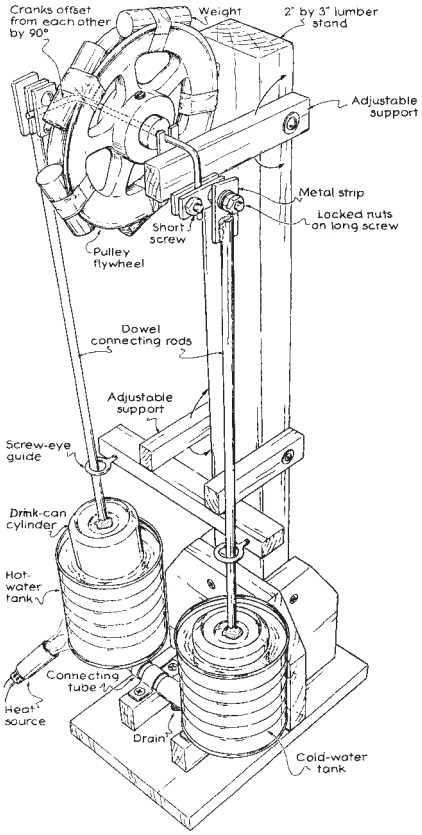


Figure 1. This is the Stirling engine that appeared in *Scientific American*. Our model is similar but a bit easier to build.

main wooden support. Use one screw for now so that the brackets can be adjusted later.

To finish the crankshaft, place a 10mm piece of drinking straw over each crankshaft end and slide them up to the flywheel. Holding the shaft near the flywheel, use another pair of pliers to make a 90° bend in the shaft. Now make another 90° bend back the other way about 20mm further along the shaft. The end of the shaft should be parallel to the centre section of the shaft. Repeat this step for the other side of the flywheel, making sure that the steps in the shaft are at right angles when looking from the end of the shaft, not opposite each other.

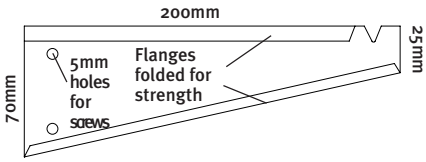


Figure 3. The top brackets are made from sheet metal.

Assembly

Place the flywheel into the top brackets, making sure it spins smoothly. Before running the motor, balance the flywheel using pieces of Blu-Tack. Place each of the drink can/dowel assemblies into each of the larger cans, and over the 19mm copper pipes. Slip each dowel onto its respective crankshaft end. You can stop the dowels sliding off the crankshafts by pressing a small piece of plastic wire insulation over each end of the crank.

Rotate the flywheel and make sure that everything moves freely. The small cans may rattle around inside the larger cans a bit. If you wish you can make a set of guides as in figure 1. You will notice that our unit is not exactly the same as that in the diagram, but the main components are very similar.

Getting it running

The next step is to oil the crankshaft where it runs in the top brackets, and also on the dowel. Remove the stopper or plug from the tee piece under the cans, and fill up both cans with water until overflowing. Do this outside, or on the sink. Rotate the flywheel a couple of revolutions. The pistons will push out any excess water, and water will also drain from the tee piece. Make sure that when the pistons are in their upper positions, there is still enough water to cover the ends of them, so that the water seal is not broken. If they are too high, lower the top brackets. The best position will be when the cans just clear the bottom of the larger cans when in the down position.

Once all the excess water has drained from the copper pipe, replace the plug and start heating one of the cans of water with a blow torch or other source of heat. Be careful, and don't burn yourself! Once the water has come close to boiling point, you can flick the flywheel slowly. All going well, the motor should start to run and continue at up to 60 revolutions per minute, though it is more likely to be half of that figure.

As we said at the beginning, this is a difficult project, and don't be dissappointed if it doesn't run first time—ours didn't, until we made a few adjustments as mentioned above.

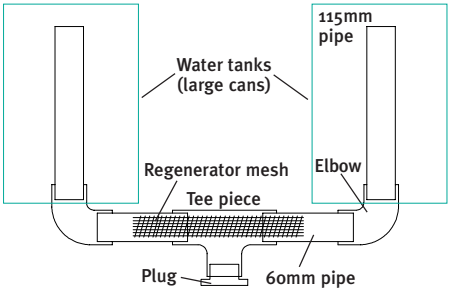


Figure 2. This shows the assembly of the pipes. Note the regenerator mesh inside the pipes.

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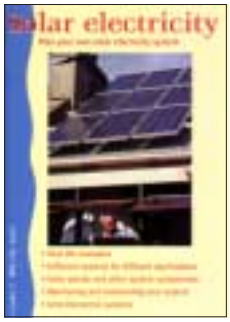

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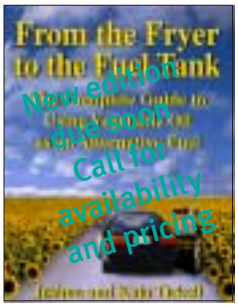

FROM THE FRYER TO THE FUEL TANK

Author: Joshua Tickell

Softcover, 94pp

Reviewed in *ReNew* #66

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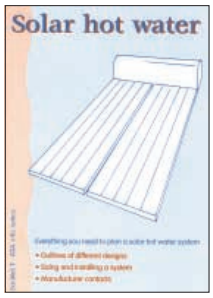

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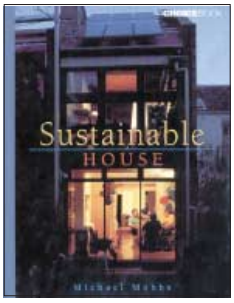

SUSTAINABLE HOUSE

Author: Michael Mobbs

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Michael takes us on a tour of his sustainable house in Sydney, which provides all of its own power, as well as taking care of all of its waste water on-site. This book contains many great ideas on how to make your house less of a burden on the planet. This house was featured in *ReNew* #60.

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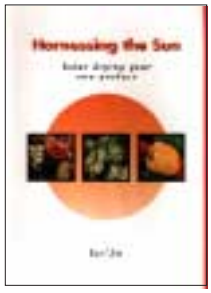

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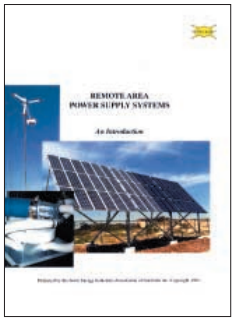

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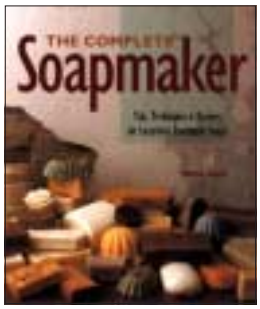

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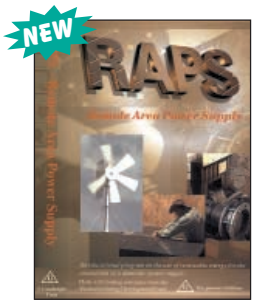

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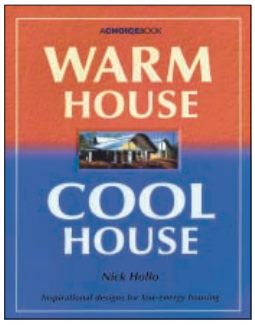

WARM HOUSE, COOL HOUSE
Author: Nick Hollow
Price: $27.50 Softcover, 172pp
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An easy to read introduction to the principles of energy-efficient housing design. Covers a broad range of topics, and contains an abundance of drawings, plans and photographs. The author is an architect well versed in the field of low energy design.
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Available back issues of ReNew (formerly Soft Technology) All back issues are $5 including postage within Australia.

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Like it or loathe it, Australia will have a 10 per cent GST from 1 July 2000, and the price of just about everything is set to rise. This includes *ReNew* magazine and membership to our publisher, the Alternative Technology Association.

Subscriptions to *ReNew* and ATA memberships are prepaid for one or two years, so the GST will be imposed on any pre-paid subscriptions that continue beyond 1 July next year. This means that we have been forced to raise our subscription and membership prices by 10 per cent now in order to cover the GST that we will be charged next year. Yearly subscriptions will rise $2 to $22, while yearly memberships will rise $4 to $44. Concession membership to the ATA now costs $33, while overseas ReNew subscriptions cost $27 for New Zealand and $34 elsewhere.

The cover price of *ReNew* has remained stable at $5.50 for the past four years, though we have decided to raise it in order to cover additional GST administration costs. As yet it is not clear how much our production costs will increase next July, and we consider it prudent to be financially prepared. We have kept this price increase to just seven per cent (40 cents) and hope to be able to maintain our new cover price of $5.90 even after the GST is imposed.

We hope that you continue to enjoy *ReNew* into the new millennium!

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* 11 watt model pictured

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Phantom loads you can't see!

