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ReNew

Technology for a sustainable future

Environmental products index
More than 450 listings

Visit an Indonesian environment centre

Simple regulator modifications

Solar bread

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Valued at $3570

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

Do it yourself micro-hydro

How electricity deregulation will affect you

Self-sufficient city living

Home building to reduce your impact on the planet

Issue 72 Jul–Sep 2000
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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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Email: contact@federalbatteries.com.au

Also available from selected Solar shops and specialist battery outlets.

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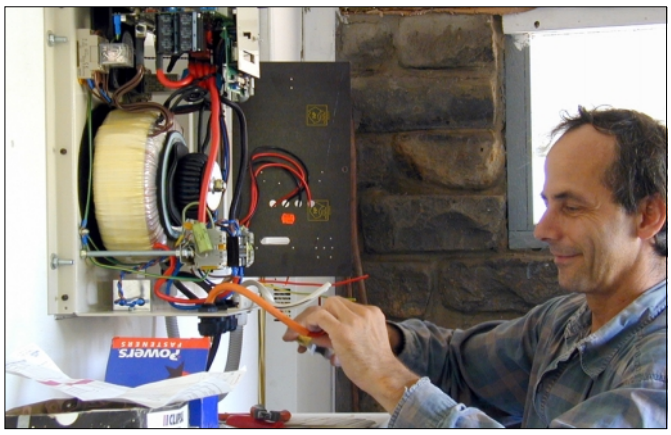
features

PPLH is an Indonesian environmental education centre which promotes renewable technology and sustainable farming techniques. See page 22 for the full story.

COVER STORY: The Chapmans show how their 'normal' residence reduces their impact on the planet. Cover photo and above photo: David Johns



The ATA and *ReNew* has finally gone solar! Thanks to ATA staff and volunteers, we are on our way to completing the office power system. See Lance Turner's overview on page 67.

New additions to the *ReNew* and ATA power system.

We help you choose a micro hydro system to suit your onsite water resource. See our Buyer's Guide page 32.

regulars

Kids love these water-activated animal pills. See Noel's step-by-step directions in Treasures from Trash, page 62.

Find out how to make energy efficient solar bread. Page 81.

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

Trees: our mates the carbon suckers

It seems that most of the talk in Australia with regards to reducing the amount of greenhouse gas emissions centres around the planting of trees. These carbon 'suckers' are being hailed, rightly, as essential to the conservation of the planet, however inconsistent government policy allows our mature and old growth forests to be harvested at an alarming rate, and then subsequently replanted with new forests, in what appears to be a form of environmental interaction unique to humans.

Almost every day in the *ReNew* office we receive federal government press releases announcing the allocation of funds to groups for the planting of trees, or to support programs to develop new fuel technology designed to neutralise the effect of motorists using their vehicles with ever-increasing regularity.

Tree planting and improved technology are only two of the many approaches that need to be employed to reduce the impact of human activity on the planet, but it seems that the majority of public finds earmarked for environmental protection is being channelled into these areas, rather than a balance of programs which will challenge the average Australian and educate people about modifying behaviour that is carbon producing.

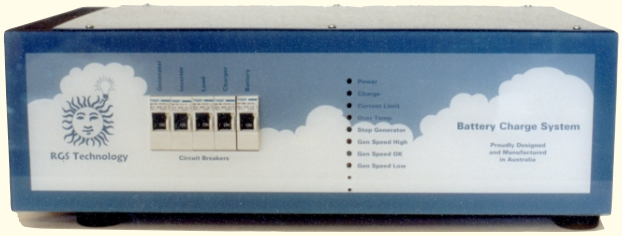
The valid rationale that at least tree planting is achieving something that is tangible and positive *now,* sometimes seems meaningless, especially when plants are being itemised and quantified and given a human waste disposal role, rather than acknowledged as important in their own right as part of a diverse environment.

On a different note I should mention that the Photovoltaic Rebate Program, has so far captured the imagination of almost 500 hundred Australians who have applied to the Australian Greenhouse Office for a share in the $31 million fund allocation to install solar systems on their residences. This program has kept every renewable energy installer I have spoken to working flat out, and will extend to community buildings from 1 July 2000.

In this issue of *ReNew* we visit Roger and Susy Chapman's sustainable house (cover story), and a community garden project in St Kilda, Victoria, that has converted what was formerly the lawns of a bowls club into a rich food garden. North of Melbourne in Northcote, a similar project has begun—which suggests that bowls is losing popularity in inner-city Melbourne, but more significantly, shows how positive innovation can save some community open space from private development.

Alternative Technology Association staff and volunteers have been the main contributors to this issue of *ReNew*, with Erika Maksem quickly becoming an expert on electricity industry deregulation in order to explain the new rules of the National Electricity Market. ATA volunteer Alison Sutherland tells us about an Indonesian environment centre where she volunteered over the summer, and another volunteer Sarah Milne has compiled not one, but two, *ReNew* indexes to help readers and office staff pinpoint exactly what *ReNew* issue that product review appeared in… This should prove a great general resource and save us all here at the ATA from scouring back issues of *ReNew* to service phone enquiries of this nature.

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
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***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.

Solar-powered and water self-sufficient in the inner city

Kulja Coulston visits the Chapmans, a young family which has proven that anyone can build their own energy efficient home

Photo by David Johns

I didn't even need to check the street number of Roger and Susy Chapman's two-storey town house when I set out to conduct my interview. Their fully-sustainable house is clearly identifiable at a glance from a bridge on Ballarat Road, a main road through Melbourne's western suburbs.

From the bridge there is also a view of the city, the West Gate Bridge stretching across the Maribyrnong River and the expanse of the western suburbs. On the drive-by one can't help but suppress an ironic smile when the Chapman's solar array and solar hot water unit catch the sun as it appears through the smog haze, with a backdrop of Melbourne's most polluting industrial centre.

Although they aspired to build a house which appeared 'normal' in almost all aspects of its design and construction, with the majority of the technology concealed in the walls, the Chapman's have created a home which stands out as the only rooftop in their area featuring renewable technology.

They were the first house in Footscray to utilise grid-interactive technology—but it seems they may have started a trend. A neighbour two doors down has recently installed a 1kW grid interactive system with funds received under the Photovoltaic Rebate Program.

The house

Roger is a carpenter and built and designed the town house himself over a period of eight months. Happy just to fulfil the dream of building his own

Photo by David Johns

Visible from a nearby bridge, the Chapman's house stands out as the only renewable technology rooftop in Melbourne's western suburbs.

home, Roger originally had no intention of incorporating any renewable technology at all in the construction.

They bought a house with subdivision potential three years ago on Alexander Street, Footscray, and began investigating the permits and processes required to subdivide the backyard and split the block into two titles, with the new property access from Scott Street.

Roger began the Certificate IV in Renewable Technology at Swinburne University in 1998. By the end of 1998, they were planning the house. At this stage Roger was interested in applying alternative energy to a country property, but after reading Michael Mobb's *Sustainable House* he decided to apply it to their new Footscray house.

'Initially I had no alternative technology in mind at all, and then I got interested in alternative energy technology,' he said. 'The course inspired me, but even then when we were thinking about building the house it was never our original intention to go the whole hog.'

The Chapman's house is designed to be essentially allergy-free, and throughout its construction they endeavoured to use ethically sourced and sustainably manufactured materials.

Spurred on by *Sustainable House*,

Roger and Susy decided that their new home would incorporate aspects of that design (see *ReNew* #60 for our feature on this house) and be water self-sufficient, but rather than be a retro-fit focusing mainly on technology they had the added freedom of building from the ground up.

The construction process began when their second child was only a few months old. Among washing nappies and caring for Levi and Aneisha, Susy set about designing and planning the interior of the house and selecting energy efficient lighting that would create a warm atmosphere. She liked the idea of building an allergy-free house with reduced impact on the planet, and selected new kitchen appliances with low power consumption, including a gas stove and oven, and a gas Rinnai space heater for the lounge area.

But after researching more deeply into non-toxic products they found that in many areas they were breaking new ground, and without some compromises the cost and time expenses would set the building process back many months.

'After talking to Susy's chemical engineering brother I realised that everything was toxic to a degree, depending on the dose, so instead of having this unrealistic goal of having a completely allergy-free house, we changed it to what level of toxicity we were willing to put up with. That was a freeing feeling for us. We no longer felt bogged down with that particular issue,' said Roger.

Non-toxic elements

After researching window frames that were made from sustainably harvested, non-rainforest timbers they found that the cost and the time delay of three months was, in this instance, unrealistic for them to accept. In the end they chose aluminium window frames, which have high embodied energy in the manufacturing processes, but which will never need replacing or chemical protection.

They were more successful with the house framing and wall materials, with 95 per cent of the frame constructed using Australian plantation timber. They chose reverse brick veneer and Radcon radial sawn blue-gum timber cladding for their appearance and for thermal mass. Also for thermal mass, Roger decided to build on a slab rather than stumps.

On the floors in the main living area they have ceramic terracotta look-a-like tiles which are also used outside into their small back yard to create the feel of inside/outside living space. Upstairs the house has exposed polished Tasmanian Oak floor boards.

The outside space is partially sheltered with transparent polycarbonate to enable the light to penetrate through the full-length glazed north doors, purchased second hand for $100.

Passive solar design

The 150 m^2 townhouse is attic-style with a roof pitch of 38 degrees and orientation of 30 degrees to the west of north. The constraints of the block meant that the orientation was unable to be completely north facing, as they wanted the house to extend to both east and west boundaries to provide maximum space, with zero offset from the front of the block.

'I didn't go to the extent of incorporating all the features to get the sunlight to penetrate deep within the house. As it is we have a lot of north glass and it is bright for most of the day, and it's orientation is efficient enough,' he said.

Energy efficiency features

For insulation they chose a combination of natural woolblend and polyester, with sisalation and double-glazed windows.

In the ceiling the insulation R value was 3.8, the exterior walls was 3.3 and the internal walls was 1.5. With those basics: bulk in the walls, a slab on the ground and thermal mass on the inside to stabilise the temperature, the Chapmans were satisfied that their house was thermally efficient. All win-

Photo by David Johns

Inside the Chapman's house appears like any other, a regular visitor would have no idea that the house was solar-powered and water self-sufficient.

dows are double-glazed except the full length glazed back doors which will have a thermally efficient curtain.

The interior lighting is a combination of compact fluorescents and halogen down lights. The 10 watt extra-low voltage dichroic halogen down lights are separated into clusters with dimmers.

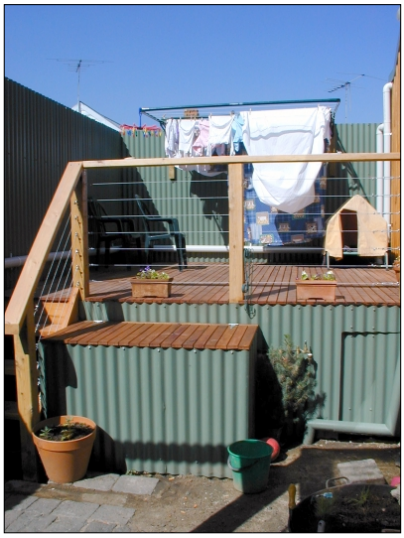
In order to monitor the performance of the house they will fit one sensor upstairs and one down stairs with sensors in the ceiling and on the roof to measure irradiation and heat.

'A lot of people are building energy efficient homes, they say they work well, but how well? When we were planning this house there were few opportunities for us to look at the performance of other houses, hopefully for educational purposes we can accrue information that will be useful for others. Eventually all of our household data will be available live on a website,' said Roger.

Water system

Roger and Susy decided that there was no reason for them to connect their new house to the mains water, and instead installed a 25,000 litre concrete water tank to supply all of their water needs. Having learned from *Sustainable House* that some bureaucrats were reluctant to support unconventional initiatives, and after being misinformed on a number of occasions by bureaucrats that it wasn't possible to build a house without mains water, Roger and Susy prepared a presentation outlining what they wanted to achieve.

Roger uses a compass to ensure his solar water heater faces due north.



Above: The 25,000 rainwater tank is disguised under the raised back porch; the Wattsworks greywater holding tank is located in the smaller box.

Above right: Susy and Levi pose in their 'normal' second floor bathroom which is connected to the Wattsworks.

Photo by David Johns

Roger had monitored the average local rainfall and calculated it by the roof area. The rainwater collection system includes a diverter which sends the first 10 litres of water from the roof into a down pipe to use on the garden.

'I found that we should expect to collect an average of approximately 150 litres of water per day which fell short of the expected daily usage of 240 litres. I decided to install a Wattsworks system which would save on 30 per cent of our daily usage by recycling the bathroom water through a holding tank and into the toilet cistern,' he said.

They decided to install flush toilets rather than a Dowmus biolytic system, which was their original intention, as they were satisfied that the local sewage disposal plant at Werribee used similar environmentally sound principles in their treatment of waste, and is also a local source of Green Power.

Due to the drought conditions in Melbourne and general water restrictions in Victoria the Chapmans currently run the risk of running their tank dry, and pending a good rain, they may need to rely on siphoning water from the tenants in their original residence—an extension to their already special relationship which includes informal chats over the back fence to discuss all matters of business.

'We realise that sometimes we may need to rely on our neighbours or buy in water, but that is a small price to pay considering the enormous water savings we are making by relying on our tank,' said Roger.

The process of installing the water tank was arduous, with heavy machinery required to break up a bluestone rock shelf where the water tank was to be located. The expensive hole was dug and the water tank installed, but before Roger filled it with enough mass to hold it in place, a good rain floated the tank raising it 300mm from ground level, making it necessary for the back decking to be raised 300mm higher to cover the top of the tank.

