SOLAR HOT WATER SYSTEM BUYER'S GUIDE

ReNew

Technology for a sustainable future

WIN!

Valued at $3570

RGS Battery Charge System and Federal 24 volt battery bank (see page 7 for details)

We go on the road with solar power

Renewables on remote Aboriginal communities

Avoid these common RAPS mistakes

Build your own datalogger

Send us your *build your own* stories and be in the running for a Trace C40 regulator. See page 53.

Rent with solar and wind power without upsetting your landlord!

Issue 73 Oct–Dec 2000
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Step 1. **Take one Australian Greenhouse Office Renewable Energy Rebate**

Step 2. **Mix in one SEIA accredited system designer/installer**

Step 3. **Add one of the many high quality, efficient True Sinewave Inverters from Solar Energy Australia**

AND

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Horizon series of inverter chargers integrate a 2200 watt sinewave inverter, 80 amp three stage battery charger and 40 amp load transfer switch all in one great package. Simplify and improve the performance of your system. Plus our exclusive 2 year + 3 year warranty option.

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Medium sized stand alone inverters from 900 watts to 3800 watts. These units are focused on efficiency, reliability and practicality.

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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
8G31OT	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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Facsimile: (02) 9807 3700
URL: www.federalbatteries.com.au
Email: contact@federalbatteries.com.au

Also available from selected Solar shops and specialist battery outlets.

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Oct–Dec 2000

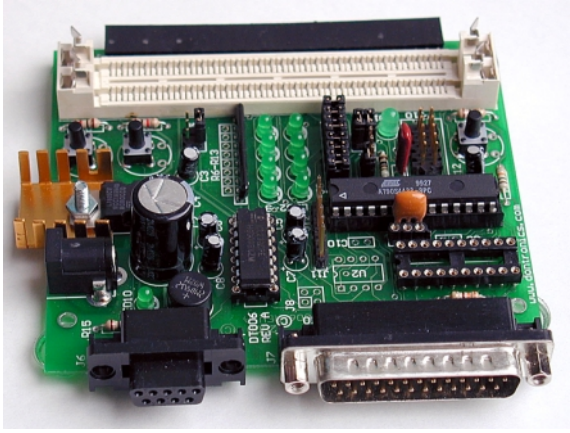
features

COVER STORY: In past issues of *ReNew* we have discussed the potential of a solar-powered laptop. We tried it out and show you how, page 32. Cover photo and above photo: Andrew Taylor

Renewable energy systems offer great benefits for people living in remote areas of Australia. We visit three Aboriginal communities where renewable RAPS are operating with great success. page 17.

Getting creative with your home energy system is another way to custom-design it to suit you. Check out our feature on an interesting home renters' system, page 22.

For those that see treasure in other peoples' trash, a visit to a tip shop is like being a kid in a candy store. Page 38.



This microcontroller can be used to monitor almost anything, and it's cheap too! Page46.

regulars

This solar lantern has proven a popular item in countries around the world. See our review in products on page 74.

A trip down memory lane. Looking back on the history of the Alternative Technology Association. Page 40.

About ReNew

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

ReNew also covers sustainable transportation and housing issues, the conservation of resources, recycling and broader environmental issues. *ReNew* is available from newsagencies, by subscription and as part of ATA membership. ATA membership costs $44 per year, and offers a range of other benefits.

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editorial

Celebrating 20 years of reporting on renewable energy

This is a special issue of *ReNew* as it marks 20 years of reporting on appropriate and renewable technology. *Soft Technology* was established as the only community-based forum in which to share ideas and promote products designed to lead us towards energy reform and conservation. Over its history *Soft Tech*, now *ReNew*, has provided information, ideas and inspiration to tens of thousands of Australians seeking a more sustainable lifestyle.

After the initial print run of a few hundred, *Soft Tech* quickly became an important reference for the DIY backyarder who didn't want to follow the path of ready-made appliances or the consumption patterns of modern lifestyles. Where there were no alternatives available, people pushed the boundaries of what was achievable, fashioning their own energy systems and control gear, and aspiring to low-energy living.

As you flick through back issues or scroll through the pages of *SoftROM,* pretty much anything to do with household energy use and conservation has been covered in one form or other, with practical solutions and tips provided by multitudes of energy enthusiasts. Even now, when new readers first learn that the magazine has been published for two decades, it is common for people to play 'catch up' and order 10 or 15 back issues.

Michael Harris, who was an editor of *Soft Technology*, and long-time manager of Alternative Technology Association, said that when he and a few others were discussing photovoltaic technology as an option for domestic use back in the yea-olde days of the late 1970s, it was still a developing concept and not commercially available. It was straight out of the space station talk, and their commitment to it placed them in a league of their own (people of vision now, strange techno-hippies then). See our ATA history on page 40.

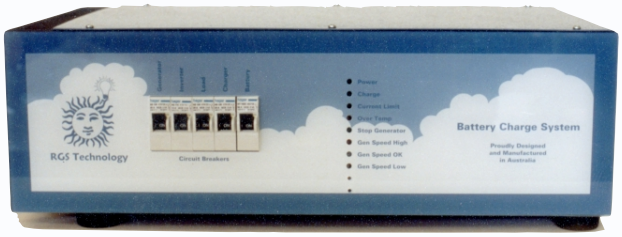
As we step into the next decade of environmental publishing, we do so in a very different atmosphere, literally. We don't speak of renewable energy technology as alternative any more, and hope has been replaced with urgency.

Our article on Germany's programs to source 21 per cent of its power needs with renewable energy by 2010 (page 28) is an example to Australia and the world for what needs to happen. In comparison to Germany's hard-line approach, the Australian government's mix of programs to cap greenhouse gas emissions, including plans for just two per cent of renewable energy to be sourced from renewables by 2010, is put to shame.

This issue of *ReNew* has developed into somewhat of an assessment of the opportunities available for the renewable energy industry in all sectors. It points towards ways to improve their adoption in remote areas and in all manner of other settings such as our article on renewables for renters, and people on the road.

As we talk of moving from the carbon into the hydrogen age, let's hope that we will soon share in something of Mick Harris' nostalgia which reflects how far we have really come.

Kulja Coulston



WIN!

An RGS Battery Charge Controller and Federal 24 volt battery bank

in the ReNew/RGS Technology/Federal Solar Batteries subscriber competition

Total prize value: $3570*

The RGS Battery Charge System is the first battery charger to be designed specifically for the independent power supply market. It indicates power, charge, current limit, over temp, stop generator and generator speed (high, OK and low).

This controller will integrate with the rest of your system and is compatible with all leading brands of inverters, generators and batteries. The stop generator relay function allows this system to automatically stop petrol pull start generators when the batteries are fully charged, minimising generator running time.

The Federal 8L16 420 amp-hour 24 volt battery bank included in this competition is supplied by Ryde Batteries and will compliment the charging system. The Federal Solar Range uses micro-porous polyethylene envelope separators to eliminate short circuits and extend battery life.

Features of the RGS 24 volt 40 amp Battery Charge System

- Output voltage: 12-16V DC, 24-32V DC
- Output current: 0-40A DC
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- Soft Start Time Delay: 1 minute
- Dimensions: 500mm wide x 350mm deep x 160mm high
- Weight: 15 kg
- Protects: generator input, inverter input, load output, charger input, battery output, heatsink temp

***Take out a *ReNew* subscription or ATA membership before 12 January 2001, and you could win an RGS Battery Charge System valued at $1650 complete with a Federal 8L16 420 amp-hour 24 volt battery bank supplied by Ryde batteries valued at $1920. Total prize value $3570 plus tax if applicable. See the conditions below, and get your subscription in today!**

Conditions and how to enter

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

(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 1 June 2000 to 12 January 2001. Subscriptions/memberships must be paid by 5pm on Friday 12 January 2001 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$35 elsewhere. Two year subscriptions and memberships are also eligible.

(7) To subscribe or join the ATA, use the subscription form on page 58 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 as freight costs will be FOB.

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

The *ReNew*/RGS Technology/Federal Solar Batteries subscriber competition is proudly sponsored by RGS Technology and Ryde Batteries. For more information RGS Technology can be contacted on ph:(03)5470 5890, fax:(03)5470 5892. Ryde Batteries can be contacted on ph:(02)9879 5422, fax:(02)9807 3700.

BP Amoco shareholder challenge

A coalition of BP Amoco shareholders and environmentalists called for the company to abandon its planned Northstar offshore oil production facility in the Arctic Ocean, and longer-term plans for exploration in the Arctic National Wildlife Refuge. The coalition said BP should instead divert the funds to large-scale photovoltaic production. At the BP Amoco Annual General Meeting, 13 per cent of shares, or one in six votes cast, supported the resolution to stop the Northstar project. The value of these shares is US$12 billion. The company resisted saying it already held 20 per cent of the PV market and its conventional business interests was what made this possible. BP Amoco plans to expand its investment in renewables by five or six fold in the next seven years.

Renewable Energy World

Californians paid to retire polluting vehicles

Tough emissions testing in California means that many older vehicles will fail to meet the state's standards. These polluting vehicles must be repaired or retired from the road. Under a new program, Smog Check Consumer Assistance Program (CAP), Californians can collect US$1000 to permanently retire a vehicle or up to US$500 to assist with repairs. CAP is effective from 1 July 2000 and hopes to cause the removal of 50,000 polluting vehicles from the streets.

Australia's emissions increase

The uproar and embarrassment following the release of the 1998 National Greenhouse Gas Inventory figures has all but disappeared, leaving in its wake widespread concern about Australia's failure to address climate change issues on a national level.

The figures indicate that Australia's greenhouse gas emissions in 1998 increased to 454 million tonnes of carbon dioxide per year compared to 431 million tonnes in 1997—with the rate of Australia's greenhouse gas emissions pegged at 16.8 per cent above 1990 levels.

By increasing emissions, Australia is becoming less able to achieve its reduction targets of 108 per cent of 1990 levels, as negotiated under the 1997 Kyoto Protocol. The government has attempted to shrug off renewed pressure for it to 'get serious' about greenhouse by claiming the increase was expected and due to economic growth, and a 'mix' of reduction policies introduced since 1997 should ensure this rate was not repeated in subsequent years.

Friends of the Earth climate campaigner Tristy Fairfield said the community won't be duped by inaccurate economic arguments.

'Globally in 1999 emissions dropped by 0.5 per cent, while the world economy expanded 2.5 per cent in the same year. In 1998 China's economy grew by 7.2 per cent while its emissions dropped 3.7 per cent. Denmark and Germany have also had remarkable success in decoupling energy demand from economic growth,' she said.

Selectronic Australia

Renewable energy company Selectronic Australia has acquired a 51 per cent stake in Power Solutions Australia. The companies will continue to operate as separate entities, retain existing management and market their own products.

Changes to old star rating system

The red and yellow appliance energy rating labels are being revised to encourage manufacturers to further improve the energy efficiency of their products.

Identified by a green band, the revised labels have been in use since 1 April 2000 and are measured to a tougher standard so that what was once a four star fridge may only be two and a half stars under the new system. To help consumers with the transition, manufacturers will be able to mark the new label with statements like 'rated four stars under the old scale'.

Consumers can also work out the yearly running costs of products carrying the new label by applying the 'thumb test'. By placing a thumb over the last digit in the energy consumption figure box, consumers can estimate the dollar running cost of the product.

All labelled products on shop floors must carry the revised label by 1 October 2000, although warehouse stock can continue to carry the old label until 30 September 2001. For more information www.energyrating.gov.au

Energy News

ATA General Manager on SEA board

Alternative Technology Association's General Manager Libby Anthony (right) has been selected to sit on the board of the Sustainable Energy Authority of Victoria (SEAV), formerly known as Energy Efficiency Victoria.

Libby is the only member of the board from an environment or community group and said her appointment would give voice to community concerns about greenhouse gas emissions.

'To me the really important thing is to cut Victoria's greenhouse gas emissions. It is important to do this by decreasing demand for electricity as well as supporting the installation of renewables such as solar hot water units, wind farms and photovoltaics,' she said.

'I think it is an exciting time for developing greenhouse policy in Victoria and I am looking forward to working with the other members on the board. The board has a strong team of people with varying talents with experience in big business, electricity supply industry, marketing promotions, local government and the housing industry.'

Other members of the board are: Mike Hill, Carolyn Lloyd, Sheila O'Sullivan, Dr Harry Anthony Schaap, Greg Bourne (Chair) and Keith Fitzmaurice.

Solar hot water rebate program introduced in Victoria

Victorians wishing to install a solar water heater will be able to do so more cost effectively following the introduction of a new solar hot water rebate program available from the Sustainable Energy Authority.

The program is available only to approved systems installed by an accredited installer. The rebate amount is dependent on the system performance and ranges from $800 to $1000 for a standard two panel, 300 litre system capable of delivering 200 litres of hot water. More information about the rebate is supplied as part of the solar water heater buyers guide on page 65 of this issue of *ReNew*, or from the SEA website www.sea.vic.gov.au

Globally the wind industry is growing at a faster rate than the personal computer industry. Finally we are seeing evidence of this in Australia with three new windfarms on the eve of construction


The dawn of a new era...

New wind power system for Western Australia

Australia's biggest wind-powered electricity generating system will be built near Albany by state-owned utility, Western Power. Costing AU$45 million, the windfarm will consist of 12 turbines on 65-metre towers, which will become operational in July 2001. A commercially viable system not requiring government subsidies, the windfarm will have the capacity to produce a collective 22 megawatts of power, enough to power 17,000 homes or 75 per cent of Albany's requirements. The generators and 35m long blades which are the main components of the system will be built in Germany by Enercon.

Toora's 22MW windfarm

Stanwell Corporation Ltd may start construction on its planned 22 megawatt windfarm at Toora in Victoria later this year following the receipt of local council planning approval and a generation license from Victoria's Office of the Regulator General. It now awaits only final approvals. The windfarm will most likely comprise 12 turbines on 70m towers.

Stanwell is wholly owned by the Queensland state government and has 1400MW of coal-fired generation and 139 MW of hydro in its home state. The $35 million windfarm at Toora will be its first project outside of Queensland.

Pacific Hydro's 18MW windfarm to be completed in 2001

Power company Pacific Hydro Limited has selected German-based An Windenergie as its preferred bidder to construct its 18 megawatt windfarm at Codrington in Victoria. Codrington is situated midway between Warnambool and Portland on Victoria's south west coast. The $33 million, 14-turbine development will be located on private land which is currently used for grazing. The turbines will be placed on the high points of two limestone ridges that run parallel to the coast. Powercor Australia has signed a memorandum of understanding for the purchase of the electricity. Construction will begin later this year and be completed in the second quarter of 2001.

Wind industry radical expansion globally

People around the world are harnessing their wind resources with the installation of thousands of megawatts of wind turbines.

United States: FPL Energy has purchased 200 Vestas Wind Systems turbines to be used in its quest by the end of 2001 to add 500MW of wind power to its already-existing 1000MW windpower portfolio. This is equivalent to 30 times the entire wind capacity of Australia.

Italy: Tomen Corp, a Japanese trading company has built a 170MW wind power station in the south of the country near Naples.

Mexico: Plans are underway to issue a tender for a 50MW of wind equipment to be installed at Juchitan in the Oaxaca Province. Already seven 225kW Vesta turbines are operational on the site.

The investment in wind is increasing at an unprecedented rate with Spain soon to be leading the pack with its aim to install 10,000MW of wind over the next 10 years.

World's largest wind turbine

The world's largest rotor blades measuring 38.8 metres in length have been manufactured by LM Glasfiber. The blades were mounted to a Nordex MW N-80 generator located 80 metres above the ground.

Demise of infamous greenhouse enemy

The Global Climate Coalition, infamous for its successful advertising campaign which eroded public support for the American government's planned carbon reduction program, has all but collapsed following the mass exodus of the world's most powerful corporations. BP Amoco, Dupont, Royal Dutch Shell, Ford Motor Company, Texaco, Daimler Chrysler and General Motors have all left the GCC, which has lost credibility due to its position which denied climate change caused by the warming of the earth.

Shell, BP Amoco and Dupont are now among 21 other corporations including Toyota, Enron and Boeing which have joined a new group called Business Environmental Leadership Council which requires its members to have their own programs for reducing carbon emissions.

Green Energy Market

An internet-based Green Energy Market is being established in Australia to permit the trading of green energy rights. The market is the brain-child of 15 Australian power generators and energy companies which are preempting the issuing of renewable energy certificates as part of the government's mandatory two per cent renewables legislation.

The GEM will be separate from the National Energy Market and is being funded by the member groups to the sum of $768,000. Members include Origin Energy, Optima Energy, Australian Gas Light Co, Powercor, Pacific Hydro, Aurora Energy, CS Energy, Energex Retail, Ergon Energy, Hydro Tasmania, Snowy Hydro Trading, Stanwell Corp and Macquarie Generation Pacific Power.

PV rebate won't make the distance

More than $8.5 million of the $31 million allocated for the Photovoltaic Rebate Program was commited in the first six months of the four-year program.

At this rate the funds will be exhausted before the end of the four years, with applications still being received from all states and territories.

The program was initially available only to domestic residences but is now open to community use applications. The rebate is calculated to pay $5.50 per peak watt. The minimum system size is 450 watts and the rebate is capped at $27,500 (5kW). For more information contact 1300 138 122.

Buyer's guides are useful

We are in the process of designing a solar powered electrical system to suit our needs and find your buyer's guides an invaluable source of information. It's a steep learning curve, and I'm amazed at the range of products available—very encouraging!

I have been growing kangaroo apples and was delighted to find the recipes included in issue 71. Perhaps I will be able to contribute a few of my own in due course.

Thanks for a great magazine—more good ideas than you could poke a stick at, and many practical ones to try out. It's very reassuring to know there are so many people out there going 'alternative' and taking responsibility for their use of resources. Good to be joining them!

Margaret Kelly, Edenhope VIC

Save heat, don't make it!

I was able to get a wood heater from a colleague essentially for nothing, and with $150 was able to purchase a few fittings to bring the whole heating system into line with the Australian Standards regarding wood heaters. The heater itself is already recognised as meeting or exceeding the standards, and I had them check it out for me at the heating shop to make sure it was still in top condition.

Ok, so far, not very interesting. What is interesting is that in our neighbourhood there might be, say, 150 homes spread over, say, 100 acres or so (roughly 40 hectares, it's semi-rural, nothing smaller than 1/2 acre blocks). In the past three weeks, many of those homes have started using their wood heaters because of the onset of the colder weather. Of those who've started using them, most have them on a significant amount of the day—for example more than eight hours every day/night for the past week, mostly during the night. A couple have even run their heaters continuously, or at least apparently so for two or three days! At least I assume it's continuously, because the chimneys are smoking slowly all day, and I'm sure they'd be on all night too since it's colder at night! We've found that with the insulation that we put in our house, that we've only 'had to' use the heater twice in the past three weeks, and only for about four hours at a time. Any more than that and the house becomes uncomfortably warm. I say 'had to' because we really

Electric pushbike conversion

Using what was available around my workshop I converted a pushbike to battery power.

I started by moving the rear wheel back two inches, which allowed me to install a four inch diameter electric motor attached to a gearbox. The motor is a 12 volt DC unit made by Bosch. It came from a lawnmower of German design.

As power is lost through the transmission, whether it be gears, chain or belt drive, I have tried to keep any loss to a minimum, keeping in mind that the speed must be reduced 8 to 1, and bevel gears are used in the gearbox to provide a right angle drive.

The bevel gears came from the differential of a 'Mini' and have a reduction ration of 1.7 to 1. With an added reduction of 4 to 1 from the sprockets from the gearbox to the rear wheel, I get the road speed I require.

The battery is just a 12 volt car battery that I bought from K-mart. In hindsight I should have shopped around and bought a better one that gave me more ground clearance. A sealed battery would remove any worry should the bike fall over. A circuit breaker is installed on the handlebars, which also acts as a master switch.

I have been working on electric projects for 15 years, and would be pleased to hear from anyone with similar interests.

John Randall,
28 Stoddart St,
North Geelong VIC 3215

didn't need to turn it on, but wanted to see how effective it was.

So, in a nutshell, before someone goes spending $2000 dollars on a good quality wood heater, and then spending several hundred dollars annually on questionably sourced fuel, maybe spending a few hundred dollars, once, on good quality insulation would save them heaps of money and reduce the impact on the environment. In my case, the only reason we have a wood heater is because we got one essentially for free. Before we had it, I was fairly convinced we would not spend $2000 on a heater and more on fuel, but rather a few extra dollars on a couple of extra blankets. Now that I've seen how effective they can be in a properly insulated house, I'm even more convinced that spending $2000 up front to heat a poorly insulated house is a lose-lose proposition.

I hope you can make use of this in an up-coming issue, because I really believe there are still a large number of people out there who are band-aiding the symptoms by spending $2000 on heaters, rather than curing the problem by insulating their house properly!

David Emrich,
demrich@ihgtech.com.au

'Animal seed' concerns

I was appalled to read the article about Noel's Treasures from Trash in issue 72. I hope that no-one goes ahead and makes these dangerous things. Everyone, even little children, knows that capsules are for swallowing.

So, in the first place you have people pouring out medications (and hoping that little children don't eat those) and then you take thin foam and paint on it with textas (non-poisonous?—not specified) and after much fiddling about you presumably present a child with a collection of capsules.

What happens if the child then swallows them? I am quite shocked that such an article appeared in a magazine which aims to save the environment and look after people.

Irene Gale, r-grayle@msn.com.au

Irene, we can certainly can understand your concerns. While the Noel's Treasures from Trash column is aimed at providing interesting projects for children, we would certainly expect that there would be adult supervision while making and using these toys. There are many dangerous things in the average home, some that can be swallowed, like chemicals and medicines, and others that can be even more dangerous, so it goes without saying that there should always be some form of supervision for younger children.

Lance Turner

An embarrassment of riches?

I am keen to utilise the microhydro opportunity we have at Rosneath Farm. (for more details about our Permaculture Village, see www.rosneath.com.au). We have a dam holding 60 megalitres, which has a catchment of 80ha. By my calculations, we have 800 megalitres falling six metres from the dam overflow pipe, which is 600mm in diameter.

I can sure identify with the comment that the cost of a microhydro system would be mainly determined by the site works. Can any readers help me with my embarrassing problem? The embarrassment was heightened when I recently went to visit Ted Trainor to see the amazing things he is doing with water on the edge of the George's River. When I described the nature of my problem, he turned, looked at me disbelievingly, and said 'You're a millionaire.' But I'm not, because I don't know what to do! Yet.

Here is the rub. How do you design a system that will withstand and maximise the wide variation of flow rates? If it rains heavily, it might run through the pipe 600mm diameter for 24 hours. Most of the time it would be running through the pipe at about 150mm deep. And of course at the beginning and end of the season it would be running through only 2 - 3cms deep. All this occurs over the middle of the year, from (usually) May until October. One year it was still trickling in February. This describes the problem on the input side.

On the output side, the most logical place to utilise the power would be in the village centre, which is between 400 and 600m north of the centre of the dam wall. Our very first forecasts of demand suggest something in the order of 50kwhrs/day average over the year, when the place is fully developed, which could be some years.

So we have time to explore the detail, but before we start that level of analysis, I need someone to give me some ballpark figures on what it might cost to sensibly and productively harness the flows, and how much output I might expect. Anyone care to have a go? If you email me directly, I'll do a summary article for the magazine in, say, three months.

Warwick Rowell, Rosneath Farm,
warwickrowell@rosneath.com.au

Smelly intruder

Whatever the argument for or against wood heating our position is and always will be very clear.

Our house has a large wood stove having used it only a couple of times we have chosen not to do so ever again due to the repulsive stench that the thing emits.

It seems that in our surrounding area at least 80 per cent of the houses have a wood heater of some kind and some

even have two chimneys which I assume means two wood fires.

Every night, as the weather begins to cool, the sky becomes foggy and smelly and our clothes and linen get that smoke filled smell of a camping trip, only they are just on the washing line. This encourages us to use a dryer in winter times to escape the smell.

Whether or not the wood heater is or isn't a deadly pollutant it is most definitely an offensive and intrusive invader to the neighbourhood that finds the smell of a burning tree unbearable.

Paul and Alice Green, WA

Buying the right insulation

I am considering putting insulation under the wooden floorboards of my house. I have been researching the different possibilities available. Unfortunately, I am getting conflicting information on insulation from various people and businesses obviously arguing for their own particular product.

How do you rate the 'Glass Wool Batts' made in Sydney and what are your views on the other alternatives on offer: fibreglass, Rockwool, polyester, acoustic-thermal batts, as well as cavity wall and reflective foil insulation?

I am interested primarily in the efficacy, health risks associated with installation, long term consequences of such insulation and the production processes associated with these different types of insulation.

I would also appreciate any tips as to where one can find unbiased information on such products.

Konrad Knerr,
kknerr@austethical.com.au

We did an insulation buyer's guide in issue 71 of ReNew, which is available as a back issue from us for $5.50. My advice is steer clear of the glass wool batts (fibreglass) and the Rockwool, which are made from similar materials. There are too many health risks associated with these. If you have ever handled this stuff, then you will know just how irritating these fibres are, and it is difficult to see how they could not be doing damage inside your lungs when you breathe them in.

My preference is the polyester batts or a reflective foil type material, we have some Astrofoil here that is quite an interesting material and seems to work very well at reflecting radiant heat.

Anyway, I suggest that you get the insulation buyers guide, it will help you with making a decision.

Lance Turner

Those breadmakers!

Before reading Dave Lambert's article on bread makers I had sworn black and blue that I would never own one. In fact I thought bread makers were a conspiracy by the power generation firms keen on finding new methods to increase their electrical out put. I didn't realise a home made loaf only requires 265 watt-hours of energy to bake. Not only that, but fresh bread out of the oven doesn't need toasting, whereas I always toast my store bought bread because it's not as fresh as I'd like it. Imagine my surprise when I calculated that the energy I use to toast a whole loaf of bread is 320 watt-hours!

Now as soon as I get my cow and a bread maker, I'll never have to duck out to shops again (saving even more energy).

Jacob Strickling,
jacob@afsenterprise.com.au

Excessive grid voltages

A few years ago I bought an Emu Power Meter to check our domestic power usage, as a guide for later in life when we plan a solar powered system in our proposed country home.

I recorded our mains supply voltage for a time and wrote to the SEC complaining of high mains voltage to about 256 volts. The SEC quoted an acceptable limit of about 259 volts—a figure which I believed to be high and contributing to an unnecessarily high power bill.

Following the recent media flap on voltages and a coincident three blown light globes in two weeks, I put the meter back on line. Between 24 June and 23 August 1999, (over 100 readings at various times) the supply varied between 245 and 259 volts, with the majority of readings above 252 volts.

Generally, readings below 250 volts were taken during late afternoon to about 6pm, while the highest readings, 258 to 259 volts, were taken between late evening and 6am.

Since I took these readings, United Energy has obviously reduced our supply voltage by at least 8 to 10 volts, with readings now rarely over 248 volts and sometimes as low as 236 volts. Is this a case of United Energy 'keeping their house in order', or 'power to the people'?