You might think that you have eliminated all the phantom loads in your home—but have you? Jose Campos explains that there is more to some appliances than meets the eye.

Innocent looking boxes like this one could be wasting a great deal of power in your home.

Phantom loads are those sneaky electricity thieves found in home appliances that are always 'on' or in standby mode. Most of them are obvious—like the clock in the microwave or the 'standby' light on the TV.

By themselves they only use a small amount of electricity, but phantom loads start to add up, especially those that are running all day and night, every day of the year.

While these are phantom loads that you can see, there are others that you may not even know exist. One such invisible phantom is power filters which exist because of the requirement that modern appliances are limited in the amount of electrical noise, or interference that they can produce.

Those damn lines!

We are all familiar with the dots and lines on the TV screen as a car goes past, the kids screaming about noise on their stereo when we use devices like hairdryers or drills, or, in the case of RAPS systems, the annoying hum in the background of radio stations thanks to the square or modified-square wave inverter.

These problems are all the result of electrical noise being produced by electrical equipment interfering with other devices on the same circuit or in the vicinity.

In order to reduce the amount of interference that is caused to other devices, and to reduce a device's susceptibility to this interference, a framework known as the Electromagnetic Compatibility Framework (EMC) has been introduced in most countries around the world. This requires that appliances not only produce minimal electrical noise, but also that they be immune to any noise they encounter.

The culprits

So, where does all of this noise come from? In older appliances, most of the noise came from electric motors, as well as arcing in switches and contacts. However, recent advances in electronics have produced a proliferation of more sophisticated, but unfortunately, more noisy appliances. Devices like microwave ovens, switchmode power supplies and variable speed motor controls produce large amounts of electrical noise, so the EMC framework has been formed to address this.

The framework ensures that every new appliance produced now has to comply with the new rules and noise emission standards. Products that comply will carry the CE or C-Tick logos.

Well, by now you will be wondering what on earth EMC has to do with phantom loads? Well, I will tell you a little story to explain.

It all started when a friend of mine, while renovating his house, decided to get rid of his old inefficient appliances and buy all 5-star rated ones, expecting to get some return on his investment with savings on his electricity bills.

After a while he realised that either he was not patient enough, or the savings were just not eventuating. Having heard about phantom loads, he called me and we decided to investigate.

Before I go further, I should warn of the dangers of electricity—if you aren't qualified, don't touch. Call a licensed electrician to do your testing.

Going through the house, we did all the usual tests, worked out all of the usual phantom loads and switched them off one by one. After all of the obvious appliances had been disconnected, I thought the power meter would be reading zero. It wasn't. I looked at the watt-hour meter in the switchboard and the meter was still spinning. We

rechecked the appliances, but everything was turned off.

By then I was a bit suspicious that something was leaking to earth, so I checked each conductor one by one. There was 50 milliamps (mA) out of the active, 48mA back through the neutral, and 2mA back through the earth line. So where was this 12 watts of power going to if all the lights and appliances were off?

I didn't really want to do it, but I had to check each branch of house wiring going out of the main switchboard in turn.

One hour later, and I finally found one of the culprits taking about half of the phantom current. What was it? An innocent looking dishwasher with its main front panel switch in the off position, mains indicator off, dead as a bat. Or was it?

After we dragged the beast out from under the bench, we saw the power point in the 'on' position. When we turned it off, the phantom current dropped to zero. Bingo! Something inside the dishwasher must be drawing power before the dishwasher's main power switch.

I removed the cover of the dishwasher and there was the culprit—an innocent looking EMI/RFI (electromagnetic and radio interference) filter used to stop the nasties coming down the electricity wires from upsetting the dishwasher's delicate electronics, and to stop the noise produced by the dishwasher from polluting those same power lines. It was actually warm to the touch.

But why was the filter connected between the plug and the main switch? I guess it could be to stop the noise created by the front switch itself, especially if the machine is switched off with the motor and heater running during a cycle.

The electrical technicians out there might be thinking that most of the current flowing through the filter was reactive power, not real power, but I checked the power factor and it was close to one, as the filter is a combination of inductors and capacitors. This filter was drawing about 5.5 watts continuously.

So, 5.5 watts times 24 hours times 365 days is around 48 kilowatt-hours of wasted power per year, nearly $6 worth in most parts of Australia.

My friend had installed energy efficient appliances to save power, but because of this inbuilt phantom load, he was using power needlessly.

Well, the rest was easy. His washing machine and clothes dryer were connected to a power point half hidden behind a cabinet and I just guessed—machine switched off, power point on. The rest is obvious. There was another filter and another 25mA or so being drawn, and so here was the other 6 watts.

So my friend had bought these two more efficient machines, but a good deal of the power he was supposed to be saving, some 100 kilowatt-hours, was being wasted in these filters.

So, what is the moral of this story? These machines contain these filters so that they will run properly and comply with EMC legislation, but unless you are turning them off at the wall, not the front panel switch, they are collectively wasting a lot of energy.

But large appliances are not the only devices with built in line filters. Computers have them, and so do some power boards, so have a look around your house, there may be more phantom loads than you realise.

Wind power arrives in Australia in force

A report on the first Australian Wind Energy Conference

The title of this article probably seems overly optimistic, but after attending the first annual Australian Wind Energy conference, held recently at the University of Newcastle, I feel it may well be true. There was a real confidence among delegates that large scale wind power will at last be a reality in Australia.

At this conference, it was clear that there are commercial projects being proposed, investigated and implemented all over Australia. In the last year there has been a 5MW wind farm installed at Crookwell, and a number of sites in Victoria, NSW, South Australia, Queensland and Western Australia are all being considered.

Wind project developers were well represented at the conference, including a few overseas outfits. Turbine manufacturers obviously consider that there is something worthwhile about to occur with most of the major turbine manufactures also represented.

There was a strong 'market' focus. Greenpower was portrayed as the key initial driver for financing projects but there also appeared to be a general concensus that this market would be insufficient to maintain a sustainable Australian wind industry. Consequently there was also much focus on the Federal Government's two per cent renewables target. Phil Harrington of the Australian Greenhouse Office presented a good overview of the two per cent renewable target, and the audience grilled him on government policy as it relates to wind.

A range of opinions were expressed during the conference, those below represent the key points:

- A two per cent renewables goal is a good start for Australia, but revision and extention of this goal needs to considered.
- Whatever mechanism is employed, there is a need for certainty to foster investment, in particular the mechanisms for trading of renewable energy certificates needs to be quickly established.
- The wind industry needs to cement itself into the overall energy industry and to succeed needs to work with its allies to increase its market share rather than try to split the existing market between the current players.
- Wind energy is mature, but it is up to the industry to demonstrate this and put the projects on the ground, formalise their political power and make themselves heard. The success of this will determine the success of the industry.

A resolution to form an Australian Wind Energy Association was made at the end of the conference and a steering committee formed. One assumes that many of the above points will be on the agenda of the association.

The conference was also about technologies as well as wind farm development and there were many interesting papers presented on different technologies and avenues of research with an excellent overview of turbine development from UK consultant, Andrew Garrad. But it was not just about large scale wind turbines (500kW, 750kW, 1MW, 1.5MW and getting bigger—there are proposed offshore turbines in Europe rated over 3MW).

It was also about the humble RAPS wind turbine, the bread and butter of many of those in this fledging wind industry. Of particular note was the work of the conference hosts, University of Newcastle, who have developed turbine blade manufacturing technology which has led to use of their blades in a some Australian turbine developments.

Photo: Trevor Robotham

The 660kW Kooragang Island turbine.

The prospect of local manufacturing was also raised. A newly formed partnership between Dutch turbine manufacturer, Lagerwey, and Latrobe Valley company, Renewable Energy Asia Pacific (REAP) had everyone talking. REAP plan to manufacture Lagerwey turbines under licence in the Latrobe Valley; Green Power industry replacing Brown Power industry!

It was not all work at the conference, a field trip to the Kooragang Island Turbine (660kW) and the Fort Scratchly turbine (5kW) was included, only the organisers failed to tee up any wind! ✲

By Adrian Oakey. Adrian has worked as an engineer in the wind industry in New Zealand over the past two years. Next year's conference will be held at Churchill in the Latobe Valley, Victoria. Watch ReNew's event calendar for details.

A new column explaining the Australian Standards for stand alone power systems

This is the first in a series of articles looking at the Australian Standards for stand-alone power systems, otherwise known as remote area power supplies (RAPS).

These Standards were written following requests by the renewable energy industry to have uniform guidelines on safety, design, and installation. Some time ago a draft version of standards for stand-alone power systems was issued for public comment. After considering these comments the committee responsible *(EL42)* for writing the standards have released the first two parts of the three part standard:

- *AS4509.1-1999 Stand-alone Power Systems Part 1: Safety requirements*
- *AS4509.3-1999 Stand-alone Power Systems Part 3: Installation and maintenance*

Part 2 is yet to be released, this will look at design of stand-alone power systems.