The solar system

Roger and his electrician installed 18 BP 75 watt photovoltaic modules for a total of 1350 watts. They had planned to install a 2.5kW inverter, but due to a high demand in sales this was unavailable. Solar Energy Australia supplied a 4kW inverter instead.

Originally they were going to purchase nine solar modules which would have supplied approximately 70 per cent of their peak energy requirements, which was estimated to be 5.5kWH per day, but due to the $7425 received under the PV Rebate Program they decided to install a system which supplied 100 per cent of their electricity requirements.

Unlike the Beasley 350 litre solar hot water unit, which Roger mounted to be positioned exactly north facing at an angle of 30 degrees to the roof, the solar array lies flat due to the small 57 m^2 roof space on the north facing side.

The local electricity distributor, AGL, will supply a smart meter and modem to the Chapmans in order to compile a consumer load profile. The load profile will help AGL formulate pricing processes for other customers wanting to install grid interactive systems. The meter will also be capable of reading gas and water consumption should all utilities agree to this. This would simplify billing and make trips through the Chapman's house to the water meter in the backyard unnecessary.

The water meter will allow City West Water to accurately calculate sewage disposal costs which are normally paid as part of a normal water bill, which the Chapmans will never receive.

Education plans

Susy has a background in teaching and together she and Roger plan to open their house up to school groups and the general public to run information sessions and activities. Almost every room in the house has a computer network port to allow them to better demonstrate on computer the main system features and their performance.

The garage is to be the main classroom. Inside it has the inverter mounted on the wall, and a wood heater which will be used to provide hot water backup for the gas booster.

Thorough metering of the house will enable other home owners to gain an understanding of energy and cost savings. They also plan to start a business called Environmental Housing which will operate as an energy efficiency consultation service to assist others to plan energy efficient housing.

'The house cost $125,000 to build including the appropriate technology. People are interested in the extra cost of the technology and how much money we will save, but when we started the project the economic benefits were just an added bonus. When we started the project we did the 'extras' because Roger was interested in the technology. We thought the cost was worth it because of the environmental savings,' said Susy.

'Someone asked me whether the water in our toilets is dirty. Many people seemed to be concerned with this sort of thing to the extent of wanting a 'blue loo'. When you think of how much water is saved and the environmental damage that is prevented through reuse, some water discolouration is a small price to pay. After all it's only shower and bath water. Our kids will grow up with sustainability as a priority knowing that we're interested in their future.'

The Chapman's house will be open for public tours, student groups and corporate groups as of June 2000. For bookings please call (03)9689 0282 or email: chapmans@net2000.com.au

They thank Colin Chapman, John Blik, Going Solar, ATA, Onga Pumps, Quantum Elect. Services, Cleary Plumbing Service, K & C Stork, Radcon, Swinburne University Tafe, AGL, Architecktonic, Beachamp Engineers, Rowena Barnes, City West Water and family and friends for all of their help and support.

Mobile phone recycling program

Old analogue phones which have been superceded by digital technology, would normally be disposed of as landfill, but can now be recycled as part of Australian Mobile Telecommunications Association's recycling program. The program involves the collection of mobile phone batteries by MRI Industries. The batteries are then shredded and the nickel alloy and cadmium recovered for reuse by Ausmelt. Disused phones can be returned to Telstra T-shops, Optus World, Orange, Strathfield Car Radios and Vodaphone stores. Enquiries should be directed to Peter Russel at AMTA on phone: (02)6230 6055.

Star watching

The Australia Competition and Consumer Commission and the Australian Greenhouse Office will actively investigate the accuracy of the energy efficient star rating system for household appliances. Where the AGO identifies instances of consumers being mislead by erroneous star ratings, the ACCC will investigate and prosecute to its full powers.

NSW forests to act as carbon 'suckers' for power company

Tokyo Electric Power Company has signed a $30 million agreement with State Forests of New South Wales to plant 10,000 hectares of forest to offset their greenhouse gas emissions in Japan. The agreement includes the option open the company to plant 40,000 hectares over the next 10 years. Although still not ratified, NSW Premier Bob Carr said the carbon trade agreement was in line with the Kyoto Protocol to reduce greenhouse gas emissions.

Dietary solution for animal methane emissions

Scientists in Scotland believe they have found a way to reduce the amount of greenhouse gases released into the atmosphere—a bacteria supplement added to farm animal feed to reduce the amount of methane produced when the animals break wind.

Research indicates that after consuming the bacteria, Brevibacillus Parabrevis, the amount of methane produced by each sheep tested fell from four litres per day to two litres. The results are said to be promising. Methane is one of the main greenhouse gases contributing to climate change and currently 30 to 40 million tonnes are released to the atmosphere each year.

Offshore wind new European fashion

Growing resistance to wind turbines in Europe, particularly the Netherlands, Denmark and England, has forced wind developers to look offshore for new locations.

Already, successful wind installations have been constructed offshore in Denmark, and there are more on the way with Germany planning to locate a 1,000 megawatt wind park in the North Sea, and Sweden, the Netherlands, England and Ireland all looking towards the horizon for appropriate locations.

Despite the terrestrial unpopularity of wind farms, like the Welsh wind farm described in the *UK Mail* as 'petrified forests of metallic grey towers,' the wind industry in Europe is booming. It is believed that offshore farms will enjoy stronger winds and escape opposition to the visual impact of the 100 metre towers.

Spain gets serious with 1400MW of wind

Establishing itself in Europe as a new contender in the renewables industry, Spain has placed one of the world's largest recorded orders for wind turbines. The order for 1,800 units will be supplied to Spain's main wind power plant owner, Energía Hidroeléctrica de Navarra, in a deal worth more than US$675 million. The turbines will have a total capacity of 1,400MW and will be delivered over the next three years.

Biodiesel draws a crowd

Participants in the Earth Day 2000 celebrations in Washington DC, witnessed Kohler generators, fuelled with biodiesel made from vegetable oil, provide almost one megawatt of electricity to power the event. The crowd of 350,000 people enjoyed the smell of popcorn in the breeze and information from Joe Jobe, executive director of the National Biodiesel Board. For more information contact: www.biodiesel.org

PV Rebate Program

Already more than $3 million of the $31 million fund pool offered under the Photovoltaic Rebate Program has been distributed since 1 January 2000. As of 1 April 2000, more than 541 applications had been processed resulting in 423 approved installations across Australia. The program will run for four years, or until the money is fully distributed. Community buildings will become eligible to apply for rebate funds as of 1 July 2000.

Calculate your household greenhouse emissions

The Sustainable Energy Development Authority has launched an online calculator to enable householders to work out the amount of greenhouse gas emissions they produce by using electricty generated from coal-fired power stations. The site: www.greenpower.com.au is designed to inform people about the greenhouse benefits of Green Power by demonstrating the difference between the current emissions with those of a similar residence utilising Green Power.

Odd sods

An organisation was running an 18kW air compressor 24 hours per day, seven days per week. The compressor would cut out when the air in the twin receivers was up to pressure, but the 18kW motor kept running. Since installing a pressure cut off switch, savings look like being as much as 99.8 per cent.

Energy Efficiency News Victoria

Biofuels to call Australia home

Moama in southern New South Wales is set to be home to the world's largest biofuels production plant. Moama Oil Refinery plans to produce biodiesel made from waste canola oil and retail it widely for 60 cents a litre by the end of 2000.

In some rural areas the price of diesel is around 90 cents per litre, so the economic savings are obvious. More impressive, however will be the environmental savings which are estimated to be a 75 per cent reduction in greenhouse gas emissions—enough to bring a smile to the face of people and plants everywhere. It is predicted that large fast food outlets will supply used vegetable oil.

Already 80 tonnes of biodiesel is produced annually worldwide.

The Weekly Times 26 April 2000

Lindsay Hart (L) of SEA with our winner Garry Bartlett. Lindsay offered to upgrade the 12 volt inverter prize to a 24 volt inverter to suit Garry's system.

Our SEA subscriber competition winner

Garry Bartlett of St Andrews, Victoria, is the lucky winner of the *ReNew* and Solar Energy Australia 12 volt inverter/charger subscriber competition, offered in issues 70 and 71.

Garry is a long-time reader of *ReNew* who re-subscribed for two years with the hope of landing the inverter/charger to complete his system. For more than four years he has been working towards solar self-sufficiency for he and his family—the only missing component preventing solar 'lights on' was an inverter.

When presenting the prize at the *ReNew* office, Lindsay Hart of SEA was discussing with Garry his system, and realised that the 12 volt inverter prize offer would be inappropriate for Garry's 24 volt system. With no hesitation, Lindsay committed to upgrading the $3890 prize to a $4790 24 volt inverter/charger.

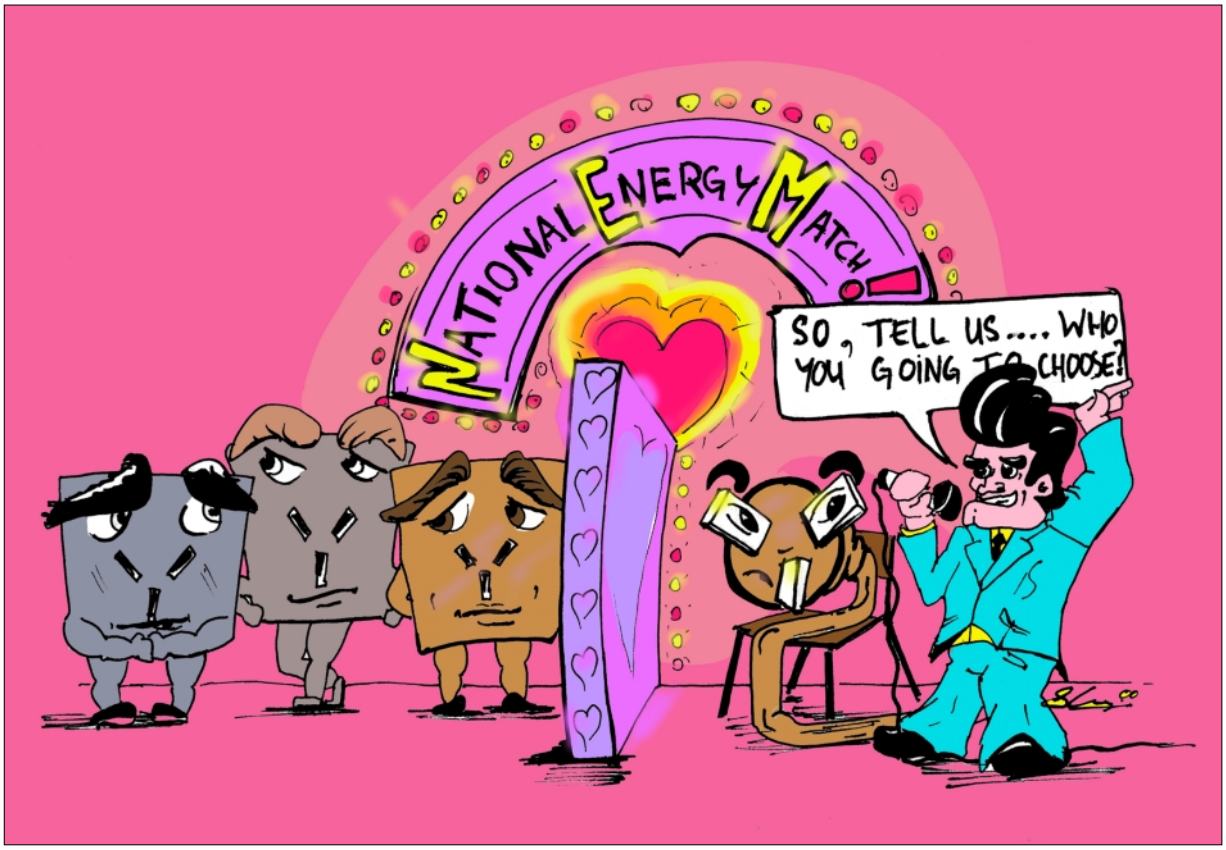
'My long-term goal is to have no utility bills. It has been so frustrating to wait for so long, but now I will be able to complete my system and run all of my 240 volt tools and household appliances from solar energy. Today's my lucky day,' said Garry.

The world's largest roof-integrated PV system

This 1 megawatt solar rooftop is located in the heart of the Ruhr region in Germany and is the world's largest roof integrated solar power system. Of the 12,000m^2 roof area Pilkington has installed 10,000m^2 of Optisol photovoltaic solar-glass modules. A total of 2,900 Optisol modules have been incorporated. To achieve sufficient sunscreening inside, while still providing lighting, six module types have been used, each with differing ratios of glass area. The glass area ranges from 58 per cent glass to 86 per cent with output ranging from 250 to 416 watts per module.

Correction and apology

In issue 71 of *ReNew* it was reported in the article *Should I buy Green Power or 'renewable' energy* that Pacific Power was burning native forest trees for power. This information is incorrect. Pacific Power has not used any timber or timber wastes for fuel in any of its facilities at any time. *ReNew* and the author unreservedly apologise for any embarrassment this may have caused the company. The error was made by a NSW researcher.



Deregulation and competition: what does it mean?

Erika Maksem explains the implications of electricity industry deregulation for residents and small business

As a result of the deregulation of the electricity supply industry on 1 January 2001, residential electricity customers and small business in the Australian Capital Territory and Victoria will become eligible to choose their electricity suppliers, New South Wales comes into effect on 1 January 2002 and South Australia 1 January 2003. But despite there being less than six months to go and over six million residential sites affected by the change, the implications of competition for residential customers remains uncertain. Will the reform process bring any windfalls for residential customers or will they be left out in the cold?