Robert Vickers,
Mount Waverley VIC

*I am delighted when ReNew readers send in voltage reports from all around the country, although nobody should attempt to measure mains voltages unless they know **exactly** what they are doing.*

Mr Vickers' measurements correspond almost exactly to what I have measured and logged at my home in inner suburban Melbourne.

Since the high voltage problem was raised in ReNew #68, there have also been reports of voltage reductions in Anglesea and Toolangi. Even in those locations, it is difficult to determine whether it is the power companies adjusting only a distribution tranformer (the mean commercial response to customer complaints), or whether they are taking us seriously, and actually resetting the voltages at the larger zone substations. This latter possibility, if confirmed, would be a great consumer and environmental victory, and something for which the electricity distribution businesses would deserve some acknowledgement. The Office of the Regulator General should publicly disclose what is actually going on behind the scenes.

Imagine that a million households each has a continuous 50 watt phantom load, and a continuous 75 watt lighting load. Based on my experiments, each such house will save 10 watts (continuously) at 240 volts supply compared to say a 252 volts average supply. Every million houses will thus save 10 megawatts continuously. This is roughly equivalent to the greenhouse gas saving of one thousand Breamlea Wind Generators, and the customers pay less, instead of having to fork out more money to salve their consciences by buying Green Power.

When the new Australian 230 volt standard takes effect in 2003, we must pressure the power companies and the state regulatory authorities to match the real supply voltage to the new standard. Anything else would be monopoly rent extraction in my considered view, but don't hold your breath waiting for the ACCC or the state regulators to enforce the correct voltage.

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Serving remote power needs with renewables

The penetration of renewable energy into outback Australia relies on sufficient funds, robust system design, maintenance services and education. Kulja Coulston visited three Aboriginal communities which have successfully addressed these issues

The quest for self-sufficiency is a life goal of millions of people all around the world, especially as it becomes more obvious that the burning of fossil fuels for electricity is unsustainable in the long term.

In metropolitan areas some people achieve this by supplementing their power needs. In areas without an established electricity grid, renewable energy remote area power supply (RAPS) systems can replace diesel or petrol generators, eliminating the polluting and noisy reality of running these machines every day.

Generators are a fact of life for most people in remote areas who pay out tens of thousands of dollars each year for fuel, and even then live without the 'flick of the switch' convenience of 24-hour power, as generators are not economical for most people to run for extended periods.

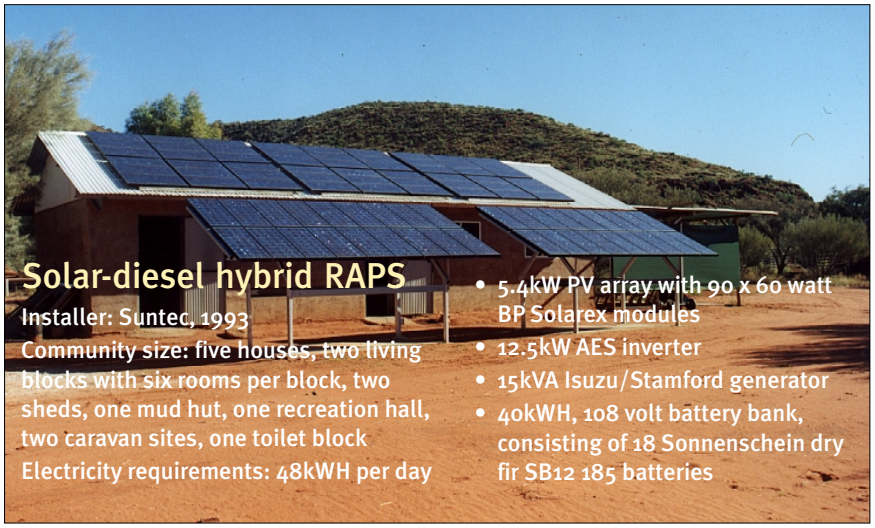
For Aboriginal people living in remote areas of Australia, being able to independently support the needs of the community without depending on outside services is a fundamental quality of life issue and essential for self determination.

Many communities are distant from towns where services like a reliable electricity supply, town water, health services, fuel and food supplies are available. Sometimes communities are located hundreds of kilometres from such technical and physical services.

Minimising the reliance on services from outside the community is of ongoing importance, and using the available abundant natural resources such as the wind and sun can be the most reliable and cost effective way to achieve this.

However autonomy doesn't arrive with a renewable RAPS system, especially in areas where there is limited access to town services or information about the alternatives to generators.

Many communities are reluctant to take on the responsibility of technology they don't understand, or don't have the funds for the high capital outlay of renewables. Experience shows



Solar-diesel hybrid RAPS

Installer: Suntec, 1993

Community size: five houses, two living blocks with six rooms per block, two sheds, one mud hut, one recreation hall, two caravan sites, one toilet block

Electricity requirements: 48kWH per day

- 5.4kW PV array with 90 x 60 watt BP Solarex modules
- 12.5kW AES inverter
- 15kVA Isuzu/Stamford generator
- 40kWH, 108 volt battery bank, consisting of 18 Sonnenschein dry fir SB12 185 batteries

that unless 'new' technology is accompanied by appropriate education and maintenance services, chances are they will not fulfil their potential.

In areas where there is no one who can identify even simple problems, the most high-tech automatic systems won't eliminate the need for maintenance.

So how do renewable energy RAPS fit into this scenario?

Situation with renewables

The Aboriginal-controlled Centre for Appropriate Technology (CAT) in Alice Springs recently conducted a market survey which focused on renewable RAPS.

Renewable Energy in Remote Australian Communities is the most extensive field market survey on the use of renewable energy systems in RAPS in Australia. It details the use of 350 power and water pumping systems at 130 remote sites. It was carried out by CAT staff and commissioned by the Australian Cooperative Research Centre for Renewable Energy.

As part of the survey they visited 88 Aboriginal communities in four states and found that only 64 per cent of the renewable energy systems were operational at the time of visit. The situation was better with the diesel generators (79 per cent) and petrol generators (67 per cent). Ninety per cent of solar powered bores were operational. The attitude towards renewable technology was not as high as expected, with 40 per cent of owners unhappy with their systems.

The reasons for dissatisfaction were

Wind-diesel hybrid RAPS

Installer: EcoEnergy, 1995
Community size: five houses
Electricity requirements: 19kWH per day
- Synergy S20,000 wind turbine variable axis type
- 5kW Butler Solar interactive inverter
- Yuasa XS 108VDC flooded cell type battery bank, capacity 30kWH
- 7kVA 1500rpm diesel Isuzu/Stamford generator

many and varied, and included component failure, demand management problems, neglect and unmet high expectations about the capabilities of the systems. However lack of maintenance support for systems was the main complaint quantified in the survey, and is one of the major issues that needs to be tackled to obtain a viable renewable energy product in remote regions. The findings indicated that only eight per cent of local people knew how to maintain their own RAPS system, so dependence on outside expertise was widespread.

System success

While taking us to visit a community with a large solar installation, David Lowe, who is one of the survey authors, hoped the findings would help the renewable energy industry and government to improve services and equipment available in remote areas.

The community David drove us to had been established as a drug rehabilitation centre and was located about 70km west of Alice Springs.

The solar system on this community had been successfully operating for the past eight years and was installed by Alice-based company Suntec Design.

Toni Wallace from Suntec said the system's strength rested on the use of high-quality components which were chosen for their proven performance in remote areas. Suntec only installs components with a proven track record of few running problems.

'It is common for people to leave the community and for new people to arrive. We try to make our systems bullet-proof with very little to fiddle with. We make ourselves available 24-hours a day and people know they can call us anytime with questions.'

Taking a long-term interest in the system even after installation can prevent many problems before they develop—such as a recent one on this community where someone thought 'no noise meant no power' and had manually switched the system to run from the generator.

Over time this community has been able to meet all of its power needs with their solar array. As more capital became available the community invested it the system, enlarging its size from the original 1.62kW to the current 5.4kW peak.

The huge array has reduced reliance on the diesel generator making it a cost-effective and has reduced the amount of time required to maintain it, as the generator is the most maintenance intensive component of the system. Solar panels need only we washed down a few times each year. The community now has 24-hour power and more time to spend running the centre. System monitoring such as checking the battery charge and servicing the generator until recently had been well performed by one community member who has passed away. It is hoped another resident will take on this task to ensure the system continues to function well.

Benefits of renewables

Renewable energy installer Mike Farrell, whose business EcoEnergy is based in Alice Springs, has been installing systems on communities for decades. He said while renewable RAPS systems required less maintenance and had much lower running costs than systems which relied on generators, system planning was fundamental to their success. He said that some manufacturers were now building system components that were able to cope with the harsh environment but systems still needed to be carefully designed to incur as few problems as possible.

The technology now available for use in remote areas has helped him mini-

mise the risk of fault.

'When designing a system, the choice of components is extremely important to ensure the reliability in adverse conditions and minimise maintenance requirements,' he said.

'One of the major problems we have with installations on remote communities is the lack of funds for any ongoing preventive maintenance, so it is important that the system is reliable from the start.

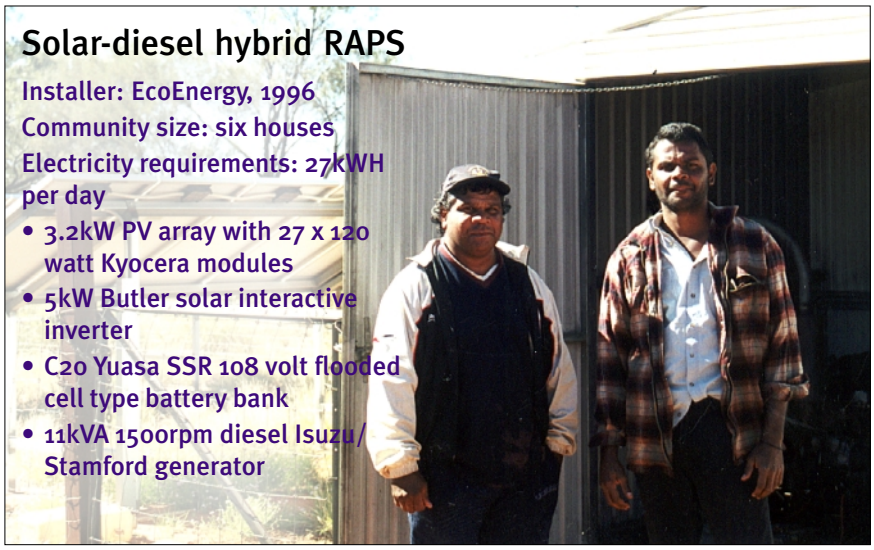
'Travel to some of our sites is up to 1700km from Alice Springs, and quite often after the defects liability period there will be very little maintenance carried out, and we may not hear from the client until there is a problem with the system,' he said. 'Repairs can be expensive if problems are not reported early.'

Mike will routinely telephone and where possible drop by to check the system and discuss any owner concerns as without this most owners had few sources of advice. This kind of service is not mandatory and many communities do not receive this from technicians. For installations distant from Alice, EcoEnergy, where possible, provides instructions over the phone to avoid costly service visits. Installers in these areas have learned that this method can avert major problems down the track, saving them and the owners time and money.

In order to conduct business in these remote areas Mike flies a light aircraft into some sites. He also has an Oka truck and numerous four-wheel-drive vehicles.

Financial benefits

It was in one of his 4x4s that we travelled to visit a community located approximately 200 kilometres south of Alice Springs. More than 70kms of this was driven along a rough dirt track which would have been impassable for a normal vehicle. After few hours of driving through some of the most spectacular and rugged landscapes I have seen, we arrived at a quiet community of five houses.



Solar-diesel hybrid RAPS

Installer: EcoEnergy, 1996
Community size: six houses
Electricity requirements: 27kWH per day

- **3.2kW PV array with 27 x 120 watt Kyocera modules**
- **5kW Butler solar interactive inverter**
- **C20 Yuasa SSR 108 volt flooded cell type battery bank**
- **11kVA 1500rpm diesel Isuzu/ Stamford generator**

Five members of the community were sitting around a fire when we arrived and after initially introductions, took us to see their food gardens and livestock, including two of the world's fattest pigs. They told us that their centralised wind-diesel hybrid RAPS system had improved their lives dramatically since it was installed three years previously, and had operated almost fault-free for all that time.

The system was economical to install and had enabled them to cut their diesel consumption to just 2050 litres per year (5.6 litres per day). This community had a solar-powered telephone, solar water heaters and solar-powered bore. One member of the community was mainly responsible for its maintenance and understood the systems very well.

The financial benefits of renewable RAPS were more obvious at the third system we visited, located north of Alice.

This community had six houses and required an average of 27kWH per day. Before the centralised 3.2kW solar system was installed in December 1996, each house was running its own generator which meant that the sound and smell of the engines was constant throughout the day and night.

Their generator-only system experienced many faults and had started to incur huge fuel costs and required seemingly constant maintenance. Generator use has now been reduced to just four hours a day and diesel to 2800 litres per year (7.8 litres per day). While their current solar-diesel hybrid systems experienced some difficulty, due to the generator being allowed to run dry of fuel, this was less detrimental than their previous experiences.

Increasing the use of renewable RAPS

As successful renewable RAPS systems become more common, trepidation about their performance will lessen. However it is still early days and renewables continue to suffer a bad reputation due to problems experienced in these areas in the past.

To promote further adoption of renewable systems in remote areas CAT recommended innovative funding schemes and better availability of information about the benefits of renewable technology, coupled with training courses and service backup.

Some of these services are already, or will soon be available to remote communities.

The Federal Government has diverted money from the diesel excise tax to the Australian Greenhouse Office Renewable Remote Power Generation Program to offset the high capital cost of renewable energy RAPS. The program is designed to encourage the installation of renewable energy systems to replace diesel power generation.

Under the four-year program, Queensland and the Northern Territory will receive $7 million each, Western Australia will receive $27 million, Tasmania $1.5 million, New South Wales $2 million and South Australia $1.9 million. In addition WA has its own state-funded RAPS scheme which has been operating since 1996 with good success.

While the states can choose on which projects to spend this money, it is available only for the capital costs of the systems and is supplied in a lump sum. Ongoing maintenance costs are the responsibility of the system owners or installers.

Funds from the AGO program will allow many people in remote areas to install renewable technology who otherwise wouldn't be able to afford to. There is the risk communities will be encouraged to install systems that are eligible for funds but which may not be the most appropriate. Unless the owners understand what they are buying, the capital alone will not guarantee system appropriateness or longevity.

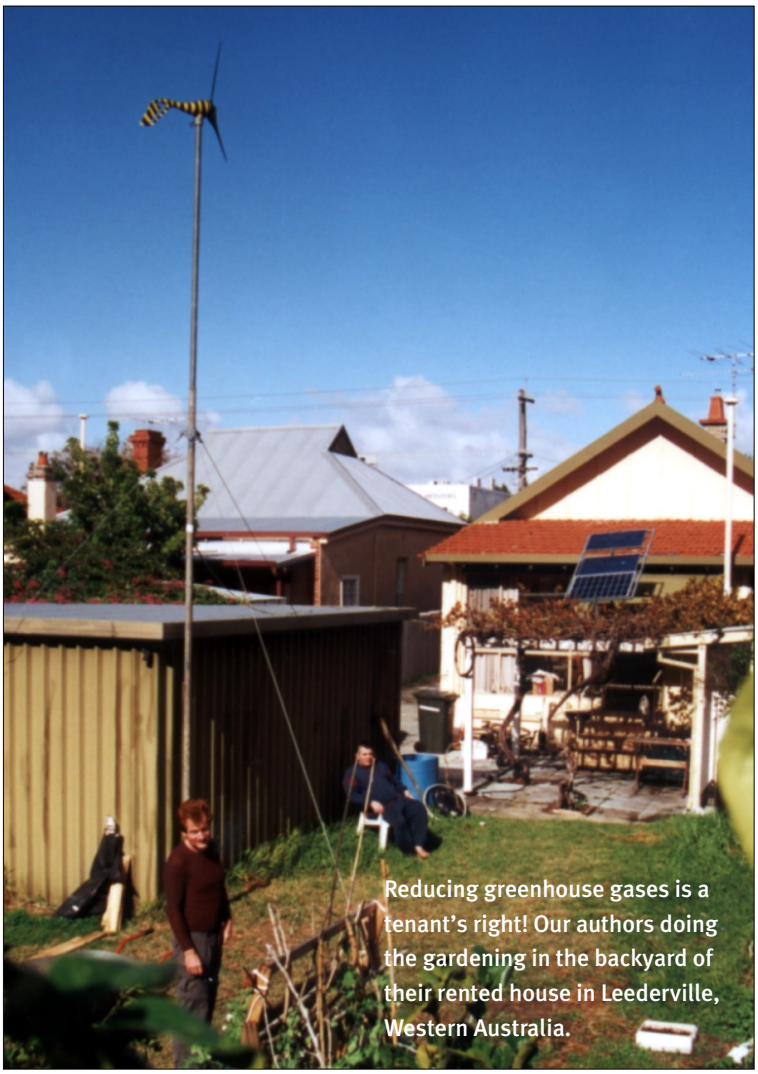
'It is quite possible to encounter a travel cost of $1500 to replace a $2 part. During warranty this is almost always at the installer's expense,' said Mike Farrell. After warranty this cost is footed by the owner, and resulting in systems being left in disrepair if funds are unavailable.

While rebates are essential if renewable energy is ever going to replace diesel in remote areas, the experience with the WA RAPS program highlights the need for effective training and back-up support to accompany the funds. They found that funds without support can exacerbate existing energy supply problems.

CAT runs some training courses where local people can learn about the technology. Renewable energy companies find it's in their best interest to demonstrate and explain the requirements of the system when they are installed. However the current state of affairs sees generators still being preferred due to the 'better the devil you know' attitude. It seems renewable technology still has a way to go before more people will entrust their livelihood to it in remote areas.

Renewables for renters

Staying within the limits of a standard tenancy agreement while running a suburban house almost entirely from renewable energy was the challenge. Three months and lots of fun later it is fully up and running. By Dennis Stanley and Julian Ilich



Reducing greenhouse gases is a tenant's right! Our authors doing the gardening in the backyard of their rented house in Leederville, Western Australia.

Claremont WA

- One Solarex 40 watt panel (free)
- Plasmatronics PL20 regulator
- SEA inverter
- six 40 aH 12 volt gel cell batteries (free)

Cost: $1420

Location: Claremont WA
The first solar system—Julian's story

It all began when I was renting a small two story townhouse in a large complex. I had just inherited a free new 40 watt Solarex solar panel after someone at work had burned a hole through it with a magnifying glass (trying to see if it would increase the output). As I got the panel for nothing I decided it was time to see what it was really like to use a renewable energy system in the home. This first system ran the upstairs lights, my stereo and my then housemate Steve Sertis' stereo.

The initial system comprised the Solarex panel (the hole did little to affect output), six 40 amp-hour 12 volt gel cell batteries connected in parallel, a Plasmatronics PL20 solar regulator and an SEA 450 watt sinewave inverter.

The batteries came from the local wheelchair repair clinic, they had a lot of fairly good to very good 12 volt deep cycle batteries available free of charge. Battery powered wheelchairs would often come in from country Western Australian patients with batteries that weren't necessarily dead, but were replaced because it would cost a lot to have the chair serviced again. I went through the collection of batteries with a multimeter and a large halogen globe to check the loaded voltage before picking the good ones.

They were installed in parallel in a battery box. It turned out that six large batteries in parallel with one 40 watt panel was not effective as there was never enough solar power to fully charge them, and so in time they wouldn't hold charge too well. I decided to put 30 amp switches between three lots of two in parallel. Using the battery pairs in rotation worked much better.

The Plasmatronics solar regulator was about twice the cost of other standard regulators, but its functionality and ability to read the performance of the system day by day made it a rewarding choice. It was exciting to come home and see how many amp-hours came in from the solar panel that day, and therefore exactly how

A 'work in progress' Julian manually tracking the solar panels at Leederville

much we could crank the stereos up that night.

The SEA inverter was chosen because it was moderate in capacity, had no risk of producing hum on the stereos and is reasonably priced. It has never stopped working. However the supply frequency isn't exactly 50Hz, therefore any electric clock that needs 50Hz to keep time didn't work very well. Over a week my innocent looking bedside clock radio lost time and I missed several early morning trains to work before realising what was going on. In addition to losing time I discovered that it drew nearly 10 watts so it will now probably spend the rest of its days in clock radio heaven.

Mounting the solar panel was the biggest problem. The sunniest site was on the back carport roof located on the opposite side of the building to my bedroom, which was not ideal. In addition I was afraid it would blow away and land in the next door neighbour's kitchen. After much procrastination I mounted it on the carport roof, clamped to the vertical fins. For extra storm protection I added wire fishing trace that fixed the panels to large washers which were epoxy glued onto the metal roof. In hindsight this was a bit of overkill. The power cable then ran over the roof to the battery bank.

This basic system operated for about six months without a problem until I dismantled it to move in with fellow enviro-freak Dennis Stanley who was renting a house not far away. We had grand plans to extend my system to include a wind turbine and biodigestor.

Leederville WA

- Two Solarex 40 watt panels (free)
- One Kyocera 80 watt panel
- Plasmatronics PL20 regulator
- SEA inverter
- 12 Century 12 aH 6 volt batteries (free)

Cost: $3100

System two— The Leederville Experiment Dennis' story

I had been living in the Leederville house for some time and had a permaculture garden on the way. I was really interested in Julian's setup. We had similar ideas so he moved in and the project went ahead.

We were on a mission to see how far we could go in a rented house. We wanted to set a bit of an example but we were also curious to see if we knew as much about this stuff as we thought we did. I, being the leaseholder, was acutely aware that as tenants we had to adhere to special considerations.

Dennis checking that battery charge.

• We couldn't interfere with the property—this meant no drilling, no cement footings, et cetera.

• Any energy system needed to be portable—renters tend to move around from property to property at the whim of a landlord, so this is important.

• Nuisance factor. A more subtle consideration was that tenants generally have little sway with the authorities. The first whisper from a disgruntled neighbour could cause the landlord to demand it all be taken down, so considering any negative impact on others around you is very important. The positive impact is that if we manage to raise awareness of these issues then perhaps our neighbour's children will have a cleaner world in which to live.

With these considerations in mind, we began our mission.

The solar system

Our system, which would eventually include an AIR403, called for a whopping 400AH of battery storage. I had previously salvaged some batteries from the forklift at work, so I approached the forklift company for some more. They were very helpful. I was shown a pallet of old batteries and was told to take what I wanted—I took 12 batteries. With the three I already had I hoped to find at least eight serviceable ones. The batteries in question were Century 12A 6 volt 100AH.

I set about rescuing them. I got four serviceable pairs and housed them in a box made from salvaged packing ply. Heavy-duty castors, also salvaged, were installed on the box so moving the batteries around was a cinch.

Then came the solar panels. We wanted to add to the system that Julian already had. We got another Solarex 40 watt panel from his work and added a Kyocera 80 watt from the '12 Volt Shop' to take the total to 160 watts.

I was interested in building a tracker. We looked around and were most impressed with the design of a passive solar tracker that utilised differential vapour pressure to force a fluid from a sunny vessel to a shady vessel, thus upsetting the balance and tipping the panels toward the sun. We decided to start by building the tracking mounting only, and get the solar panels up as soon as possible. A few days in Julian's off-site workshop and the mounting was ready. After a trial assembly we packed all the nuts and bolts into a paper bag and slowly transported it home on the roof racks. I was so confident in the strength of our system I suggested a good wind test was to drive home with the tracker assembled, panels and all, on the roof of the car. Julian thought this was unnecessary.

(As most of you would know, motivation is the principle moderator in any project, and this project was no exception. As a solution we had announced the celebration of our solar system well before it was ready—it was little more than some panels in the shed and a few drawings. Nothing like a deadline I guess. The party was approaching and people were to arrive in only a few hours.)

We took our panels and tracker off the roof of the car, set it on the pergola and lashed it down among the grapes with rope. No drilling or permanent fixtures allowed. The panels were mounted with only a 'little' fuss.

Dennis and Julian invested more than a little creative energy into their system. Here they are pictured attaching the blades to their Air403 which was hand-painted to resemble a bumble bee.

Our Bumble Bee. The Air403 is an important feature of the back yard

(Already our guests were arriving. No food, not even any light, at this stage.)

Still running around with tools and wires, we hooked up the batteries and the inverter and celebrated the installation of our solar system. Our guests helped with the preparation, and with a bit of communal cooking a good night was had by all.

The huge irony was of course that because it was already dark we never bothered to actually connect our panels to the batteries. The lighting we used all night was battery power, originally derived from the grid. There, I've aired my dirty secret but first thing next morning we connected the panels and have been using solar powered lighting ever since. At the moment our tracking system is no more than a loop of rope that you can tie off in any position. That's what you call a 'work in progress'.

Performance

Even through the dead of winter we have kept our head above water. First day we got 42AH and we average between 30 and 40—our record is 52AH per day. We expect much more in summer and hope to even run the fridge

Dennis is not alone in his dependence on mother nature

with a new inverter. It has to be said that in terms of reducing our greenhouse emissions the majority of our savings are efficiency savings that anyone can implement without needing to go to renewable energy.

Try this exercise next weekend. During the day unplug your fridge and turn off everything in your house the normal way as if you were leaving the house for the day. Go out and look at your meter. Is it still turning? This is your phantom load, caused by appliances using power even though they are not being used.

Now go around the house unplugging (or turning off with the switch) different appliances one at a time to find out where your power is going. You can estimate the load by timing how long it takes the disc in your meter to spin one turn, then work out how many spins per day. Divide that by the spins per kWH written on the meter and you have your phantom load in kWH per day. This may sound like a trivial exercise. That's what I thought. Our phantom load was 2kWH per day or one third of our bill. Our main offenders were two stereos left in standby mode and a halogen light transformer that was continuously connected to the mains with the 12 volt side switched.

We now turn all appliances off at the wall (rather than just the remote control) and unplug the bad lamp when not in use. This little effort saves more greenhouse gas emissions than our entire renewable energy system and anyone can do it. We also use energy saver compact fluorescents or standard fluorescents for all our lighting. The savings you make with these lamps will more than pay back the expensive purchase price, provided they actually last as long as the manufacturer claims. My experience here is that you get what you pay for and spending a few extra dollars for a reputable brand will be a good investment. Many of our cheap lamps failed very prematurely. We have had no problems with our Philips ones.

The Air 403 wind turbine and tower

The wind turbine had always been in the Grand Plan but the fear of the neighbourly complaints and the problem of pole placement kept it on hold until we at least had a solar system up and running. Just to make sure it didn't fall through we had purchased it early on in the piece. I recommend this technique for ensuring you follow through with your intentions—a $1000 wind turbine lying under the bed is pretty useless when the batteries are low. It was also around this time that we recruited Adam Coffee, master welder (he says so himself), for the tower construction.

The initial plan was to attach a pole to the outhouse wall, running up alongside the already-existing six metre long sewerage vent pipe. We thought that as these were of similar height and close together, it would make our turbine quite inconspicuous. However, the logistics were quite problematic as we would probably have needed a concrete footing which was not feasible in a rental place. The other concern was working out how to attach it to the wall without drilling and bolting it.