Other standards relevant to the installation of stand-alone power systems are listed and referred to in AS4509, including AS3000, and AS4086. These standards cover other areas of electrical installations, including 240 volt AC wiring.

We will focus on *Part 3, installation and maintenance*, and concentrate on one section: *Section 12, System documentation*.

Recently I have been involved in inspecting stand-alone power systems under the Queensland government's RAPS rebate scheme, and I have found that system documentation is one thing that could be improved. The system documentation section lists the information that *should* be supplied, but this is currently only a recommendation and is not governed by legislation.

The following items are among the documentation recommended by the standard:

- A system manual complete with a list of supplied equipment, system performance, operating instruction, shutdown procedures, maintenance procedures, commission records, original energy usage, system connection diagram, and equipment manufacturers' handbooks.
- Battery log book
- Generating set service book

If you are a supplier or installer of RAPS systems, you would have prepared most of these documents at the quotation stage. For example you may have already supplied a list of equipment with your quote. Your quote may also include the energy usage for the client, and the performance of your system in relation to the client's energy usage.

As for the other requested information, you should receive handbooks from the manufacturers of system components, and the procedures may be set out within those handbooks. If not, you should be able to prepare them by discussing their operation with the supplier.

If you are the owner of a RAPS system, or intend to purchase a system, this information is a benefit to you as it will enable you to understand your system, and assist in troubleshooting with the installer.

Next issue we will look at signage within a RAPS system, unless readers have questions about specific issues. If you would like a particular area addressed, please contact either *ReNew* or myself at edwards_paul@bigpond.com or pedwards@dme.qld.gov.au

By Paul Edwards. Paul is a member of Standards committee EL42, and an Alternative Technology Association member. A full list of members of the Standards Committee is included within the Standards. Should you wish to purchase these standards contact Standards Australia in you local capital city or via their web site at www.standards.com.au

Compact fluoros: still the best bang for your buck?

Energy efficient compact fluorescent lamps, or CFLs as they are known, have been available for over a decade now. While they have made considerable inroads into the domestic lighting market, the vast majority of sales are still standard, energy hungry incandescent globes.

The main reason for this is the most obvious one—the initial cost of compact fluoros is very high compared to incandescent bulbs. Another reason is the poor quality of some compact fluoro brands, especially those made in Asia, which can often burn out very quickly.

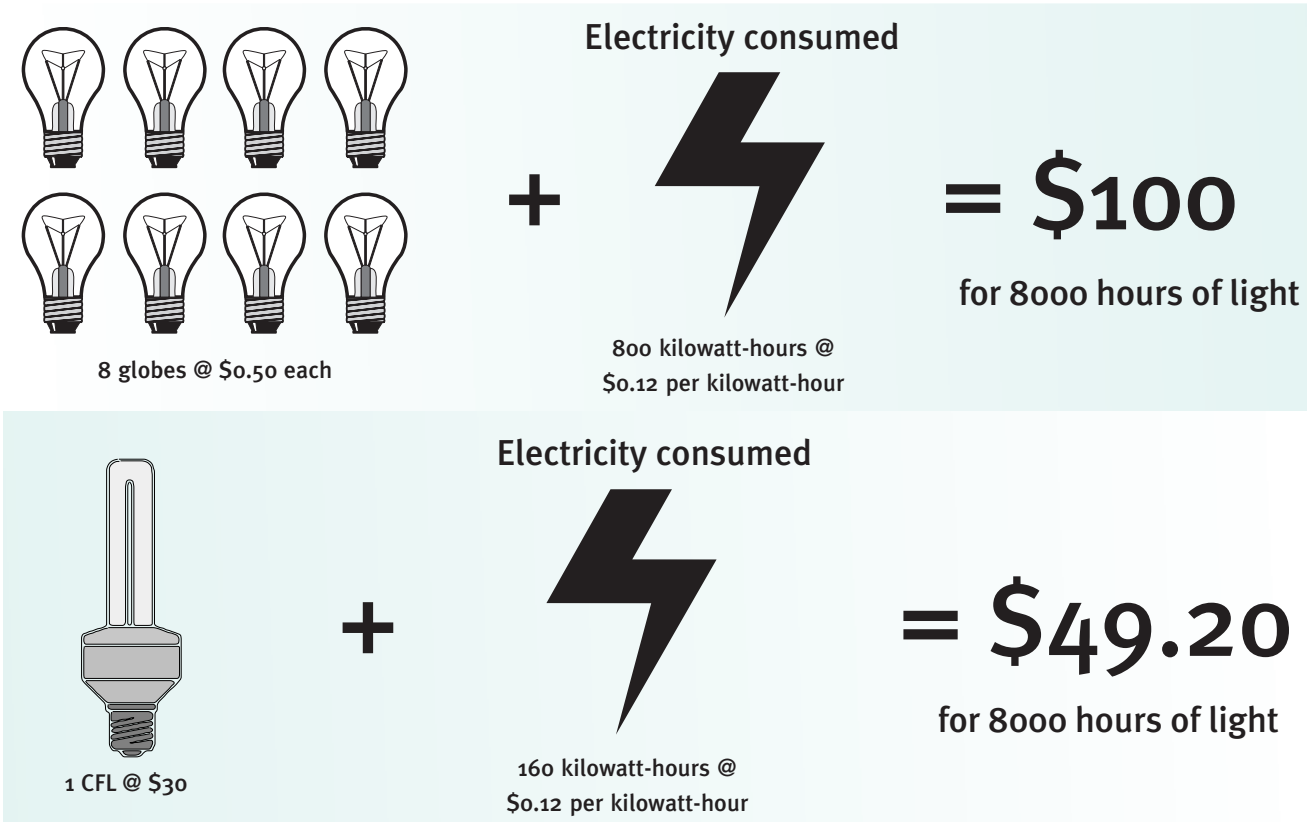
But initial cost should not be the main consideration when looking at lighting options—power consumption needs to be looked at too. To understand just how much power and money an energy efficient light can save, let's look at an example.

A twenty watt compact fluoro has around the same light output as a 100 watt incandescent bulb. It also has a rated life of 8000 hours, compared to the incandescent's 1000 hours. Below is a comparison of total lifecycle cost of the two lighting alternatives over an 8000 hour period.

The compact fluoro lamp comes out well on top, costing less than half of the incandescent lamp over an 8000 hour period. However, this comparison is only valid if the CFL lasts for its rated 8000 hour life, and unfortunately, many don't.

So, to make it worthwhile, you need to look at purchasing one of the more expensive lamps, such as Wotan, Osram or Philips in order to achieve true savings. The old saying 'You get what you pay for' is particularly true when it comes to compact fluoro lamps.

Cost comparison: compact fluoro versus incandescent over 8000 hours of use.



A bright light future

Light emitting diodes are one of the fastest developing lighting technologies, and promise to reduce energy consumption enormously.

This 99 LED array uses white LEDs and was built for a special project featured in ReNew #62.

We have looked at light emitting diodes (LEDs) in past issues of *ReNew* and *Soft Technology*. These devices have great potential for replacing many forms of lighting in all manner of applications, from car brake lights to security, home and street lighting.

In a nutshell, LEDs are semiconductor diodes that emit light when a small current is passed through them. In recent times, the light output of these devices has improved greatly, to the point where their efficiency has exceeded that of incandescent lamps, and is now similar to that of other lighting technologies, in particular, gas discharge lamps like fluorescent tubes.

One problem stopping LEDs becoming more widely used has been that they only produce light of a single colour, such as red, green or blue. However, white LEDs appeared on the scene two or three years ago, and have rapidly increased in light output to the point where a single LED has the output of a small torch globe.

White LEDs

For many years, white LEDs were a Holy Grail to semiconductor researchers. The problem was that semiconductor materials only emit light of one frequency (each frequency is seen as a different colour), but white light is made up of a whole spectrum of colours.

Another problem was that the readily available colours of a few years ago (red, green yellow and amber) were not really suitable for mixing to produce a reasonable approximation to white light.

However, once high-intensity blue LEDs started appearing, it was only a matter of time before someone realised that mixing yellow light with blue would produce a good rendition of white light, suitable for most purposes.

The new white LEDs contain a blue LED chip of very high intensity over which is a layer of phosphor material similar to that used in fluorescent lamps. The blue light excites the phosphor, causing it to emit yellow light. This mixes with the blue to provide a bluish white light of high intensity. White LEDs are now available with outputs of 6 candela at a 17° angle. An array of these would make quite an impressive spot light, while using very little power.