Background

Until 1990, the electricity supply industry in each Australian state and territory was controlled by either one state owned authority or a combination of authorities that were responsible for the generation, transmission and distribution of electricity. In 1991, work undertaken by the Industry Commission recommended ways in which to increase national productive output, including restructuring the electricity supply industry into separate elements and introducing competition into generation and retail supply. Since then, State and Territory governments have been restructuring and reforming their state owned utilities in preparation of the National Electricity Market (NEM).

What is the NEM?

The NEM is a wholesale market for the supply and purchase of electricity that began in 1998 as a way of introducing competition in the wholesale market and of opening access across the ACT, NSW, Victoria, Queensland and South Australia,

whose residential customers will be able to choose their electricity supplier in 2003. The NEM uses the concept of a pool where all electricity output from generators is centrally pooled and scheduled to meet electricity demand. This pool is managed by the National Electricity Market Management Company (NEMMCO) and applies across the interconnected power system comprising of the ACT, NSW, SA and Victoria. A power transmission line is being built over the NSW border to bring Queensland into the grid by the end of the year, and Tasmania is expected to join the NEM if an electricity interconnection with Victoria goes ahead. However, it is unlikely that Western Australia and the Northern Territory will be directly involved because of the long transmission distances involved, although both are working on their own industry reforms.

The purpose of the NEM is to increase efficiency in the electricity supply industry by introducing competition into the generation and retail sectors so that electricity companies will use their assets more efficiently and reduce costs, benefits that customers should be able to take advantage of when they become 'contestable'.

What are 'contestable customers'?

When customers become eligible to choose their electricity supplier, they become 'contestable customers'. This means that customers can choose whom they buy their electricity from, but remain customers of their distribution company that owns the wires and poles that transport the electricity.

Contestability started in Victoria in December 1994, followed by NSW in October 1996, the ACT in October 1997, Queensland in March 1998 and SA in December 1998, and occurs in five phases determined by customers' annual electricity consumption measured in megawatt hours (MWH). Phase one affects 40 gigawatt hours (GWH) or 40,000MWH-plus customers, phase two affects 4 GWH or 4000MWH-plus customers, phase three affects 750MWH-plus customers, phase four affects 160MWH-plus customers, and customers using less than 160MWH, or who spend less than about $20,000 on electricity each year, become contestable in the last phase.

Customers who decide to change suppliers or renegotiate an agreement with their current supplier, need to sign an electricity supply agreement, a contract stating that they agree to purchase electricity from their chosen supplier. In Victoria, electricity brokers have been out in the field advising and negotiating supply agreements for businesses for the past couple of years, with a telemarketing service performing a similar function. Customers can sign three or four year agreements and non-incorporated sites, which include all residential customers and 50 per cent of small business, have a five business day cooling off period within which to terminate the agreement. At this time, there is no set method for signing up residential customers and small business, however, David Rees, managing director, EnergyCor, an independent energy brokering consultancy, says it will probably trial having brokers going door-to-door to explain and negotiate supply agreements with customers.

Implications for residential customers

In April 1999, the Office of the Regulator General which controls electricity standards and prices in Victoria, commissioned a consumer research study into the implications of competition on residential customers. According to the study, it is unclear, based on overseas experience, whether the introduction of contestability for residential customers will deliver substantially lower prices or service improvements.

The study states that the public benefit of contestability depends on four factors. The first is customer inertia, with residential customers being reluctant to transfer retailers because of transaction and

search costs. For instance, as of April 1999, 16 months after the introduction of retail competition in California, the Californian Public Utilities Company reported less than one per cent of the domestic market had transferred retailers. Similarly, in the United Kingdom, the Office of Electricity Regulation reported in December 1998 that data collected from electricity suppliers suggested only around five per cent of the domestic market had signed agreements.

The second factor affecting public benefit is the cost of metering technology. Residential customers currently use household meters that measure accumulated energy monthly or three-monthly. However, under deregulation, wholesale energy is sold at prices that fluctuate half-hourly, so that energy consumption must be measured in half-hourly segments using a smart (or interval) meter which larger businesses that are already contestable have had installed. Although there is no upfront cost to install the metering technology, customers are charged a monthly fee for the cost of hiring the meters and keeping the telephone line open. But at a total cost of around $950 per year, new metering technology is not a serious short-term consideration for residential customers or small business. In Victoria alone, over two million meters would need to be installed.

'It is unclear, based on overseas experience, whether the introduction of contestability for residential customers will deliver substantially lower prices or service improvements.'

As there is no way of determining residential energy usage in half-hourly lots, retailers will be unable to charge residents according to the actual amount of energy they use. Although there is currently no decision about the way that retailers will buy wholesale electricity for their residential customers, according to Murray Massey's article 'Power Politics' in *BRW*, it is expected that come 1 January, the payment settlement system between retailers and generators will be based on consumer 'profiling'. Under this system, payments would reflect household profiles, assuming a common usage pattern for households with similar numbers of occupants and electrical appliances, while not encouraging re-

tailers to better understand their customers and their consumption patterns.

Third, with the number of participants in the retail business, there is a lack of incentive for retailers to seek the custom of residential customers outside their locality. According to Gavin Duffy, policy officer with the Victorian Council of Social Services, 'red tailing', or the failure of retailers to seek the business of smaller, less profitable residential customers, is just one of a number of issues that need to be tackled before the residential market becomes contestable.

Last, there is the actual cost saving and the lack of cost incentive when savings and transaction costs are compared. In the United Kingdom, for example, dual fuel purchasing from one retailer can create meaningful financial benefits for residential customers. By providing gas and electricity, retailers can reduce their operating costs and pass the savings onto their customer, with retailers offering customers extraneous benefits like yearly savings for electing to pay bills by direct debit or free service calls for urgent repairs.

Energy efficiency and the fate of renewable technology

In a deregulated, competitive electricity supply industry, the prospects for the development of meaningful energy efficiency programs appear rather dim. Distributors that offer energy efficient services generally focus their efforts on larger customers because the transaction costs are lower. They also pursue the most easily accessible efficiency savings.

Unless they are offered support for energy efficiency projects, distributors will limit energy efficiency programs to high-return niche markets. Restructuring therefore would not create a business incentive for distributors to promote energy efficiency as efficiency services do not offer the distributor a competitive advantage. Distributors also face the potential for lost revenue as customers conserve electricity.

Green Power customers

As for the renewable technology market, in the American states that have considered, or are restructuring, their electricity markets, policymakers have concluded that restructuring would not, at least in the foreseeable future, provide favourable conditions for developing the renewable technology market. However it is still unclear, with regard to the US example, the extent to which competitive electricity markets will support renewable technologies.

Residential customers can support renewable technologies by electing to have a percentage of their electricity supplied by renewables. But as conservationist Jill Redwood pointed out in the issue 71 of *ReNew*, customers need to take care that they're not paying premium prices for so-called 'renewable power'. She recommends that customers considering buying accredited Green Power from retailers are informed about where they source their power. In addition, residential customers can also take advantage of initiatives like the Commonwealth Government's Photovoltaic Rebate Program that gives cash rebates to households to install grid-interactive or stand-alone PV systems as a way of encouraging the long-term use of PVs to generate electricity.

Cooperatives

Giving hope to the future of renewable technology in the competitive electricity market are electricity co-operatives. Co-operatives are member-driven bodies that are committed to community development, not creating wealth for investors. Membership is open to all electricity consumers who invest their money as shareholders, and in return they use the co-operative's services and are provided with a regular rebate based on their electricity usage. In the US, there are more than 1000 co-operatives, including generation co-operatives that generate power and sell it to distribution companies or consumers, purchasing co-operatives that purchase power on behalf of members from distribution companies or power generators, and distribution co-operatives that buy and own an electricity distribution company. Alternative Technology Association, the publisher of *ReNew*, is considering establishing a wind co-operative to supply its members with electricity generated from wind power.

With contestability for the under 160MWH market only months away, there is still much uncertainty and apprehension about what deregulation will bring for residential customers and small business. Rees of EnergyCor believes that contestability will not even register with most customers because of a lack of information about what the reform process will bring. So what advice does Rees offer customers trying to negotiate this minefield of ifs and buts? One simple rule:

'Don't automatically accept what your current supplier is going to offer you,' he says. 'Shop around.' That's what competition's all about.

For further information, contact your state or territory regulatory body. Also see the following websites:

Office of the Regulator General

http://www.reggen.vic.gov..au

National Electricity Market Management Company Limitied

http://www.nemmco.com.au

National Electricity Code Administrator Limited

http://www.neca.com.au

Centre for environmental and social change in Indonesia

On a recent trip to Indonesia, Alison Sutherland discovered an environmental centre rich in beauty, vision and inspiration

I was quite aware that, as an environmental engineering student with a particular interest in appropriate technology and a long-term addiction to travelling, that at some stage down the track the time was going to come for me to combine the two.

With the scary prospect of my graduation looming, I decided to visit Indonesia in January/February 2000 and see exactly what was being done about its environmental problems. I planned to put in a bit of volunteer work, learn some new skills and discover whether I had anything to offer the community on a long-term basis.

Political history

With over 200 million people, Indonesia is the world's fourth most populous nation. Java is the most densely populated island, with over 800 people per km^2.

Indonesia's recent political instability has been well publicised, especially since the demise of long standing President Suharto in 1998. His reign characterised by corruption, nepotism, military abuse and the draining of valuable resources from regional areas, has left a deep impact on the people and economy of Indonesia. Many people are just beginning to know the freedom of having a political voice—it's now okay to have ideas on community policy and it is possible in some ways for government bureaucracy to be challenged.

Recent turmoil in East Timor and in other regional centres such as Aceh, Maluku and West Papua has caused

Traditional lubung silo from Lombok. Rice, corn or dried cassava is stored in the top part which is raised to keep out rats and other small animals as well as water. The bottom platform is used for sitting, chatting, smoking or resting. Groups of males can be seen doing this all over Indonesia.

Left: PPLH prides itself on environmental education and runs courses in sustainable and alternative farming techniques.

many foreigners to be too scared to visit Indonesia fearing hostility; or they boycott the country because of its appalling human rights reputation. Having been to Indonesia prior to my recent visit, I knew that whatever was occurring politically, it was not representative of the views of the people or their hospitality.

I believe that to boycott the country for political reasons leads only to a catch 22 situation, where the people there who are aware of their limited access to news, current affairs and general information, and who have an insatiable thirst for more knowledge, are denied one of their most important avenues for acquiring it—international links.

So I set off, with no fixed idea of what to expect from the environmental sector, but fully aware that factors such as intensely high population, political instability, virtually zero economic growth and limited education were not generally favourable for environmental awareness.

What I found, however, nestled among those aforementioned factors, was a place and organisation awesome in its beauty, depth of thought, breadth of scope and inspiration.

Centre for Environmental Education

Pusat Pendidikan Lingkungan Hidup (PPLH) 'Centre for Environmental Education', started off as a small group of people meeting and discussing environmental issues and traditional agricultural methods. It has now become a non-governmental organisation with five centres across Indonesia employing approximately 100 staff members. Although supported by the government, the centres receive no financial assistance from it. The centres do receive donations or funding from external sources, usually for mechanical equipment, but largely survive independently on income generated from their guest facilities and educational programs.

Their symbol taken from the well known yin yang, is indicative of the PPLH philosophy. This is one way of moving towards balance and harmony within the environment, always with a mind open to new thoughts and learning experiences. The education department uses co-operative learning methods and creates a relaxed environment to promote environmental awareness and to encourage people to express their opinions freely. This is not the norm in Indonesia, as a result a large part of PPLH education programs is centred around building a space where people feel comfortable speaking out.

The main centre at Seloliman, East Java was completed in 1990. Situated on the slopes of Penanggunagan volcano, it is surrounded by a lush expanse of tropical rainforest. It was the first environmental education centre to be established in Indonesia. PPLH now has branches in Sanur, Bali, a marine centre in Puntondo, South Sulawesi and a newly established (March 2000) urban centre in Surabaya.

One of the most striking things that impacted on me as I was guided around PPLH was how much was happening on the 3.7 hectare site, and how well the space was utilised.

The buildings themselves combine Javanese, Balinese and European architecture with excellent design principles. The general-use buildings such as the meditation/mushola, seminar rooms and restaurant are open structures which make the best of the 360 degree views and allow air to flow freely through. Many of the buildings are surrounded by ponds which enhance this cooling mechanism. These ponds are home to Javanese catfish which not only eat mosquito larvae but, in the case of the restaurant, facilitate water treatment from the kitchen.

Other features include fields of ecological farming, a traditional medicinal plants garden, animal husbandry, composting, recycling, children's playground, forest walks, an extensive library with publications in English and Indonesian, aquaculture ponds, as well as solar cookers, solar water heaters, solar photovoltaic panels and a mini-hydro system supplying most of the centre's energy needs.

PPLH has a publishing department which produces magazines and a bi-

monthly bulletin. It also publishes various books, newsletters and leaflets about environmental practice.

The whole space has a wonderful energy to it, which I attribute not just to the beautiful surroundings but to the people that work there. Although many of the employees admit to not starting out with a firm commitment to the environment, they were just after a job, they say it didn't take long before the principles sunk in and now they wouldn't want to work anywhere else.

PPLH power system

When exploring PPLH I observed that, sadly, there were some parts of the energy system in disrepair, and as with all remote energy stations there is not always the know how or materials to fix the system to maintain maximum efficiencies.

The Siemens solar panel has 36 polycrystalline cells which operate with an efficiency between 10 to 12 per cent and maximum output of 50 watts. Due to a power surge, the regulator is now broken and the maximum output is unfortunately less. It can still run a small DC radio, when not too cloudy, which is regularly used to communicate between the Surabaya and Seloliman centres.