Our proposed solution was called The Big Clamp. It was supposed to firmly attach the tower to the top of the wall using only rubber, many small and intricately welded pieces of steel, and lots and lots of clamping force. It might have worked but seemed like a big hassle. Project momentum was slowing down quite a bit.

Eventually after months of deliberation one day I just asked Julian, 'Why don't we just make a guyed tower and put it at the corner of the shed?' 'Okay' he replied, and the decision was made just like that. So that day work on the tower began.

Our final design consisted of some heavy walled 2.5 inch galvanised water pipe from a local salvage yard, guyed with three salvaged cables to three salvaged star pickets belted deep into the ground. Its base fit into a tube welded to a large piece of angle iron, also belted deep into the ground. Tension in the cables was adjusted with some simple turnbuckles constructed from several bolts, shackles and threaded rod. The turbine itself was mounted two metres above the guys to a piece of galvanised pipe that fit tightly inside the heavier pipe. All in all the tower reached seven metres in height, was very sturdy (thanks to Master Adam) and cost $15 and a small tin of zinc-rich paint.

A use for odd socks

Now the turbine itself has its own story. It was the basic AIR403 land version. It is supplied as rough unpainted alu-

minium and looks pretty industrial. So not being happy with this look, and guessing that the neighbours wouldn't either, I took to it with some yellow and black paint to turn it into what is now known as Our Bumble Bee.

The turbine was simply attached to the top of the tower with its inbuilt clamp system and a piece of rubber for better grip. The wires run down the inside of the tower and exit midway onto the shed roof before beginning the 20 metre journey to the battery box. It was during the installation of the power cable that we arrived at the problem of how to stop the cable vibrating against the inside of the pipe and possibly making lots of noise. It was then that we discovered a most innovative use for odd socks. The cable running inside the tower was carefully wrapped in many of Julian's odd socks. One by one they disappeared down in to the pipe until the whole cable was prevented from hitting the side wall. Problem solved with salvaged materials again.

'We turn off all appliances at the wall ... this little effort saves more greenhouse gas emissions than our entire renewable energy system and anyone can do it.'

And before we knew it, it was all done. The tower was raised, guys were tightened, the turbine was connected to the battery and the system was complete. It was time for another celebration. Little did we realise that the wind was going to pick up appreciably before the next morning and we were to awaken to the sound of whipper-snippering in the backyard. But this be not a whipper-snipper, this be Our Bumble-Bee.

Yes, it was a little louder than we had imagined, and it was not something we would be leaving running often in a residential area, but after installing a large shorting switch the next day we reckoned that Our Bumble-Bee could still be part of our family.

As per usual we just finished installing the ammeter and switch in time for the guests to arrive, and so communal cooking was the call of the night once again. But this time it was done to the sweet sound of Our Bumble-Bee out back and under lights powered by the sun. What more could one want.

Germany leads the quest for a cleaner, greener world

By supporting its wind industries Germany has created more than 20,000 jobs and will generate 21 per cent of its power from renewables by 2010. Story by Christian Ters

After almost one year of long and difficult negotiations between the German energy industry and the German government, it was decided that Germany would phase out nuclear power over 32 years. To achieve this end each nuclear power plant has been allotted a maximum generating capacity, which, once exhausted, would signal the closing of the facility. These generating capacities of power stations are transferable, which could see some stations still operating after 32 years. For example, if one power company runs, say, three power stations, all credits could be transferred to one station which could allow it to remain active for longer.

Nuclear power plants in Germany supply 33 per cent of the total energy demand. As the trend is towards the increased consumption of nuclear and fossil energy, the German Federal Government and the German Bundestag (house of parliament), in agreement with the European Union, have set themselves the objective of at least doubling the percentage share of renewable energy sources in total energy supply by the year 2010. This will help protect the environment and manage global warming, as well as guaranteeing a reliable energy supply.

This objective is part of the German commitment under the Kyoto Protocol to reduce greenhouse gas emissions by 21 per cent by the year 2010 and the German Federal Government's aim to reduce carbon dioxide emissions by 25 per cent by the year 2005, relative to 1990. In order to achieve this target, it is necessary to mobilise renewables like wind energy, solar energy, biomass and hydro power.

Economic aspects of renewables

Currently, renewable resources are insufficiently used, although many are available in large capacities. There will be two consequences if we fail to supply a much larger share of our energy requirements by these sources:

- we will find it more and more difficult to meet our obligations in terms of the climate change, at both European and international level
- we will exclude growth opportunities for our economy.

The German renewable energy association (BEE) expects an average annual turnover of DM8 billion by 2010.

Renewables can help to reduce our dependence on energy imports and therefore make our energy supply more reliable. Currently, the EU depends on energy imports to cover approximately 50 per cent of its energy consumption.

The growth of the German economy is heavily dependent on small and medium-sized companies. Therefore if we use renewables for our energy needs we will create jobs, especially in this economic sector, which is very important for the structure of the Federal Republic of Germany. Furthermore, the production and use of renewable energy sources will promote sustainable regional development, which will help to improve social and economic cohesion within the community and harmonise living

conditions within Germany.

In three European countries—Germany, Denmark and Spain—the governments have introduced minimum prices for feeding renewable generated electricity into power grids. In all three countries the introduction of wind energy converters was based on minimum prices guaranteed by law and this has stimulated market development (initially in the wind energy sector), which has led to an efficient industry with considerable export opportunities. This has countered predictions that the introduction of minimum price systems would hamper productivity.

More than 20,000 jobs have been created in the wind industries in Germany. Production costs and compensation has reduced by 50 per cent since 1991 due to the associated economies of scale and global competition. In other sectors where renewable energy sources are used, the Renewable Energy Sources Act should produce successes similar to the wind energy sector.

The solar energy market

The main problems in the photovoltaic and solar thermal markets are similar to the initial dilemmas of the wind energy sector. The production and installation costs are still higher than the production cost of conventional energy sources. The total costs for the installation of a 3kW PV array for example are about DM 36,000 (AU$30,000).

In fact because of low demand, higher production volumes are not possible, as low market share does not allow economies of scale to become effective. In addition, the external costs in conventional energy sources are not reflected in their price. The conventional energy sources still benefit from substantial government subsidies, which keep their price artificially low.

Grid interactive generation

In the past, the Electricity Feed Law, which became effective on 1 January 1991, provided compensation rates for the wind energy sector. Nine years later, by the end of 1999, as much as 4400 peak megawatts has been installed within the territorial scope of the Act, accounting for about one-third of the capacity installed worldwide.

During a normal wind year, the 7879 turbines installed in Germany produce 8.5 billion kilowatt hours. This is equivalent to two per cent of the national annual electricity requirement. The most northern state, Schleswig-Holstein, is rapidly approaching the 20

per cent mark with an installed capacity of some 1000MW.

The new government in Germany—a coalition of green and social-democratic parties—has now changed the circumstances for the remaining renewables. Primarily the government wants now to support power generation from PVs. Before this national commitment, the states in Germany had their own programs, which varied from region to region. These isolated programs did not have the power to change market conditions or lead to an expansion of production.

100,000 roof and new market incentive program

In September 1999 the parliament started with the so called '100,000 roof program' and the 'market incentive program'. Until 2003 the German Government has committed to support each of the programs with DM1000 million (AU$833 million), including solar hot water systems and heat pumps.

The 100,000 roof program is for solar PV systems only. This program is newly-established and supplies much better conditions for getting a credit than schemes that were already offered by the government. That means that you can borrow at a favourable rate of interest. The loan period is about 10 years and the interest rate is about two per cent, 4.5 per cent less than normal. The credit is based on peak PV output. Therefore a 100 per cent credit is provided up to a peak PV output of 5kW. The maximum amount is DM13,500 (AU$11,250) per kW. Electric current by PVs over 5 kW are encouraged with 50 per cent credits.

Before April 2000 people were eligible for a credit without paying any interest. The impact was enormous. The demand rapidly increased. Before April more than 32 megawatts of PV had been installed. In March the government determined that there was no need to run a program with such conditions. In April the applications were delayed by the Kreditanstalt für Wienderaufbau (KfW) the fund administration body, and in the meantime the German government modified the program to introduce the above interest rates, provided interest-free for the first two years.

The boom on the solar technology market has not stalled because of the interest rates. More applications have been submitted to the KfW to a volume of about 40 megawatts, so incentives have had the desired effect of creating demand for solar electricity. This has caused a supply problem in the short term as manufacturers have full order books and cannot respond instantaneously to the huge demand. Delivery of extra equipment or raw materials can take weeks or months.

In addition the program has benefited other niche markets. Manufacturers like Solarc Innovative Solarprodukte GmbH based in Berlin which develops concepts for applications in the range of 1-500 Watt are recording sales growth. One of its first products worldwide is a solar charger called 'scotty' which charges mobile phones, personal organisers, GPS-systems and small appliances like Walkman or Discman. Although nobody knows for sure how the industry and markets will respond in the long term, it is understandable that PV businesses are choosing to enjoy this harvest period for a while, before making another wave of investments later.

The new market-incentive-program primarily supports solar hot water systems and heating pumps. But there are limitations, which need to be considered. The support depends on the size as well as the type of collectors:

- for collectors up to 100m^2 each square metre is subsidised with 250DM (AU$208)
- for collectors above 100m^2 each square metre is subsidised up to 125DM (AU$104)
- for evacuated tubes up to 75m^2 each square metre is subsidised up to 325 DM (AU$270)
- for evacuated tubes up to 75m^2 each square metre, subsidised with 160 DM (AU$133)

The compensation paid for heating pumps is:

- for heat pumps above 13kW the subsidy is 200DM/kW (AU $166/kW) if you set up a hot water system at the same time, otherwise it is 100DM/kW (AU$83/kW)
- Heat pumps over 13kW with 100DM/kW (AU$83/kW)

Constraints exist only in combination with a solar electricity system.

Renewable Energy Sources Act

The impact on the economic growth was caused by another important decision. The 100,000 roof program and the new market incentive program in combination with the new Renewable Energy Sources Act is an incentive for households, companies and public institutions to set up solar technology or invest in other systems like biomass to produce electric power. The new law was established in April 2000 and was accompanied by a new pricing regime for renewables. In combination with measures aimed at internalising external costs, the purpose of this pricing regime is to bring renewable energy sources closer to conventional energy sources in terms of their competitiveness.

In order to continue to facilitate major improvements in technological efficiency, the compensation rates specified in the Renewable Energy Sources Act vary depending on the en-

ergy sources, the sites and the installation sizes involved. Furthermore, they will decline over time and will remain in effect for a limited period of time. The fact that the rates will be reviewed every two years guarantees that they will be updated continuously and at short intervals to reflect market and cost trends.

One of the great issues is that the 100,000 roof program does not benefit people who had previously installed PVs. Energy companies pay only 27 pfennigs (22.5 cents) per kWH to people feeding renewable electricity into the grid. In economic terms this wasn't enough to warrant the purchase of solar panels. Now the conditions have totally changed and investments in PVs make sense because the compensation to be paid is at least 99 pfennigs per kWH (82.5 cents/kWH).

The maximum size allowed is 5MW for PVs directly fixed to the roof and only 100kW for free-standing panels.

Starting 1 January 2002, the minimum compensation paid will be reduced by five per cent annually for new electricity generation installations commissioned as of this date. Under the Renewable Energy Sources Act the following compensation will be paid for electricity generated from biomass. At least:

- 20 pfennigs (16.6 cents) per kilowatt-hour in the case of installations with an installed electrical capacity of up to 500 kilowatts.
- 18 pfennigs (15 cents) per kilowatt-hour in the case of installations with an installed electrical capacity of up to five megawatts.
- 17 pfennigs (14.1 cents) per kilowatt-hour in the case of installations with an installed electrical capacity of over five megawatts.

As of 1 January 2002, the minimum compensation amounts will be reduced by one per cent annually for new installations commissioned as of this date. The following compensation will be paid for electricity generated from geothermal energy. At least:

- 17.5 pfennigs (14.5 cents) per kilowatt-hour if the installation involved has an installed electrical capacity of up to 20 megawatts, and
- 14 pfennigs (11.6 cents) per kilowatt-hour if the installation involved has an installed electrical capacity of over 20 megawatts.

The compensation to be paid for electricity generated from hydro power and gas from landfills, mines and sewage treatment plants will be at least 15 pfennigs (12.5 cents) per kilowatt-hour. For wind energy the compensation is at least 17.8 pfennigs (14.8 cents) per kilowatt-hour for a period of five years starting from the date of commissioning.

The competition between energy companies has increased over the past two years because the energy market in European countries has been deregulated, which has caused electricity prices to fall. Today you can choose between different products. For example the Bewag in Berlin (the regional Energy Power Company) offers ecopower, multiconnect or classic electric power. The power companies also distinguish between private and business customers.

As a private customer the price for eco-power is actually very high because it is produced by renewable energies like biomass, wind turbines or PVs. The price for eco-power is about 34.9 pfennigs/kWH (28 cents kWH). One of the cheapest types of electricity available is multiconnect because it might be produced by nuclear power plants in Poland, France, Germany. You pay 20 pfennigs/kWH (16 cents kWH). The tariff for business customers is much more favourable.

Solar electricity is now an option for people who do not care about environmental issues, because under the new acts the costs for installation are covered after an estimated 14 years, and after 20 years most households will profit from their PV array.

Outback computing

ReNew hits the road with renewables

Solar-powering portable electrical equipment can be the most convenient and effective way to be independent on the road.

In issue #70 of *ReNew* we explained how to use a solar panel to charge the battery of a laptop computer. This included information about matching the panel size to the power requirements of your computer to enable the substituting of a solar panel for the computer's battery charger or plug-pack.

Here at the *ReNew* office we decided to put this to the test on a recent magazine assignment up north in Alice Springs and the remote desert areas of South Australia.

In the office we use a desktop computer as the main component of our imaging system. We have an Olympus digital camera which we purchased in 1999 to reduce the environmental impacts of publishing by eliminating the need for the polluting chemicals required for film processing.

This camera works really well, and in high-resolution mode we can take up to 16 images which we upload straight onto the computer for use in the magazine. This saves us money too!

When planning the trip up north we didn't want to revert to using a conventional camera, so decided to take a laptop computer with us to enable the camera's use on the road.

Adding a solar panel to the imaging system meant that any photos we took would be the most eco-friendly images around. But better still, it meant that we wouldn't have to worry about finding a mains power supply that we could plug into for a few hours while the computer battery reached full power.

Publishing revolution! This image was taken using a digital camera and uploaded onto a solar-powered laptop. No polluting chemicals or power sources required.

The computer used a 10.8 volt 3.4 amp-hour lithium-ion battery which had a charge life of approximately two hours when used to run the computer. This is not very long compared to more modern computers and it was certainly not enough charge to guarantee use of the computer and camera for the entire two-week trip if we went a long way off the beaten track.

Choosing the panel

The laptop we took was a Toshiba model 660CDT which required a 32 watt solar panel. The laptop's power pack provides up to a maximum of 2 amps, and a 32 watt panel will provide about the same amount of current.

A phone call to Going Solar's retail outlet in North Melbourne led to the loan of a $500, 32 watt Uni-Solar flexible solar battery charger as sponsorship for the duration of the trip (thanks Maree and Ralf!).

We had decided that taking a flexible panel was the best option for our purposes as they are more durable than rigid frame modules. They comprise a Canon nine-layer, triple junction amorphous panel attached to a cushioned vinyl backing material with reinforced stud holes along the edges. This design means that it doesn't have to lie flat and can be strapped to almost anything, which allowed us to attach it to the side of our vehicle when it was stationary or lay it on the ground, depending on the sun's position.

The 32 watt panel was easy to store when not in use, being 1.4 metres long, 0.42 metres wide and weighing just 2.4 kilograms.

Performance

We found that the best way to use the solar panel was as a battery charger. The computer's battery would charge in just over two hours when the panel was in full sun. We usually placed the panel on the roof of the vehicle or draped it across

the front windscreen resting on the bumper bar, with the cable reaching through the front window to the computer inside.

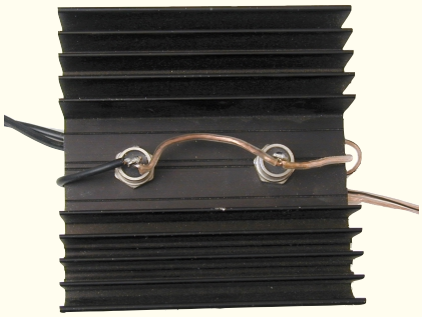
When the sun was not high, or even when the panel was not in direct sunlight, we found that it was still sending some charge to the computer. This meant that we could have the panel up against the inside window when driving the long distances between locations, and the computer battery was still being charged. This worked better than expected, but we could not rely on it to always bring the battery up to full charge.

At one stage we tried to operate the computer straight from the panel when the battery was flat. We found that this was not a good idea and led to stress on the computer and crashes. This ocurred because full output from the panel was not always possible due to clouds shadowing the sun periodically, or maybe just bull dust collecting on the panel causing a slight decrease in output.

Using the panel as an external power source when the battery had sufficient charge was no problem. The computer relied on both power sources, flicking between the two searching for enough current to run. Sometimes this happened continuously depending on the time of day and weather.

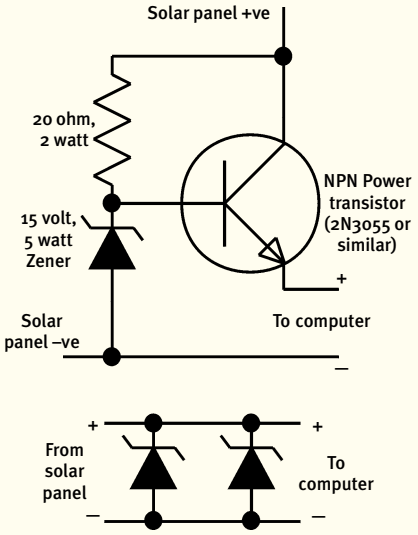
In the end we ran the computer from the battery most of the time, using the panel as a charger when the computer was not in use. We found this arrangement was more convenient on the road as running the computer from battery meant there were no leads to worry about. This arrangement was sufficient for our purposes as uploading images doesn't take very long, and we never ran the battery flat at a time when we would be inconvenienced waiting for it to charge.

Carrying spare batteries is a logical solution if high-use was a priority. Making sure the computer's power-down functions are activated is also a good way to ensure the battery charge lasts for longer.



Making it work

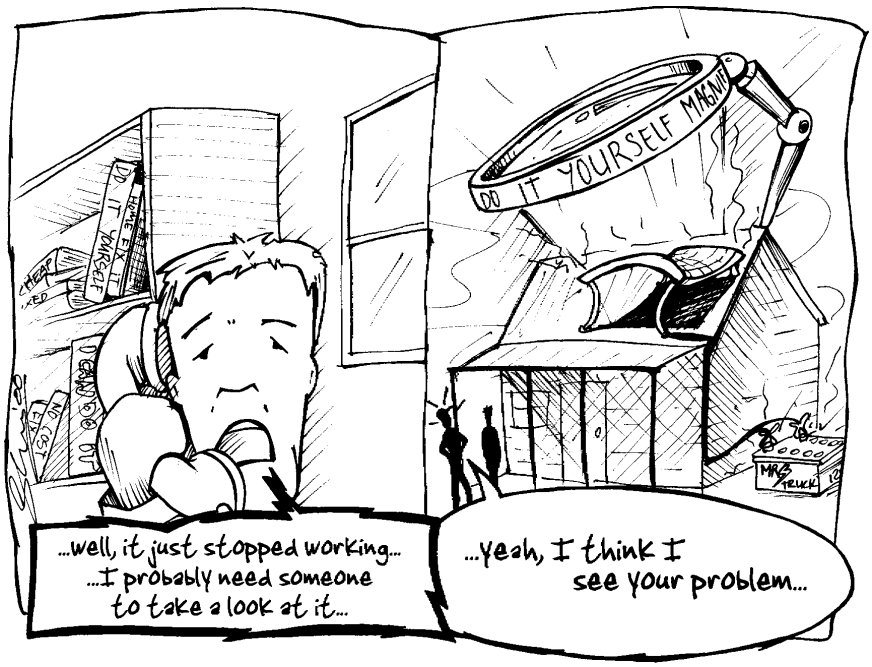
While the laptop required a regulated voltage of no more than 15 volts, the solar panel can provide over 20 volts when the battery is charged. To prevent possible damage to the computer, we decided to use a very crude but effective regulator. This consisted of no more than a pair of 20 watt, 15 volt Zener diodes wired in parallel (to handle the possible 30 watts or more from the panel) mounted together on a large heatsink. The circuit diagram can be seen at right, and our test unit above.



However, if you don't know where to get Zener diodes of this capacity, you might want to consider the other circuit shown, which uses a 5 watt Zener to provide a fixed voltage to the base of a power transistor, also mounted on a large heatsink, which then controls the voltage to the laptop.

Common RAPS mistakes

Lance Turner



Here in the ATA head office we hear many stories of renewable power systems that don't work as intended, or that have failed altogether. The reasons are many and varied, but most of them seem to boil down to one common theme—ignorance of some part of the system design or maintenance.

No matter what the reason, systems that don't work properly have been the bane of the renewable energy industry for many years. There would not be a single installer who has not heard something like 'My mate had a solar power system, and it never worked right.'

Comments like this do nothing for the industry, as most designers and installers are aware. This is one of the reasons that the Sustainable Energy Industry Authority has worked to set up an accreditation system for those who wish to install renewable energy systems. But while this is great in theory, there are still problems that even the best intentions cannot overcome.

What's more, like it or not, the general public will still continue to try and install their own systems. Whether this is due to an interest in understanding how it all works, or just to save the installation costs, it still happens and always will.

So, what are some of the problems that are commonly found in renewable power systems? We have listed a few below, along with the reasons for them, and how to avoid or fix them.

Systems designed to a budget, not power needs

This problem is very common, and can often be the cause of many of the other problems mentioned later in this article.

Renewable energy systems are expensive, and cost is often factored into system design, but it should be understood that doing this will always cause other problems somewhere along the line.

Also, while you may think you are saving money initially, cutting corners means you will have a system that is most likely running on its limits a lot of the time, causing premature failure of various system components such as those listed earlier. This, of course, costs money to fix, and spending an extra thousand or two initially may save you a lot more than that a few years down the track.

Another problem comes when buying a secondhand system. These appear in places like the *Trading Post*, and while they may appear to be a bargain, they often are not. It is very unlikely that an advertised system is going to be ideal for your needs—the chances of someone else having the same total loads is unlikely. What's more, buying a secondhand system means that you are also buying the design of the system, and if it is poorly designed, then you will end up inheriting these problems.

If you are looking for a system that will meet your needs without being a solar boosted fossil fuel powered system, then you must do a full load assessment and design the system accordingly—scrimp on the system components, especially the batteries, and you will regret it, and it will end up costing you a great deal more than the initial savings.

All of these things, and more, have to be factored into the cost of a system. If the cost is beyond your means, then you must reduce your loads. This is not hard to do, and it is surprising where you can save power. For instance, an alarm clock may draw only two watts, but it will keep that 2000 watt inverter running all the time. At such a low load, the inverter will easily be drawing 10 watts or more, which can add up to 100 to 200

watt-hours more than necessary per day, depending on other loads in the system.

Add to this all of the other phantom loads in the average house, such as appliances in standby mode, and the savings can be in the order of 0.5 to 1kWH per day or more. Savings of this size can considerably reduce the size of a system, and allow you to buy within your budget.

While undersizing of a system is often caused by the lack of design experience, qualified installers also install systems that may not meet the energy needs of the owners. We regularly hear of systems installed by qulified installers that have proven too small. The main factor here seems to be the budget restrictions of the customer.

As you will be starting to realise, many of these problems are interconnected. The solution, of course, is to do the sums properly, and make sure that the people using the system understand its limitations. This is one of the most important aspects of a successful renewable energy system—not expecting more than it is designed to give.

Specification of wrong or unsuitable components

This seems to be a common problem, I often get phone calls from people who have had problems due to the wrong component being used.

A recent example of this was the supply of a 20 amp regulator to be used with four 75 watt BP Solar panels in a 12 volt system. These panels are rated at 4.45 amps each, giving a total of around 18 amps. However, any installer should know to allow at least 20 per cent overhead for current rating of a regulator, with a preference of 30 per cent or so.

This is due to a number of factors, but a common one occurs when you have a clear, bright, but cold day, with light cloud. Under these conditions, a panel may produce more than 110 per cent of rated power or more. Conditions like this are not uncommon, and for the system above, the regulator would be running at its maximum limit.

Another factor to be considered, especially with power handling devices like regulators, is that the closer you push the electronic switching devices inside them to their limits, the hotter they will run and the shorter will be their life. So, it makes sense to specify a unit with that extra capacity.

All system components can be incorrectly specified. For instance, an inverter not designed to run in extremes of temperature should not be locked in an

unvented battery shed, unless you want it to have a very short life. This applies to most other components as well, heat is a big problem in summer, and can damage many parts of a system. Batteries, especially, are susceptible to damage when the temperature exceeds 38°C, as positive plate corrosion increases past this point.

One component, if you can call it that, which is often sized incorrectly, is the cabling in the system. All cables suffer voltage drop along their length when a current is running through them, and an excessive drop means lost power and excessive cable heating that, in extreme cases, can lead to cable damage and even fires.

This is one aspect of a system that is often overlooked by the do-it-yourself installer, and has resulted in many systems being unable to perform as expected. The lack of understanding of cable sizing can cause many strange problems in a system. An example told to us by Peter Pedals of Rainbow Power Company is that of multiple lights on one circuit. One light works adequately, but when other lights are switched on they progressively become dimmer until their light is unusable.

No fusing

This deserves a heading all of its own, as it is a very common problem, and probably the most dangerous. Even a small lead-acid battery bank can provide a lot of current into a short circuit, and can quickly turn you house wiring into a large heater element, burning the house down in the process.

The idea of fusing is not just to protect the appliances attached to the batteries, but to protect the cables. The fuses must be rated to adequately protect all of the cables in a system, so relying on the main 250 amp battery bank fuse is not good enough. As you decrease wire sizes, you need extra fusing.

This means that the wires from the battery to distribution panel should have a large fuse, such as 250 amps. The smaller circuits coming from the main distribution panel should each be protected by a fuse that is rated at or less than the continuous current carrying capacity of that cable.

Of course, while fuses are probably the most common system in use, you can use circuit breakers if you wish. They have the advantage of being instantly resettable, without the need to replace anything, and they can also act as disconnects for the various circuits.

Systems not designed for expansion

Now this is a common problem, and it may occur for a number of reasons.

Though a system may be sized to suit the loads currently used in the home, little room for expansion may be available. So, if a new appliance is added to the home, the occupants may soon find their batteries going flat all too often, with excessive use of the backup generator being required.

The solution is obvious—make sure that the system is designed with enough spare power to cover any purchases of new appliances likely for at least the life of the battery bank, which will be around 10 years or so.

How much extra capacity should you install? That will depend on whether you are a tech-head, and like all the latest gadgets, or prefer the simple life and can easily do without that electric hot air corn popper.