Energy and cost efficiency

The biggest drawback with LEDs at the moment is their cost. The white LED array pictured above cost around $400 two years ago, and would still cost around $350 today, though with new LED technology, it would be much brighter.

LEDs are quite low power consumers, but do you really need to have lights that only draw a few watts, especially if they are so expensive?

It is true that compared with most other appliances, lights don't consume a huge amount of power, but when you consider how long some lights are run for each night, then power consumption can be quite surprising. And when you are producing your own power, having inefficient lights like incandescents can cost a lot more than you might realise.

As an example, if you were to replace a 40 watt incandescent with a LED array using 8 watts, and were to use that light for five hours per night, you would save 160 watt-hours of power per night. This doesn't sound like much, but if you needed to produce that power using solar panels, you would require up

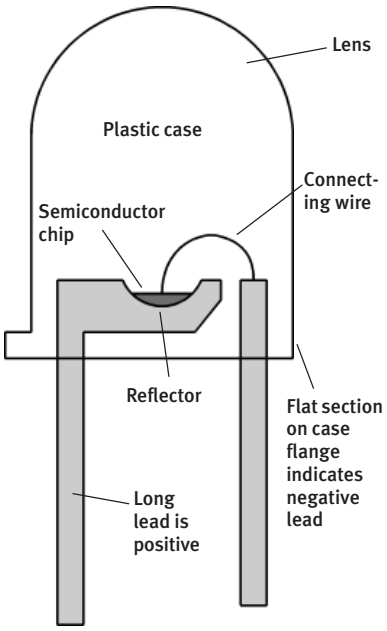
Two of a large range of LED arrays available from Holly Solar in the US. The array on the right contains 36 white LEDs, and is designed so that many arrays can be connected together to produce lights of almost any size.

What's inside?

There is really not much to a light emitting diode. They basically consist of a tiny chip of semiconducting material, with strange names like gallium arsenide and cadmium telluride, encapsulated inside a moulded plastic case. There are two leads that exit the base of the case which are connected to the chip. The longer of the two leads is usually the positive, and the negative lead has a flat section on the case flange near where it enters the case.

The diagram below shows the structure of the most common 5mm T1 3/4 case, though there are many other case types, both smaller and larger.

Variations include LEDs with two or more chips of different colours side-by-side, with a separate positive lead for each chip. This allows one LED to output more than one colour. LEDs of this type are used in multi-colour display boards or for multi-function indicators—eg, green means 'ok', red means 'oh-oh!'.



to a 60 watt panel, which has a retail cost of around $500!

So, even though LEDs may be expensive, they can save you a lot of money in power generating equipment in a RAPS system. And this doesn't include other savings, such as smaller diameter cables and smaller batteries.

Other LED advantages

The low power consumption of LEDs is not their only positive attribute. Having no filaments, LEDs have an extremely long life. Most are rated to 100,000 hours of use, which equates to around 45 years of use at six hours per day! Even then, they will continue to work, though with a reduced light output.

Another advantage with these devices is that, being fully encapsulated in plastic, they are virtually indestructible. They can be subject to high vibration and shock without problems, and are impervious to water and most chemicals.

What's on the market?

Most of us have seen the high-brightness lights used on cars for eye-level brake lights, as well as on bikes for safety lights, or the tiny keyring torches with red or amber LEDs inside.

Other commercial uses of LEDs are warning beacons, (see the Products section of issue 68 of *ReNew* for an example), solar garden lights, and small arrays designed to directly replace incandescent bulbs.

These LED bulbs are available from companies such as Ledtronics, Jade Mountain and Holly Solar in the US, and are available in DC and 120 volt AC versions (see side bar for contact details).

One area where LEDs have been embraced with open arms is that of information displays. These include traffic warning signs, moving message displays, and even giant-sized TV screens at sporting grounds.

In the future

So, what does the future hold for this type of lighting technology? My expectation is that, with the development of

The US made DecorLED is a 120 volt AC bulb and comes in a range of colours, including white. They are designed for low-level lighting and displays.

Where to get them

Australia

Control Component Distributors: Solar powered LED warning lights. Ph:(08)9459 9131, mobile: 0417 177 259.

K&C Stork: LED array solar-powered warning signs. Ph:(03)5368 7370, mobile: 0418 548 499.

Lateral Technology: LED marine beacons and lights. Ph:(03)9772 9019.

L-Tronics: One-off manufacture of LED arrays and bulbs in any colour and voltage. Ph:(03)9758 2275, www.netspace.net.au/~spod

LUA Electronics: Information displays and electronics signs. Manufacture their own LEDs. Ph:(03)9543 3311.

Sustainable Technologies Australia: Solar LED garden lights. Also distributors for the Jade Mountain range of products. Ph:(02)6299 1250, email: catalog@sta.com.au, www.sta.com.au.

Overseas

Holly Solar: Lots of white LED arrays and bulbs in many shapes and sizes. www.hollysolar.com

Jade Mountain: Also many LED arrays and bulbs in white and other colours. www.jademountain.com

Ledtronics: A huge range of LED bulbs in all available colours. www.ledtronics.com

even brighter and more efficient LEDs, we will see the end of incandescent bulbs within five to 10 years, and possibly even fluorescents not too long after that.

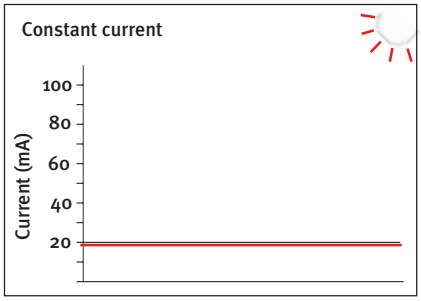
What about using LEDs now? Well, if you have a RAPS system, or just care about energy efficiency and reducing landfill, then there are a number of companies with products that can directly replace your light bulbs right now. While most of the development work seems to be happening overseas there are some Australian companies who are also developing LED lights. Those we have found are also listed in the sidebar.

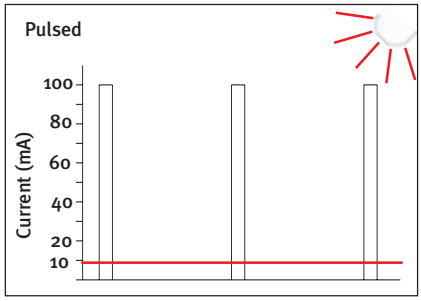
This LED bulb, made as a one-off by L-Tronics, runs directly from 240 volts and has 144 red LEDs in six panels of 24. While it only uses 20mA (about 5 watts) it has a light output equivalent to a 40 watt incandescent 'party' bulb.

Finger on the pulse

There are two ways to drive LEDs, one of which can produce significantly higher light outputs from less power. Most LEDs are simply driven with a constant current (using a simple current-limiting resistor) of up to 20 milliamps or so, and while this works fine, many LEDs can be made to produce more light using a pulse system.

By sending short pulses of up to 100 milliamps or so through the LEDs with large spaces between them, the effective light output can be increased while the actual power used will be less. The graphs below demonstrate this principle. The green line in each graph represents the average current used in each method. Note that while the peak current in the pulsed method is 100mA, the average current is half of that of the continuous constant current method.





When driving LEDs with a pulse circuit, there are a couple of things to look out for. Firstly, it seems that not all LEDs will give a higher output when driven this way, especially the ones of debatable quality that sometime appear on the market. Also, some LEDs will not tolerate pulsing at all, and will suffer instant death if you try this.

You must also make sure that the pulse circuit has the correct mark-space ratio—that is, the LED is turned on and off for the correct amount of time. The off time is usually around 10 times longer than the on time, to give the LED chip time to cool off, and so that the average current does not exceed the device's ratings.

[Product review]

Harnessing shower power

Callum Morrison puts an electricity-free bathroom extractor fan to the test

Callum's daughter Skye approves of the energy-saving Envirofan.

Imagine a bathroom where no steam escaped from the shower cubicle to grow mould, the mirror never fogged up, the window did not need to be open and the noisy electric fan was replaced with a quiet fan powered by the shower water.

On the rare occasion when I cleaned the bathroom, I thought there must have been a better way to arrange things to reduce mould build-up. When I heard about the Envirofan this presented an opportunity to enclose the shower cubicle and ventilate it through the wall.

The Envirofan takes some of the pressure out of the shower water before it reaches the shower head to spin a ventilation fan for the bathroom. Not only does it replace the need for an electric fan but it can safely go where no electric bathroom fan has ever safely gone before. Electric fans must be located at least 1.5m from showers for safety reasons.

There appear to be some small but practical environmental and health benefits of using this device. Less electricity is used than by powering a distant electric fan. Energy is also conserved in other ways.

The fan turns on and off automatically with the shower, so it can not be left on or off by mistake. This adds an element of safety, as there is no reaching for an electrical switch with wet hands after your shower has begun.