The micro-hydro system has also suffered from power problems and is now due for an upgrade. The system was completed in October 1994 with the objectives to:

- manufacture an environmentally friendly local source of energy
- provide power to the PPLH centre
- channel power to the remote village of Janjing which, until this time was not connected to any electricity system
- use the system as an educational tool for groups at the centre to learn about alternative energy sources
- create an awareness in the village of Janjing about the importance of their local water catchment.

The theoretical capacity of the scheme is 12kW but actually operates at 9kW due to mechanical inefficiencies. Since the installation the system has accumulated over 40,000 operation hours (8400h/year) with an estimated output of 30,000 kWh/year.

Above: The traditional medicinal plants nursery.

Left: Due to system damage, caretaker Mas Sukadi walks the 3km return journey from Janjing to the microhydro plant twice a day to operate it manually.

The existing turbine is a type T12 cross flow which is connected to a generator in a small powerhouse beside the river. Water used for the hydro system is diverted to a small weir at a much higher level than the course of the natural river. From here water travels through a sediment trap and either through a grate and drainage pipe to the river or through a 50m long horizontal 400mm in diameter pipe to the holding tank. This regulates the flow of the water before it passes through the pipe running to the turbine. This pipe has a 300mm diameter and is 36m long. The vertical height to the turbine (that is, effective head) is 14.3m and the flow rate through the turbine is 150 litres per second. From here water is discharged via a tail race back to the river.

Electricity transmission

A three-phase transmission line transmits the generated electricity to a distribution station at PPLH. Here the voltage is reduced from 380 volts to 220 volts. There are three magnetic circuit breakers which each allow a maximum transmission of 5kW. One line goes to the village of Janjing (a single phase supply using two cables) where 26 of the 33 houses are connected. Each connected house has a 0.5 amp circuit allowing for a power supply of about 120 watts.

The second transmission line sup-

plies the northern buildings at PPLH and the third those buildings to the south of the distribution station. The micro-hydro plant was controlled electronically until about a year ago when the electrical load controller (ELC) was damaged. The system is now operated manually by the caretaker Mas Sukadi, who walks the three kilometre return journey from Janjing to the plant twice a day. Rapid changes in load have led at times to wildly fluctuating voltages and some of the electrical equipment at the centre has been damaged. The office equipment such as photocopiers, facsimile, and computers are now run on government electricity (PLN).

Klerak: Seed pods from the klerak tree are broken and soaked in water. This water lathers like soap and is then used by the laundry and kitchen to minimise the use of commercially produced detergents.

System improvements

Due to equipment failure and the increasing demand for electricity, PPLH has proposed an upgrade of the mini-hydro plant to a 23kW system using a design flow of about 300L. A T14 crossflow turbine has been selected, with the old turbine being retained for demonstration and training purposes. As part of the upgrade it is proposed that kilowatt-hour meters are installed so that the energy use can be calculated and a fair payment system determined. Currently the villagers in Janjing don't pay for their electricity.

A new electronic controller will be part of the upgrade to ensure that the quality of the electricity is suitable for running sensitive office equipment.

The increase in the energy supply will lead to new development opportunities for the surrounding villages, some of which include a rice milling machine, grinders for rice, wheat, coffee and chillies, wood processing machine and a welder.

The micro-hydro system is a good example of how decentralised development in rural areas can encourage the local people to create their own local economic cycles independent from the central government and co-operate to improve living conditions and income in their own community.

The centre has become instrumental in demonstrating the need to protect the surrounding environment. Rainforest areas are rapidly becoming scarce on Java, as the dense population tries to find more resources on the island to sustain themselves and acquire all those wonderful inventions such as televisions and motor vehicles. The lure of land clearing, in order to plant teak or mahogany (timber which fetches very nice prices) is all too apparent even in the Seloliman region.

Fortunately the local catchment is almost guaranteed protection. Since the installation of the micro-hydro system the local people recognise that the forest has an important regulatory function for the water resources. These are needed not only for irrigation of their rice paddies but for their electricity supply. Clearing of the forest leads to heavy silting, and wood shards released from logging operations obstruct the grates which necessitates regular cleaning.

Finally, the benefits of the hydro scheme can be looked at in terms of what it would have replaced. The negative impacts of operating a diesel powered generator have been avoided. These include high levels of noise, risk of fuel spillage and high greenhouse gas emissions—the hydro system has saved approximately 150,000kg of CO2 emissions since 1994.

Visitors

The centre receives approximately 12,000 visitors annually. Sunday is the busiest day, which sees the centre teeming with school children, mostly from Surabaya (1.5 hours north) but international schools as far as Bandung and Jakarta have also been known to visit.

Recent political problems have resulted in lower numbers of visitors. School groups from as far as Jakarta and Bandung that previously came every year, have skipped visits due to trouble in the capital. The number of foreign visitors has also fallen. Before the political upheaval, PPLH associated with seven international travel agencies: now they liase with just one.

Community development programs

For any developing country it is obvious that environmental education would be seriously limited if they

couldn't incorporate sustainable principles with economic growth. Perhaps most inspiring at PPLH are the community development programs. These involve motivating the villagers, through education of environmental concerns, to increase employment and raise their standard of living.

Agricultural training is given in dairy farming, free range chicken rearing and other alternative farming techniques that enable villagers to develop a market of quality local food. One group of 10 women are making recycled paper using simple technology and passive solar principles. Presently they are trying to improve drying methods so that the natural colour fixes without fading. If they can improve the quality there is an opportunity to export the product to Europe.

A group of men is aspiring to value add to the existing kapuk (cotton like fibre) industry. The nearby village of Sempor currently sells 800,000 tonnes of rough kapuk annually. This is worth Rp500,000 per tonne (A$100). By splitting the pods into seed and fibre they can sell the product for Rp7,500,000 per tonne (A$1500).

It is inspiring to talk with these people, who often have so much enthusiasm and so many great ideas. It helps and is nice to speak Indonesian but many of the staff know some English. This is not to say that there aren't cultural barriers/issues that sometimes need to be addressed.

In Indonesia a visitor is a guest so it is best to give them notice of when you are coming—so they can prepare your stay and be proud of their hospitality. Some Indonesians are modest about describing their work and it may take a while for them to believe you're really interested. However, once they do they'll talk to you about everything from hiking and caving, to music, birdwatching and fabric painting with natural pigments. I have Hudi, Budi, Agus, Bandung and especially Anton to thank for many long, insightful conversations.

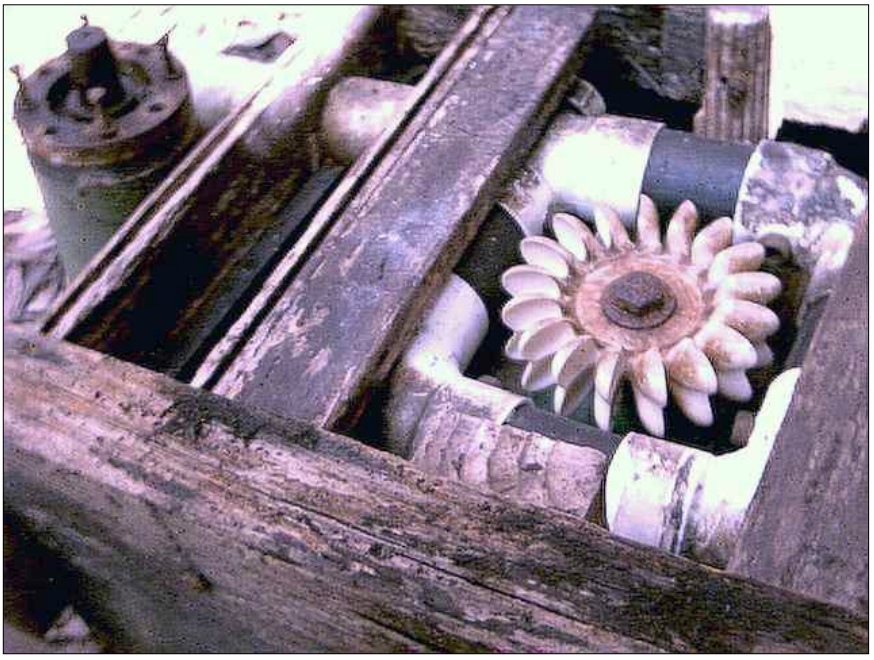
PPLH often has foreign volunteers and is very supportive with arranging accommodation, longer visas and transport to and from work. The guest accommodation includes dormitory space for up to 60 people, eight bungalows each sleeping four and two guesthouses which will each accommodate six to 10 people. Typically one month's lodging and food costs approximately Rp150,000 (A$30). The people at PPLH are interested in establishing international links with other environmental groups for the exchange of information.

PPLH can be contacted via its webpage: www.webcom.com/pplh/home.html

Micro-hydro madness

If you have access to a creek, you'll find even a modest one is capable of generating useful electricity. You can buy a micro-hydro turbine, or you can build your own. Greg Tendos shows us how NOT to go about the latter!

I started experimenting with micro-hydro turbines some years ago. I was originally inspired by our water ram pump, which manages to pump 20,000 litres up a 30 metre head in about two weeks. So why couldn't the power in the stream be used to make electricity?



Greg's Pelton wheel system.

Model 1: the hub cap

Armed with the Rainbow Power Company's (RPC) 5th edition catalogue, I began experimenting, and soon discovered gearing was absolutely useless, and that for low flow, low head situations, a car alternator cannot be driven fast enough using direct drive.

The first turbine was made from a hub cap cut into 14 vanes and reinforced, attached to a car alternator. Fifty metres of Draincoil pipe was laid to provide a five metre head from a natural dam. This setup actually ran long enough to generate enough power to excite the alternator field coil (using a small battery to kick-start this), but maintaining 12 volts was difficult. Pretty soon some vanes blasted off and the turbine was never to run again.

I then replaced this turbine runner with a nylon Pelton wheel purchased from Lateral Technology. Still using the car alternator, this did a better job, but was hardly good enough to celebrate. Other problems with this setup included the feed pipe springing numerous leaks, and clogging of the inlet filter.

Model 2

A lot more planning went in to the second version. There was 12.2 metres of head available over 145 metres (the height was measured by totalling numerous spirit-level line-of-sight readings). An environmentally safe limit of 2.5 litres per second taken from the stream was set (partly decided by experimentation). I then calculated the potential water power: 12.2 metre head x 2.5 litres per second flow x 9.8 metres per second^2 gravitational acceleration gives 299 watts. Even a third of this would be terrific!

Creek flow was estimated at 10 litres per second (about half of this in summer and about double this in winter). Fortunately, the creek is spring-fed from a large valley so it flows all year round, and my neighbour was kind enough to allow us 50 metres onto their property to a shallow but disused dam.

I also found that water suction at the source caused by the flow falling down the pipe is essential for low flow systems. I initially tried elevating pipes to a secondary tank, but it doesn't work unless there is an over abundance of water.

I purchased 96 metres of 2 inch (inner diameter) polyethylene pipe. This was connected to 49 metres of 90mm PVC stormwater pipe. Black tar paint was used on the PVC to allow it to blend in with its surroundings. The polypipe is cheap and very durable. The RPC book indicated that at 2.5 litre per second there is only 6.88 metres of head loss per 100 metres, or 6.88 per cent, so it seemed unnecessary to go to three inches or more, where it gets quite expensive.

Batteries for the system were a gift from God. The company I worked for had six brand new 100AH lead-acid gel batteries which were totally neglected for their 12 month life in a standby

power source—only one survived. So I had this one to start with.

Cable was another synchronistic surprise—it literally fell out of the sky when a truck pulled down telephone wires directly outside our property. It was a bit of a challenge stripping and connecting 200 pairs, although using the back edge of a utility knife to quickly strip insulation soon got this under way. The 300 metre round trip (150 metre one way) measured up at 0.7 ohms.

As the photo shows, the four nozzle pipework with embedded Pelton wheel almost looks professional. Three two-inch elbows, one side entry connector, four pieces of two inch polypipe and four 8mm threaded brass inserts complete the plumbing. Drilling holes for the brass inserts in the PVC elbows was delicate and difficult, but with practice can be done accurately.

The model 1 turbine was made from a recycled hubcap—unfortunately, it didn't last very long.

The final magical ingredient was an old magnetic tape drive motor purchased from an ATA member. These have enormous internal magnets and are most efficient at very low rpm. Connecting the leads of two of these together, manually turning one seems to turn the other at the same speed!

With a couple of nephews to help, we installed this generator using a quartz-halogen automotive globe as a load. We cheered as a good section of the valley was bathed in glorious light.

Fine tuning and a home-made shunt regulator built from bits purchased from Oatley Electronics completed the

system. With 3.8 amps at 13.2 volts, we were getting around 50 watts. Additional to this was wire loss of 3.8 x 3.8 x 0.7 = 10 watts. Open circuit voltage was 42 volts. Configured for a 24 volt system, with two 12 volt batteries connected in series, gave 25 volts at 2.5 amps for a respectable 62.5 watts with a loss of less than 5 watts.

The rest of the system

Choice of inverter can be tough but Selectronic offered a wholesale discount due to my work connection in transformer design. The SA21 provides clean sinewave continuous power of 1200 watts (and three to four times that of surge) and can be connected to either 12 or 24 volts. With such fabulous features at a good price, I couldn't refuse. With a small switchboard modification, pretty soon we were running the lights in the house.

Model 3: the RPC housing

Despite working well, the system suffered from two major bugs: clogging of the inlet mesh filter after rain, and the requirement to change the generator brushes every month or two (custom manufactured by D and L Patton). With a heavy, soaked hardwood base on the turbine housing, it was murder carrying the unit up the valley to change brushes.

Attributes of final system at a charge voltage of 13 volts

Current = 8.8 amps.
Power into battery = 13 x 8.8 = 114.4 watts.
Voltage at generator = 13 + 8.8 x 0.07 = 13.6 volts.
Power at generator = 13.6 x 8.8 = 119.8 watts.
Flow rate = 2.3 L/s using 14mm nozzle indicating an apparent head of 12.5m.
Indicative water velocity at nozzle = 14.87m/s.
Actual measured head = 12.2m.