Reliance on one energy source

Let's face it, when most people think of RAPS systems, they immediately think of solar panels. Solar is easy to implement, and works anywhere, though it is better in some places than others. What's more, you don't need a reliable source of water or wind to produce power, nor do you need high towers.

Its simplicity makes solar the most attractive solution in most cases, and many systems end up using only a solar array and a fossil-fuel powered generator as a backup. But is this the best way?

In many cases, no it isn't. In many sites it will be possible to use other sources of energy, and quite often they can be cheaper than solar panels. This means that a 1500 watt solar array could be replaced with a 1000 watt array and a 400 watt wind turbine, and the resulting system may perform better and be cheaper.

Current solar panel rebates aside, wind turbines are cheaper per watt than solar panels, and will perform adequately in many sites, especially along coastal areas, where winds are strong and persistent. Remember, just because there is not much wind at ground level, doesn't mean that this is the case at 20 metres up. If you are unsure of your site, one way to tell is to put up a tower with an anemometer on it and record wind speeds.

There will, of course, be places where wind doesn't work so well. Many areas of inland Australia have low average wind speeds, making them unsuitable, or at least less financially viable for wind power.

The number of suitable sites for water power is far less again, requiring either a fast moving river or stream, or one with adequate head to drive a suitable turbine. However, if you have such a site, even if it is a long way from the house, seriously consider it. Power can be generated at a relatively high voltage for transmission over long distances with low power losses, and then converted to the battery bank voltage at the other end.

The upshot of this is that, in many cases, relying on solar alone is not the best thing to aim for. If the opportunity exists to use another renewable energy source (or even two) then it should be investigated, not dismissed because it may seem too hard at the time. Besides, in the long run, it may save you some money and extend the life of the system's batteries by reducing their average depth of discharge.

Poor system maintenance

Most RAPS systems are not 'set and forget', though many people would like them to be. While a system can be made close to this, there will always be some maintenance.

Batteries often suffer the most from poor maintenance, whether it be from loose connections or, more commonly, incorrect electrolyte levels.

Most system components can suffer if they are not looked after, and this also applies to the generating equipment. While solar panels usually just need an occasional cleaning, wind and hydro turbines need regular inspections and maintenance. Most of these machines come with a maintenance schedule, and this should be adhered to as much as possible. Remember, replacing the bearings in your wind turbine every two or three years could save you from having to replace the whole turbine after five years due to a serious bearing failure.

No safety signage

Another common problem not often thought about is that of safety signs.There are numerous signs required for RAPS installations, including no-smoking warning signs on the outside of battery sheds, battery safety and emergency instruction signs, and even labelling of the various system components and power controls, like fuses and disconnects.

System shutdown procedure signs are also a good idea, it is possible to damage system components by, for instance, disconnecting the battery when full charge current is still available from the solar array. The sudden jump in voltage can easily damage any appliances connected to the system.

Planning your system is not as hard as it sounds. The ATA sells a booklet, *Solar Electricity—Plan your own solar electricity system*, that provides enough information to allow you to produce an accurate plan of your system requirements. It costs $5.50 (inc GST) plus postage. See our books page for more details.

Revaluing 'rubbish'

Reclaiming useful items from landfill has real environmental and economic spin-offs. Emma 'skip-scab' Tucker discovered 'tip shops' are also a renovator's dream come true

An obsession with junk runs in the family. My mother almost got trapped in a skip at my primary school while retrieving craft materials that had been throw away. My uncle's yard looks like something out of Wacky Wednesday with lampshades suspended from trees and other reclaimed items sitting in piles.

So it's no wonder that I can't pass a skip without checking it out. Over the years I have scored a huge blackboard, desks, books, computer bits and pieces. Some items have been forfeited because of a lack of a car, having been carted off before collection can be arranged.

About three years ago I met a woman who had lined up a job at the tip shop in Hobart. A facet of her job was to scavenge for materials off the tip face, which were then sold in the adjacent shop. Being an old hand at salvaging items at tips, and seeing first-hand the incredible things that people chuck out, I was impressed with the common sense in intercepting reusable items and reselling them.

In Hobart it was a group of concerned citizens that established first the tip shop at Glenorchy in 1994, followed by a similar facility at McRobies Gully Road in 1995. They were concerned that reusable goods were ending up in landfill, and got inspiration from a similar operation called Revolve in Canberra. The McRobies Gully Road shop is still run by the same collective. It is a community-orientated organisation with a co-operative set-up where the employees are also the employers.

When seeking to renovate my own house, avoiding wasteful building practices was one of my main priorities. So I was thrilled when I came across a 'tip shop' close to home.

Your choice of best seat in the house! Tip shops can take some of the effort out of sourcing cheap second hand materials.

The Eaglehawk Recovery and Sales Yard beside the Eaglehawk landfill site, just outside of Bendigo in Victoria, takes some of the hard yards out of finding construction materials and fittings. For those of us who get a fission at the sight of a skip and the treasures it may contain, a visit to the yard it is akin to being a kid in a lolly shop.

When aiming to build or revamp a house on sustainable principles, it is integral to ensure all aspects of the building process aspire to this. Most people consider the source of household furniture and the materials used, but forget that the labour component needs to be sustainable too.

How many people cite incredibly low figures for the construction of their houses, but do not include in the final price tag of the project the cost of skip-scabbing and sourcing materials over a long time frame, let alone the potential cost of storing these materials.

The Yard has also streamlined the tipping process to prevent the disposal of useful or reusable materials into landfill. Up until I took a load of rubbish to the tip, I assumed that the yard salvaged for goods straight off the tip face as in Hobart and Canberra, but soon found out that they intercepted any useful material before it hit the tip face.

I recently went through the process of taking a load of 'rubbish' to the tip (knowing that any thing useful would be retrieved). The first step is paying the drop-off fee, which is dependent on how much stuff you have.

Once we had parted with our $4.50, we drove on to the inspection canopy

The Eaglehawk Recovery and Sales Yard serves as a model for best environmental practice.

where we had a chat with a staff member of the yard who checked out our load and pulled off a kitchen cabinet. We later saw this in the sales yard adorned with a $20 price tag.

Staff separate the materials into recyclable materials and 'goods'. The recyclables are sold on to recycling companies and the goods are loaded onto a truck or ute and transported down to the yard to be resold. The yard encourages people to drop items off directly.

What's there

A wander around the yard in Eaglehawk reflects what fortunes people throw away. There are all manner of household items like stoves, fridges, crockery, kitchen appliances, doors, windows, loos, baths, basins, chemical storage containers, vacuum cleaners, bikes, toys, building materials, firewood, furniture, electrical parts, tiles, et cetera.

Michael Klerk of Hobart's Resource Tip Shop likens a tip face to an archaeological dig. You can glean a sense of history and of societal values by what ends up there. The material evidence of broken relationships is often apparent. The more modern an item often the less reusable it is. A bar fridge full of still-iced beer that turned up at one tip could surely tell a tale.

Landfill angst

Councils are increasing aware that at the present rate of waste disposal dumps are fast filling up and the ongoing costs of maintaining landfill sites and the high costs of finding land to replace tips that have been filled is unsustainable. More than 3440 tonnes of material (see box) was diverted in a 12-month period at the Eaglehawk yard. It is a model of best practise and its success is being investigated by local councils from Mildura, Swan Hill and Moama.

According to Peter Buck, supervisor at the Eaglehawk Recovery and Sales Yard, when the yard opened in 1994, it was estimated that the landfill had 15 years left in it. Six years later this figure is between 15 and 20 years.

The yard is also a bonus for the local community. It is an independent economically-viable entity run as a non-profit organisation. It employs seven full-time and three part-time staff, and runs three vehicles. The Resource Tip Shop in South Hobart employs 16 people on a standard four-day week.

There is no reason why every tip shouldn't have a tip shop. The community and environmental spin offs are enormous—as is the excitement of poking around for that serendipitous find!

Material	Tonnes
car bodies	80
light metals	780
heavy metals	520
non ferros/ferrous metals	52
batteries	26
firewood	104
gas bottles (300)	2
rubber	520
paper/cardboard	20
glass	27
plastics	227

In the year 98/99, 3440 tonnes of waste material was diverted from the Eaglehawk landfill. The tip shop has average daily sales (various) of 3t/day.

Contacts

The Eaglehawk Recovery and Sales Yard: Eaglehawk VIC (03)5446 3467

Revolve: Fyshwick ACT (02)6239 3691, Symonston (02)6295 70141, Belconnen (02)6254 8989

Resource Tip Shop: South Hobart TAS (02)6234 3772

A History of the ATA—20 years on

Andrew Blair

The solar workshop was built by a band of dedicated volunteers, and is now the home of the ATA National Office.

The Association had its origins back in the 1970s. With some people concerned that we humans were using up fossil fuels and polluting our planet, various groups formed in an attempt to provide an alternative to this consumer lifestyle. One of these groups was the Friends of the Earth which was particularly opposed to Nuclear Power and the use of Uranium.

A meeting was held in a church room in Carlton, an inner Melbourne suburb in Victoria. Steven Ingrouille, who called the meeting, remembers that he planned for 40 people but when 200 turned up they had to change the venue to the main hall. With such strong interest the Alternative Technology Co-operative was born. For several years, Friends of the Earth provided it with a home.

The interests of the members varied but the main theme was to make less impact on our planet by actually doing something, and not just talking about it. Bicycles (and bike trailers) instead of using motor cars, mud bricks, solar, water, and wind power, energy from crops by the production of oils or alcohol, composting toilets and methane gas digesters were all techniques for reducing the adverse impact of people on this earth.

One of the outcomes of the formation of the Alternative Technology Co-operative was the establishment of a trading place for the members, a place where they could sell their goods. Going Solar was established at 375 Queen Street, in Melbourne by Stephen Ingrouille and Tony Stevenson.

Mudbrick moulds, the Dalrak mudbrick press, spinning wheels and bicycle trailers were some of the strange alternatives available from this interesting but off-beat shop. A ceiling fan powered by a photovoltaic solar panel hanging out the window was one of the unusual displays.

With the main motivators of the co-operative now caught up with the running of a retail business, the co-operative languished and some three years after the Going Solar shop was started a new organisation was established, The Alternative Technology Association.

Mick Harris was the leading force in this new association. It was recognised that the good news of alternative technology needed to be spread not just to those who lived in Melbourne but also those who lived in country areas and in other states of Australia. They were exciting times when Mick produced the first issue of *Soft Technology* magazine.

Typed on an old typewriter and with pictures pasted in, it was photocopied and stapled together. Mick recalls that the first edition of *Soft Technology,* published in June 1980, had 18 pages and was sold for the princely sum of 85 cents. The first 100 copies sold out and another run of 100 copies was produced.

Changes over the years

The main aims of the association have remained unchanged, the promotion of sustainable technologies, a reduction in the use of fossil and nuclear fuels and a reduction in the use of all resources. The earth is a fragile ecosystem and we have an obligation to care for it.

However, the technologies have changed considerably and it is the technology that has been the focus of this association and its publications.

In the early days the technologies that were being advocated and the equipment being sold in the alternative shops included equipment that was well know to country people, but was being rediscovered by city people, many of whom had never lived in the country.

For country people the idea of generating electricity or pumping water from the power of the wind was nothing new. Similarly they had been using firewood for cooking and the production of hot water since the first white settlers came to Australia. They understood about hydraulic rams, hand pumps, motors, generators and batteries for electric power.

Added to these old technologies were newer technologies such as solar water

heating and solar electricity. These had not been seen before and provided exciting possibilities for those who wanted to give this self-sufficient lifestyle a try.

For those unaccustomed to the skills of self-sufficiency the whole idea was mind blowing and very exciting. Alternative lifestyle books were full of stories of people doing their own thing. Stories of mud brick houses, combustion stoves, chooks and ducks, Daisy the cow and Bugs the pet rabbit were as much a part of the family as the children.

People leaving life in the city to lead a self-sufficient life on a block of land in the country felt like pioneers. They were breaking with their past. They were discovering new things in their environment and in themselves. It was so exciting that they wanted to tell the world about it. *Soft Technology* was one of a number of magazines that encouraged them to tell their stories.

Throughout all of this period *Soft Technology* magazine concentrated on the equipment and the ideas that its readers had tried and which they were keen to share with each other.

Spreading the word

The Alternative Technology Association has never been one to just sit round and talk. It has been an action organisation and it still is. It is this ability to involve its members in doing something that makes it a very special organisation.

The Victorian Government through its Energy Information Centre was advocating the use of passive solar house design. Some of the members of the ATA refurbished a normal suburban house along these lines. Being in need of a place to make their project ideas become reality, they decided to build a workshop based on the same principles.

Solar Workshop

The Solar Workshop was built over a long period of time by a small group of dedicated ATA volunteers at CERES in East Brunswick (CERES was originally established as a community park and gardens). The workshop featured walls of basalt stone and a huge north facing window to capture the winter sun. It had its own wind generator, photovoltaic array, batteries, inverter, lighting and solar hot water system—all demonstrating just what was possible.

The workshop was used for the running of various education courses. Many school children visited CERES and the solar workshop was part of their tour. The Association provided many of the displays that were part of the former Brunswick Electricity Energy Park. More recently the workshop has become the National Office of the ATA.

Adult education courses

Hands on practical courses were run in the Solar Workshop; courses such as wind power, solar hot water, low voltage appliances, home welding, alternative building techniques, rural water supply, and power away from the mains. All of these course involved both theoretical, and hands-on practical components. The courses were directed by people with significant experience, usually ATA members.

Some of the courses were run through the Council of Adult Education and were open to the public. Invariably the course concluded with a practical session in the Solar Workshop. These courses are still being run at the CERES site.

Mobile displays

As part of its on-going commitment to show the world alternative technology equipment, members took displays to schools and public functions. Using a member's station wagon and a trailer for transportation was difficult and time consuming. What could be transported was limited. There had to be a better way of doing things.

The first Energy Display Trailer appeared in 1989. It allowed the display items to be properly packed away and stored. When a member wanted to present a display, the trailer was hooked onto their car tow bar and away they went.

Over the next few years the trailer was used to present the message of alternative technology at many schools and community events. It was a huge break-

John Molenaar, the ATA's education officer during the mid 90s, with participants in the solar model boat and solar model car challenges.

though and very successful.

A two wheeled car trailer however was still too limiting and a semi trailer display was planned. The result of this planning was the 10 tonne, 12 metre long Energymobile. The interior had a large array of equipment, displays and information. Photovoltaic panels and wind generators on the roof provided the power for the displays, which were made interactive so that they could be operated by the visiting general public.

The Energymobile attracted great interest where ever it went and government funding was obtained to take it on tours all around Australia. It was a brightly coloured display, and along with enthusiastic members of the association, it made a big impression.

It made the old energy trailer look very tired and rather old-fashioned by comparison. Although the Energymobile was taken to schools it was difficult or impossible to manoeuver in the restricted spaces available at many of them. Often, schools could not even get a booking as the Energymobile was occupied elsewhere. It became obvious that a new trailer was required and the Solar Shuttle was built in 1994. The Shuttle had many of the displays of the Energymobile but in a more compact format.

More recently the Recycle Factory, another trailer-based display, was set up to educate people, and school children in particular, about the technologies of recycling.

Media

From 1993 to 1996 the ATA did regular radio spots in Victoria and NSW. Members provided expert knowledge and opinion in energy discussions. Not only did this provide an interested public with information but continued to provide the Association with exposure and significant credibility.

The Association still continues to do occasional radio interviews on stations including 3LO, Triple J, 3CN and ABC Regional Radio, and these always generate considerable public interest.

In 1995 the ATA's web site was established by a dedicated group of computer-savvy volunteers. The site allows people from all over the world to access information about the ATA, its resources, and renewable energy in general.

The site includes sections publications, including numerous articles from back issues of *Soft Technology* and *ReNew*, as well as sections on the mobile educational displays and other ATA projects.

ATA across the country

Interstate readers of *Soft Technology* realised that although they were getting information from the magazine, they

wanted to meet other members. ATA branches were established in all states of Australia, starting with Sydney, Canberra and Brisbane in the early 90s. These were followed by branches in Tasmania, Adelaide, Perth, Alice Springs, several in regional Queensland and even one in Auckland (NZ).

Publications

Soft Technology, and later *ReNew*, was sent to various individuals all over Australia and in fact the world. The distribution through shops was handled by Gordon and Gotch and *Soft Technology* appeared in newsagents from 1992 onwards. This greatly increased its circulation.

Alternative Technology Australia was a book put together, using cut and paste method, based on the first 12 editions of *Soft Technology*. *Build Your Own Green Technology*, a book containing the more popular articles from *Soft Technology* sold its first print run of 3000 copies and was joined in 1994 by the *Green Technology House and Garden Book*.

A whole range of information leaflets were also produced around this time. These were available for sale on the Energymobile and at other community events. They covered such topics as solar fruit drying, low voltage appliances, planning a wind generator system, building a solar cooker, water power, and recumbent cycles, and were designed to provide answers to often asked questions. In most cases they promoted ideas rather than commercial products.

Finances

In the early days of the Association the enthusiasm and the time of the few members was what allowed the organisation to exist. There was a small annual subscription to help offset the expenses, but like most voluntary organisations it was the commitment of the members that kept it going. The first issue of *Soft Technology* provided some real income but was very little reward for the work that had gone into putting it together.

Active volunteers produced many of the ATA's displays. Here a small group are making the Solar Workshops' solar water heater

When the Energy Display Trailer was taken to schools this provided a modest income. The main operator for many years was Noel Jeffery and by taking only his costs and no wage the trailer provided income for the Association.

Work on the Solar Workshop was helped with a grant of $3000, which provided the concrete slab floor.

When the Energymobile was planned a grant towards it was obtained from the Victorian Government through Energy Victoria. There was also federal funding for the tours that were run throughout Australia.

By the mid 1990s the Association had expanded considerably and income from the sale of the magazines, advertising, publications and membership as well as government funding meant that the Ross House office required regular paid staff to be in attendance. The payment of $100 a day was the same for everybody, including the driver of the Energymobile.

The Association was growing too fast and there was a significant cash crisis. The Energymobile, although supported by government funds, was in fact being subsidised by funds from other sources. The Breamlea windgenerator, originally purchased from the defunct State Electricity Commission of Victoria was sold to member Michael Gunter, which provided some cash. There were too many office staff, and for a while things looked grim. A committee, including several people with financial and business expertise, was elected in the mid 90s. Magazine sales and memberships increased. The proposed sale of the Energymobile was averted and the Association emerged intact from a rather rocky stage of its history.

Who made it all happen?

There are many people who have contributed to the ATA, most of who cannot be acknowledged in this short history. Many were volunteers, working on the trailers or the Energymobile, on the workshop, in the office, on the committee, providing articles, photos or drawings for the

Arguably the most famous face of the ATA, the Energymobile took renewable energy to people across the country.

magazines, and others as employees. Some stand out for their contribution.

The Association has a history that it can be proud of, due to the persistence of a comparatively small group of active members through good times and bad. It is this persistence that has made the Association so significant and successful.

Tony Stevenson was one of the first and most enthusiastic ATA members. He took part in radio programs talking about alternative technology. Along with Steve Ingrouille he established the Going Solar shop in Melbourne. His passion for windpower made him one of the best informed practical wind generator people in Australia.

He established his own business, Survival Technology, in the outer Melbourne suburb of Croydon North providing his customers with wind and solar systems. He was a major force behind the building of the Solar Workshop. A founding member of the Alternative Technology Retailers' Association, Tony was busy, optimistic and enthusiastic about his and other people's achievements. Tony knew so much that many people relied on him. This put under ever-increasing pressure, a pressure that he could no longer stand and in September 1995 took his own life, having contributed enormously to the technology which he saw as the hope for our polluted world.

Steve Ingrouille has provided a steady influence on the Association throughout its existence. As the owner of the retail outlet, Going Solar, he was always ready to write an article and provide advertising for the magazine. He has a good knowledge of products and he does not keep this information to himself but has always been ready to share it with others. Steve's open and honest approach to the industry is something that has made his business in North Melbourne very successful and has had a significant influence on the ATA.

Mick Harris had very ambitious ideas from the outset. It has been his ambition and hard work that has resulted in much of what exists today. He used his skills to produce the magazine and books, the sales of which have provided significant income enabling the ATA to survive. He has lobbied politicians, manufacturers, and advertisers and planned the Energymobile tours. He acted as driver and chief speaker, selling the alternative technology concept to parliamentarians, those who visited the displays, and those who listened to him on the air waves, as well as the members of the Association itself. He ran the office at the time when the staff numbers were at their highest. Always convincing and enthusiastic, Mick

worked incredibly long hours. He eventually took a break in 1994 and he now continues his contribution on a more controlled basis.

Alan Hutchison has been involved since the ATA's inception and produced frequent articles for *Soft Technology*. They were technical by nature but Alan made them readable and provided all the detail required for people to make whatever it was that the article was about, be it an anemometer or a solar regulator. Alan has his feet firmly planted on the ground and he brought to the association a pragmatism that was lacking in some of the head-in-the-air enthusiasts.

Noel Jeffery almost single handedly did school tours with the old Energy Display Trailer between 1989 and 1991. With an old Volkswagon Kombi van and the trailer he travelled all over the state. As a retired school teacher and principal, Noel had a lot of contacts that he used to get his displays into schools. Noel loves to talk and this gave him the opportunity to enthuse over the possibilities of alternative technology. He made models which demonstrated the principles involved and this skill persists to the present day as he presents his *Treasures from Trash* in *ReNew* magazine.

Bruce McKenzie was largely responsible for the creation of the Energymobile in its present form. He contributed many ideas and articles based on his own experience with alternative technology. He conducted education courses and was a driver of the Energymobile.

Ross Horman was another Energymobile driver and has stories to tell of the problems that beset one of his tours when the motor was being run on diesahol, a diesel/alcohol mixture. At one stage, while trying to stick to a very tight schedule, the truck just refused to go. Eventually it was discovered that the experimental fuel had blocked the filters.

Libby Anthony has acted as General Manager for the association for four years. Libby's insightful understanding and attention to the details that matter have seen the Association grow under her careful direction.

Imelda Evans and Claire Beaumont were two people who were pivotal in bringing *Soft Technology* into the mainstream. They took what was basically a tech-heads magazine and massaged it into a product far more appealing to the general public.

Lance Turner took over much of the work of ensuring that the magazine *Soft Technology* and later *ReNew* continued on the same high standard when he started in 1994, work he is still doing.

Michael Linke worked on *Soft Technology* and *ReNew* for over three years, and greatly improved the format and layout. Under Michael's direction, sales figures steadily increased, and *ReNew* has become a popular and diverse magazine.

Many people have contributed to the Association and the production of the magazine and these include *Adrian Oakey, Bob Fuller, Adrian Braun, Nikki Brand, Dieter Gunter, Trevor Robotham, Herb Wildes, Gunter Wilke* and *Chris Moss.* More recent contributors, both staff and volunteers, include *Suelette Dreyfus, Erika Maksem, Alex Zafirellis, Michelle Douglas, Erica Charola, Kris Lakusa, John Molenaar, Herman Out, Brendan Eisner, Alison Sutherland, Simon Brink, Joanna Tierney* and many others.

The future

For years Steve Ingrouille has said how tired he gets of people saying that solar technology is the technology of the future. He says that it is here and available right now, and of course he is right. It is like buying a car. There will always be improvements in the next model but what is available now works well. If you wait for the improvements then the chances are that you will die waiting.

The Association is made of doers, not waiters. The impressive thing is what these doers have done over the past 20 years. They have changed an industry from being alternative to mainstream. The name Alternative Technology Association may need to be changed, but one can be assured that whatever the name, the members will continue to push the boundaries of technology as they actively seek a better world for themselves and all people.

Build Your Own Smart Datalogger

by Lance Turner

When we last covered datalogging, back in issue #71 of *ReNew*, we looked at using an old PC as a means of monitoring and recording data from many sources. We also mentioned that we would be looking at using a cheap microcontroller kit to perform a similar task using much less power.

Microcontrollers are basically a complete computer on a chip. They contain nonvolatile RAM (you don't lose the program when power is removed), working memory, and writable memory for data storage. They also have numerous input/output pins that can be individually configured, and many now have analogue to digital converters built in, so they can accurately measure voltages directly. And all this can usually be bought for less than $20 per chip!

We looked at a number of different units, but we wanted one that was readily available, relatively cheap, was versatile and could be expanded. Eventually I came to the web site of Dontronics, based here in Tullamarine, and run by long term microcontroller guru Don McKenzie.

Information overload

Landing on this site is quite confusing, even for the experienced electronic enthusiast, and there is an awful lot of jargon all over the place that assumes prior knowledge of these devices. However, there is a 'Newbies' button which takes you to a page that explains things a bit more clearly, and points you in the direction of one of Don's more recent developments, the Little rAVeR kit. Why the weird capitalisation? Well, this kit uses the AVR microcontrollers from Atmel. These micros have from eight to 40 pins, from one to eight kilobytes of flashRAM for program storage, and from 64 to 512 bytes of eeprom for data storage.

The great thing about these modern micros is that they can be programmed directly from the parallel (printer) port of a PC in a matter of seconds. They can be programmed up to 1000 times, and they can write to their internal eeproms at least 100,000 times, so you are unlikely to wear one out. As mentioned before, some of them also have up to eight channels of analogue to digital conversion (ADC) built in, allowing them to monitor more than one input at once. Very handy!

Getting back to the Little rAVeR kit (known as the DT006 board), we ordered one from the Dontronics web site at a cost of $65 plus a few dollars postage, and it arrived in the post a day or two later. Less than an hour with a soldering iron and the unit was up and running. Note that the kit is supplied without instructions, these are available from the Dontronics website. You can also buy the board already assembled and tested if you are not confident about doing the work yourself. If you are not a good solderer this may be the best option, as the board has quite fine tracks and pads.

The board has a number of features that make it easy and versatile to use. These include an on-board power supply so that it can be powered from either an AC or DC power supply of up to 18 volts or so, a serial communications port so that the micro can talk to the PC while it is running the program, two buttons for inputs, a row of eight LEDs for outputs, a reset button and a pair of simm sockets. Simm stands for single inline memory module, and was a standard used by older computers for their plug-in memory. They were available in 30 and 72 pin simms, and it is the 30 pin sockets used on this board. However, while they are standard simm sockets, they are not used for memory. It seems that some time back someone developed a small microcontroller board that used a standard 30 pin simm socket to connect to the outside world, and so the simmstick standard was born. There are now all manner of simmstick boards available, many of them from Dontronics.

The upshot of all this is that the DT006 board can not only program AVR micros in its chip sockets, but you can also plug in one of the AVR micro simmstick boards into the simm sockets and program them as well. This is great if you want to make more than one datalogger or whatever, as the simmstick boards are cheaper and simpler than the DT006 board, thus reducing costs. Indeed, you could easily do production runs of microcontroller controlled equipment using the simmstick bus and program them all from one DT006 board.

Giving orders

Before the unit can be used you need to be able to program it. While there seems to be a lot of different programming systems available on the net for the AVR devices, most of them use assembly language (nigh on impossible for the novice to master) or one of many high level languages such as C.

However, a link on the Dontronics site took us to a site where a freely downloadable demo version of a program called Bascom-AVR was available, developed by MCS Electronics in Holland.