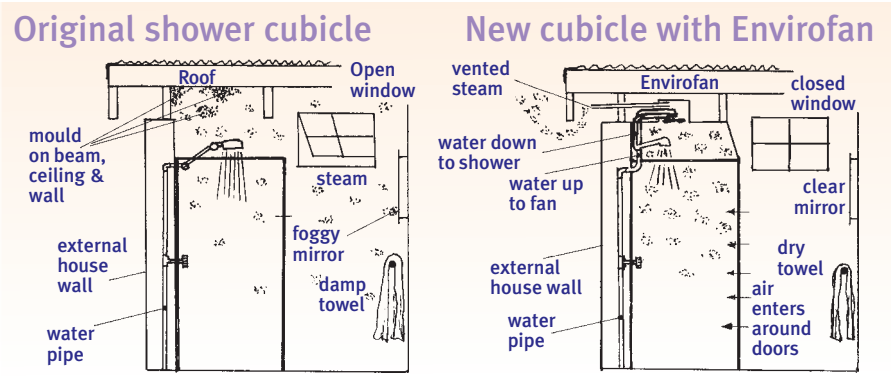
The bathroom is warmer because the window does not need to be open and less cold air is drawn into the house and the bathroom by a less powerful but well placed fan. There is less need for heating in the bathroom and less hot water is used to stay warm.

On the morning I tested air temperatures it was 0°C outside, 12°C in the bathroom and 25°C in the shower cubicle. I hang my towel next to the cubicle door and dry myself in the shower cubicle. Stepping out dry into 12 degrees is quite comfortable compared to the often freezing conditions associated with facing an open window while dripping wet!

Another benefit of the Envirofan is that moist air is efficiently contained and discharged directly out of the bathroom from the shower cubicle. The moist air can be kept from fogging the mirror, dampening towels and supporting mould growth on the walls and ceiling.

One limitation of the Envirofan is water pressure. The manufacturer suggests at least 12 litres per minute is needed to ventilate a bathroom and have performance rivalling an electric fan. By enclosing the shower the fan does not have to ventilate such a large space, it is closer to the steam and does not have to work as hard or use as much water. Although not tested I believe a water conserving shower head running flat out may drive the fan effectively if it only has to ventilate a shower cubicle.

We have relatively high water pressure and the fan was still spinning at a water



reason the Envirofan is not recommended to be installed in front of water conserving shower heads.

Before buying the Envirofan I suggest taking a bucket and your watch (waterproof) into the shower. See how full the bucket gets in one minute.

We are lucky to have very high water pressure but future versions are likely to further reduce the need for high water mains pressure and also allow the use of low flow shower heads.

The trial has worked well and I will soon replace the temporary plastic, cardboard and masking tape installation with proper bathroom materials. This innovation makes for less bathroom cleaning, a more pleasant shower and a better start to the day. ✲

The Envirofan costs $80 plus $9 postage and is available from EPC Development Group, PO Box 12, Babinda QLD, 4861. Ph (07) 4067 1188. It is also available from Rainbow Power Company, Ph (02) 6689 1430.

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, PO Box 2001, Lygon St North, East Brunswick VIC 3057.

AC generators

I can't find any information on using a 240 volt motor as a generator. Several people have told me it can be done, but none of them have actually done it.

Can you point me towards any information on this topic? Maybe you could tell me whether it can be done or not, and if yes, how is the motor set up, what speed is it run at, would you run it in reverse, and what power will it put out.

Scott Pepper, Northcote VIC

Using AC motors as generators involves connecting a suitably rated capacitor across the motor terminals. It can also be done on a 3-phase motor with three capacitors.

However, there are one or two things to watch. The first is that only some motors will work. This is because only some motors have enough residual magnetism to excite the stator windings, and thus start producing power. Fortunately, the commonly available Crompton-Parkinson is one of those motors that can be used as a generator.

The capacitor required depends on the size of the motor. The approximate value for a ¼ hp motor is 12 to 20 microfarad. There was an article in issue 31 of Soft Technology that deals with this, and this issue will be available on our new CD-ROM, to be released soon.

Lance Turner

Large solar water heaters

My daughter has just had twins after three previous children, and their house will have to be extended. She is concerned that because the new larger hot water service will have to be at ground level, she will lose the benefit of solar.

I told her that I didn't think this is so. Could you please supply me with details of the pumps available to overcome this problem, and names of suppliers?

Jim Moore, Merbein VIC

There is no reason that a ground-based water heater cannot have solar collectors attached, indeed the Solahart Aurora is just such a system. It was featured in issue 67 in the Products section, and uses gas boosting. Solahart also makes the Streamline system, which is similar but with electric boosting.

The Aquamax can be used in a split system, it is a gas-fired, ground-based water tank that has provision for connecting to solar collectors.

However, there is no reason why you need to have a ground-based system at all, most solar water heater manufacturers have systems of 300 litres or more, which should be adequate for even the biggest family, providing water-efficient shower heads and appliances are in use in the house.

If you have already purchased the new water heater, and wish to install solar collectors, you will need a pump to circulate the water. Details of two suitable pumps can be found in the pumping buyer's guide in issue 67 of ReNew. You will also need a suitable controller for the pump, so I suggest you talk to a solar water heater installer.

Lance Turner

12 volt light timer

It's the time of year when I must insist my family members turn off lights in our 12 volt powered house.

There's one light in particular in our walk-in wardrobe that should be fitted with a 2 to 5 minute timer. Would you have a design for one I could install to this light switch, or some other type of switching mechanism?

A Cauchi, Huonville TAS

I don't know what type of switches you have installed, but if you are using standard 240 volt wall switches, then you could replace the switch with a timer switch, available from electrical wholesalers.

These work by using a piston inside a tube with a very small air inlet. When you push the button, air is expelled from the tube as the piston moves down, and the light is turned on. As the air slowly enters the tube via a small screw-adjustable hole at the back of the switch, the piston creeps back out until the switch is tripped off.

There are also a number of timers available in kit and pre-built form from companies like Jaycar Electronics and Dick Smith Electronics, such as the Flexitimer or the multi-timer module in the Dick Smith's Discovery Series range. These are between $20 and $30, and run directly from 12 volts and have a relay on board that could switch the light directly.

Lance Turner

A six-volt fluoro

I would like to run a 6 volt fluorescent tube from a 6 volt lantern battery. Can you please tell me what circuit I would use?

Ron Bluhm, Yinnar VIC

I am not sure what you mean by a 6 volt fluoro tube, I assume you mean a 6 watt tube. Fluoro tubes themselves have no voltage rating as such.

A fluoro requires a very high voltage to 'fire', typically hundreds of volts, and will then run at up to 100 volts or so while actually running. This requires the use of a special fluoro inverter, which is not particularly easy to build. There are a number of these inverters on the market for 12 and 24 volt use, but I have not seen one for use on 6 volts.

The simplest way to get a circuit to run a small tube from 6 volts would to be to cannibalise a (4-cell) fluoro torch or lantern. These are quite cheap and are readily available from hardware and camping stores. You need to be careful of the output voltage of even a small inverter—they can be dangerous and may give a nasty bite, so don't touch the fluoro tube connections while it is running.

Apart from this, the only other suggestion I have is to forget the fluoro altogether, and use some of the new white LEDs instead, they are far

simpler to implement, and last almost forever. An article on these appears elsewhere in this issue.

Lance Turner

Charging nicads

We have used a remote power system for our household power for nearly 10 years now. The system consists of an array of photovoltaic cells of various types and vintages that produce about 7 amps at 24 volts, and a Platypus Power micro-hydro unit which contributes up to 5 amps when the creek is flowing.

Last year I replaced the battery charge controller with a PL20, which handles the sum of both PV and turbine input.

I have recently obtained a set of second-hand nicad cells to replace the lead-acid ones we are currently using. The nicad bank consists of 20 cells which I am told allows for the lower voltage of nicad cells.

As the PL20 has a program that allows the user to adjust all of the settings, I am hoping it will be capable of controlling the new battery setup. Are you able to advise me what the settings should be on the PL20 to give best performance on the new batteries?

As I am not yet familiar with the characteristics of nicads, could you please give me a rundown on what to expect and how they should be managed and maintained to give maximum performance and life? Do these nicads suffer from the same memory effect that their smaller counterparts do?

As a result of the new nicads I have some redundant lead acid cells to sell or trade if anyone is interested in making an offer. At this stage they're still being kept charged to keep them in good order.

Neil Padbury, Wodonga VIC

Large format nicads do not suffer from memory effect like the small cells do, so this is not a problem.

As far as charging the cells is concerned, I have heard numerous industry people tell me that nicads generally do not need to be used with a regulator, though the manufacturers of nicads say this is not the case, and a regulator should be used.