Essential equations

Voltage = current x resistance.

Power = Voltage x current = Current² x Resistance = Voltage²/Resistance

Energy (kWH) = Power (kilowatts) x Time (hours) or

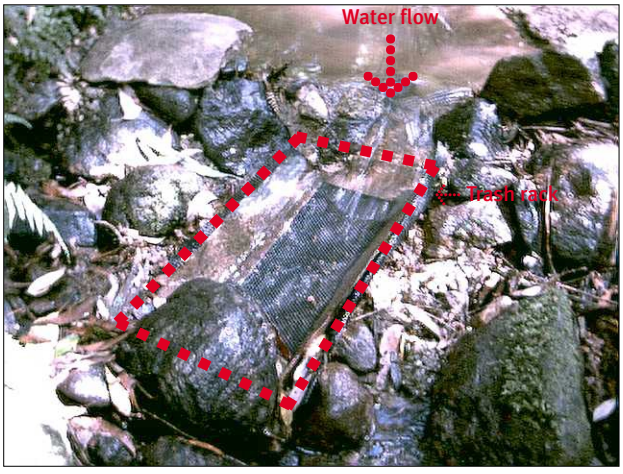
Energy (Joules) = Power (watts or J/s) x Time (seconds)

Pressure (kPa) = 10 kPa per metre water height (head)

Water power (watts) = Height (metres) x water flow (litres per second) x gravitational acceleration (9.8 metres per second²)

However, I managed to purchase a second hand RPC housing at low cost and installed my hardware into this new unit. Performance did not change until I experimented with the nozzle fittings. There was a slight improvement in power with two nozzles blocked off and the other two at 11mm. The housing is lightweight so made the task of changing brushes easier.

A sane person may have had enough by now, but no, not me! Another synchronistic event occurred—a work associate made a wholesale purchase of Nickel Cadmium batteries from the dismantled Monash Medical Centre backup supply. Although 12 years old, their design life is 25 years and can last much longer with normal use, and at $50 each they were a bargain. Despite the very lethal element Cadmium, we figured the best way to recycle these was to use them until they expired. Ten of these 1.2 volt cells provided a 12 volt, 750 amp-hour battery bank, enough to match the inverter's needs.



The simple self-cleaning trashrack system. Water flows through the mesh while rubbish is carried away.

Model 4: the Platypus

The system was by now getting seriously big, apart from power generation. An average household uses 10 to 20 kilowatt-hours of electricity per day, whereas we had a mere 50 watts power or 1200 watt-hours per day.

Unfortunately, modern appliances are a testimony of the highly inefficient appliances produced by our manufacturing industries, where power utilities and governments insist on producing environmentally damaging but quite needless quantities of power, resulting in a 'who cares, it's cheap' situ-

ation while the planet suffers at the hands of the few who can afford it.

That aside, while web browsing I landed on the Platypus Power site, which indicated that the Platypus PM1000 could produce a possible 130 watts from my existing system. The permanent-magnet alternator was not available by itself but was sold as an integral unit with a single-nozzle impulse wheel runner. The advantage over a Pelton wheel is it accepts a vast range of flow rates and still operates very efficiently. Peter Barret of Platypus Power told me the alternator was about 85 per cent efficient and the system overall was about 60 per cent efficient.

We reconstructed the dam according to Peter's instructions. Instead of draining into a filtered depression, water flows over the wall to a mesh angled at about 30 degrees into a rectangular planter box where the pipe is connected. In this way, debris flows over the top and theoretically the system never needs maintenance. This is precisely how large hydro systems are built. An excellent mesh is Gutter Guard available from hardware stores—the shape literally attracts water through its holes.

Ideally, the collector pipe needed to be around 300mm below the mesh, but we only designed ours for 100mm. As a compromise, a spherical rock was placed at the mesh base to build up water height, and because there was still adequate sloping mesh above the higher overflow point, the system still works satisfactorily even in low-flow drought conditions. In the worst case, there is almost no overflow, although dam leakage and springs keeps the creek flowing. Even with the first 30 metres of pipe running empty, the system still generates about half power. Photovoltaic panels take over at this point anyway. Normally, the overflow is substantial.

With great hopes and anticipation, we substituted the old unit but it was a bit of a shock when only 3.1 amps, or 3.1 x 14.3 volts (16.5 volts at the generator) = 44 watts was being generated: less than before! With Peter's remote assistance we checked for blown diodes, rocks (yes, there was one stuck in the nozzle at one stage), open and short circuit load tests, and did pressure measurements—something was drastically wrong.

The problem turned out to be a combination of generator output voltage and cable losses. If the target output power was say, 120 watts, then for a 12 volt system:

Current = Power / Voltage = 120 / 12 = 10 amps

Voltage at generator = battery voltage + (10 x 0.7) = 19 volts—this voltage was not possible with this generator!

So, calculating cable loss for this current, we get 10 x 10 x 0.7 = 70 watts—a ridiculous amount of loss.

The Platypus excels at its design voltage but, unlike the tape drive motor, suffers enormously if operated above this. By changing a part in the generator we had the option of going to 24 volts, thus halving the current. Recalculating for the same 120 watt target:

Current = Power / Voltage = 120 / 24 = 5 amps

Voltage at generator = battery voltage + (5 x 0.7) = 27.5 volts—much more reasonable.

So, cable loss = 5 x 5 x 0.7 = 17.5 watts, which is certainly manageable.

Plans were made to purchase another 10 batteries, but on a final visit to the recyclers, synchronicity stepped in again. Standing before me was a three metre high drum of aluminium power cable, ready to be chopped up. A 20 metre test indicated our 300 metre round trip could be brought down to less than 0.1 ohm, so I quickly negotiated a price of 50 cents per metre and purchased 600 metres.

Unravelling four 150 metre lengths and loading the stuff on the roof rack was murder, but worth it. Once installed in place of the telephone cable, the 300 metre round trip registered a mere 0.07 ohm. This was more cost effective than an upgrade to 24 volts, and for the 120 watt target, cable loss could be reduced down to only seven watts.

A word on pipe losses

Before the cable upgrade, pipe friction loss was investigated. The RPC tables seemed inconsistent with manufacturers' data, and a call to Peter Pedals confirmed that the 50mm (two inch) data was incorrect. That is, metric 50mm is an outside diameter whereas imperial two inch is an inner diameter specification—they have far different performance.

Also, (my mistake) 6.88 metres per 100 metres does not mean 6.88 per cent head loss, but actually 6.88 metres vertical head loss per 100 metres horizontal pipe length. For our two inch pipe we were actually losing around four metres of our precious 12.2 metres, and so our 120 watt target was not attainable. Purchasing the 10th edition catalogue addressed the discrepancies, but I should mention RPC have done a lot more homework regarding feed pipe sizes, cable sizes, flow and head and can instantly provide an accurate power estimate given all these parameters using their unit.

The finishing touch was to upgrade the pipe. Friction loss has an incredible 5th power relationship to diameter, so friction decreases dramatically as diameter increases. Three-quarter inch copper pipe, for example, has 1/10 the friction than ½ inch pipe. Because the first 50 metres comprised flimsy 90mm stormwater PVC pipe, this was chosen to replace the 2 inch poly. Three or four inch poly was an option but quite expensive, as was 100mm sewer pipe—tough but too much PVC for my liking. So instead of four metres head loss we would expect 0.5 metres instead. Interestingly, the cheaper alternative of running two lengths of two inch poly pipe results in a rather poor 1.8 metre head loss instead.

The pipe must slope downward all the way, and due to thin walls must be securely laid as it may blow apart at the lower end (don't use this pipe for higher head). No glue was necessary but the turbine itself had to be securely tied down despite a partially dug-in pit housing to stop pressure bucking the whole set up out of position (and to save me getting drenched) with the gate valve off. Painting before installation enhanced the blending in—fully burying the pipe was next to impossible due to massive boulders. Some way of shutting off the source water is also necessary for maintenance.

Over a period of time I have developed numerous spreadsheets on generator performance and appliance use budgeting. If anyone would like these spreadsheets or to pose any question on related topics, or if someone in the nearby hills would like to install my old functional components, contact me at gten@hotmail.com.

[Buyer's guide]

Tap your onsite power resources

The last time we looked at the micro-hydro market was in Autumn '94, so we thought it was about time we looked at them again to see what's new

Well, what's new is that there are fewer players in the market this time round, as can be seen from the table in this article. However, there is still an excellent range of turbines available in the under 20kW class, in both AC and DC output models.

Why buy a micro-hydro?

The potential kinetic energy stored in water situated above sea level is considerable. You just need to look at the deep pools often found below large waterfalls or how the rocks in a creek are worn smooth, to be awed by its power.

Harnessing the power of water is by no means a new concept. Water wheels have been used for centuries for milling, grinding and other types of mechanical work. Actual turbines came in to play to replace water wheels and power electric generators in remote areas in the mid 19th century.

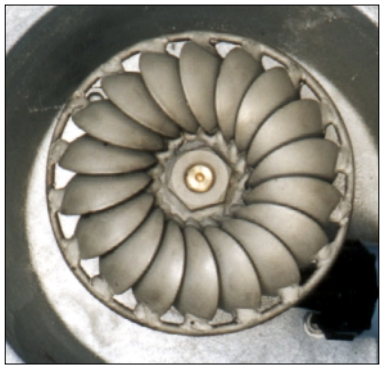
Nowdays they are increasingly being used in developing countries due to their relative low cost, comparatively simple maintenance, clean renewable nature and the abundance of suitable hydro sites. With environmental awareness increasing, the push is away from big centralised power sources and back towards energy systems that use local natural resources.

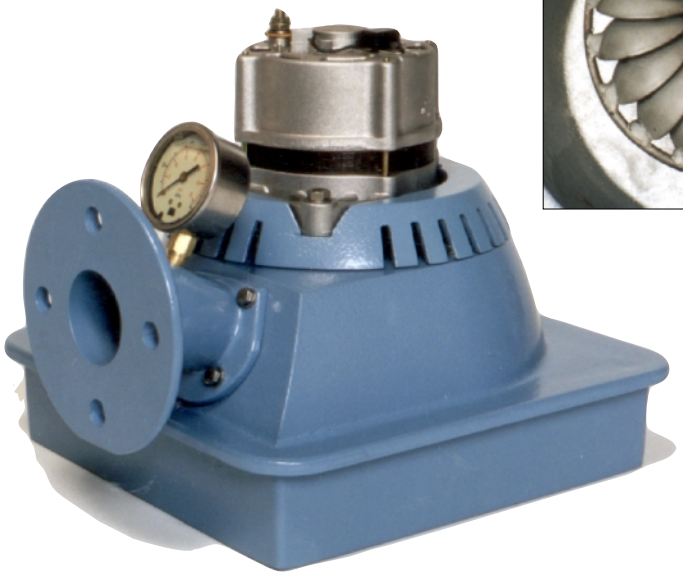
All that aside, if you have a remote property and need to supply reliable power, then in many cases, a micro-hydro turbine will be the best option.

Turbine types and siting

The basic layout of most micro-hydro systems involves the turbine, mounted at some low point on the creek or river, being fed by pipes running from a much higher point in the water source. The weight of water in the pipes causes a ralatively high water pressure at the turbine end of the pipe, thus providing a means of driving a turbine. To get an idea of the forces involved, try aiming the jet from an ordinary garden hose at your hand. You will feel the force of the water striking your hand and being deflected. This is how many turbines work, in a round-about way.

Flow rate and head (the vertical height that the water falls) are the two major factors governing the amount of power available from a site. To cope with the difficulty of providing an efficient turbine for the various different possibilities, such as high head and low flow, vice versa, or a situation with varying flow rates, several different types of turbines have been developed.





The popular Platypus Power range is available in DC battery charging and AC output designs. Here you can see a DC output M1-125 unit, as well as the stainless steel hybrid runner (right).

The turbines available generally fall into one of two categories—impulse turbines or reaction turbines.

Impulse turbines

Examples of impulse turbines include Pelton, Turgo and Banki Crossflow. The water is directed through one or more nozzles and onto the 'runner' (turbine wheel). This rotates above the level of the water source, and the water falls below the turbine to the tail water, usually flowing from there back into the creek.

This turbine won't function submerged in water, so it must be situated above the maximum flood level that the water source may reach. This often leads to valuable loss of head, which is one reason why this sort of turbine isn't used in low head applications.