As its name implies, Bascom-AVR is a BASIC compiler that produces files suitable for the AVR range of microcontrollers. It is 99 per cent compatible with Q-BASIC and includes an inbuilt program simulator so that you can run your software even before uploading it to the micro. The only limitation with this demo version is that it can't generate machine code files for the AVR micro that are more than 2k in size. However, the standard chip that comes with the Dontronics kit, the AT90S2313-10PC, only has 2k of program space, so it is not a problem, and you can do quite a bit with a 2k program.

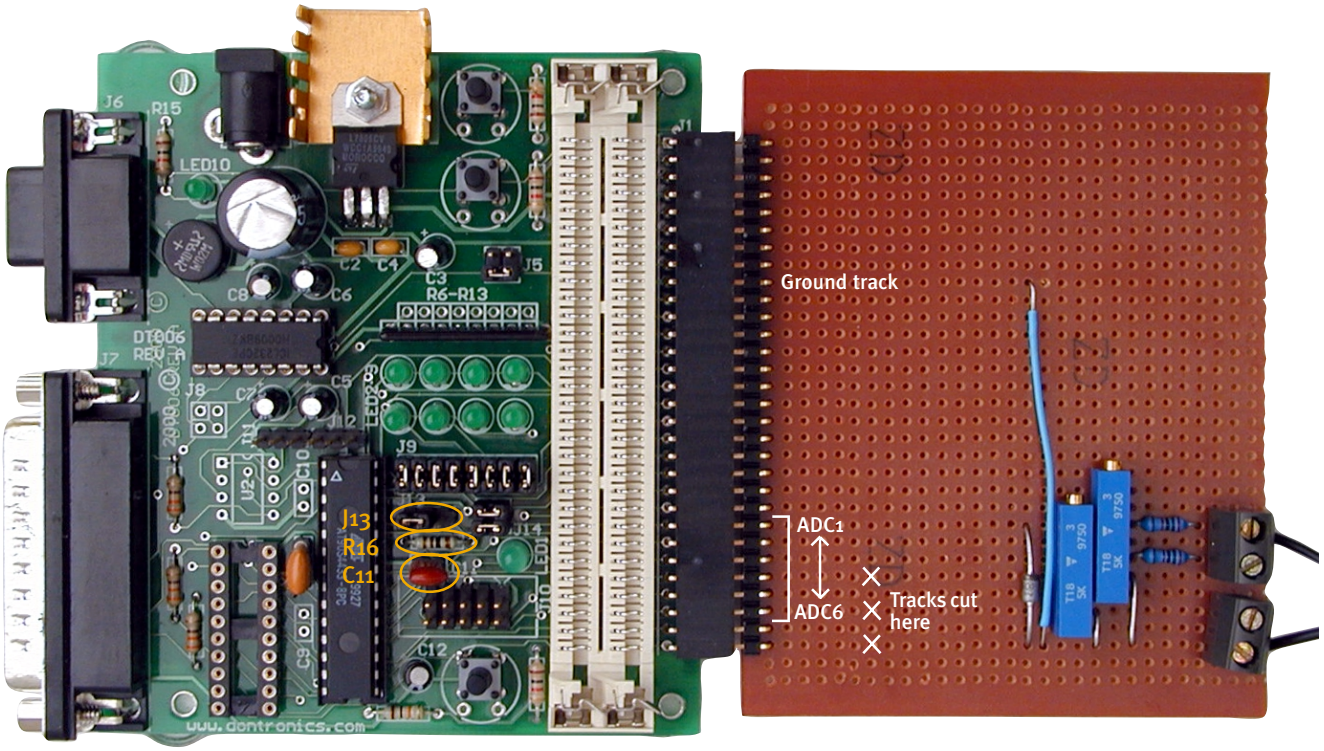
We downloaded the installation files and had it all up and running in a few minutes. After a few initial setup changes we had one of the sample programs opened, compiled, and downloaded into the AVR micro. It really was quite easy to get going, once the board was assembled.

Now it was time to start writing the datalogging software. This took a while, as I had not done much programming for a few years, and I was used to the old GW BASIC interpreter, not Q-BASIC, but it didn't take long to get the hang of it.

Anyway, I finished a simple program and soon was at the point of actually wanting to read external voltages and record them. The only problem was, the 2313 chip had no ADC on board, so I was faced with a couple of options: either change to a chip with ADC built in, or provide a separate ADC chip and control it with the microprocessor. I decided to go with the former, as the DT006 board has space for fitting the 28 pin versions of the AVR chips, as well as the 20 pin 2313 supplied.

I went to the Atmel web site and grabbed a copy of a table which listed all of the AVR devices. A quick look through this list told me that the AT90S4433 was what I was after. It had twice the eeprom than the 2313 and six channels of ADC, as well as 4k of flashRAM, though with our freebie programmer, we can still only use 2k.

Going back to the Dontronics site, I found this chip was available from them and so ordered it for the cost of $18 plus $2 for an 8MHz (megahertz) resonator to go with it (I have since discovered that Altronics in Perth also sell the AVR micros, with the 4433 costing $15.95).



The extra components for the 28 pin chip can be seen above. Also note the empty 20 pin chip socket. Don't try to run both chips in the board at the same time, they won't be too happy about it! Our simple interface board can be seen on the right.

The resonator is a small device that makes a series of pulses, (known as clock pulses) for the micro. The micro performs an instruction in the program each time it receives a clock pulse. A 10MHz resonator (10 million pulses per second) means the chip will process up to 10 million instruction per second. The 2313 comes with a 10MHz resonator, which is too fast for the 4433, which is limited to 8MHz.

I also had to fit a 28 pin socket for the new chip, plus a few extra components for the ADC. These were C11 (0.1uF), R16 (100 ohm) and J13 (you need to link pins 1 and 2, to connect the + voltage reference pin of the ADC to +5 volts). These extra components are listed on the schematic diagram for the DT006 board available on the Dontronics site. They can be seen marked on the photo elsewhere in this article. By the way, in case you are wondering which pin is pin 1, it is always the one with the square solder pad.

Connecting to the world

Now that the board was up and running, I needed to finish off the software so that it could access the ADC ports of the new chip and store the data in the eeprom for retrieval later. This proved quite simple, requiring only a few extra lines of code, and the logger was soon doing its thing. Now, the next step was to interface the logger to the real world. While this sounds simple, there are a few things that must be considered as it is possible to damage the micro if you do it wrong!

The first thing to realise is that the micro runs from a regulated 5 volt supply and that you can feed only voltages between 0 and 5 volts into the ADC inputs. So, how do you measure a 12 or 24 or even higher voltage in a power system? The simple answer is to divide the voltage down to something safe for the micro. This takes nothing more than a pair of resistors, or, in our case a resistor and a variable resistor, so that we could adjust it for an accurate division by 10 of the voltage. This way we could read up to 50 volts. Also incorporated into the circuit was a 5.1 volt Zener diode to clip the voltage level in case it should accidentally be exceeded, either through an excess input voltage or incorrect adjustment of the voltage divider. The circuit diagram for the voltage divider can be seen in Figure 1.

Another thing to remember is that the voltage to be measured must share a common ground with the micro. This is simple to do, as the DT006 board has a row of output pins on one edge of the board which include both +5 volts (pin 7) and ground (pin 9). Also, voltages must not be negative, as this also can damage the micro. The Zener diode in our circuit not only clips positive voltages to around 5 volts, but will also limit any accidental negative voltages to around -0.7 volts, which should save the micro from damage.

The simple interface was built on a piece of Veroboard, which is just printed circuit board material with copper tracks on one side and holes drilled through to take components. Our board gave us enough space to add other interface circuits later, should we so desire. It was connected to the DT006 board by a plug-in header strip (a row of pins that plugs into a row of sockets) that was supplied with the DT006 kit.

Testing it out

Once we had the datalogger and software up and running it needed to be tested on some real world voltages to make sure it was working. This was simply a matter of connecting the input leads across a few different voltage sources. We used a 1.5 volt 'C' cell to start with, followed by both six and 12 volt lead acid batteries. The logger produced data as expected, so it was now time to go and log part of the ATA's power system as a real-world test.

The next step was to set the logger up to sample once every five minutes, to give us 21 hours worth of sampling, and attach it to the 24 volt battery bank in the ATA's power system. The resultant data can be seen in the chart in Figure 2.

We will also be using the datalogger to monitor other parameters of our power system in the future, including current, battery temperature and light levels. All of these will require simple interface circuits, which we present in a future issue of *ReNew*, along with an option for increasing the memory storage capacity of the logger.

In issue 71 we mentioned using a special Hall effect sensor, the UGN3503, to measure the magnetic field generated by current flow in a wire. Our initial experiments with this device showed that it is not sensitive enough to record low current levels, so we will look at using an amplifier to boost the voltage measured across a shunt.

Writing the software

So far I have just briefly touched on the software used to run the logger. As mentioned earlier, the Bascom-AVR software

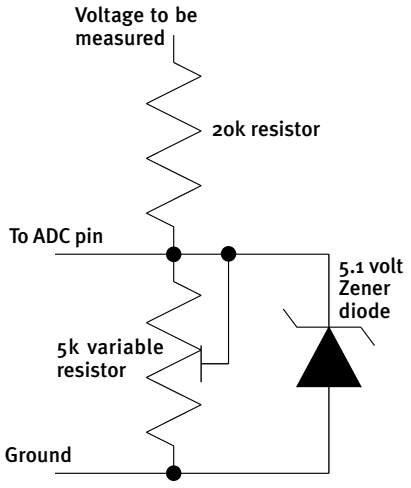


Figure 1. The simple circuit used to interface the microcontroller to the outside world.

is a compiler, simulator and programmer all in one. It is very simple to use and a full manual of all of the instructions and their uses can also be downloaded from the web site. There are a few things that need to be set up before trying to program the microcontroller, including: the type of chip you are using; the baud rate for communication (I used 9600 for everything); the micro's resonator speed; and a few other things before you can successfully program a chip.

Once all this is done you simply load in your program, or sit down and start writing one, and, when you are satisfied that it is ready, press the compile button. The compiler will look at your program line by line and tell you if there is anything wrong, converting it into machine code suitable for the micro you have chosen in the process.

If it compiles okay you then have the option of uploading it directly into the microcontroller or running it in the simulator. We found the simulator to be quite useful but there were problems with timing loops being ridiculously long. For instance, the 'wait 1' command, which will cause the micro to wait for one second, would take minutes to execute in the simulator.

If you are happy that your program is ready just press the program button and the programmer window will appear. If your micro is not plugged in, is not responding, or is set to the wrong chip for the program you have just compiled, you will be warned of this by the programmer. The next step is to program the chip by clicking on the program button. You will be given a warning that you are about to erase the chip, to which you click yes. You will then see a status indicator steadily increasing as the program uploads, and there it is, a fully functional datalogger!

I should mention here that many of the pins on the micro have more than one use. For instance, three of the pins used to program it also run the LEDs on the board in some of the test programs supplied, so it is necessary to disconnect the board from the computer once it is programmed. So, after disconnecting the logger from the computer's parallel port, connect it to a serial port via the 9 pin connector on the DT006 board. We just plugged it into the COM2 port of our computer.

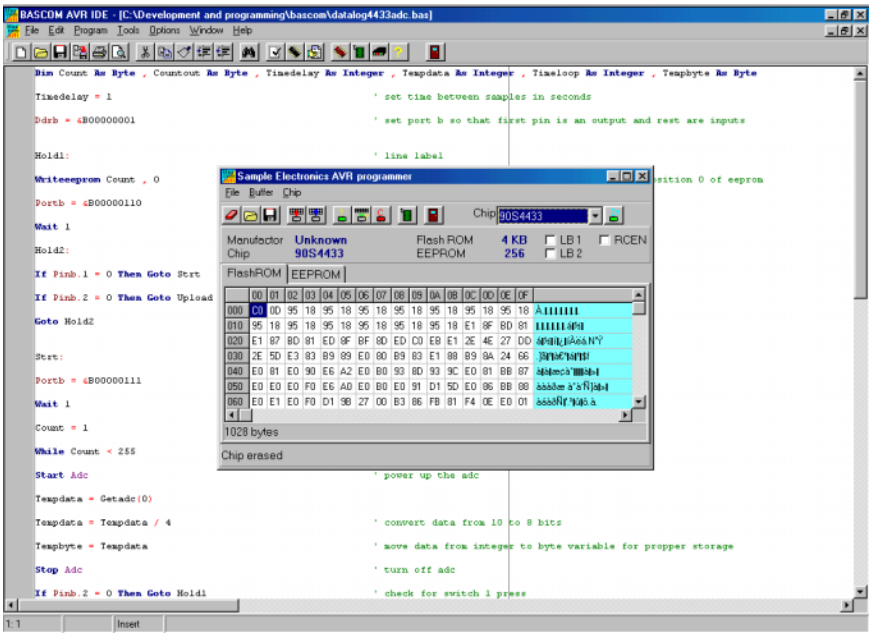
Now, when you apply power to the logger (make sure it is disconnected from power while making the connections) it will go into standby mode waiting for you to press the first button. Once it detects a button press, the LED that was on continuously will start to flash about once per second. To stop logging you can either press the reset button (recorded data is lost doing this) or press the first button again for about one second. This stops logging and causes the logger to go into standby mode again, but also ensures that data logged to that point remains downloadable.

While the logger is connected to the computer's serial port you can use a terminal program like Hyperterminal, Telix or the terminal built into Bascom-AVR (just press control-T) to view what the logger is sending out over the serial port. As it takes a sample, it will send it out over the serial port using the 'Print' command and store the data in the eeprom.

Once you have some data stored and the logger is in standby mode, press the second button and the contents of the eeprom should be dumped to the terminal program quite quickly. This can then be saved as a text file or copied into a spreadsheet or other program to create a graph of the data. The LED will also flash quickly when this is happening.

More information

While a flashing LED is adequate indication of what the logger is doing, it is reassuring to be able to read something a little more informative. Liquid Crystal displays are just about everywhere nowadays and they have become very cheap to purchase. What's more, the Bascom-AVR software allows you to connect a standard parallel interface LCD to any six I/O (input/output) pins of the micro and write to the display directly.



The Bascom-AVR demo software allows a program written in BASIC to be compiled, tested and sent straight to the AVR microprocessor. Not bad, for free!

```
Dim Count As Byte , Countout As Byte , Timedelay As Integer , Tempdata As Integer , Timeloop As Integer , Tempbyte As Byte
Timedelay = 300                                          ' set time between samples in seconds
Ddrb = &B00000001                                        ' set port b so that first pin is an output and rest are inputs
Hold1:                                                   ' line label
Portb = &B00000110                                       ' turn on led 1
Wait 1                                                   ' wait one second
Hold2:                                                   ' line label
If Pinb.1 = 0 Then Goto Strt                             ' check for switch 1 press
If Pinb.2 = 0 Then Goto Upload                           ' check for switch 2 press
Goto Hold2                                               ' go back to start of checking routine

Strt:                                                    ' start of datalogging routine
Portb = &B00000111                                       ' set led 1 off
Wait 1                                                   ' wait a second
Count = 1                                                ' set count variable to 1
While Count < 255                                        ' start a loop with a max of 255 cycles
Start Adc                                                ' power up the adc
Tempdata = Getadc(0)                                     ' get data from ADC
Tempdata = Tempdata / 4                                  ' convert data from 10 bits to 8 bits
Tempbyte = Tempdata                                      ' move data from integer to byte variable for proper storage
Stop Adc                                                 ' turn off adc
Print "Sample " ; Tempbyte ; " At Count " ; Count        ' print data to terminal
Writeeeprom Tempbyte , Count                             ' store data in eeprom
Incr Count                                               ' increase count by one
'start time delay but keep checking for button press
For Timeloop = 1 To Timedelay                            ' go through the time delay a set number of times
If Pinb.1 = 0 Then Exit While                            ' check for switch 1 press and finish logging if detected
Waitms 250                                               ' wait 1/4 second (250 milliseconds)
Waitms 250                                               ' wait 1/4 second
Portb = &B00000110                                       ' turn on led 1
Waitms 250                                               ' wait 1/4 second
Waitms 250                                               ' wait 1/4 second
Portb = &B00000111                                       ' turn off led 1
Next Timeloop
Wend
Writeeeprom Count , 0                                    ' store current number of data samples in position 0 of eeprom
Goto Hold1                                               ' go back to start

Upload:                                                  ' line label
Readeeprom Count , 0                                     ' get number of samples from eeprom
Countout = Count - 1                                     ' decrement number by one to get true number of samples
For Count = 1 To Countout                                ' set up a loop
Portb = &B00000110                                       ' turn LED on
Readeeprom Tempbyte , Count                              ' get data from eeprom
Print Tempbyte                                           ' print it to serial port
Waitms 50                                                ' wait 50 milliseconds
Portb = &B00000111                                       ' turn LED off
Waitms 50                                                ' wait 50 milliseconds
Next Count                                               ' go to next sample in loop
Goto Hold1                                               ' when finished, go back to start of program
```

I bought a cheap display from Oatley Electronics (part # DL6—$12 each) via their web site, and after receiving it in the mail, connected it to six of the port D pins of the micro via the veroboard (most of the data pins come out on this board, making hookups easy). In the sample program you can see the 'Print' statements that send the text and information to the computer via the serial port. Replacing these with the 'Lcd' command sends the text to the LCD instead. Note that, while the display has eight data and two control lines, it is set up with only the upper four data and two control lines connected. It is quite happy to run this way.

The program for using the LCD, along with numerous other files, will be available from our web site at www.ata.org.au/71datalogger.htm.

Use in the field

Now you need to take the plunge and connect the logger to something you want to monitor and set it running. But before you do that, you need to decide on the

time delay between samples. This is worked out in seconds, and must be entered into the second line of the program, 'Timedelay = X', where X is the time in seconds. So, for a delay of 10 minutes, you would use 600. For 255 samples, this would give you 42.5 hours of logging.

Once you have changed this line, compile the program and upload it to the logger as outlined earlier. Your logger is now ready to go into the real world and work for you.

Connecting it is simple, providing you are careful. Make sure polarity is correct, that is, negative to negative, positive to positive. It is best to power the logger from a separate 12 volt power source. We used a small 12 volt battery to power the logger, as it only uses about 30 milliamps when running.

Providing you hook it up correctly, you can just press the 'go' button and walk away. When you return to collect the data remember to ensure the logger is in standby mode. If you left it until it ran out of eeprom space it would already have returned to this mode. If it is still logging, press the start/stop button and ensure that the LED stops flashing.

Now you can disconnect the voltage being logged (and power to the logger if you wish) and take it to your computer for retrieval of the data, as described earlier. If you have a laptop, you don't even need to take it away from the site, just upload the data and start it logging again.

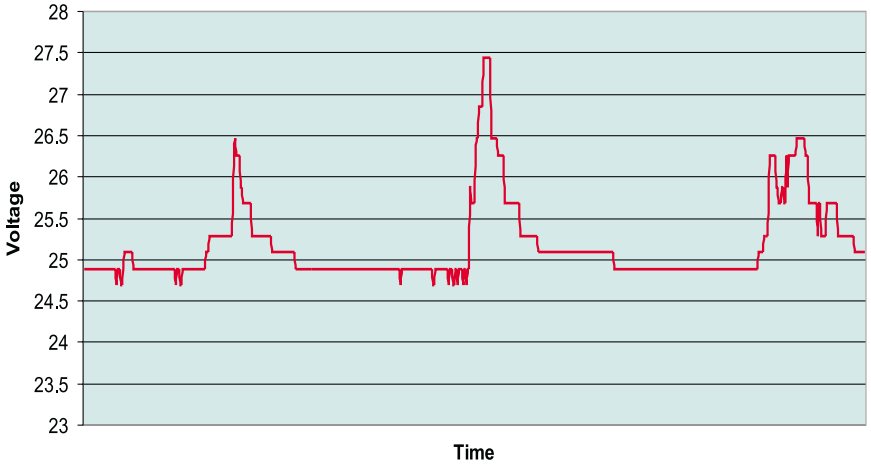


Figure 2. A plot of voltage versus time taken during a partly cloudy three days in Melbourne. Note the resolution steps of around 0.2 volts. This chart was made by importing the data from several logging sessions into a spreadsheet.

Note that you should disconnect the voltage being logged first to ensure no possible damage to the microprocessor, though this is unlikely given the 20k resistor between the micro and the voltage source.

That is about all there is to using this device. What you connect to it, and how you do so, is up to you. Just remember to keep the input voltages within limits.

Data conversions

By now, if you have been playing around with a micro board similar to what we used, you will have realised that the data you get out is not actually a true representation of what you have measured. This is because the AVR chip uses a 10-bit ADC, which allows it to record any number from 0 to 1023, while we are storing the data as a number from 0 to 255 by dividing it by four before we store it. This is necessary because the eeprom only provides 8-bit storage, and trying to store 10-bit data in it will not work—the data stored will be meaningless.

Anyway, the division by four means that the data loses a bit of accuracy but it is still quite close to the measurement if it were taken with an 8-bit ADC.

But the data still does not mean much. What has a number like 126 got to do with the voltage of a 24 volt battery? We obviously need a conversion factor, which we can calculate quite simply. We know that at 50 volts, our ADC input will see a full 5 volts (the voltage divider divides it by 10), and will output 1023, which then becomes 255 when it is divided by four. So, if 255 represent 50 volts, then a count of one would represent 50/255 or 0.196 volts.

So our ADC is still accurate to about 0.2 volts, which is not bad. Getting back to our earlier example, to get the real voltage represented by the number 126, just multiply it by 0.196 and you get 24.7 volts.

But you don't want to have to go through all your data and multiply each one by 0.196 or whatever, so the simplest method is to paste the data into a spreadsheet and use a simple formula to do it for you. However, I tried this but could not work out how to do it in Microsoft Excel, and not wanting to learn another tedious Microsloth program, I wrote a quick GW-BASIC program to do the file conversion for me. This should work in most versions of BASIC with few changes, other than maybe having to define variables. My version of GW-BASIC will also be available from the ATA's web site, along with the conversion program.

Writing your programs

While this may seem a bit daunting, it is not that hard, and a weekend learning the BASIC language is well spent. An example of a simple datalogger program can be seen opposite, and you should be able to follow what the program is doing if you go through it line by line and read the comments in the right-hand column. Any text preceded by an apostrophe (') is a remark, or comment, and is ignored by the compiler. They are just there for the convenience of the programmer.

We have written a number of different programs, which will also be available on the ATA's web site. You are free to download and modify these as you need.

There is a warning we should mention here. If you write your own programs make sure that you do not include a write to the eeprom in a timing loop. As the micro runs at close to eight million instructions per second you could wear out the eeprom in less than a second if you were to make this mistake, so be careful! If you look at our program you will see that the write eeprom command is outside the timing loop, and the eeprom is only written a total of 256 times (once to each location) for an entire datalogging cycle.

```
1 'Simple data conversion program Written by Lance Turner in a fit of
boredom, 28/06/00
10 CLS
20 INPUT"Filename of input data: ",FILENIN$       ' Get name of file to open
30 INPUT"Filename of output data: ",FILEOUT$     ' Get name for new file
40 INPUT"Conversion factor: ",FACTOR             ' Get conversion factor
50 FILENIN$=FILENIN$+".txt                       ' Add ".txt" to filename
60 FILEOUT$=FILEOUT$+".txt"                      ' As above
70 OPEN "I",1,FILENIN$                           ' Open input file
80 OPEN "O",2,FILEOUT$                           ' Create output file
90 LINE INPUT#1,INDATA$                          ' Read data from input file
100 IF EOF(1) THEN CLOSE:END                     ' Check for end of file
110 LOOP=1                                       ' Start a loop
120 INDATA=VAL(INDATA$)                          ' Change data to number
130 OUTDATA=INDATA*FACTOR                        ' Do the conversion
140 OUTDATA$=STR$(OUTDATA)                       ' Change result to text
150 PRINT#2,OUTDATA$                             ' Save result to output file
160 LOOP=LOOP+1                                  ' Increment the loop
170 GOTO 90                                      ' Do it all again
```

This simple GW-BASIC program will convert the raw data from the datalogger into something more useful. Just enter the name of the data file, a new output data filename, and the conversion factor.

Getting creative

While monitoring power system voltage and current may seem a good use for a logger, there are many other possibilities. Remember, these devices don't work only as passive input-only devices, but can indeed be used to control things attached to them—using suitable interface circuits, of course.

When in output mode each pin of the micro can provide up to 20 milliamps of current (with a maximum total of 200mA at any one time). This can be used to not only run LEDs, but, by connecting a transistor and/or relay to an output pin, would allow the micro to switch almost any electrical device.

So, using just one of these boards, you could keep an eye on battery voltage, light level and temperature, and use it to operate a generator, trigger a warning device, or turn off unnecessary loads. The possibilities are endless, and quite a sophisticated system could be built around one of these micros.

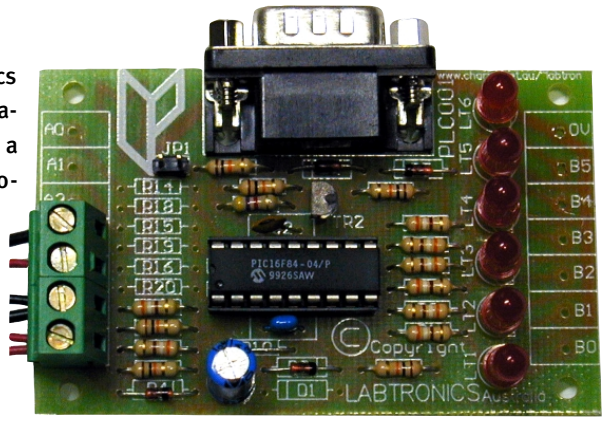
Other micros

There are now many microcontroller kits on the market, some of which use the PIC range of chips—as found in the well known BASIC Stamp range. These are tiny microcontroller boards, supplied ready built, that contain a 16F84 PIC microcontroller and support circuitry. They get their name from their size and that they too are programmed using a version of BASIC. But unlike the AVR chips, the BASIC Stamps have a basic interpreter already programmed into them. This cannot be modified, and when you upload your program they

store it in an eeprom—where they also store data. So the smaller your program, the more data you can record. Because it uses an interpreter, the BASIC Stamp runs its programs much slower than the AVR chips, but when you are waiting 10 minutes between samples, who cares!

There are several retailers selling BASIC Stamps or their own versions thereof, and they start at less than $100, but the cost of these in general, by the time you have it set up in a system, is more than the Dontronics boards.

While researching this project we came across a company called Labtronics in South Australia that sells a very simple kit based on the 16F84 micro for use as an educational tool for schools. The PICfun kit is available for just $28 plus postage, making it excellent value for experimenting and for simple systems. While the programming language supplied is more difficult to learn than BASIC, Labtronics is apparently looking at other programmers. They are also in the process of developing a new board with ADC and other features, and this is also expected to sell for a very low price. See the contacts list at the end of this article for details.



The PICFUN kit from Labtronics in SA is intended as an educational aid for schools. It costs a mere $28 and could be programmed to perform many tasks, including battery regulation, sun tracking and temperature control. It could even become the heart of a datalogger with additional memory.