We contacted Plasmatronics, the manufacturers of the PL20, and they suggested that you could use the standard flooded-lead-acid program for your nicad bank. The trick seems to be to avoid excessive gassing and exposing the plates from the electrolyte boiling away. They also suggested that you could get slightly higher system efficiency by setting the charging voltage to 31 volts for a 20 cell bank.

In issue 67 of ReNew we published a response from John Paton of Solar Charge to a similar question. He suggested that nicads should be charged to a higher voltage than lead-acid. By his calculations, you should be charging to 34 volts.

Lance Turner

Car alternator wind generator

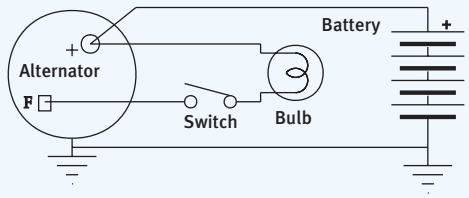
I want to use a 40 amp (internally regulated) car alternator in a home made wind generator to power my battery bank. I currently use an alternator in conjunction with a petrol motor.

The switch between the light bulb and the field is initially in the off position. Once the motor is started, the switch is turned to on and the alternator starts charging.

I assume that if there is no wind, the power from the batteries would flow back into the alternator. How could I overcome the problem?

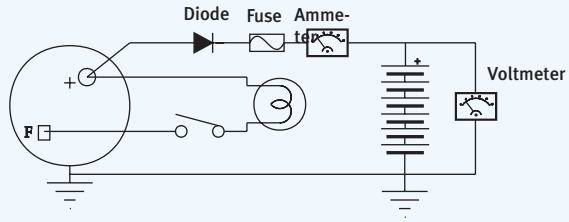
I also want to install a fuse to protect my alternator from damage as well as install a voltmeter and ammeter. If you could send me a diagram I would dearly appreciate it.

Wayne Briscoe, Geebung QLD



Wayne's original configuration when charging from a petrol motor.

A circuit diagram to enable use of the alternator for a wind turbine.



Apart from the problems associated with using a high speed generator like a car alternator in a low speed machine like a wind generator, the answers to your questions can be seen in the diagrams above.

You can stop current flowing back into the alternator field with a diode, it should be rated to take full alternator current, and will need to be adequately heatsinked. A Schottky diode is the best bet, these have a much lower voltage drop across them, and so don't waste as much power. However, if using a diode, the alternator must be able to self-excite, that is, it needs enough residual magnetism in its field to start producing power without the application of an external source of electricity.

Another option is to omit the diode, and replace the field switch with a speed-controlled switch, so the field only has power when the turbine is spinning fast enough to charge the batteries.

The fuse and diode go in the positive line along with the ammeter or ammeter's shunt, if it is separate. The voltmeter is connected directly across the battery.

Lance Turner

[Sustainable technology events]

Send details of events to *ReNew*, PO Box 2001, Lygon St North, Brunswick East VIC 3057, Fax:(03) 9388 9322, email: ata@ata.org.au. For event updates, see our web site at http://www.ata.org.au/

Going Solar events for 1999

- **9 October—Non-toxic paints and finishes**
- **13 November—Solar electricity**
- **11 December—Solar hot water**

Contact: Going Solar, 322 Victoria St, Nth Melbourne 3051, ph:(03)9328 4123, www.green.net.au/goingsolar

SRD Talks

22 September—ecological building materials
13 October—Everyday products—responsible design in our daily lives

Contact: Society for Responsible Design, PO Box 288, Leichhardt NSW 2040, ph:(02)9564 0721, fax:(02)9564 1611, email: srd@green.net.au, www.green.net.au/srd

Passive and Low Energy Architecture

22-24 September, 1999
Centred in Brisbane, QLD

Includes a symposium in Melbourne, a visit to the 'green games' Olympic site in Sydney, a tropical architecture workshop in Cairns and the main conference in Brisbane.

Contact: Conference Secretariat, ICTE Conferences, The University of Queensland, Brisbane QLD 4072, ph:(07)3365 6360, fax:(07)3365 7099, email: sally.brown@mailbox.uq.edu.au

Solar Energy International workshops

- **3 October—overview of solar, wind and water power for home use**
- **4-9 October—PV design and installation**
- **11-15 October—micro-hydro power**

Contact: Solar Energy International, PO Box 715, Carbondale, CO 81623, USA, ph:+1 970 963 8855, fax:+1 970 963 8866, email: sei@solarenergy.org, www.solarenergy.org

Model Solar Vehicle Challenge

16-17 October, 1999
Scienceworks Museum, Spotswood, VIC

This event will include competitions for both model solar cars and boats.

Contact: Paul Wellington or Catrina Mahony, ph:(03)9903 2156, fax:(03)9903 2766, email: Paul.Wellington@eng.monash.edu.au, web site: http://mec.eng.monash.edu.au/solar/index.html

National Water Week

17-23 October, 1999—NSW
An awareness campaign to promote our most precious resource—water.

Contact: Terry Biscoe, ph:(02)9954 9904.

World Solar Challenge

17-26 October, 1999
Darwin, NT to Adelaide, SA

Contact: World Solar Challenge, PO Box 1111, Kent Town SA 5071, ph:(08)8303 2337, fax:(08)8303 2339, email: wsc@saugov.sa.gov.au, www: www.wsc.org.au

World Solar Cycle Challenge

18-24 October, 1999
Alice Springs, NT to Adelaide, SA

A race for hybrid, solar assisted human powered vehicles.

Contact: World Solar Cycle Challenge, PO Box 1111, Kent Town SA 5071, ph:(08)8303 2337, fax:(08)8303 2339, email: wsc@saugov.sa.gov.au, www: www.wsc.org.au

World Solar Gliding Challenge

17-23 October, 1999
Darwin, NT to Adelaide, SA

Contact: World Solar Gliding Challenge, PO Box 352, French's Forest NSW 2777, fax:(02)9453 0777, email: hxmor@msn.com, www: www.wsc.org.au

Environment Japan '99

20-23 October, 1999, Osaka, Japan

Aimed at promoting importing environmental products into Japan.

Contact: Japan External Trade Organisation, Level 19, Gateway, 1 Macquarie Place, Sydney NSW, ph:(02)9241 1181, fax:(02)9251 7631, web site: www.environmentjapan.org

Electric & Solar Vehicle Conference

25-26 October, 1999, Adelaide, SA

To be held after the finish of the World Solar Challenge.

Contact: World Solar and Electric Vehicle Conference, PO Box 8178, Station Arcade, Adelaide SA 5000, ph:(08) 8387 3877, fax:(08) 8322 6290, email: Myriad@wsc.org.au, www: www.wsc.org.au

Seed savers conference

30-31 October, 1999
The Seed Centre, Byron Bay, NSW

Twelfth annual conference will coincide with the inauguration of the new seed centre.

Contact: The Seed Savers' Network, BOX 975, Byron Bay NSW 2481, ph:(02)6685 7560, fax:(02)6685 6624, email: jude@seedsavers.net, www.seedsavers.net

APEC Technomart

1-6 November, 1999, Gold Coast, QLD

This year's event will have a large component dealing with environmental conservation.

Contact: C/- Fisher Adams Kelly, Level 13, AMP Building, 10 Eagle St, Brisbane QLD 4000, ph:(07)3229 2624, fax:(07)3221 2260, web site: www.pacrimtechnomart.com

SEIA Energy Smart Expo

8 November, 1999
Australian Technology Park, Sydney

The inaugural event of the recently formed Sustainable Energy Industries Association.

Contact: Suzanne Dunford, SEDA, ph:(02)9249 6107, email: sdunford@seda.nsw.gov.au

Recycled organics conference

23-25 November, 1999
Hyatt Regency Coolum, SE Queensland

Aimed at sustainable organic recycling.

Contact: Exceptional Events, ph:(07)3350 6909, fax:(07)3359 2397.

Renewable Energy Fair

27-28 November, 1999
Hanging Rock, VIC

Will include displays on permaculture and agriculture, tours of local energy efficient buildings, more exhibitors, bigger display tents and more food available.

Contact: Going Solar, ph:(03)9328 4123.

Solar '99

1-3 December, 1999
Deakin University, Geelong VIC

This is the 37th annual conference of the Australian and New Zealand Solar Energy Society, and focuses on opportunities in a competitive marketplace.

Contact: ANZSES Administrator, PO Box 1140, Maroubra NSW 2035, ph:(02)9311 0003, fax:(02)9311 0004, www.ecse.monash.edu.au/prof/solar/solar99

Clean Energy 2000

25-29 January, 2000
Geneva, Switzerland

Forum to review clean energy policies and energy planning in the context of the Global Energy Charter.