The Pelton wheel is probably the best known and commonly used of the im-

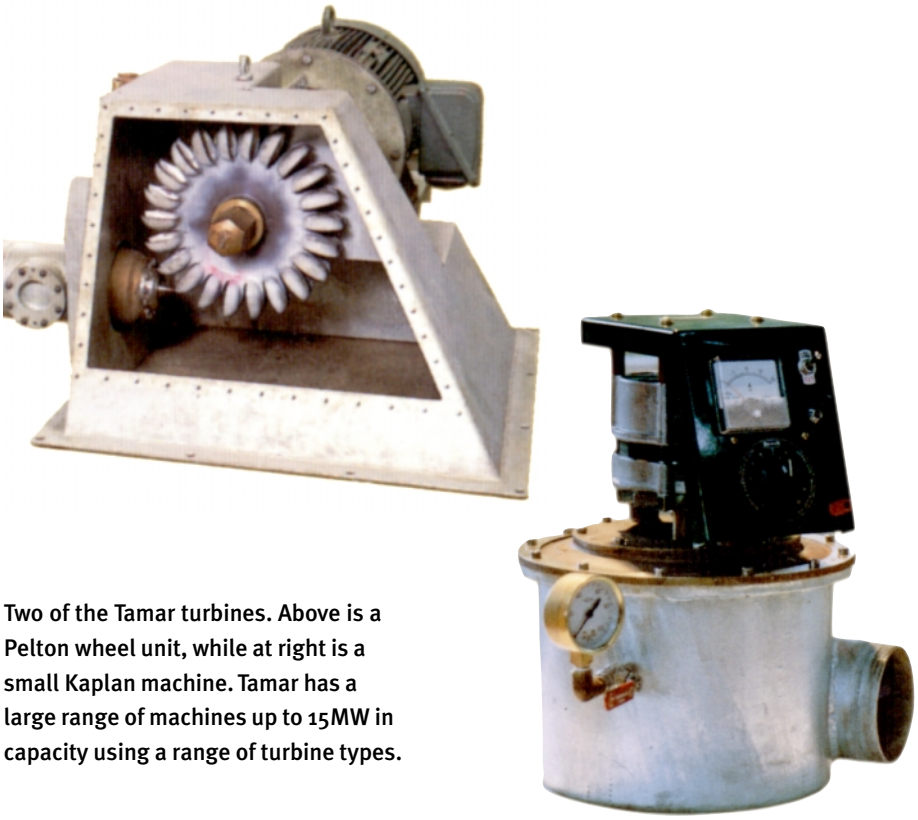
pulse turbines. The Turgo is very similar, but has a slightly higher efficiency. Both types run at relatively high speeds, allowing them to be directly coupled to a high speed generator, but Turgos will spin at a greater rpm for the same size jet diameter.

Turgos can also be arranged to spin at half speeds, allowing efficient operation at low heads.

The Crossflow turbine is somewhat different. It uses a cylindrical type rotor through which the water passes twice. It can be used with virtually any head (1 to 200 metres). These systems are good for water pumping, and the Planetary Power machines are sometimes used this way.

Reaction turbines

This class of turbines includes the Francis and Kaplan turbines. The blades



Two of the Tamar turbines. Above is a Pelton wheel unit, while at right is a small Kaplan machine. Tamar has a large range of machines up to 15MW in capacity using a range of turbine types.

on these turbines are submerged in the water itself. As the water flows over them, lift forces are created, much like the wings of an aircraft. It is these forces that cause the turbines to rotate. The tail water is discharged via a draft tube which creates a negative pressure on that side of the turbine. This means that the fall of water after the turbine can also be included in the net head, which is very significant if there is not a lot of head to begin with. The Francis turbines are the most efficient of the reaction turbines but are generally more expensive.

Reaction turbines tend to be bigger and are more expensive than impulse types, so if you're lucky enough to have a choice between a high head, low flow site or a low head, high flow site it's best, economically to opt for the former.

Other things to consider if you're thinking about installing a micro-hydro system are generators, load regulation, civil works and electrical work.

AC or DC?

There are two common systems available, DC, or battery charging turbines, and AC turbines.

The DC turbines are designed to feed their power into a battery bank for use at a later stage. These are well suited to sites that may not flow all of the time, but do have regular or seasonal flows. Some systems use micro-hydro systems to provide power during the winter months, when water is most abundant, and relay on other power sources, such as the sun, during the hotter, dry part of the year.

If you have a good flow of water all year round, then an AC turbine may be the best option. These produce power at 240 volts AC, just like mains power, so you can draw power from the turbine directly, without the need for batteries, inverters and the like. An excellent example of this type of system is the 13kW turbine at Stevensons Falls, near Marysville in Victoria. This turbine supplies power directly to lights used to illuminate the falls at night.

The disadvantage with this system is that you are limited in the amount of instantaneous power you can draw from the turbine. For example, if you have a 1.2kW system, then that is the most power you can draw from the turbine. Loads larger than this will need to be powered from some other source. You can, of course, use an AC turbine to charge a battery bank, just like a DC turbine.

Power control

Load regulation of most turbines usually occurs by 'dumping' the excess energy into some form of load. This is often a series of light globes or heating elements, such as in a hot water system.

Rainbow Power Company's 300 watt Pelton turbine.

Regulation is required to avoid large voltage fluctuations, and to keep the turbine running at a near constant speed. There are several types of regulation systems from simple on/off switching to variable load dumping, where the load dump connected to the turbine varies inversely proportionally to the main load.

As an example, if you have a 1kW turbine, and you are using 200 watts from it, then the other 800 watts will be dumped into the load dump. If your load increases to 650 watts, then the excess of 350 watts will be dumped. This system can be achieved in several ways,

but a commonly used system is to switch in load dump elements of varying sizes in the right combinations to form a load dump of the correct size.

A novel approach to regulation has been taken by Tamar. It has developed a water economiser that varies the water flow through the turbine, depending on the load. This reduces the power produced by the turbine, reducing the power dissipated by the dump loads. This system suits sites where the flow is intermittent or water storage in a weir or dam is used.

Tamar has another device, 'Automatic Start' which actually stops the turbine if the load falls below 40 watts. When a load of 40 watts or greater is applied the machine automatically starts in a few seconds. It is designed to help the system cope with intermittent power requirements such as a refrigerator.

Civil works

This refers to the other parts of the system, including head (penstock) and tail (draft) pipes, dams and other parts of the water supply system. It may involve as little as a couple of hundred metres of plastic piping with a screen filter at the collection point, right through to a large weir or dam, along with the other associated parts. These include trash racks, which deflect solid material from entering the feed pipe, control valves, and even flood control systems. Be sure not to underestimate the effect the civil works will have on the cost of the system—it can become very expensive if you can't do it yourself.

Some councils charge a fee for water taken from a stream, even if it is returned at a later stage. Check with your council before planning a system

Buying a turbine

This can be an involved process, as you have to determine head, flow rates at the selected site, ease of access, type and amount of power required from the turbine and possible environmental disruption to the area. Remember, to minimise the effect you have on the local ecosystem, you must not take all of the water from the water source to run through your system. If you are unsure, set yourself a limit of, say 50 per cent of the total flow at the lowest flow rate period, usually during summer or the dry season.

Once you have these details worked out, you can then start thinking about the type of turbine you want. You just match the site requirements with the turbine most suitable in the table. If more than one turbine seems ideal, then

you will have to look at other factors, including price and maintenance requirements, though you should also look at these initially. It all depends on your priorities.

Other turbines

We have covered the most common commercially available turbine types, but there are others you may want to consider. These are mainly used in direct flow applications, and include waterwheels and immersion generators.

Waterwheels are usually undershot, where the lower paddles of the wheel are simply placed in the flow of a river or stream, or an overshot wheel, where waterflow is directed from the source to the top of the wheel, where gravity takes over, causing the weight of the water in the wheel 'buckets' to pull the wheel around.

While there are no commercial manufacturers of waterwheels that we know of, they are a quite simple device to make. There have been several designs for these devices published in previous issues of *ReNew* and *Soft Technology* in the past, and if you are of the do-it-yourself persuasion and have a useful creek with good flow but little head (common on small properties), then they may be the best option, though for electricity generation some form of gearing up would be needed. Floods can also be a problem for undershot wheels, as they need to be placed in the water source directly, but overshot wheels can be located to safer areas and water diverted to them.

Immersion generators, like the no longer available Tyson turbine, use turbines similar to a boat propeller and work on the lift principle. They are reaction turbines that can be placed in a flowing water source and tethered to a point on the bank, or to a cable run across the river. The Aquair turbine is an example of this type, but is unavailable in Australia, as far as we could ascertain.

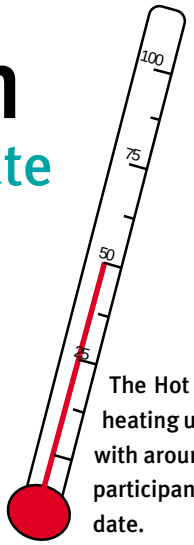
Brand	Model	Rotor type	Rotor material	Voltage	Power (kW)	Head range (metres)	Flow range (litres/sec)	Generator type	Regulation	Price $	Comments
Planetary Power, PO Box 765, Atherton QLD 4883, ph:(07) 4096 2420, fax:(07)4096 2558, email: planetary@planetarypower.com.au, www.planetarypower.com.au	Walsh River LH6-180	Banki-crossflow	Epoxy coated mild steel	12, 24 or 48V DC	1	1-8	6-52	Permanent magnet	Separate controller with switchable 12, 24 or 48 volt output	POA	
	Walsh River LH6-300				0.6	1-3	10-54				
Platypus Power, 1/57 Churchill Ave, Bright VIC 3741, ph:(03) 5755 2383, fax:(03) 5750 1777, email: plapower@netc.net.au, www.netc.net.au/platypus/	PM1000	Hybrid impulse	316 stainless steel	12, 24V DC	0.75	5-80	0.5-7.5	Brushless permanent magnet	BPLAT20 or B-PLAT40 (depending on turbine power output)	2,206	
				48V DC	0.75					2,407	
	M1-125			230V AC	0.8	10-100	1-9.5	2 pole or 4 pole induction alternator (depending on head)	IGC-10 controller	POA	Price includes turbine/generator, controller, gauges and stove element load dump
	M2-125				1.8						
	Q3/150			230V single phase or 400V 3 phase AC	2	20-100	2-12	4 pole induction alternator	IEESR2 induction generator controller	6,200	
	PP7/150				7	15-45	5-60			10,655	Price includes turbine/generator, controller with metering, dump elements, discharge pit and baseplate.
	PP15/150				15						
	PP7/200				7	45-100				13,375	
	PP15/200				15						
	PP20/200				20					15,485	
Powerflow Technologies, PO Box 11822, Wellington, NZ, ph+64 4 384 1988, fax:+64 4 384 1977, www.powerflow.co.nz	Powerflow are currently updating their range of turbines at present, but they produce crossflow and other turbine systems complete with controllers. Contact Powerflow for more details.										
Rainbow Power Company, 1 Alternative Way, Nimbin NSW 2480, ph:(02) 6689 1430, fax:(02) 6689 1109, email: rpcltd@nor.com.au, www.rpc.com.au	Rainbow Micro Hydro	Pelton	Epoxy resin composite	12, 24, 48, 100V DC	0.3	7-80	0.2-7	3 phase, 4 pole induction alternator (see comments)	Switchmode converter/regulator	POA	AC from generator stepped down and rectified by switchmode controller
Tamar Designs, 67 Main Rd, Exeter TAS 7275, ph:(03) 6394 3132, fax:(03) 6394 3179, email: tamar@tamar.com.au, www.tamar.com.au	LCP1	Pelton	Bronze or stainless steel	12, 24V DC or 240V AC	0.1 - 3	16-100	1-7	24V DC, single or 3 phase	Load controller for single and 3 phase systems	POA	Can manufacture systems to suit individual site requirements
	LCT1	Turgo			0.1 - 3	6-42	2-13				
	AP2	Pelton			0.85 - 9	28-120	4-13				
	AP3	Pelton			1.9 - 15	34-150	7-21				
	AT1	Turgo			0.8 - 1	20-70	5-17				
	AT2				0.49-15	10-90	6-30				
	AT3				0.45-15	6-80	10-50				
	SP3	Pelton			6-24	60-150	13-60				
	ST3	Turgo			12-34	55-100	28-100				
	F6	Francis			0.1-8.5	2-20	6-70				
	F9				0.5-45	2-30	30-220				
	F10				0.8-70	2-50	50-300				
	FS2-110	Semi Kaplan			0.3-3.5	1-20	30-100				
	FS2-135				1.7-15.4		45-150				
	FS2-165				2.6-23		100-330				

Free showers from the sun

Hot 100 update

Alternative Technology Association's Hot 100 program is still running. As part of the program a five per cent discount is available for ATA members from Solco, Active Solar Systems will give a 10 per cent discount, as will Solahart on selected models.

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



The Hot 100 is heating up, with around 50 participants to date.

Four new Hot 100 participants tells us about their systems...

In early December we took the plunge and bought a solar hot water unit from Solar Edwards. It's a 305 litre close-coupled system with a glycol circulating through the two panels which transfers the heat to the potable water isolated in the stainless steel tank.

Earlier that year I had completed the Solar Hot Water subject from NMIT's Certificate in Renewable Energy Technologies and so was permitted by Edwards to act as lackey for the installation (and receive a small but appreciated discount for my trouble).

It was a great experience, and a long day, as we played host to three separate tradespeople. First was the installer, Mark Sneddon from Edwards, featured with me in the photo; second, the electrician who wired up the element for the backup boosting; and third, the plumber who disconnected the old system and plumbed up our new one.

By the end of the day we were enjoying hot water heated by the sun and loving it! Since early December last year, we have had the element on just three times, otherwise the sun has done all the work. We haven't looked back!

Brad and Jo Lane Welsh,
Melbourne VIC

Discounts are available to ATA members from these participating companies

[Hot 100 update]

As part of our ongoing renovation we have just installed a Solahart 302J solar hot water system (300 litres, two panels with glycol heat exchanger). For boosting we have kept our old gas-fired storage system set up with bypass valves. This complicates the process of switching the boosting on and off, but has the benefit of allowing the use of gas system to the end of its working life, and defer the choice between Solahart's standard electrical and optional gas boosting systems. The location for the system is near perfect—the back of the house faces due north and the upper part of the roof is at 34 degrees to the horizontal.

B Goddard and F Dillon,
Flemington VIC

I have just returned from a wonderful holiday on Flinders Island and was impressed to see wind generation supplementing the diesel generators. It was also terrific to see a number of islanders with solar hot water systems and some also with photovoltaics.

Having just installed a Solahart Black Chrome solar water heater, I've very happily joined the ranks of those enjoying free hot water, and one day also hope to install my own PV system on my Cranbourne home, hopefully in the not too distant future.