In conclusion

With the availability of these amazing little chips, many people are experimenting with them and coming up with all manner of ideas. A quick internet search revealed dozens of ideas and designs, including a neat little temperature datalogger using a 16F84 chip and a small serial eeprom to store the recorded data.

Many of you may be thinking that 255 samples is just not enough for any real datalogging, and in some cases this is true. It would also be nice to be able to use the full 10-bit data from the ADC of the microcontroller, rather than cutting it down to 8 bits. To this end, I have

written a program that takes the 10-bit data and stores it in two bytes of the eeprom, but this of course has the trade-off that only 127 samples can be taken.

However, there is no reason why more memory cannot be added to the system, and we plan to look at this if there is enough interest. Atmel, the makers of the AVR micros, also makes many other devices, including a range of separate eeproms up to 64 kilobytes in size. At one sample per minute, this is over 45 days worth of data storage! These devices appear simple to use, and should interface nicely to the microcontroller. What's more, by having the eeprom on its own plug-in card, data collection is just a matter of unplugging the full eeprom from the datalogger and plugging in an empty one. The eeprom with the data can then be taken back to the PC so that the data can be uploaded.

Another function that may be added later is a real time clock so that not only can we store data, but the time and date as well. But for the moment you will just have to record manually what time you started and stopped the logger—an inconvenience, but not a major one.

Getting the bits

The DT006 kit can be purchased from Dontronics (www.dontronics.com). The DT006 page can be found at www.dontronics.com/dt006.html. This page gives you the instructions to assemble the kit, as well as detailing the optional parts for the board. A full circuit diagram can also be found here. To get the Bascom-AVR software go to www.dontronics.com/runavr.html which has links to the Bascom-AVR website as well as information on setting up the software and making the parallel cable to connect the DT006 board to the PC. Note that we used a standard parallel cable which worked fine.

The MCS Electronics (developers of the Bascom-AVR software) web site is at www.mcselec.com

To look at the Labtronics PICfun kits, go to www.chariot.net.au/~labtron/

BASIC Stamps can be purchased from MicroZed Computers, www.microzed.com.au but originate from Parallax Inc, www.parallaxinc.com

The PIC archive has some interesting information on PIC micro projects: http://come.to/thepicarchive

There will be numerous files available from the ATA's site, including the GW BASIC conversion program and a number of different versions of the datalogger files, including the LCD version. Go to: www.ata.org.au/71datalogger.html

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/

ATA workshops 2000

CERES site, Lee St, East Brunswick, VIC

- Solar hot water: 29 Oct
- Greywater: 15 Oct, 19 Nov
- Solar Electricity: 8 Oct

Fee: $77 for ATA members, $88 for non-members, inc GST. Contact: ATA, ph:(03) 9388 9311, email: ata@ata.org.au

CERES workshops 2000

CERES site, Lee St, East Brunswick, VIC

- Creative mosaic: 7-8 Oct, 4-5 Nov, 14-15 Nov, 14-15 Dec
- Ferro cement design: 19-20 Oct, 2-3 Dec
- Strawbale building: 11-12 Nov, 4-5 Dec
- Cob building: 9-10 Oct
- Wrought iron: TBA

Fee: $130 ($110 concession). Contact Anna Rathgen or Keith Jesse, ph:(03) 9387 2609, email: ceres@ceres.org.au

S11 action

11 September, 2000
Melbourne VIC

Protests will centre around the World Economic Forum to be held in Melbourne on 11 September.
Contact: Friends of the Earth, ph:(03) 9419 8700, email: foe@foe.org.au

Handmade Houses Tour

23-24 September, 2000
Tallowood Community School, Bowraville NSW

Two-day, self-drive tour around the Nambucca Valley visiting 20 alternative homes and buildings, featuring alternative building materials, solar power and recycled and reject materials.
Contact: Tallowood School, ph:(02) 6564 7619, email: tallow@nor.com.au, or Faye, ph:(02) 6564 4003, email: ffwelsh@nvi.net.au

IMBY Festival

14 October, 2000, Wodonga, VIC

Helping people become environmentally responsible in their 'own back yard'.
Contact: The Manager, PO Box 1040, Wodonga VIC 3689, ph:(02) 6023 2327, fax:(02) 6023 2425, email: hansen@parklands-alburywodonga.org.au

International Sustainable Energy Expo & Convention

31 October - 1 November, 2000
Royal Exhibition Building, Melbourne

Presented by the SEIA and covers renewable energy, energy efficiency and demand side management.
Contact: SEIA, ph:(02) 4422 2206, email: seia@welldone.com.au

Compost 2000

14 - 16 November
Melbourne, VIC

Covers all forms of organics recovery and composting, including energy production from agricultural waste, bioremediation, water conservation and many other aspects.
Contact: DMP Pty Ltd, 52 Cluden St, Brighton East VIC 3187, ph:(03) 9593 3699, fax:(03) 9593 3573, email: ddirectm@bigpond.net.au

RACV Energy Breakthrough

17 - 19 November, 2000
Maryborough, VIC

This event is now in its 10th year, and allows schools to compete against each other in a race for energy efficiency.
Contact: PO Box 194, Maryborough VIC 3465, ph:(03) 5461 0621, fax:(03) 5461 0665, email: martinm@cgoldshire.vic.gov.au

SEGRA 2000

20-22 November, 2000
Ballarat, VIC

Developing and implementing strategies for sustainable economic growth in regional Australia.
Contact: SEGRA Secretariat, GPO Box 2301, Brisbane QLD 4001, ph:(07) 3210 0021, fax:(07) 3210 0044, email: mansol@bigpond.com

Communities Conference 2000

22-26 November, 2000
Crystal Waters Permaculture Village, QLD

The theme for this, the third Communities Conference, is Creating Vibrant Culture. Will explore community aliveness culturally, ecologically and economically. Incorporates the Blooming Arts Festival.
Contact: Communities Conference 2000, 37 Crystal Waters MS16 Maleny QLD 4552, ph:(07) 5494 4887, fax:(07) 5494 4833, email: morag@permaculture.au.com or beelzebarb@hotmail.com

Solar 2000

29 November - 1 December, 2000
Brisbane, QLD

Titled 'From Fossils to Photons, Renewable Energy Transforming Business', this is the 38th annual conference of the Australia and New Zealand Solar Energy Society.
Contact: Conference Secretariat, ICMS, PO Box 3496, South Brisbane, QLD, ph:(07) 3844 1138, fax:(07) 3844 0909, email: solar2000@icms.com.au, www.solar2000.aust.com

2001 Water Odyssey

1-5 April, 2001
National Convention Centre, Canberra

The 19th Federal Convention of the Australian Water Association.
Contact: Quitz Event Management, PO Box 632, Willoughby NSW 2068, ph:(02) 9410 1302, fax:(02) 9410 0036, email: dbquitz@bigpond.net.au

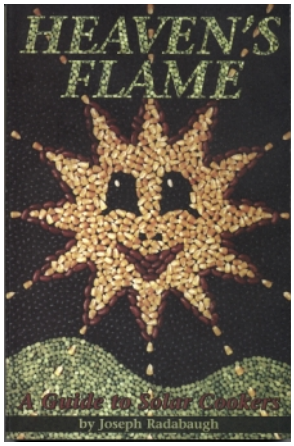
Sustain 2001

8-10 May, 2001
Amsterdam, The Netherlands

The world sustainable energy exhibition and conference.
Contact: PO Box 77777, NL-1070 MS Amsterdam, ph:+31 20 549 1212, fax:+31 20 549 1843, email: sustain2001@rai.nl, www.sustain2001.com

Heaven's Flame

Author: Joe Radabaugh, Homepower Publishing, ISBN 096 295 8824 Available from Solar Cooking Interest Group, 23 Morely Street, Maddington WA 6109, RRP $36



Joe Radabaugh's first edition of *Heaven's Flame* is dedicated to David Rode who Joe says 'shared with me an innocent vision and appreciation for the power of the sun and the miracle of solar cooking'.

The author is one of a growing group of grass roots people whose passion is expressed through working locally to save the planet. For years he has attended craft fairs and flea markets around his home in the north-western United States displaying not just his SunStar cookers but actually cooking on the spot. Nothing is more convincing than burning your fingers on a piece of hot cake fresh from a cooker.

Joe has a refreshing down-to-earth style which answers most questions about this earth-friendly cooking practice. He is rightly critical of social scientists who discuss world fuel shortages, cutting forests for cooking fuel and population growth with not so much as a mention of the solution offered by solar cooking.

Barbara Kerr and Sherry Cole of Arizona, after patenting their box cooker, gave it royalty-free to anyone. Similarly Joe benevolently put the SunStar in the public domain. 'This means it is yours' he says, 'if you find a way to get the design out, you have not only my blessings but my sincere thanks.'

This book covers two themes—the history of solar box cookers and Joe's personal experiences with them. In 143 pages the book comprehensively covers two hundred years of people and organisations in South America, Asia, Europe and Africa using direct sunshine for cooking.

Joe's observations of his own experiences and methods are easy to read. There's no overwhelming technological jargon. He explains in delightful detail how to build a fully-functioning appliance. His design uses cardboard, not fibreglass insulation. He tells about cooking in glass jars and coffee tins rather than expensive stainless steel cookware.

Guidelines are given on designing your own cooker: for example, based around a piece of recycled glass. The illustrations are good. There are clear explanations and easy-to-follow methods. Following *Heaven's Flame,* an unskilled scout or guide would have no problem constructing a SunStar cooker to amaze friends on a camping trip.

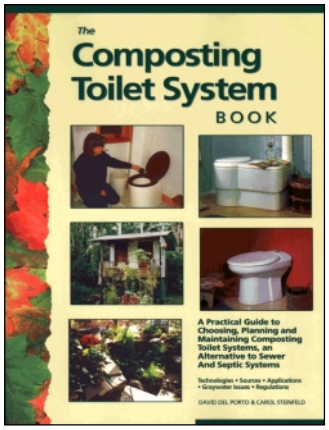
Concepts such as heat storage and thermal pane (a scaled double-glazing) are included as well as discussions on stands, reflectors, paints, glues, hinges, working with cardboard and maintenance and rebuilding a well-worn cooker.

I was impressed with this book and admire Joe's commitment. I would have liked more recipes. The lack of metric measurement detracts a bit from an otherwise excellent guidebook. I recommend *Heaven's Flame* to anyone wishing to know about the evolution of solar cookers and to those wishing to construct their own cooker.

Dave 'Sunny' Miller

The Composting Toilet System Book

Author: David Del Porto and Carol Steinfeld, The Center for Ecological Pollution Prevention 1999. Available by mail order from the ATA.
RRP $43.90. ISBN: 0 96667 8303



For anyone who has an interest in composting toilets this is the book you have been looking for.

David shares his 27 years experience in the field of human waste disposal in a very thorough and easily read format. Carol Steinfeld as a professional writer makes sure the jargon is converted to normal speak.

I was very taken by the completeness of this volume, with a broad range of subjects covered in sufficient depth to satisfy all but the PHD student. Areas covered include a history of human waste, how composting and other toilet systems work (or don't), choosing, planning and installing systems, and most importantly operating and maintaining various systems.

David also takes the reader into the homes of people around the world to discuss the pros and cons of their experiences of living with a composting toilet. This valuable section tells you what the sales people don't and what you really want to know.

No book on composting toilets would be complete without discussing greywater and this one covers it very thoroughly.

The excellent photographs, drawings and flow charts certainly enhance the text and make the subject much easier to understand without the need to get your hands dirty. The brief description of 50 different systems completes this excellent volume. Highly recommended.

Trevor Robotham

Other books on the subject

The Humanure Handbook by Joseph Jenkins, 2nd ed. 300pp. An excellent text with details on Microbiology, worms, disease and sawdust toilets. Available from Environment Equipment, ph:(03)9587 2447. RRP $43.00 plus postage.

Not Just Down The Drain by Stuart and Lisa McQuire. A guide to re-using and treating your household water by a local Melbourne author. Available by mail order from the ATA. RRP $16.45.

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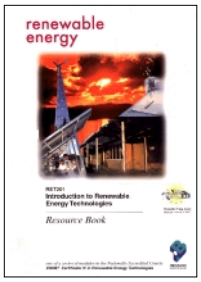
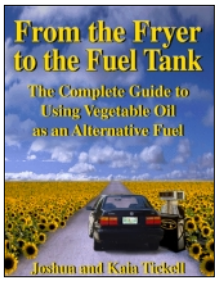


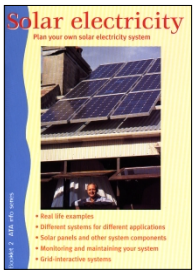
INTRODUCTION TO RENEWABLE ENERGY TECHNOLOGIES

Brisbane Institute of TAFE
Price: $73.70 Softcover, approx 300pp
Reviewed in *ReNew* #70
One of the Resources books from the Certificate IV in Renewable Energy Technologies, this book contains a wealth of information on renewable energy systems, their sizing and design.
Item code: IRET



FROM THE FRYER TO THE FUEL TANK

Author: Joshua Tickell
Price: $43.90 Softcover, 94pp
Reviewed in *ReNew* #66
A great book that shows the reader how to make a clean-burning renewable fuel from waste vegetable oil. Gives detailed instructions on the manufacturing process, as well as how to use the fuel in a standard diesel vehicle.
Item code: FFTFT



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Author: Hugh Piggott
Price $30.80 Softcover, 160pp
Reviewed in ReNew #61
The ultimate resource for anyone who has ever wanted to build their own wind turbine. Provides practical advice on how to design and build a machine up to five metres in diameter.
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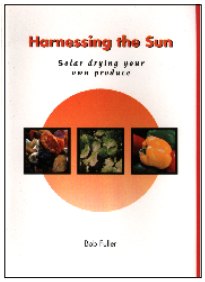

HARNESSING THE SUN – SOLAR DRYING YOUR OWN PRODUCE

Author: Bob Fuller
Price: $19.25 Softcover, 74pp
In this book Bob Fuller explains how to successfully prepare and dry many types of foods for preservation. Also includes six different plans for making your own solar food dryers.
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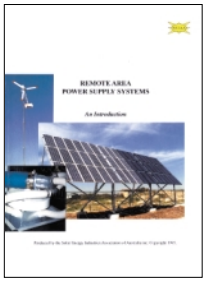

REMOTE AREA POWER SUPPLY SYSTEMS: An Introduction

Price: $33.00 Softcover, 100pp
Reviewed in *Soft Technology* #53
Enables the average person to gain a good grasp of what RAPS systems are all about. Covers individual system components, correct sizing, safe installation and maintenance.
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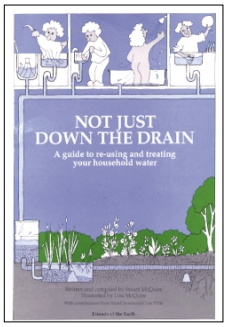
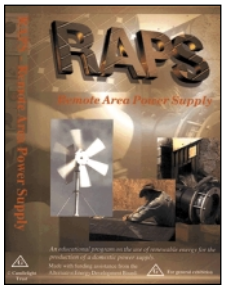


NOT JUST DOWN THE DRAIN

Author: Stuart McQuire
Price: $16.45 Paperback, 59pp
This guide to re-using and treating your household water provides practical solutions for on-site treatment of water and invites everyone to take responsibility for household water use. Stuart McQuire helps you to assess whether your house is suitable for water recycling and what kind of recycling is most appropriate. *Item code: NJDD*



RAPS Video

Price $43.95
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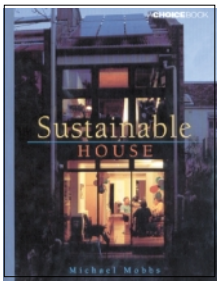
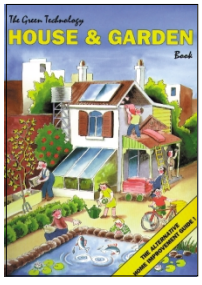


SUSTAINABLE HOUSE

Author: Michael Mobbs
Price: $38.50 Softcover, 188pp
Michael takes us on a tour of his sustainable house in Sydney, which provides all of its own power and waste water recycling on-site. Contains many great ideas on how to make your house less of a burden on the planet. This house was featured in *ReNew* #60.
Item code: SHB



THE GREEN TECHNOLOGY HOUSE AND GARDEN BOOK

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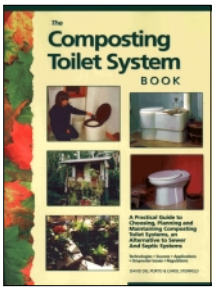
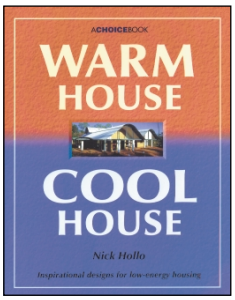


The Composting Toilet System Book
Authors: David Del Porto & Carol Steinfeld
Price: $43.90, Softcover, 234pp
This book covers many different composting toilet systems, including those available in Australia and thorough general information about composting toilets. Includes a chapter on greywater.
Item code: CT



WARM HOUSE, COOL HOUSE
Author: Nick Hollow
Price: $33.00 Softcover, 172pp
Reviewed in *Soft Technology* #54
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. *Item code: WHCH*

Soft Tech and ReNew Back issues

Available back issues of ReNew (formerly *Soft Technology*) All back issues are $5.50 including postage within Australia.

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Micro-hydro buying guide; Solar on the road; Earth-covered housing; RAPS around Australia; Ducted air central heating; Better light from halogens; The Electric mini; Make a 'Putt-Putt' boat; Build a solar panel sun tracker; Solar airship.

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Soft Tech Issue 49
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ATA members go places! These Melbourne branch members inspect a micro-hydro turbine on a field trip to Gippsland

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[The Pears Report]

Emissions from energy grow—time for consumer action

As Australia's energy consumption increases, Alan Pears calls for an urgent redress of financial incentives to deliver even more power

The Australian Government is lurching further into crisis over global warming. The 1998 national greenhouse gas inventory has been published, and shows accelerating growth in energy-related greenhouse gas emissions, particularly electricity. The prognosis for 1999 looks similar.

Electricity emissions growth has been driven by increasing use of the filthiest power stations and encouragement of increased electricity consumption in homes and business by electricity retailers whose profits depend on growth.

Electricity emissions rose by 10 per cent in 1998, while generation rose only(!) by six per cent, showing that dirtier power stations have taken market share from cleaner ones. While many point the finger at the power stations, it must be remembered that a power station generates electricity only when someone uses it, so both supply and demand sides of the equation must be considered.

To a great extent, the problem relates to the market frameworks. What we are seeing is the outcome of the creation of a viciously competitive market that places zero value on the environment, has excess coal fired generation capacity and can easily increase profits (or reduce losses) by selling more power.

Conventional electricity generation and supply is very capital-intensive. Once the asset is owned, the cost of generating or supplying an extra unit of electricity is very small compared with the revenue that can be gained, so under the energy market rules it makes financial sense to sell as much power as possible. For example, the average cost (including capital) of generating coal-fired power is three to four cents/kWH at the power station. But the immediate cost for coal supply and plant operation is less than one cent/kWh. So as long as the station earns more than one cent/kWH, it is better to run the plant than shut it down, even if the electricity sells at less than the long-run costs. This situation is not financially sustainable, which is why some investors are now suing their financial advisers, and the market value of power stations has fallen. But, while this fiasco plays out, the losers are the environment and suppliers of sustainable energy solutions.

Key priorities for governments should be a review of regulatory frameworks to reduce the financial incentives to deliver more power, and the development of workable 'exit strategies' that facilitate closure of the most greenhouse intensive older power stations. The sticky problem is working out how this can be done without it being seen as a 'bail-out' for private investors who made poor judgements.

The problem is compounded by the widely held view that most electricity distributors and retailers are going to be absorbed into a small number of larger companies over the next few years. So now there are 20 teams of CEOs, marketing managers and PR managers fighting for their own jobs by flogging as much power as possible. This leads to very aggressive marketing and, in turn, high electricity growth.

Conventional market logic says that as demand grows towards supply capacity electricity prices will rise, creating an incentive for investment in energy efficiency and new supply capacity. This model involves consumers being passive victims of energy price rises, and responding after costs increase, rather than actively shaping the market conditions. We can learn a useful lesson from the Japanese strategies of the past few decades.

The Japanese, who are consumers rather than suppliers of many resources, actively encourage over-investment in resource supply capacity in other countries and work to keep suppliers disorganised and competing with each other. The outcome is that they keep prices, and hence their input costs, low.

It should also be remembered that investments in energy-consuming equipment and buildings lock in the level of energy use for many years, while energy prices could increase within a few years, driven by competitive forces and emissions trading or carbon taxes. So ignoring the likelihood of future increases in energy prices leaves energy consumers at considerable financial risk. The aim should be to minimise future increases in energy prices and drive down total energy costs through strategic investment in sustainable energy solutions. (Total energy cost is the amount of energy used multiplied by cost per unit of energy.) This approach is a guaranteed winner. It's bemusing that very few seem to be applying it.

An increase in electricity prices of just one cent/kWH would increase electricity costs for Victorian households and business by around $300 million each year. So a smart state government should be encouraging hundreds of millions of dollars of investment in en-

ergy efficiency, cogeneration and renewables each year on the grounds that it will help keep energy prices low, as well as bringing financial savings through reductions in energy use. Applying this approach nationally, governments should be driving billions of dollars of strategic investment in sustainable energy each year.

One constructive strategy is for each business or government agency to charge itself a levy on the cost of energy it uses—effectively an in-house carbon tax. This has two effects. First, it raises the perceived price of energy and encourages investment in energy efficiency and cogeneration, at a level more consistent with likely long-term energy prices. Second, it creates an internal pool of money that can be used to fund larger sustainable energy projects. Smart organisations will take this approach instead of waiting for price rises, a national carbon tax or emissions trading scheme, as it will put them well ahead of the game.

Which government will be the first to introduce such a scheme within its own operations and then offer incentives and support for business to follow its example? For those interested in applying this strategy, a levy valued at $20 per tonne of CO_2 would add about two cents/kWH for electricity, $1.30/GJ of natural gas, and five cents/litre of petrol.

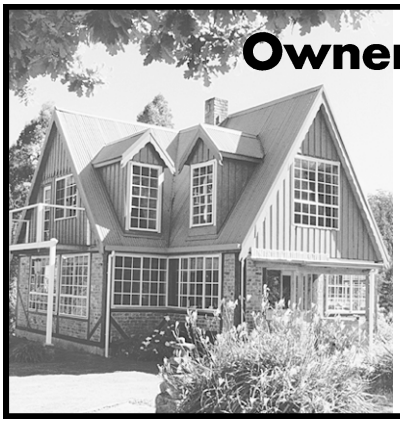
Basslink—Tasmania's lifeline, or a noose around our wallets?

Pressure is now building for construction of the $500 million, 500 megawatt capacity Basslink undersea cable. The supporting arguments sound appealing. Tasmania's economy could grow (that is, their wasteful use of electricity could expand without having to implement cost-effective energy efficiency measures) using Victoria's brown coal-fired electricity, while Tasmanian hydro would help Victoria to cope with increasing peak demand. Wind farms in Tasmania would supply green power to the mainland.

'Electricity emissions growth has been driven by increasing use of the filthiest power stations and encouragement of increased electricity consumption'

The reality is likely to be far from this. If Victoria can't manage its peak demand using energy efficiency, load management, cogeneration and renewables (mostly at negative cost), it could install 500MW of gas turbines for less than $200 million. The cost of using Basslink would increase the price of Tasmanian wind power, making it uncompetitive with wind generators at good sites in Victoria. There would probably be a large overall flow of energy to Tasmania, leading to replacement of renewable energy by fossil fuels. Efforts to establish a wind energy industry in Victoria could be set back, while hundreds of millions of dollars that could have been invested in cost-effective energy efficiency measures would be tied up in one cable.

Once projects like Basslink are built, the money can't be recovered and used for something else. So it is in the interests of the Tasmanian government to promote construction of Basslink with private money. It will have access to more electricity, its money won't be at risk, and if the cable turns out to be uneconomic, the Tasmanian economy will have an asset subsidised by whomever provided the capital.

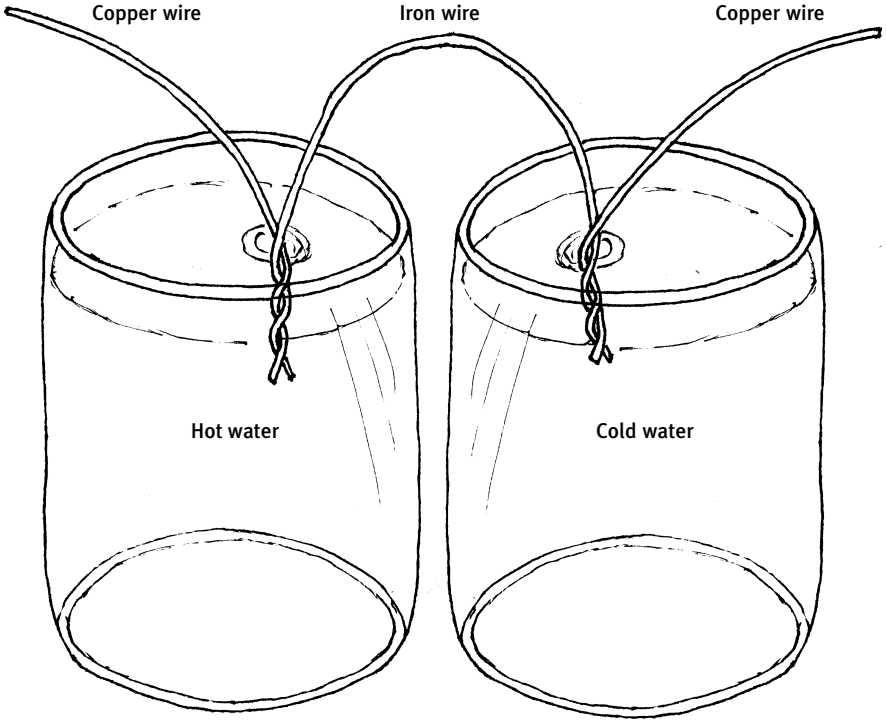


[Kid's stuff]

Noel's Treasures from Trash

To make your own Thermopile you will need:

- some pieces of copper wire 10cm long
- some pieces of iron wire 10cm long
- two pairs of pliers
- a sharp knife and fine sandpaper
- a glass and a mug about the same height
- some ice and some boiling water
- a digital multimeter
- a piece of styrofoam about 70mm square



Just a few bits of wire and some hot and cold water, and you can make electricity seemingly from nowhere!

A thermocouple is a device for making electricty directly from heat. Before solar cells existed, one way to make electricity was to connect a large number of thermocouples in series. This is called a thermopile. A thermocouple is made by joining two different types of wire together at the ends. If the ends are at different temperatures a current will flow through the wires.

The current and voltage is very tiny, so you need to connect many hundreds or even thousands of thermocouples together to make enough electricity to light an LED (light emitting diode).

Construction

Scrape about one centimetre of the ends of all of the wires until both ends are clean and shiny with no insulation or dirt. Take one wire of each metal, and twist them together at one end so that only the cleaned sections are connected. For thicker wires you will need both pairs of pliers—grab the wires together with one pair of pliers, about 12mm from the end, and twist the ends together with the other pair.