Contact: Clean Energy 2000 Secretariat, Rue de Varembé 3, POB 200, CH-1211 Geneva 20, ph+41 22 910 3006, fax:+41 22 910 3014, email: conference@cleanenergy2000.com, www.cleanenergy2000.com

Renewable technologies conference

9-11 February, 2000
Tamil Nadu, India

A forum for anyone interested in the implementation of renewable energy technologies.

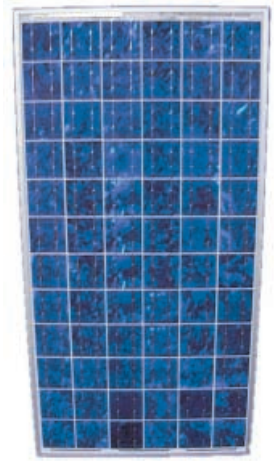
Contact: Dr C Palaniappan, Organising Secretary, 171/2, Madurai Kamaraj University Rd, Rajambadi, Madurai Kamaraj University Post, Madurai 625021, India, ph/fax:+91 452 858607, email: pen@vsnl.com

World Renewable Energy Congress

1-7 July, 2000
Metropole Hotel, Brighton, UK

Aimed at ensuring that renewable energy takes its proper place in modern society.

Contact: Professor Ali Sayigh, Congress Chairman, 147 Hillmanton, Lower Earley, Reading RG6 4HN, UK, ph:+44 1189 611 364, fax:+44 1189 611 365, email: asayigh@netcomuk.co.uk, web site: www.wrenuk.co.uk



New solar panel range

The new range of European Photowatt panels are available in sizes from 12 watts through to a hefty 90 watts.

The Photowatt panels use polycrystalline cells and are available in two different construction types, glass front with Tedlar back and glass front and glass back. The glass/glass units are said to have the advantages of maximum moisture resistance, higher rigidity and mechanical strength, and greater safety when used in high-voltage arrays.

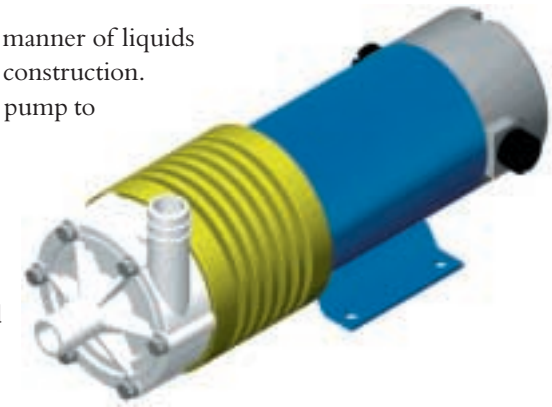
There are six models in the glass/glass range, 12, 22, 40, 50, 65 and 70 watts, while the glass/Tedlar panel is rated at 90 watts.

rrp 12W: $215, 22W: $325, $40W: $425, 50W: $495, 65W: $650 and 90W: $895.

Distributed by Solar Sales P/L, PO Box 190, Welshpool WA 6986, ph:(08)9362 2111, fax:(08)94721965, email: info@solarsales.com.au, website: www.solarsales.com.au

Marine pump

This unit is designed for marine applications but is capable of pumping all manner of liquids because of the highly corrosion-resistant plastics and ceramics used in its construction. The DC motor drives the pump rotor via a magnetic coupling, allowing the pump to be completely isolated from the motor without the need for shaft seals.



The pump is available in three different types, in eighteen different models, with numerous options including drive magnets of four, six or eight poles, different hose inlet and outlet sizes, 12 or 24 volt DC motors, and different construction materials in the pump body for different applications. Pumping rates are from 30 to 100 litres per minute, depending on model and head.

rrp: $675 for the MP-30R up to $1273 for the MP-70, plus tax if applicable.

Manufactured by Jindra Energy Conversions P/L, 5 Ngumby Crt, Vermont South VIC 3133, ph:0411 111 556, fax:(03)9887 4907.

Plug and play solar fountain kit

The Solar Garden and Waterfall kit from ARTA contains an 11 watt UniSolar solar panel on a pole mounted frame, a 12 volt pump, solar maximiser, wiring harness, fountain and plastic pipe—everything needed to set up a solar water feature, except the pond.

The components are mounted in appropriate places in the garden, and plugged together with the wiring harness. No electrical experience is needed.

rrp: $349

Manufactured by ARTA, PO Box 700, Cooma NSW 2630, ph:(02)6453 3281, email: arta@cooma.snowy.net.au

Energy management system

If you have one of the Selectronic SE range of inverters, then you might want to consider the latest add-on for these units. The Energy Management MKII package is a plug-in board that upgrades the inverter to be able to read, log, regulate and control an independent power system.

Once installed, all these functions can be operated from the inverter's front panel, the remote keypad, a remote computer, or even from a computer via a phone line.

rrp: $360.

Manufactured by Selectronic Australia, 25 Holloway Drv, Bayswater VIC 3153, ph:(03)9762 4822, fax:(03)9762 9646, email: sales@selectronic.com.au, www.selectronic.com.au

Rechargeable lawnmower

It has been several years since a new rechargeable electric mower was released, until this new machine from Victa. While not as large or powerful as a petrol mower, this unit would be ideal for anyone with a relatively small lawn to care for.

The mower uses a 24 volt system, with a 500 watt motor and a pair of 12 volt, 9 amp-hour batteries that are fitted into a removable pack, allowing you to swap the flat battery for a charged one and keep on mowing.

Like many of the Victa range, the cordless electric mower is a mulcher mower, so you don't need a compost heap for the lawn clippings.

rrp: $569

Manufactured by Sunbeam, PO Box 60, Campsie NSW 2194, ph:(02)9789 8788, fax: 1800 022 154, www.sunbeam.com.au

Solar array tester

If you have to test a large solar array to find a dud panel, it can be a time-consuming process.

The Spi-Array Tester 800 is capable of testing solar modules and arrays from 10 watts right up to 36 kilowatts. Each panel can be tested along its full power curve in less than a second, and the curve data can then be stored in memory or saved to floppy disk.

The tester also records temperature and irradiance values and can calculate accurate performance values for the panels under varying conditions.

The tester package includes the tester module, a factory configured laptop computer, connecting cable, testing software, AC charger (110/240 volt) and connecting leads for connection to the module under test.

Manufactured by: Spire Corporation, One Patriots Park, Bedford MA 01730-2396 USA, ph:+1 781 275 6000, fax:+1 781 275 7470, email: mcovino@spirecorp.com, www.spirecorp.com

Can you feel a pulse?

Not if your batteries are suffering from severe sulphation. In fact, sulphation is the number one killer of lead-acid batteries in Australia today.

The Can-PULSE battery maintenance system is supposed to help prevent battery sulphation by sending short, sharp pulses of current through the battery while it is being charged. The manufacturers also claim that, as well as preventing sulphation, the Can-PULSE system can actually reverse sulphation in a dying battery.

There are a number of different Can-PULSE products, including units designed to extend the life of 12 and 24 volt automotive and marine starting batteries, power supply storage batteries, and electric vehicle traction batteries up to 120 volts.

Distributed by Powerflow Technologies Ltd, PO Box 11822, Wellington, New Zealand, ph:+64 4 384 1988, fax:+64 4 384 1977, email: service@powerflow.co.nz, www: http://www.powerflow.co.nz

Backup power supply

With the year 2000 rapidly approaching, there seems to be a lot of concern over the reliability of electricity supplies. While there are many UPS (uninterruptable power supply) systems available, most are designed to provide less than an hour of backup power.

The VPS Storm Master is different in that it connects to a large external battery bank and can provide power for a much greater length of time. It also has an inbuilt mains battery charger and a regulator to allow solar panels and wind turbines to be connected, allowing the VPS to become the central hub of an independent power supply system.

The VPS is available with either modified square wave output in either 350, 600 or 1200 watt capacity, or pure sinewave output of either 300, 500 or 1000 watts. The system also has dual inverters to supply both front and rear power points, a separate 12 volt DC cigarette lighter socket, and four individual automatic lighting circuits so you are not left in the dark when the power fails.

rrp: modified square wave: $1800 for he 350 watt, $2195 for the 600 watt and $2699 for the 1200 watt. Sinewave prices are around $500 extra on each unit.

Manufactured by The Vital Earth company, freecall: 1800 243 626, email: vital.earth@hunterlink.net.au

Using less trees

In issue 68 of ReNew we discussed wood heaters and their problems associated with particulate emissions. Plain wood often has a high water content and can vary in quality enormously.