Mary Reilly, Cranbourne VIC

Did you know...?

- That a solar water heater can save around 2 tonnes of greenhouse gas emissions per year from the average Australian home.
- That the sun emits more energy in one second than mankind has consumed in the whole of its history!
- While only two parts per billion of the sun's energy strikes the earth, this energy is over 5,000 times the total amount of energy used by the human race.

In October I had my existing 26-year-old hot water service replaced with a Beasley 5MC315 constant pressure system with three SP151 collectors. These copper collectors are 1.2m instead of the standard 2m SP200. The smaller panels were used to ensure the correct slope of the pipe from the top of the panels to the tank, which was raised 300mm on a platform.

Frost dump valves have been fitted, as a heat transfer module is not available for three-panel systems. Living only 1.5km from Port Phillip Bay, frosts should not be much of a problem anyway.

Electric off-peak boosting is used when needed, although the tank has an extra coil added so that I can add boosting from my hydronic heating system at a later stage.

Beasley were very helpful with information and advice. It also seems a quality product. Over the short period that the system has been installed, it seems to be working well.

Malcolm Garnham,
Cheltenham VIC

Endangered species: our precious community gardens

Daniel Carins investigates two community gardens fighting for life on prime real estate land

Nestled neatly in the shadows of Luna Park on the site of an old lawn bowls club, the St Kilda Community Garden is a space where people from the most densely populated suburb of Melbourne convene to relax and socialise with their neighbours, and get involved in the serious business of growing vegetables.

However, the garden is on Crown land and property developers are forever lurking like crows in the borders, wanting to turn the land into commercially viable ventures.

Established in late October 1998, the seeds for St Kilda Community Garden were sown by the City of Port Phillip, which is caretaking the site until the State Government comes to a decision about its future use. The surrounding buildings were leased to artists as studios on short-term contracts, but the grounds themselves were vacant for a number of years and needed tending to.

Originally a crop of sunflowers was planted to provide fundraising opportunities for local schools, but in order to reduce maintenance costs and to involve more of the community, it was decided to create a community vegetable garden where residents could care for their own small plots.

After initial concerns about site contamination, which was alleviated by pH and heavy metal testing, and the apprehension of artists about the effects of increased access on the security of their studios, all was eventually smoothed out and the project is now blooming.

The president of the garden's committee, Rob Taylor, is ripe with ideas for the site: grants have been made to improve wheelchair access, moves have been made to establish educational programs on horticulture and to commission local artists to design wrought iron front gates, along with efforts to encourage the local water authority to fulfil their obligation to invest in sustainable water usage.

Above all, the committee is aiming at a community-inclusive gardens, something that the previous tenants at the bowling club, and other more traditional garden allotments have failed to do. As a result, the gardens operate an 'open to all' policy where even those who do not rent plots can pay a small yearly fee to gain access to the community plots and the front gates are symbolically left open as much as possible.

The communal gardening plots at St Kilda. The buildings at rear are leased to artists as studio space.

The garden supports a huge composting system and everyone is encouraged to mulch their garden beds to reduce the amount of water required. No pesticides are used onsite except for natural deterrents such as worm wood or concoctions of garlic and chilli spray. The main natural enemy of the garden is the couch grass, which was used in its bowling days and is now disposed of offsite.

The threat of redevelopment creeps dangerously underneath these foundations. The site falls within an area earmarked by the State Government for redevelopment, and the current rumour is that it might be turned into an apartment building. The committee is anxiously waiting to hear the decisions of the new State Government, and in the interim are determined to establish the St Kilda Community Gardens as the flagship operation in Melbourne.

As Julian Lambert, another member of the committee, pointed out, 'the bowling green could only benefit 50 or 60 people from the community. We can benefit six or seven times that'.

At present there are 150 plots used by local traders, residents and a diverse range of community groups including a local language school and a War Veterans' society. The scope and the interest is huge, and the City of Port Phillip is committed to telling the State Government that.

Tony Gardner has the job of promoting community gardens within the council as part of the Port Phillip EcoCentre. He has just set up a phone line for interested people to call for information about the garden or any of their projects. All of those involved are adamant that with enough support and coverage, they can persuade the Victorian Government that the garden's unique role in the local and wider community can showcase what can be achieved with a little co-operation and hard work, and that the profit-making venture doesn't always have to be the only venture.

Tony Gardner can be contacted at the Port Phillip EcoCentre Inc at: ecocentre@portphillip.vic.gov.au or ph:(03)9209 6491.

Left in limbo following its purchase by developers for $1.7 million, the Northcote bowls club in northern Melbourne is being transformed into a culinary and medicinal herb garden. Project coordinator, Tom Brok, who is also a residential tenant of the former club building, said the first step to convert the lawn into garden space was to establish a composting system to process organic waste onsite. Local youths in the Darebin area are already collecting waste from nine local restaurants. The lawn will then be utilised as a joint community project and made into garden beds, with the produce sold at the garden's fortnightly flea market. The site lease is currently for two years. Tom can be contacted on ph:(03)9482 3645.

ReNew and *Soft Technology* products index

This index includes every product reviewed in the product sections of *Soft Technology* and *ReNew* magazines. It outlines the product name and provides a brief description of its function and features. Divided into relevant subject areas, the index lists the issue number followed by the page number, that is, issue 71 page 77 reads 71:77. Compiled by Sarah Milne.

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Modifying a simple regulator

The Oatley Electronics switching solar regulator has been very popular over the past few years. Ross Dannecker shows us some modifications that make it an even better regulator

The simple series on/off switching solar regulator kit from Oatley Electronics has proven a cost effective and reliable performer. There are many in use throughout the country. However, it does have a couple of limitations—it is limited to about 10 amps without improving the heatsinking and it is not temperature compensated.

In this article we will take a look at some modifications that can be made to this regulator, as well as how it can be used more effectively.

Buying and building

The regulator kit is available in a 7.5 amp or a 15 amp version for only a few dollars more. The 15 amp version is better value for money—even if you think you won't exceed 7.5 amps, there is less chance of blowing up the 15 amp version.

Once you have the kit, you construct the unit as per the supplied instructions. With a little electronics knowledge you can work out which diodes are which, or you can look up the component numbers in a suitable reference book—the data section of the Dick Smith Electronics catalogue has a lot of common component information.

A 20 volt zener diode (ZD3) is used to limit the gate to source voltage of the FET. This voltage is a little high for some types of FET. The kit comes supplied with enough components to make either a 12 or 24 volt version of the regulator. If you are building the 12 volt version, you don't need the 15 volt zener diode ZD1. Use it as ZD3 instead, as 15 volts is quite sufficient to turn all the types of FETs that may be supplied.

If you are building the 24 volt version, do the same and buy a 13 volt, 1 watt zener diode to use as ZD1. The 13 volt diode will give a better range of voltage adjustment.

If your kit is supplied with a BUK456-60A FET and a MBR1545CT dual diode, then the amount of power dissipated by these components at a charging current of 10 amps will be about 3 watts for each. This is a bit high for continuous use with the heatsinks supplied. It is strongly recommended that larger heatsinks be installed and that the board be mounted in a suitably large case with ventilation slots.

A better alternative (for more experienced constructors only) is to mount the FET and diode on a heatsink external to the circuit board (or to the metal side of a large enough case) and wire them such that the charging current does not pass through the circuit board at all. Figure 1 shows a suitable arrangement using a piece of Veroboard to support the leads. Use TO220 insulated washers and heat transfer grease (or the less messy silicone rubber washers). This will enable the full 15 amp continuous rating of the dual diode to be utilised.

Once you have built your kit, you will have to do some testing before you use it. Follow the instructions given with the kit. You should now have a cost effective, reliable, simple regulator.

Charge current tapering

The care and feeding of secondary storage batteries is a large area of discussion. This article is limited to improving the performance of a simple switching regulator for solar charging of a lead acid flooded cell battery.

An important rule of thumb for charging lead-acid batteries is to limit the maximum charging current to 10 per cent of the 10 hour amp-hour (AH) rating. So for an example installation of a 200AH battery, the maximum advisable charging current is 20 amps (assuming you can afford enough solar panels). Also, batteries like to have the charging current reduced as the terminal voltage approaches the gassing point. Fortunately, solar panels are essentially constant current sources so a number can be parallelled to give two 10 amp sources and two separate voltage regulators (of the Oatley type with a series output diode) can be used. Figure 2 gives the general idea.

For flooded pure lead positive pasted plate lead-acid cells, the recommended switch-off setting point for the first regulator is 2.35 volts per cell at 25°C, that is, 14.1 volts for a 12 volt battery bank. If there is more than one regulator used in parallel, the recommended switch-off setting point for each additional parallelled regulator should be decreased by 0.03 volts per cell, giving 13.9 volts for the second regulator, 13.75 volts for the third, and so on up to five regulators.

Once the regulator has switched off, it should not switch on again until the battery voltage has dropped substantially. The recommended switch-on voltage for such a regulator at 25°C is 2.25 volts per cell, which is 0.6 volts less than the switch-off voltage for a 12 volt reg-

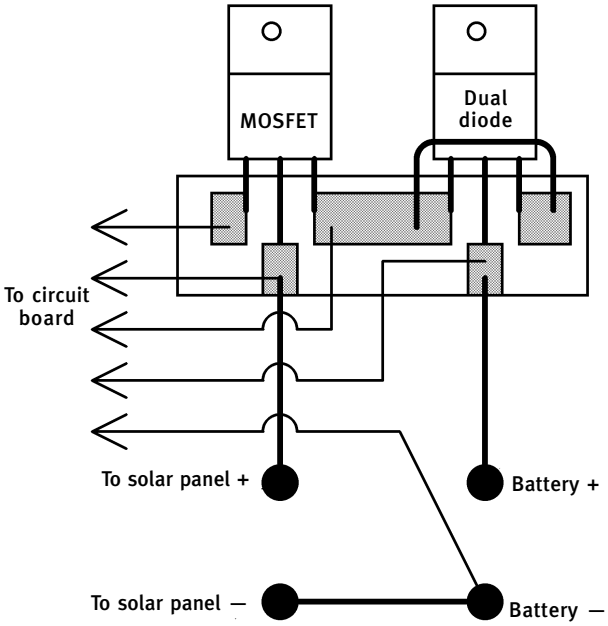


Figure 1. Mounting the power components off the circuit board. Note the small board used to support the leads. While this is not essential, it reduces the risk of snapping off a lead.

ulator. The Oatley regulator switches back on at about 0.7 volts less, which is fine. So, for the two paralleled regulators in figure 2, the one set to 14.1 volts will switch on when the battery voltage has fallen to about 13.4 volts, while the one set to 13.9 volts will switch on again when the battery voltage has fallen to 13.2 volts. See a problem? The 13.9 volt regulator may never switch back on under low load conditions.

Fortunately, this is easily overcome by using the 14.1 volt regulator to switch both itself and the 13.9 volt regulator back on as the battery voltage falls. A simple way to do this is to connect a 0.1uF capacitor from IC2 pin 14 in the 14.1 volt regulator to IC2 pin 12 in the 13.9 volt regulator.

Temperature compensation

The recommended switch-off voltage varies with temperature, decreasing by 0.006V per cell for each °C rise above 25°C. For the mathematically minded:

Voff = 2.35 -{(Ta - 25) x 0.006} volts/cell (equation 1)

The Oatley regulator is not temperature compensated, but a simple circuit modification can be done to achieve good compensation over normal temperature ranges.

By referring to your copy of the Oatley circuit diagram, you can see how this is done. Replace R3 (150k) with the network of Ra, Rb and Rt shown in figure 3. Both Ra and Rb should be 1 per cent metal film resistors. Resistor Rt is a negative temperature coefficient thermistor which has a resistance of 100,000 ohms at 25°C but changes resistance by -5.2 per cent per °C (Dick Smith Electronics sell a suitable unit, cat# R-1797).

The thermistor is used to sense battery temperature and ideally should be in close proximity to a battery cell. Use a small plug and socket (DIN types are okay, microphone types are even better) on the case housing the regulator and fully epoxy encapsulate the thermistor on the end of a suitable length of twin shielded wire lead. Earth the shielded braid of the cable at the regulator end only. High resistance values are involved, so keep it all clean and dry. A compromise is to encapsulate the thermistor in the end of the plug outside the case housing the regulator and ensure it is placed in a location where it will sense ambient temperature in the battery room, with a good air-flow and away from other heat-generating devices such as inverters.

Table 1 shows the calculations of the component values required and the calculated degree of accuracy of the temperature compensation. From 10°C to 35°C, the compensated switch-off voltage of the regulator is within 0.1 volt of the recommended value.

For the 24 volt version of the regulator, replace R3 as described above for the 12 volt version, but try Ra=220k and Rb=330k. The switch-off voltage settings are, of course, twice those for the 12 volt version. (Note that R2 is used in the 24 volt version and replaced with a wire link in the 12 volt version.)

A better charge indicator

The Oatley regulator uses one red LED as a state of charge indicator. It flashes while charging and stays on continuously when the battery is charged.

By adding the simple bit of circuitry in figure 4, the indicator can be made

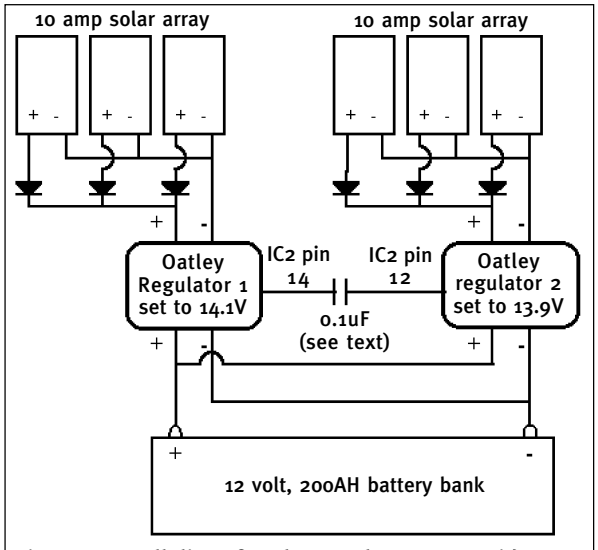


Figure 2. Paralleling of Oatley regulators to provide charge current tapering.