Take another piece of copper wire and twist it onto the free end of the iron wire in the same way as the first piece. Use the multimeter on the low resistance scale to ensure good connections. If you can solder, you might want to solder the ends together for a good connection.

Place the mug and glass side-by-side and bend the iron wire so that one end hangs into the mug and the other into the glass. Connect the meter to the free ends of the copper wires, and set it to the millivolts range.

Fill the glass with water and ice, and the mug with boiling water, and you should get a small voltage reading on the multimeter. Switch to the microamp range, and you should be able to read up to about three microamps or so.

The thermopile

To construct a thermopile, make many pairs of copper/iron wire pairs, twisted together at one end only. Push them all through the styrofoam, making sure they don't touch. Now twist the ends of each of the pairs to the ones either side of it, so that you end up with one long string of copper/iron pairs. Each copper wire should be connected to a different iron wire at each end, and each iron wire should connect to different copper wires. Make sure that you have two free ends left, one copper and one iron.

Now connect the meter to the two free ends of the thermopile and place one side of the thermopile in a mug of boiling water. Place a cold wet cloth over the junctions of the other end to keep them cool. You should be able to measure several millivolts and microamps across your thermopile. To get higher voltages and currents, use more pairs of wires and higher temperatures, such as from a flame (under parent supervision only!)

Solar water heater buyer's guide

With the recent advent of new solar hot water system rebates in Victoria, NSW and Queensland, we thought it would be a good time to look at what systems are available. This guide is an updated version of the one that appeared in issue 58 of ReNew, written by Ross Horman

Since our last guide in January 1997, there have been a few changes to the market, with some new models being added. However, most solar hot water systems are still expensive compared to most other water heaters. The good news is that recent rebate schemes introduced in some states, and updated in others, make it that little bit easier to install a solar water heater.

An Edwards close-coupled solar water heater.

How does it work?

A solar hot water system usually consists of a hot water storage tank connected via pipework to solar collector panels. These collector panels are placed on a north facing roof and at an angle of no less than 15° to the horizontal. The tank can either be situated immediately above the panels on the roof, above and a small distance away from the panels within the roof cavity, or at ground level, in which case a pump is required to circulate water through the panels.

Most solar water heater collector panels consist of a collector plate to which a network of pipes is bonded. This arrangement is then placed in a metal box with insulation behind it and a glass cover on the top.

As the sun shines on the panel the water in the pipes becomes hot due to conduction from the collector plate. This heated water rises through the panel and out through a pipe to the insulated storage tank. Cooler water from the bottom of the storage tank enters the panel at the bottom to replace the warmer water.

This is called the thermo-syphon process and requires no pumps or other devices, and is simple and very effective. However, it does require that the storage tank be situated above the collector panels.

From this we can see that the collector panel is the driving force for the circulation and so due care must be taken with its mounting and orientation if we are to get maximum benefit from it.

Where the tank cannot be located above the collectors, a pump and a differential temperature controller must be used to provide water circulation. The controller also turns the pump on when the temperature drops to 5°C as an anti-freeze function.

Collectors

The collector plate is usually copper or aluminium, however Solahart uses mild steel for most of its models. This plate is coated with special treatments to increase the absorption of the solar heat energy. These are a big improvement on plain matt black paint.

Bonded to this plate are copper pipes, or, in the case of the Solahart, steel collectors formed into many small channels. In all cases these pipes or channels are connected at the top and bottom to header pipes which also provide the

connection points to the external pipework.

One company, Solco, manufactures a system with the panel and tank made from one integral piece of rotomoulded polyethylene, eliminating pipes between the tank and collector.

Most manufacturers are now using low-iron tempered glass in their collectors for its greater absorbency and reduced re-radiation. It is also stronger than normal glass. Again, Solco has opted for the polymer option, using clear acrylic sheet in place of glass. This has the advantage of improved smash resistance, but will degrade eventually, unlike glass.

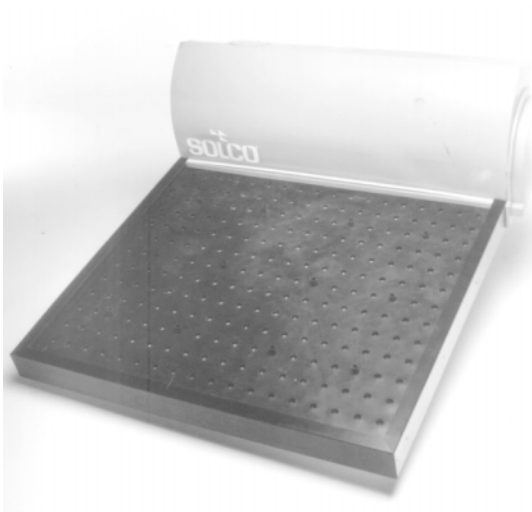
Beasley, Rheem, Solahart and Edwards make their own panels while Albury Consolidated Industries have taken over the business of manufacturing Sunbather collectors. They also supply complete systems, as well as conversion kits for existing electric water heaters. The Sundowner panels from AB&S Solar Industries have now been discontinued.

Tanks

For mains pressure systems the tank must be strong enough to hold pressures of 1000kPa and above. This means they must be made of steel. Some companies (Beasley and Edwards) use marine-grade 316 stainless steel while others use mild steel with a coating of vitreous enamel (glass). Solahart, Rheem and Quantum use glass-lined tanks.

Glass-lined tanks have a sacrificial anode fitted which is designed to be eaten away by galvanic (read corrosive) action in preference to the tank material. These anodes should be checked at regular intervals to assess wear and be replaced if required. With good-quality water this replacement time may be every five to seven years. If the water quality is poor then the replacement time will be much shorter. Failure to replace the anode when required will generally result in premature failure of the tank.

The Solco tank, being plastic, is immune to corrosion, but cannot be run at pressure, and so is a gravity fed system. Another company, Sola-Kleen, makes its tanks from copper and runs them at a reduced pressure using a pressure reducing valve on the inlet. This has the advantage of better supply pressure than a gravity-fed system, while still giving the corrosion resistance and extreme long life of a copper tank. Beasley also make some remote-coupled systems that use copper tanks.



Made almost entirely from plastic, the Solco is the cheapest commercial heater on the market, and is now available in 200 and 300 litre models.

Low pressure, gravity feed, constant pressure systems are all very similar and usually use copper tanks. These tanks are placed in the roof and are open vented. This means they can be directly connected to the heat exchanger on a wood stove. They are suitable for most water conditions and give many years of service before failure, usually due to corrosion or failed seams. Copper is very popular with recyclers.

Mains pressure tanks can be set up as gravity feed systems by adding a header tank. This may be desirable where there is no available roof cavity but the incorporation of a combustion stove for boosting is planned.

Retrofitting existing systems

It is possible to retrofit an existing electric storage hot water system to use solar heat. For a ground level mains pressure system, a special fitting can be installed on the cold water inlet. A pump circulates water from the bottom of the cylinder to the solar collectors. The hot water is injected through a small diameter pipe back into the cylinder and rises (by convection) to the top of the cylinder, where it is drawn off for normal use.

A controller switches the pump on whenever the solar collector(s) are hotter than the water in the bottom of the cylinder, and also in near freezing weather, to prevent the water in the collectors from freezing.

Gravity feed cylinders in the ceiling can have solar collectors connected to them, as long as the cylinder is above the collectors. If there is not a pair of unused connections available on the cylinder, an extra pair can be attached by a competent installer in about two hours. Combustion cookers used for hot water are also attached in this way, but it is not a good idea to connect a combustion cooker and solar collector pipes to the same cylinder outlets.

It is not really advisable to connect solar to gas storage hot water systems because they are designed for the gas to reheat the water as soon as some is used, so the sun can't really contribute any heat. However, the Aquamax system is designed to have solar collectors fitted if desired.

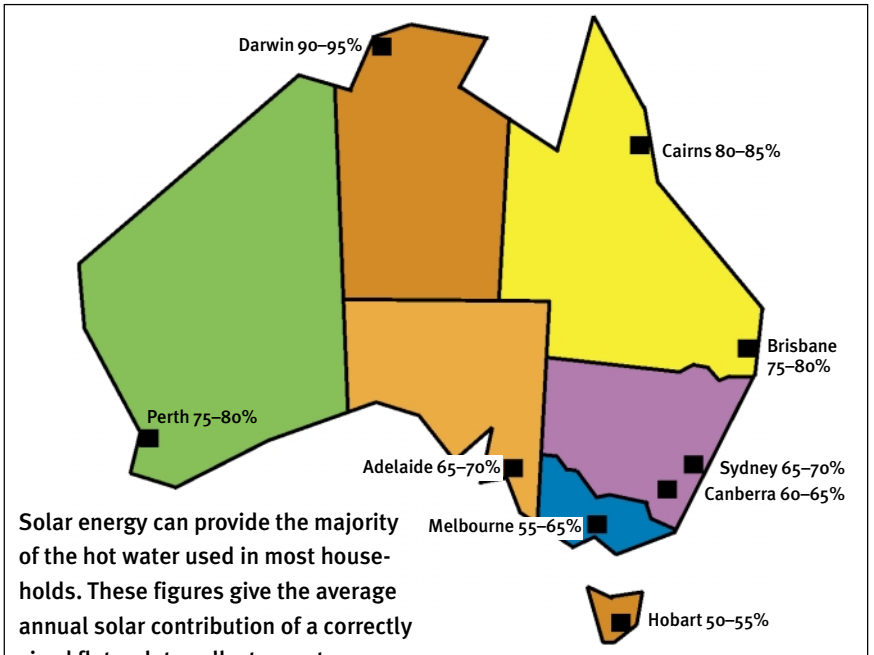
Insulation

Mains-pressure tanks are insulated with polyurethane foam. The normal industry standard foam is CFC free. Some manufacturers build the horizontal tank such that the insulation on the top is thicker than on the bottom, which makes a lot of sense considering the hottest water is at the top of the tank.

Boosting

All heaters on the market incorporate some form of boosting for times of insufficient insolation (sunshine). People on remote area power supply (RAPS) systems use woodstoves or LPG for boosting. Townsfolk have the option of gas or electricity.

Electric elements are the most common, as they fit in well with night rate tariffs and are much cheaper to fit. Gas burners and control equipment cost much more than an electrical element (up to over $1000 on the Solahart range) and this is reflected in the price of the systems. Environmentally, gas is preferable but not all systems have the ability to override the gas during the day so that the sun, not the gas, heats the water.

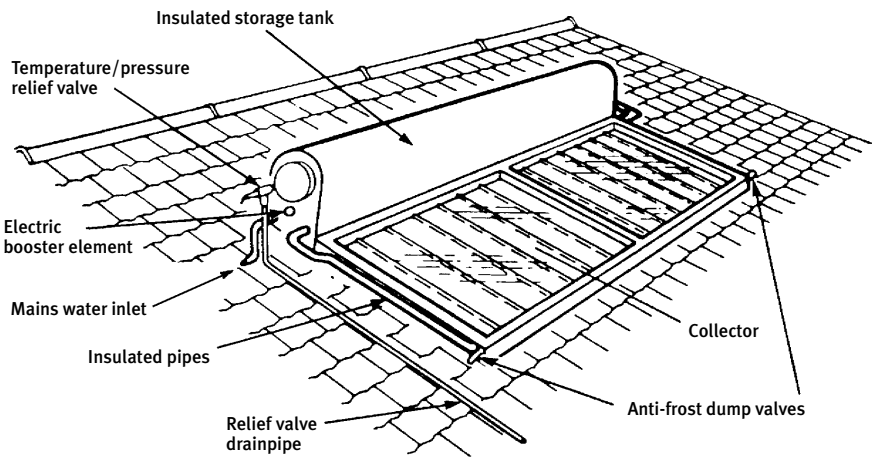


Solar energy can provide the majority of the hot water used in most households. These figures give the average annual solar contribution of a correctly sized flate-plate collector system.

Frost protection

All manufacturers offer frost protection for their systems on at least some models. This is important for anywhere that a frost may occur. A commonly used system involves dump valves which open when the temperature drops to around 4°C. As warmer water from higher in the system passes out through the valve it closes again. This process is repeated until the temperature rises again.

Several manufacturers including Solahart and Edwards offer a system with a heat exchange fluid which flows through the panels and into an outer tank around the main storage tank. The fluid in this outer circuit contains ethylene glycol, an anti-freeze additive, and does not require dump valves. However the level of fluid



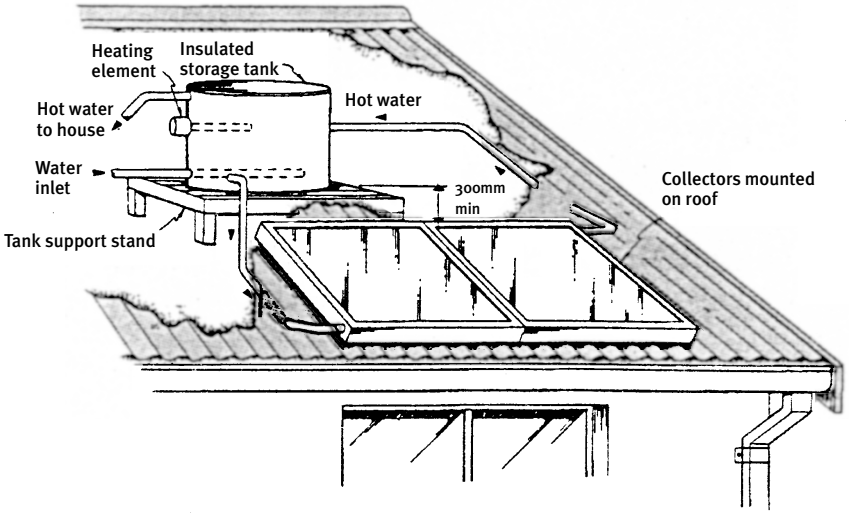
The main components of a typical mains-pressure solar hot water system.

Split systems, like this Solahart Streamline, allow the water tank to remain at ground level. Ideal for houses with limited roof strength.

in this circuit must be checked regularly and replaced after an interval as directed by the manufacturer. This fluid is more slippery than water and has been known to slip right out through the panel connectors. Owners should look out for this and replace the seals and fluid before irreparable damage is done to the collector panel. The Solco units do not require frost protection as their flooded plastic panel can stretch should ice start to form inside.

What size will I need?

Systems are usually sized the same way as off-peak electric systems, as they have a similar window of access to the booster, be it the sun or off-peak electricity. The sun is most effective during the six hours in the middle of the day. Night-rate tariffs commonly run for six hours, from 1am until 7am.



A gravity feed solar hot water system with storage tank inside the roof.

For a one- or two-bedroom house a 180 litre system is recommended. For a three-bedroom house a 300 litre system is desirable. Four to five bedrooms should be served by a 440 litre system. This sizing looks at the potential maximum number of residents rather than the actual number, as the hot-water service is a fixture in the house but the residency can easily change.

What about heat pumps?

A heat pump is a process used in refrigeration where heat is moved, or 'pumped',

from one medium into another. Air conditioners and refrigerators are the most common forms of heat pumps. In a refrigerator we pump heat from the food and dump it to the air outside the fridge through the coil at the back.

The Quantum and Solahart Sorcerer systems pump heat from the air and dumps it into the water storage tank. They are very efficient heaters, having a coefficient of performance (efficiency) of around 300 per cent. Unfortunately they need to be operating all the time with a duty cycle of eight to 10 hours per day. This means they are not suitable (or acceptable) for off-peak tariffs.

In situations where shading is a big problem for conventional systems, and drastic tree surgery is not an option, then heat pumps deserve strong consideration.

Temperature control

Under the plumbing code AS3500.4 it is a requirement that all water heaters connected to an uncontrolled heat source (solar and wood stoves) must have a 'tempering' valve fitted. This valve limits the maximum temperature for hot water to sanitary fixtures (bath, shower and hand basin) to a maximum of 50°C by mixing cold water with the hot water coming from the solar water heater.

Installation

The installation of any system should be carried out by appropriately qualified and experienced tradespeople. Unfortunately, too many systems have been badly installed in the past, resulting in poor performance and a loss of faith in solar water heating technology by the owners. Solar hot water systems do work, and work well if properly sized and installed.

Getting the most out of your solar hot water system

To optimise the performance of your system, hot water usage should occur in the morning as much as possible. This means showers in the morning and possibly putting on a tub of washing, as well as the dishwasher (if you have one) before going to work. This way the sun has the first go at heating the water before the booster kicks in at night. If the sun has done its job well the booster may not be required. ✲

Ross Horman runs his own renewable energy installation business, specialising in solar hot water systems. He can be contacted on ph:(03)5428 7676.

Solar hot water rebates

There are now rebates available for the installation of solar water heaters in three states—NSW, Victoria and Queensland. Below we have outlined what the rebates are available for, how much they are, and the various guidelines for the rebate schemes. As you will see, the schemes vary widely from state to state.

NSW

Under SEDA's Energy Smart Homes Policy, the installation of low greenhouse emission water heaters is required for all new residential development approvals. Solar and heat pump water heaters are eligible for a discount of up to $500, providing they meet the following guidelines and conditions:

- they are installed in an eligible local council area. Eligible local councils are those NSW councils that have joined the SEDA Energy Smart Homes Program and implemented the minimum requirements.
- must be capable of supplying at least 200 litres of hot water (raised at least 45°C above cold water temperature) per day.
- must be manufactured in accordance with Quality Assurance Standard AS/NZS ISO 9001 or be certified by the manufacturer as satisfying AS 2712 or Watermark standards.
- must have a minimum guarantee of at least five years on parts and one year on labour.
- solar water heaters must provide at least 50 per cent of the heating fraction by solar as per Australian Standard AS 4234.
- heat pump water heaters must have a coefficient of performance of at least 2, as per Australian Standard AS 4234.

Victoria

The rebates are offered by the Sustainable Energy Authority of Victoria, and are available for solar water heater installations that have a positive environmental effect. The rebate is a point-of-sale discount from the solar water heater manufacturer.

The rebate will vary from between $480 to $1000, depending on the size, type and performance of the system installed, and the type of water heater being replaced.

The main criteria the system must satisfy are:

- provide a greater than 50 per cent solar fraction in northern Victoria, as tested under AS4234
- must have a complete warranty of no less than five years, including frost protection
- the system must be new, not secondhand (new pre-heater collectors can be attached to existing systems)
- the system must be for residential use
- if there is a current gas connection to the house, only gas boosted systems will be eligible for the rebate (new homes that have gas reticulation in their street are considered to have a gas connection).

This last criteria means that very few solar water heaters will be eligible, as most homes have a gas connection. The main contender will be Solahart, and this is reflected in the list of eligible models available from the SEAV web site at: www.sea.vic.gov.au/solarhotwater. What's more, the gas version of the Solahart models is around $500 dearer than the electric models, which largely or even completely negates any financial advantage gained from the rebate.

While the SEAV is trying to promote the cleanest possible systems, it has greatly reduced the number of systems available for the rebate. Replacing an all-electric system with an electrically boosted solar system will still reduce greenhouse gas emissions by about 60 per cent. However, this does not seem to have been considered as an environmental benefit!

Queensland

The rebate is provided by the Queensland government, and is available to residents who purchase a new solar water heater or replacement parts for domestic purposes and install them at their principle place of residence. They do not apply to systems installed on rental properties, commercial or business properties, or holiday homes. They also don't apply to pool heating systems, or to solar water heaters being replaced due to damage from an insurable event. The system must be certified under one of the following standards:

- AS 2712
- Watermark
- AS/NZS ISO 9001

All systems must be installed by a qualified plumber.

The maximum total rebate is $750 for a system with a collector area of 3.5m^2 or greater (two panel systems) or $450 for systems with a panel area of between 1.75 and 3.4m^2 (one panel systems). Rebates of up to $150 are also on replacement panels and tanks for existing systems, up to a total of $300 (one tank and one panel) per household.

There are no restrictions on the type of systems installed, the emphasis is on getting solar water heating technology into domestic situations. As a result, all of the common systems, and even the less common, such as Solco and Sola-Kleen, are eligible.

Make	Model	Capacity (litres)	Type	Tank material	Insulating material	Total collector area (m²)	Number of collectors	Collector material	Glass type	Boosting	RRP	Comments	Warranty
Albury Consolidated Industries, ph:(02) 6021 2200	SYS1	250	Mains pressure pump assisted	Stainless steel or enamel lined mild steel	Styrofoam beads	3.7	2	Copper	Cushion mounted prismatic glass	Twin element electric	$2597.10	Uses CSIRO Nickel Black surface coating. Prices include GST.	Call.
	SYS2	315				3.7	2				$2691.70		
	SYS3	400				5.6	3				$3346.20		
	SYS4	250	Gravity feed	Copper	Styrofoam beads	3.7	2 (squat)			Electric with wood stove option	$2242.90		
	SYS5	315				3.7	2 (squat)				$2290.20		
	SYS6	400				5.6	3 (squat)				$2945.80		
	CONV1	—	—	—	—	3.7	2 (squat)			—	$1362.90	Conversion kits consisting of panels and fittings. Prices include GST.	
	CONV5					5.6	3 (squat)				$1884.30		
	CONV2					3.7	2				$1807.30		
	CONV3					5.6	3				$2288.00		
	COLL1	—	—	—	—	1.85	1			—	$493.90	Squat collector.	
	COLL2										$453.20	Standard collector.	
Beasley Industries, Bolton Ave, Devon Park SA 5008, ph:(08)8340 2299, fax:(08)8340 0829, www.beasley.com.au	26S/180	180	Mains pressure	316 stainless steel	Polyurethane	2	1	Copper	Low iron	Electric	POA	All systems use Amcro selective surface in their panels. Heat Transfer Module can be fitted to most systems.	Warranties vary from 5 to 10 years, ask your dealer.
	26S/300	300				4	2						
	26S/440	440				6	3						
	26S/600	600				8	4						
	12S1601200	160				2	1						
	12S2502200	250				4	2						
	12S3152200	315				4	2						
	12S3153200	315				6	3						
	26S180HTM	180				2	1						
	26S300HTM	300				4	2						
	5S2802P	280	Gravity feed	Copper	Polystyrene	4	2			Electric and solid fuel			
	5S3702P	370				4	2						
	5S3703P	370				6	3						
	5S4503P	450				6	3						
	5S2802PHTM	280				4	2						
	5S3702PHTM	370				4	2						
	175SC2P	280				4	2			Gas and solid fuel			
	5MC3702P	370	Gravity and mains pressure			4	2			Electric and solid fuel			
	5MC4503P	450				6	3						
Edwards Energy Systems PO Box 1415 Canning Vale WA 6970 ph:(08) 9334 4222, fax:(08)9334 4200, www.edwards.com.au	L180	180	Mains pressure close coupled	316L Stainless steel	Polyurethane	2	1	Copper/ aluminium	Low iron tempered	Electric	$2,078	Prices do not include GST. Prices will vary between distributors.	7 years on tank and solar collector.
	L305	305				4	2				$3,050		
	L440	440				6	3				$4,272		
	L600	600				8	4				$6,048		
	LX180	180				2	1				$2,308		
	LX305	305				4	2				$3,392		
	LX440	440				6	3				$4,630		
	DES125	180	Mains pressure split system			2	1				$2,296		
	DES250	300				4	2				$3,195		
	DES315	350				4	2				$3,354		
Quantum Energy Systems PO Box 301, Cardiff NSW 2285, ph:1800 644 705, fax:(02) 4953 7244, email: sales@quantum-energy.com www.quantumhotwater.com	270-S2-S Solar boosted	270	Mains pressure split system	Vitreous enamel lined mild steel	Polyurethane	4.6	3	Aluminium	—	—	$2,695	Heat pump system. Prices include GST.	7 years on tank and evaporator, 2 years on most other parts.
	270-T2-S Solar boosted	270				5.9	4				$2,998		
	340-T2-S Solar boosted	340				5.9	4				$3,317		
	340-Ti-S Solar boosted	340				9.2	6				$4,180		
Rheem Southcorp Water Heaters, 13 Rachael Cl, Silverwater NSW 2128, ph:(02)9748 5400, fax:(02)9648 3722, www.rheem.com.au	Loline - 250	250	Mains pressure split system	Vitreous enamel lined mild steel			1				POA		Up to 10 years.
	Loline - 315	315					2						
	Loline - 400	400					3						
	Solar Hiline 52T160	160	Mains pressure close coupled		Polyurethane		1	Copper	Low iron or toughened glass for cyclone areas	Electric		No frost protection system	7 years.
	Solar Hiline 52T300	300					2						
	Solar Hiline 52F300	300					2					Has frost protection	
Solahart 126 Pilbara St, Welshpool WA 6106, ph:(08)9458 6211, fax:(08)9351 8034, www.solahart.com.au	151K Gas	150	Mains pressure	Vitreous enamel lined mild steel	Polyurethane	2	1	Mild steel	Low iron	Gas	$2602.35	The information listed here was all that was supplied, however Solahart make a split system called the Streamline and a heat pump system known as the Sorcerer.	Ask dealer for warranty information.
	181K Gas	180				2	1				$3312.87		
	221K Gas	220				2	1				$3422.59		
	302K Gas	300				4	2				$4067.61		
	443K Gas	440				6	3				$5758.29		
	151K	150				2	1			Electricity	$1478.15		
	181K	180				2	1				$2188.67		
	221K	220				2	1				$2298.39		
	302K	300				4	2				$3445.42		
	443K	440				6	3				$4634.09		
Sola-Kleen, 24 Bassendean Rd, Bayswater WA 6053, ph:(08)9271 5725, fax:(08)9271 6136, www.sola-kleen.com.au	300LT XLX	300	200kPa max pressure	Copper	Treated polystyrene and wool	4	1	Copper	Low iron	Electricity	$2700		10 years
	240LT XL	240				3	1				$2400		
	180LT Single	180				2	1				$2000		
	VIP 180LT	180			Treated wool/nylon	3	1			Gas and electricity	$3500	Split system	12 years
	300LT XLX Heat exchange	300			Polystyrene and wool	4	1			Electric and solid fuel	$3300	Heat exchange units	10 years
	240LT XL Heat exchange	240				3	1				$2700		
	Smalls 60g in roof	270	30kPa max pressure			4	1				$2700		
	Smalls 40g in roof	180				3	1				$2200		
Solartech (Solco Industries) 126 Sheffield Rd, Welshpool WA 6106 ph:(08) 9356 2833, fax:(08) 9351 8290, www.solco.com.au	Genius 200	200	Gravity feed close coupled	Polyethylene	Polyurethane	2	1	Polyethylene	Acrylic	Electricity	$995	Rotomoulded plastic units with integral panel and tank.	7 years
	Genius 300	300				3	1				$1,595		

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.**

Solarising a water heater

I have been following the progress of your Hot 100 program as I would like to install a solar hot water system at our retreat in the Bunya Mountains (eventually to become our permanent home).

At present our hot water is provided by the slow combustion stove which is a great source of heat in the winter but is unnecessary in the summer (cooking is done on a gas stove). The hot water tank has been known to boil on occasions in the winter when the stove has been really stoked up for a number of days.