The Log-ett firelog is made from hardwood shavings and sawdust, compressed under heat to form hard wood blocks about half the size of a house brick. The manufacturers claim that the fire logs will burn with 88 per cent less carbon-dioxide, 66 per cent less particulate matter, and 66 percent less creosote production than the average chunk of tree, thus helping to reduce wood-fire pollution.

Other versions of the fire logs are made from recycled newspapers or waste rice husks, recycling often wasted materials.

rrp $3.50 for a 10kg bag.

Manufactured by LOG-ETT Australia, PO Box 497, Woodend VIC 3442, ph/fax:(03)5428 1466, email: c.a.n@ssc.net.au

Battery charger/generator controller

If you have a backup generator, then you need a good quality battery charger. Some chargers on the market definitely do not put out their rated power and have other problems like production of harmonics and poor power factor, which can play havoc on gen sets.

The RGS battery charge system has been specifically designed for the RAPS market. It has many features so that, when combined with other system components like the Selectronic range of inverters or PL Series Plasmatronic regulators, it can be configured to make the power system fully automatic.

The charger has a true 40 amp continuous charge current output, automatic changeover between the inverter and generator, automatic generator start and stop (when used with an autostart generator, of course), generator speed monitor, circuit breakers for the load, inverter, generator and battery, full output regulation and adjustable current limiting, overload and over temperature protection and has C-Tick approval.

rrp: around $1700.

Manufactured by RGS Technology, 27 Lyttleton St, Castelmaine VIC 3450, ph:(03)5470 5890, fax:(03)5470 5892.

Build your own solar cooker

This CD-ROM contains detailed instructions on how to build your own reflective solar cooker using cheap beach umbrellas and reflective film.

The CD uses html format, so you simply open the intro file in your favourite web browser and work from there. The plans seem very detailed, and include templates that can be printed out for cutting the reflective film, as well as literally hundreds of photos and diagrams.

rrp: $30 including postage inside Australia.

Distributed by Brett White, 10 Buller Street, Charlestown NSW 2290, ph:(02)4943 5701, email: solarbbq@bigpond.com, www.users.bigpond.com/solarbbq

Plastic batteries

There has been a lot of promises made about new battery technologies in the past, with very few new products becoming available. However, it appears that lithium polymer batteries have finally made it onto the market.

These batteries consist of layers of polymers (plastics) with different properties, sandwiched together to form a battery.

The Ultralife lithium polymer batteries have greater storage capacities than even nickel-metal-hydride batteries, making them one of the most energy-dense battery options available (up to 125 watt-hours per kilogram, compared to lead acid at 30-35 watt-hour per kg).

The Ultralife batteries can be made in almost any shape, as thin as 1mm, and can be configured in any series/parallel combination to produce a battery of the desired voltage and capacity.

The batteries are also very safe, containing no corrosive liquids or metallic lithium, and are resistant to abuse from overcharging and discharging.

Prices are not set yet, but they are expected to eventually cost around the same as an equivalent sized lithium-ion cell.

These cells are currently only available from the manufacturer, Ultralife Batteries, 2000 Technology Parkway, Newark, NY 10920 USA, ph:+1 315 332 7100, fax:+1 315 331 7800, www.ulbi.com

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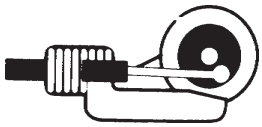

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Advertisers' Directory

Continued from page 15

test a solar panel for performance it is in fact subjected to 10 separate tests which measure over 200 individual points on the power curve—effectively over 2000 test points right across the range. This is controlled and logged by a computer and recorded against serial numbers of every single solar module.

•**'In higher temperatures silicon solar cells lose up to 30 per cent of their efficiency'.** Such a statement is potentially damaging to the solar industry. It is true that silicon solar cells lose efficiency as temperature increases, but should be considered in the context of the type of silicon solar cell and what it is being compared to and at what temperatures.

BP Solar's solar modules (which are some of the most efficient in the world) are rated at standard test conditions, which is 25°C. By the time the temperature has doubled to 50°C the module efficiency typically degrades from around 12 per cent to around 11 per cent which is still a higher efficiency than most solar modules on the market today. Degradation of output from BP Solar's silicon solar cells is referred to on the specification sheets which are available on request from any of BP Solar's Distributors or Agents. It is worth noting that these modules degrade less in high temperatures than virtually all other silicon solar cells available world wide.

•**'BP Solar gives ten years warranty and no real specs'** BP Solar's warranty on all solar modules from 40 watts up is 20 years and has been for some time. Specification are provided on every module which is "within minus 5 watts of nominal power" so it is very clear what you are buying. It is no different to buying a car with a 2.3 litre engine—you do not ask for an engineering certificate to ensure you are really getting 2.3 litres.

BP Solar, a business unit of the newly formed BP Solarex is the largest Photovoltaic Solar company in the world with annual sales expected to exceed US$160 million in 1999, and is by far, the largest solar company in Australia with an annual turnover of US$45 million.

BP Solar has had a long and distinguished record in Australia since the mid 1980s, manufacturing solar panels, balance of systems equipment, as well as offering complete turnkey services in photovoltaic system integration, such as design, installation and maintenance.

BP Solar cares about the reliability and reputation of its products. I thank you for this opportunity to respond to the letter in the previous issue of ReNew.

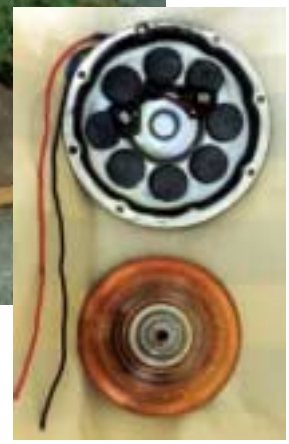
Nigel Morris, Regional Manager, BP Solar Components, BP Solar Australia

Jaycar's reply

Mr Campos returned his solar panel to Jaycar on 19 April '98. He purchased it almost two years earlier, and it was well out of the 90 day warranty.

Our technician looked at it, and found that it was within specifications, so it was returned to Mr Campos.

Bruce Routley, Jaycar Electronics



Home made electric bike

For some years I have tried to install an electric motor into the hub of a bike wheel. After many attempts with different configurations, I have at last accomplished what I consider is near perfect.

The motor is from an electric wheelchair and is at least 20 years old. It has a printed circuit disk revolving above eight magnets attached to the cover. It is about five inches round by an inch thick, and uses 5 amps at 12 volts DC. It has a 25:1 reduction gearbox and speed is 120 rpm.

I pulled the motor and gearbox apart to machine a thread on the drive shaft, and then installed the unit inside an eight inch diameter plastic tube with aluminium sides that anchor the spoke ends. Power is transferred to the motor from the battery through carbon blocks rubbing on aluminium rings attached to, but insulated from, the spokes.

I will be testing this project shortly, and am confident of success, knowing that two of these motors easily moved a metal wheelchair with a person and two car batteries.

I am finding it difficult to find any information on printed circuit motors, so if any reader can help I would appreciate it.

John Randall, Nth Geelong VIC

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Not so long ago, you would buy a 240V petrol generator. And a battery charger to plug into it. And then you would disconnect your house from your inverter, and plug it into your generator.

And then the fun would begin. Appliances would stop... then start again.... and stop again when the genny ran out of fuel.

Computers crashed, video recorders forgot what day it was, and the bedside clock just sat there blinking at you. You couldn't even listen to your favourite radio program, because the electrical noise from some battery chargers would drive you bananas. And boy, did they gobble fuel, just look at the graph on the left!

Not only that, but just when you thought you were saving the planet, you're producing the dirtiest power you can, and the most expensive. In fact, just when your ears and wallet have had enough, your batteries probably haven't- its a slow and painful way to charge batteries!

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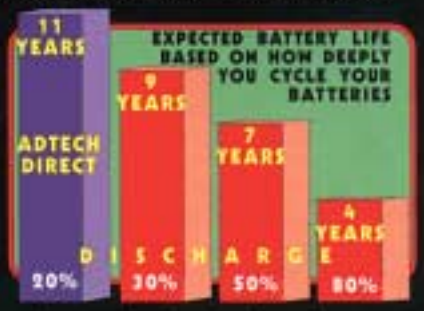
And last but not least, your batteries are never allowed to discharge too deeply, so their life is increased substantially. **With an Adtech unit, the batteries are never allowed to discharge more than 20%; this means that you can expect the maximum life from your batteries, and hence, best economy. This graph is based on data supplied by GNB Technologies (Dunlop/Exide Energystor batteries), extrapolated to one charge /discharge cycle per day. You be the judge.**



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*Not to scale! Indicative readings & measures produce

*Comparison based on one of the most common Sydney systems used in home power systems, a 5.6 kVA petrol generator and 40 Amp (cont.)(24 V) battery charger. **Comparison prices, dated Jul 95 (excl.GST) and priced at 74c, and include 800 watts