I would like to keep the existing system. Is there a way of combining it with a solar system, even if it means having more storage (at present we have 180 litres)? I believe they should be combined, not two separate systems, so we could boost the solar hot water in the summer by lighting the stove if necessary.

The roof pitch is 17° and there is a flat pergola along the north side of the house. What gradients do hot water pipes require?

John Learmont, Kingaroy QLD

There is no reason why you could not add solar panels to your existing system, provided that the current tank will be large enough for your needs when you are living there full time.

The diagram you provided shows that no area of the roof is low enough with respect to the hot water tank for a thermosyphon system to work, despite the tank being installed in the roof. The bottom of the tank needs to be at least 300mm above the top of the panel, and the roof pitch must be at least 15° to guarantee that the thermosyphon will work. Most likely a small circulating pump would be needed to push the water from the tank through the panel.

Adding a panel to the current system is probably the simplest way to do it, but the viability of this will depend upon the condition of the current tank. If it is getting a bit old, it may not be worth doing this way, and it might be simpler to replace it with a new complete solar water heater, still connected to your combustion stove for boosting. It would, of course, still have to be a gravity feed system, such as you have now.

As for the installation, there should be no problem getting the average plumber to do this, providing they have some solar hot water experience, but try to ensure that this is so before hiring anyone. The solar panels themselves should be available from solar water heater installers. I don't know of any manufacturers in your area, but Albury Consolidated Industries, ph:(02) 6021 2200, make panels and kits for retrofitting existing systems.

As far as connecting a new complete system to your current one is concerned, I don't see the point if you already have the tank and boosting system in place—it would just be extra expense.

Lance Turner

Hello from Samoa

I am currently living in Samoa (two years volunteer teaching) and your magazine gives me many interesting things on which to ponder in my spare time, something I have plenty of.

I'm hoping you can help me with a few questions. When converting AC to DC do you lose some power in the process? I will be using about 1kW DC continuously. Also I may be using voltages from 50 to 100 volts DC ?

I had thought that a generator with no load connected would happily spin using the least amount of force to turn it and as the load increased the force required to turn the generator would increase also. Is this true? I have noticed in a few articles the mention of load dumping in relation to generators, this led me to wonder if the generator produced a given amount from which you used what you need and have to dump the rest into an array of lights or some such.

How much of a generator's power rating can you safely draw continuously? A rough percentage would be helpful.

David Murray, Samoa

Firstly to the DC to AC conversion process. You do indeed lose some power in the conversion—you do in all power conversion processes. This usually equates to between five and 20 per cent, depending on the inverter efficiency. As for using a voltage range of 50 to 100 volts, I don't know of any inverter that runs across such a wide range, apart from grid interactive units, which are not what you are looking for. I assume you have some form of energy storage, such as a 48 volt battery bank? This is necessary for any inverter to run correctly, I doubt many would happily run straight from the DC output of a generator.

Whether a generator needs a load dump or not depends on the type of generator and the energy source. With a petrol or diesel generator, the generator speed is controller by the engine driving it, so no load dump is required. However, with relatively uncontrolled sources like wind and hydro, a load dump normally is required to prevent the generator from over-revving and damaging itself.

Your description of a generator requiring little force to turn it at no load is generally correct, with force increasing proportionally to increasing load.

As for what the usable percentage of a generator's power rating is, again that varies from machine to machine. The cheaper petrol powered AC generators, for example, can virtually never output their full rating, regardless of what the manufacturers claim. However, some of the DC output machines can output their full power rating. Hydro and wind turbines are a different thing entirely, and they can generally output 100 per cent of full power as long as there is enough water or wind to drive them.

Lance Turner

An undersized system

After many years of anticipation moving to alternative energy, the time finally arrived earlier this year. It has since become apparent that solar energy is still in its infancy as I have many questions and my suppliers do not have the answers.

Our shed, which is our abode whilst waiting for our house to be built, houses the system, consisting of 18 Solarex SX80 panels, a Trace C-60 regulator, a SEA 2200 watt inverter and six 4 volt Enersun 1025 amp-hour batteries. The theory is that we will run the power 100 metres to the house when it is built. All electrical appliances are 240 volt, including a fridge and freezer. We opted for a 240 volt fridge as we already owned one and the cost of replacing it with a gas/electric 24 volt unit was the equivalent of about six solar panels (at rebate price). We bought extra panels.

At the time of purchasing we were assured our system would be large enough. We have since heard that our supplier is not recommending others to do it this way. I am not sure why, we are not running out of power as such, despite many overcast days. We do have a generator and a 100 amp battery charger as backup.

The Enersun manual recommends not letting the specific gravity (SG) drop below 1.25, which is 95 per cent state of charge (SOC). However, the *Renewable Energy Resource Book* states that cycling batteries between 90 and 30 per cent SOC is often used to increase efficiency, but does cause sulphation.

When do I start the battery charger—at 30 per cent SOC or before the battery gets this low? Does it hurt the batteries to sit on a specific gravity of 1.2 for say, a week? My supplier advised to run the battery charger for a few hours every day in cloudy conditions as it takes a long time for the SG to rise from a low reading. I feel this defeats the purpose of reducing reliance on fossil fuels.

Does boosting harm batteries when done under close observation? Our Trace regulator does not admit many amps once the batteries are at 26.8 volts (after an hour on 27.8 volts) even when the SG is low. I often press the equalise button to override this as I like the batteries to take in as many amps as possible. You never know if tomorrow will be cloudy!

I also have some questions on inverters. I read in your magazine about using an Asko front loading washing machine. Was this using an inverter? My Asko 10505 would not work through the inverter, yet when plugged into mains electricity it worked like a charm. Why is this so, when the inverter is claimed to produce electricity as clean as mains power?

Our inverter has a sensitivity of 4 watts. This creates problems with appliances with small power requirements such as the answering machine. One suggestion is to plug in a night light, which is not enough to trigger the inverter alone, but along with other small loads will cause the inverter to start. This sounds good, but so far I have failed to locate an appropriate sized night light. Although the inverter has a sensitivity of four watts, it is not switching on with a 15 watt fluorescent light or a 20 watt satellite phone.

Patricia Holt,
Roseberry Creek NSW

Your battery bank does not seem big enough for your system. It has storage for a nominal 24.6kWH of energy, which, allowing four day's storage to 80 per cent DOD, equates to around 4.9kWH per day. Considering what you are running, this seems inadequate.

A DC fridge would use far less power than your AC machine, and would also eliminate inverter losses, giving a double benefit. While solar panels are cheap at the moment due to rebates, it is not just the array that should have been increased in size. The extra power from the array has to be stored, so the battery bank should have been resized, as should the regulator and associated wiring.

From the voltages you have given, it seems that your regulator is undercharging the battery bank. There is no point spending extra money on solar panels, if the charge controller doesn't let them charge the battery bank!

The Trace controller is a three-stage unit, providing a bulk charge, a fixed voltage boost charge, then a float charge at a reduced voltage. Charging the batteries to 27.8 volts is not enough, they should be brought close to the gassing voltage, around 28.9 volts. Our Trace controller brings the voltage to 28.8 volts, dropping off after an our or so at this voltage. The fact that you feel compelled to press the equalise button on a regular basis indicates the regulator is set too low. I would suggest opening up the regulator and adjusting the voltage settings to around 28.8 for the boost charge and 27.8 for the float. Note that the equalisation charge voltage for these regulators is the boost voltage plus two volts on a 24 volt system, making the equalisation voltage 30.8 volts. Check with your battery specs to ensure your regulator is set to the right voltages.

Your problem with the Asko washing machine is not an isolated one. While common sense would dictate that it should run fine on a sinewave inverter, it seems that this is not the case, and even the inverter manufacturers don't seem to know why! Perhaps if they or anyone else can shed some light on this obscure problem, they can enlighten us! I have to admit I had not tried my Asko on a sinewave inverter, there seemed little point, as the power is supposed to be better than mains quality.

Your inverter's autostart sensitivity is another common problem. The most suitable night light would be one using an incandescent bulb of a couple of watts or so. These do exist, but many night lights use the far less power hungry neon bulbs or electroluminescent plastic. You will have to shop around. As for the inability to detect a 15 watt fluoro light, this is a problem common to the 'DC path' starting system used in older inverters. We were under the impression that it had been fixed with the 'pulse' detection method used in modern inverters. Talk to SEA about this problem, if you haven't done so already.

Lance Turner

[Products]

New Bergey

There is no doubt that Bergey make an excellent wind generator, and their latest offering should be quite popular. The BWC XL.1 is a 1000 watt turbine (rated at 11.5m/s) and comes complete with Bergey's new PowerCentre controller, which includes wind generator regulator, a 30 amp solar regulator, battery fusing and monitoring, and load diversion.

rrp: $4800 including PowerCenter Controller

Distributed by Adtech Windpower Australasia, R950 Durham Lead VIC 3352, ph:(03) 5341 8232, email: info@adtech-windpower.com.au

Window insulation screen

Many homes suffer from heat transfer through their windows. In summer, heat entry can make a house uncomfortably warm, while in winter, losses through windows can increase heating bills and make the home an ice box.

The All Seasons Window Insulation screen is a solar window screen which helps reduce the heat flow through windows. The screen has a black side (absorptive) and a silver side (reflective) and is fixed to the inside of the window frame. It is not fixed to the glass in any way, and the company describes it as a 'reversible double-glazing substitute'.

In winter, the inward facing silver side deflects 72 per cent of the heat back into the room, while the outward facing black side absorbs any solar energy available. In summer, the screen is reversed. The silver side will then reflect the heat away. The window can still be seen through because of tiny perforations in the black and silver layers. The product can be fitted to any window, from a small skylight to the huge office building windows.

rrp: prices start at $60, but for larger projects quotations are provided on application.

Contact All Seasons Window Insulation, PO Box 149, Ringwood East VIC 3135, ph:(03) 9876 0721, fax:(03) 9876 0724, email: phoenix@virtual.net.au, www.virtual.net.au/~phoenix/

Energy smart toolbox

By far some of the greatest potential greenhouse gas savings are in the form of energy efficiency, yet this seems to be greatly overlooked by most authorities in Australia. However, the Sustainable Energy Development Authority (SEDA) in NSW has developed a package for businesses aimed at reducing their energy consumption, thus reducing greenhouse gas emissions and saving money in the process.

The Toolbox is a step-by-step guide to saving energy, and includes an energy savings manual, an energy management guide, an interactive CD with calculators and a greenhouse tutorial, and a directory of energy efficiency service and product suppliers.

The toolbox can help businesses understand where energy is used, calculate potential savings and reduce energy use in areas including lighting, office equipment, heating, ventilation and airconditioning, hot water systems and many other energy-consuming aspects of the average business.

rrp $ 195.00 + GST

Available from SEDA, PO Box N442, Grosvenor Place NSW 1220, ph:(02) 9291 5260, fax:(02) 9299 1519, email: seda@seda.nsw.gov.au, www.seda.nsw.gov.au

Have an energy efficient Christmas!

Christmas is a time when we are supposed to stop worrying about things and just have some fun. But have you ever stopped to think how much extra power is wasted just trying to supply all those Christmas lights?

Most Christmas lights use incandescent bulbs, but more and more we are seeing energy efficient lights using high brightness LEDs, like those here from Jaycar Electronics. These lights consist of 120 red, green and yellow LEDs on a 20 metre dark green cable, and are driven by a controller that provides eight different illumination sequences, including chase, twinkle and slow fade.

The lights are supplied with a plug pack transformer and use just 200mA at 24 volts AC, or less than 5 watts.

rrp: $44.50

Distributed by Jaycar Electronics, order freecall: 1800 022 888, email: techstore@jaycar.com.au, www.jaycar.com.au

Save your back and the environment

Drainage and irrigation pipes are usually made from concrete, which not only has a high level of embodied energy (it takes a lot of energy to make it) but is also heavy and fragile.

Recycled Plastic Technologies make a range of large diameter pipes, from 250 to 600mm diameter, made entirely from recycled plastics. Known as Green Pipe, because of its colour, it has many uses including culverts, crossovers and drainage systems.

Unlike concrete pipes, Green Pipes can be cut with a chainsaw, circular saw or angle grinder, and can be welded to form completely sealed pipe sections. Standard pipe length is 6 metres, with the option of flared ends with o-ring seals for fast assembly.

rrp (all per metre): 250mm—$20; 300mm—$25; 375mm—$38.50; 450mm—$49.90; 600mm—$83.33.

Manufactured by Recycled Plastic Technologies, 32 Dawson St, Moama NSW 2731, ph:(03) 5480 7060, fax:(03) 5482 4665, email: rptmoama@bigpond.com, www.rptgreenpipe.com. Victorian agent: Shane Phillips, ph: 0413 023 413.

New inverter range

Looking a lot like the PowerSaver inverters from Jaycar Electronics (but being blue, not yellow), the Powerhouse range from Altronics should fill the needs of many RAPS owners.

The inverters come in four sizes—two modified square wave models and two sine wave units. The modified square wave models have ratings of 1250 watts from a 12 volt DC input, and 1650 watts from 24 volts DC. They have large surge ratings of 4000 watts and 6000 watts respectively, enabling them to start loads like motors. They also feature autostart, however this does not work with fluoro lamps.

The sine wave models are available in 420 and 850 watt models, both using a 12 volt input, and have 1300 and 2500 watt surge ratings respectively. There is also a remote control panel available that can be used with all models except the smaller sine wave unit.

rrp: Modified square wave: $799 for the 1250 watt unit, $1,150.00 for the 1650 watt model. Sine wave: $529 for the 420 watt model and $1,099 for the 850 watt unit.

Distributed by Altronics Distributors P/L, 174 Roe St, Perth WA 6000, ph:(08) 9328 1599, fax:(08) 9328 3487, order freecall: 1800 999 007, www.altronics.com.au

Solar lantern

In many parts of Africa people who live in rural areas have no access to electricity. As a result, most families are forced to rely on candles or kerosene lamps to provide basic lighting in their homes.

The Glowstar Solar Lantern has been designed by Intermediate Technology Development Group as a low-cost alternative to a full solar system and is intended to provide African families with a clean source of lighting as cheaply as possible. ITDG manufactured 40 prototype lanterns for field testing, and of the first 40 lanterns on test, 30 are still in Kenya, as the owners would not give them back!

The lantern's 6.5 amp-hour gel battery can be charged from the 6 watt solar panel or an external DC source, and can be supplied with either a 5, 7 or 9 watt compact fluorescent lamp. Using a 7 watt tube the lantern gives light for 4.5 hours on a full charge.

While the lantern is targeted at African families, it should be available to other buyers in early 2001.

rrp around £65

For further information, contact Intermediate Technology, The Schumacher Center for Technology and Development, Bourton Hall, Bourton-on-Dunsmore, Rugby, Warwickshire CV23 9QZ, UK, ph:+44 1788 66 1100, fax:+44 1788 66 1101, email: enquiries@itdg.org.uk, www.oneworld.org/itdg

Plug in power

With the recent photovoltaic panel rebates, grid interactive systems are becoming quite popular. The heart of the system, the grid interactive inverter, is usually quite a bulky device that needs to be mounted on a wall somewhere. The Plug &Power system from Pacific Solar eliminates the need for a single large inverter, instead using a smaller dedicated grid-interactive inverter on the back of each solar panel.

The Plug&Power system is Australian made and consists of a complete inverter/panel unit. The panels use stainless steel frames which interlink to form a self-supporting structure. The outputs of the AC modules are connected in parallel to a system junction box which is connected to the house meter box. Electricity produced by the system is measured by a separate meter and delivered to the grid.

The inverters feature all of the standard safety features required of a grid-interactive inverter, as well as maximum power point tracking and conversion efficiency over 90 per cent at all power levels above 30 watts. They also have the option for remote system monitoring.

Contact Sales and Marketing, Pacific Solar P/L, 82-86 Bay St, Botany NSW 2019, ph:1800 776 527, fax:(02) 9666 4079, email: info@psolar.com.au, www.plugandpower.com.au

Twin filament bulbs

While fluoros are the obvious choice for energy efficient lighting they do have the drawback of not being suitable for use where they are switched on and off regularly, such as in toilets. In cases like this LEDs or incandescents are still the best choice.

Oatley Electronics has 12 volt, 36 watt incandescent bulbs that are similar in size to a standard 240 volt bulb. However, they have two separate filaments, so that if one fails you are not left in the dark and you have time to replace the bulb (why don't all bulbs have this?).

The bulb diameter is around 52mm and length is 100mm. These bulbs are made in Japan.

rrp: $5 for a pack of four. Part number (ZA0031).
Distributed by Oatley Electronics, PO Box 89, Oatley NSW 2223, ph:(02) 9584 3563, fax:(02) 9584 3561, email: sales@oatleyelectronics.com, www.oatleyelectronics.com

Evaporative water cooler

Most offices have water coolers of some sort, but they are usually energy-hungry refrigerated models that make the water so cold it hurts your teeth! If you don't want a cooler that cools water to two degrees above freezing then the Ecocooler may be the way to go.

This unit sits on a bench or counter and uses evaporative cooling to cool water from a standard water cooler bottle. The unit is powered by a 6 volt, 400mA plugpack and uses only around 3 watts of power, or 72 watt-hours per day.

While not as effective as a refrigerated unit, the manufacturers claim that it can reduce the temperature of the water enough to make it pleasantly cooler than room temperature. Figures given state that at 24°C and 10 per cent relative humidity, water temperature can be brought down to as low as 10°C. It should be understood that performance will depend on ambient temperature and relative humidity—as these go up, performance goes down.

rrp $50

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

Why use diesels?

It seems that for most mini-grid systems, such as those used to power outback towns, diesel generators are the system of choice. But diesel are not only expensive, they are highly polluting.

The Capstone MicroTurbine system is a compact, low emission power generator providing electrical power up to 30kW at 400-480 VAC, 50 or 60Hz. Solid-state power electronics allow grid-connect operation, with stand-alone battery connection and automatic grid/stand-alone switching available as options.

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The turbines are available in several versions, and can run on many fuels, including natural gas, LP gas, biogas and diesel. The unit measures 1900mm high, 714mm wide and 1344mm deep, and weighs 478kg.

Capstone Turbine Corporation, 6430 Independence Avenue, Woodland Hills, CA 91367, USA, ph: +1 818 716 2929, fax:+1 818 716 9910, www.capstoneturbine.com

Sinewave fluoro inverters

In most cases fluoros are the most suitable lighting, especially when you are generating your own power. However, running standard 240 volt fluoros from an inverter is inefficient and wasteful.

Rainbow Power Company has released a new range of Australian-made fluoro lighting inverters in 20 and 40 watt versions, both of which are available in 12 and 24 volt models.

'The inverters are designed to provide long tube life by driving the tube with a sine wave. They are also reverse-polarity protected. They are available on their own or in a complete fluoro fitting. Trade enquiries welcome.

rrp: $35.20 for the 20 watt unit, $37.15 for the 40 watt model (prices include GST).

Contact Rainbow Power Company Ltd, PO Box 240, Nimbin NSW 2480, ph:(02) 6689 1430, fax:(02) 6689 1109, email: sales@rpc.com.au, www.rpc.com.au

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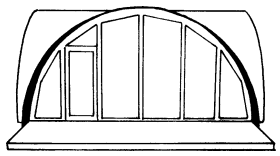

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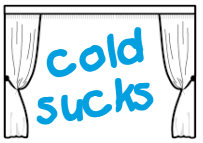

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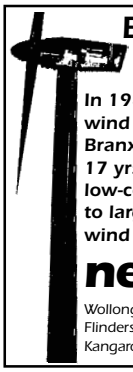

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A new *slant* on solar thermal

We take a quick look at a new solar generation system aimed at competing with photovoltaics

Solar thermal systems are certainly not new, but there has never really been any successful small-scale systems that could compete with photovoltaics.

So, when we received some infomation on a new solar thermal system that was being touted by the manufacturers, Orion Energy Management, as a 'cheap reliable alternative to photovoltaic systems', we thought we would have a look at it.

The system consists of three sections— the powerhead, the power conditioning unit and the solar collector. The solar collector consists of a series of parabolic trough mirrors about four metres long and a metre wide. They focus the sun's rays onto a tube at their focal point which contains a fluid called hydrofluoroether. This fluid absorbs the heat and turns into a gas under high pressure, which is used to drive a turbine coupled directly to an electric generator. Nominal gas temperature is 165°C

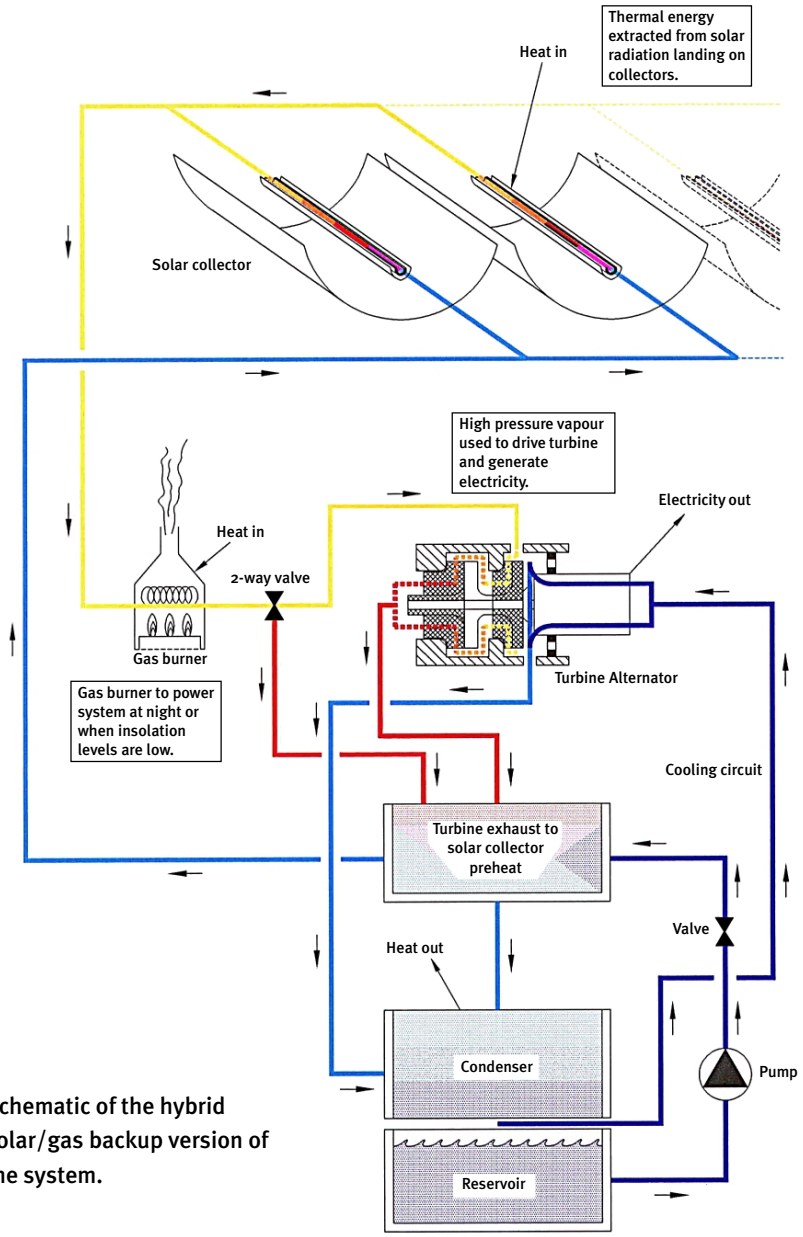
The output of the generator is fed into a switchmode power conditioner which provides a nominal 24 or 48 volts DC for charging of battery banks. Excess power is shunted to loads such as water heaters.

After exiting the turbine, the gas is cooled in a heat exchanger. Heat from the heat exchanger is then used to preheat the working fluid just before it enters the solar collectors, thus increasing the efficiency of the system.

From the heat exchanger the gas flows to a condenser where it reverts back to a liquid. There is also a separate circuit for vapour from the condenser through the generator for cooling.

The system is capable of producing from six to 100 kilowatts of power, making it a useful system for large homes right through to factories and other heavy power users. Overall efficiency of the system is between 10 and 14 per cent—similar to photovoltaics.

Other features of the system include automatic or manual solar collector tracking—in either one or two axis—and a 20,000 hour between overhauls period for the turbine.



Schematic of the hybrid solar/gas backup version of the system.

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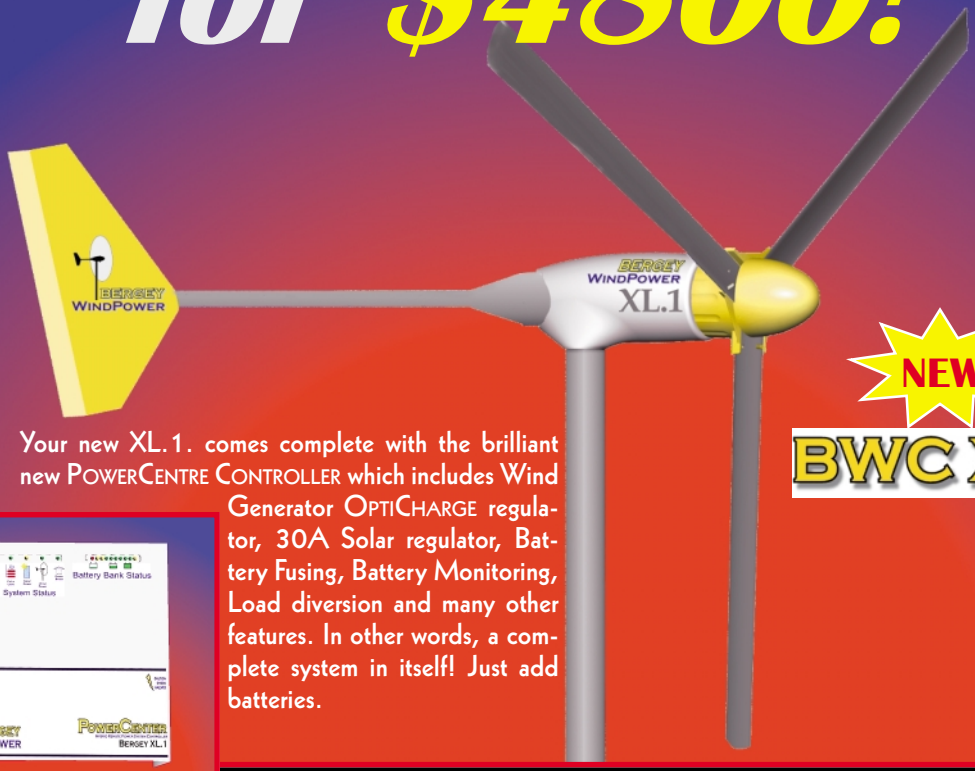

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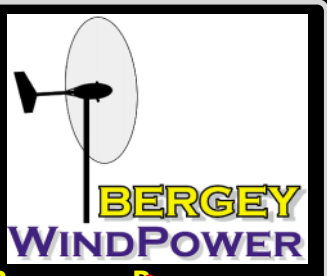

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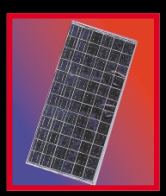

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