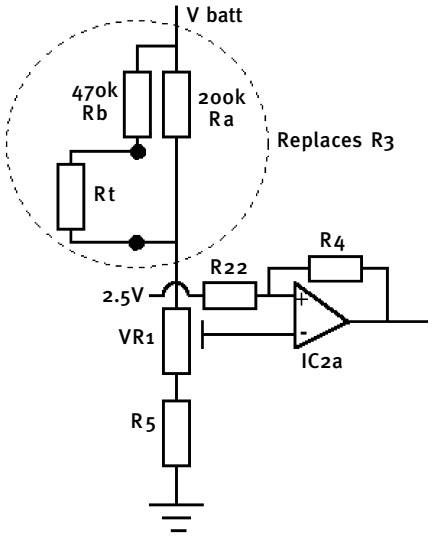


Figure 3. Adding temperature compensation to the regulator.

more interesting. Note that in the following description, D3, D4, D5, D7, R11, R16 and LED1 refer to parts in the Oatley regulator.

Remove D4 from the circuit board and run a wire from the hole that the cathode end of D4 occupied to a 2.7k resistor in series with a green LED as shown in figure 4. Mount the green and red LEDs horizontally adjacent on the case housing the regulator. If you have a bi-colour LED with a common anode connection, then that could be used to advantage (the commonly available dual ones all seem to be common cathode unfortunately).

The LEDs will flash red during charging and change to steady green when the charged condition is reached. A more easily interpreted indication.

External battery voltage sensing

This part is for experienced constructors only! If you have a fairly high charging current then this is a must.

The voltage drop between battery and regulator will vary with charging current. For a total resistance of 0.025 ohms (not uncommon), voltage drop could be up to 0.25 volts at 10 amps, or 0.75 volts at 30 amps.

Suppose you adjust the regulator to switch off at 14.1 volts (at 25°C) with 10 amps of charging current. Where did you measure the voltage? You should have measured it directly across the battery terminals, not at the regulator. Because of the voltage drop in the wiring, the voltage at the regulator will be 14.35 volts at switch off. It will start charging again when the battery voltage has dropped to about 14.35 - 0.7 = 13.65 volts.

Now, clouds arrive and the output of the solar panels drop to 1 amp. Assuming the batteries still charge to the charging end point, at what battery terminal voltage will that occur? The answer is: 14.35 - 0.025 = 14.325 volts.

For 30 Amps of charging current, the battery terminal switch off voltage will be 14.35 - 0.75 = 13.6 volts, which is actually less than the switch on voltage! So it quickly switches on again. What happens is that any regulator gets rather confused and rapidly switches on and off, sometimes in an alarming manner and the net current going into the battery may actually be small!

The way around this problem of lack of voltage regulation is either to use very thick and short wiring between regulator and battery, or to sense the battery terminal voltage separately and use this to control the regulator. Figure 5 shows the general idea.

The voltage sensing part of the regulator has connections to the battery terminals separate from the wires carrying the charging current. The current drawn by the voltage sensing circuit is designed to be small, ie 0.001 amps, so even if the resistance of the voltage sensing leads were as high as 1 ohm, the voltage drop between battery terminals and sensing circuit would be only 0.001 volt! The Oatley regulator requires only a simple modification to do this.

Firstly you need to run a piece of heavy wire directly from solar panel negative terminal to battery negative terminal external to the circuit board (similar to figure 1). Now you connect the voltage sensing lead from the negative battery terminal to one of the negative terminals on the circuit board (this is the only negative connection to the board. There is no connection of the current carrying negative lead to the circuit board). For the voltage sensing lead from the positive battery terminal, you first need to remove a small section of copper PCB track on the circuit board running from R2 to the FET/diode. Drill a small hole in the board next to the top end of R2 and solder a lead to R2 as per figure 5. This lead connects to the positive terminal of the battery.

It is recommended that each voltage sensing lead has an inline 1 amp fuse at the battery terminals to protect against disasters.

Some general system improvements

Now we will look at some installation and application ideas that can improve the general performance of the overall system.

Voltage drops in the wiring and across diodes in the system can reduce the available power from the panels. There are a number of ways to reduce these

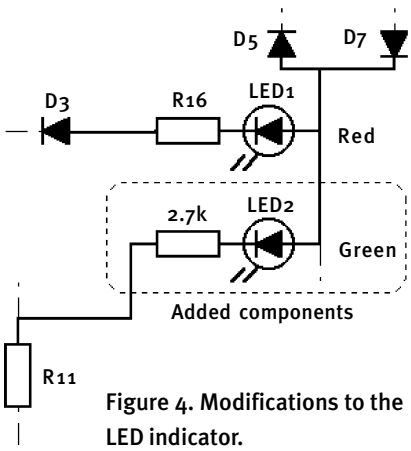


Figure 4. Modifications to the LED indicator.

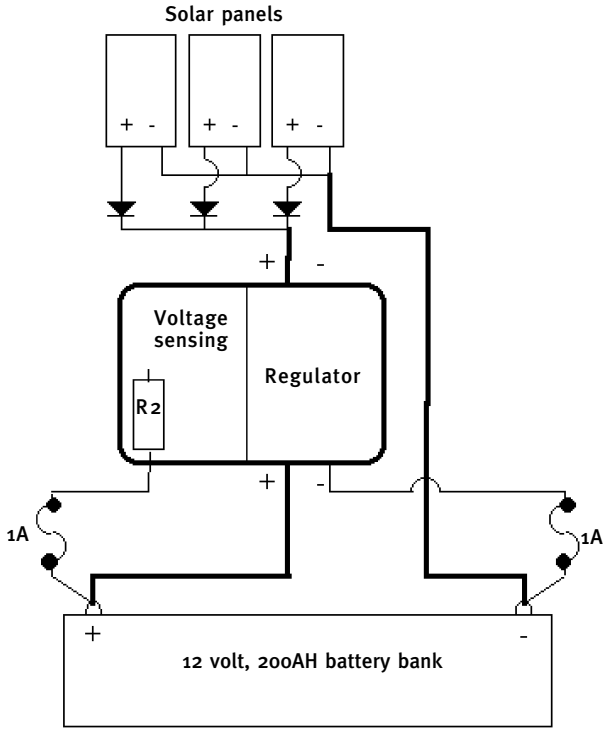


Figure 5. External battery voltage sensing.

losses, including the use of special diodes and adequately rated cables.

A Schottky power diode, which has a lower voltage drop (and therefore power loss) than an ordinary silicon power diode, is often used in series with each solar panel to avoid solar panels that become shaded taking current from other panels (this can happen regardless of the type of regulator used). A useful tip is to use a low cost dual Schottky diode device (such as a Motorola MBR1545, which is rated at 15 amps in total) and wire the two diodes in the package in parallel. This reduces the forward voltage drop slightly and hence the losses and heating of the device.

The diode current rating should be greater than the maximum output of the panel it is connected to. A small heatsink is required for currents greater than about 3 amps. On the other hand, in a small solar panel array, (say fewer than six panels) the diodes may dissipate more power than the shaded panels. On balance, diodes are probably best omitted if the array has fewer than about six panels. If in doubt, cover a panel in a couple of thick blankets to exclude light, connect it via an ammeter to a 12 volt battery (+ to +) and measure the reverse current through the panel. Then do the sums.

Wire gauge

Of course you will have used suitably sized wire from the solar panels to the regulator and from the regulator to the battery, won't you? This wire would typically have a cross section of 7mm^2 and a resistance of 0.0025 ohms per linear metre. This may seem pretty low, but the losses can still be considerable.

Let's look at some of these losses to see where they occur in the system. The solar panel isolation diodes, if you use them, will have a forward voltage drop of about 0.5 volts. With the solar panels on the roof, you would likely have a cable run of 20 metres to the battery room. So the resistance of the run is:

2 x 20 x 0.0025 = 0.1 ohms.

The voltage drop at 10 amps of current is therefore 0.1x10 = 1 volt.

Now to the regulator. The voltage drop across the regulator is due to the FET, the diode and sundry wiring and connectors. With 10 amps through the Oatley regulator, the voltage drop is about 1 volt. The regulator needs to be close to the battery, say about three metres. The voltage drop at 10 amps is:

2 x 3 x 0.0025 x 10 = 0.15V.

Therefore, The total voltage drop from solar panel to battery terminals is 2.65 volts (see Figure 6). At the regulator switch off voltage of 14.2 volts, the voltage output of the solar panel is 16.7 volts. At 20 amps, the output voltage of the solar panel would have to be about 18 volts. This is about the maximum voltage that the solar panel array can supply, and is not necesarily at its highest power output operating point.

The important message here is to minimise the length of wiring from panel to regulator and from regulator to battery. Use the heaviest gauge wire you can afford, especially if the panels are generating more than 10 amps. (If you have only a small resistance between regulator and battery, then reduce the cutout voltage setting to 14.1 volts

Temperature °C	10	20	25	30	40
Thermistor resistance Rt	213912	128848	100000	76567	44887
Desired battery volts Vb (equation 1)	14.640	14.280	14.100	13.920	13.560
Ra	200000	200000	200000	200000	200000
Rb	470000	470000	470000	470000	470000
Req=(Rb+Rt) parallel Ra	154747	149928	148052	146421	144047
% pot rotation (0% to 100%)	49%	49%	49%	49%	49%
Vb calculated	14.637	14.250	14.099	13.969	13.779
Vb desired-Vb calculated	0.003	0.030	0.001	-0.049	-0.219

Table 1. Approximate calculation of component values for temperature compensation.

as the 14.2 volt figure allowed for some voltage drop in the wiring.)

Metering

If you wish to monitor the current, wire an ammeter in series with the positive lead from the solar panel. A voltmeter should be connected in parallel with the voltage sensing leads, or directly across the battery terminals.

It is also imperative to wire a suitable DC circuit breaker in series with both the solar panel positive lead and the positive current lead to the battery terminal. If in doubt about anything described in this article or your wiring capability, seek qualified help. Remember, safety first!

Conclusion

Using the information above and a little knowledge of matters electronic, you should be able to construct, for less than $100 (meters not included), a temperature compensated solar panel regulator for charging a 12 volt or 24 volt 200AH flooded lead-acid batteries (normal telecommunications type) at the maximum advisable rate. With the dual regulator arrangement you'll even have some redundancy in case something fails.

It is important to realise that other types of batteries, such as sealed lead-acid have different charging characteristics, so the regulator as described above should not be used without some expert adjustment.

The regulator kit is available from:

Oatley Electronics, PO Box 89,
Oatley, NSW 2223,
ph:(02)9584 3563,
fax:(02)9584 3561
http://www.oatleyelectronics.com

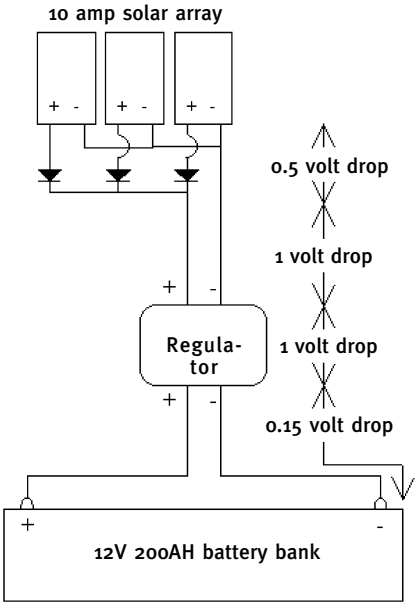


Figure 6. Voltage drops in a typical 12 volt system. As you can see, the voltage drops add up quickly, and can be several volts in systems with long cable runs.

Win a Trace C40 Charge/Load Controller

(Valued at around $400)

We are looking for great build-your-own articles and ideas. You don't have to be a tech-head, just have an idea, simple or complex, electrical or mechanical, that has appeal to do-it-yourselfers and involves renewable energy or appropriate technology in some form. It may be a regulator, pedal-powered generator, a solar cooker or anything useful, really.

Just send your ideas to: ReNew, PO Box 2001 Lygon St North, East Brunswick VIC 3057, email: altec@netspace.net.au
Competition closes Friday 13 October 2000.

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/

Sacred Run

Early June, 2000
Starting in Sydney

This is an 88 day spiritual relay run covering almost 11,000 kilometres across Australia.

The purpose of the event is to connect with indigenous people of Australia to try to raise awareness of issues concerning indigenous communities and humanity's effect on the environment.

Contact: Sacred Run Foundation Australia, PO Box 311, Bondi Rd, Bondi NSW 2024, ph/fax:(02)9386 4693, email: run2000@primus.com.au

World Renewable Energy Congress

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

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

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

Sustainable Energy Day

Wednesday 12 July, 2000
Monash University,
Clayton Campus, VIC

Organised in conjunction with WREN, AGO, IEEE, IEAust, ANZSES, ATA and Victorian University of Technology. Will showcase outstanding energy efficiency and renewable energy projects and initiatives, and will provide information on major sustainable policy developments.

Contact: Dr A Zahedi, Organiser Sustainable Energy Day 2000, Department of Electrical and CSE, Clayton Campus, Wellington Rd, Clayton VIC 3800, ph:(03)9905 5957, fax:(03)9905 3454, email: zahedi@eng.monash.edu.au

Energex 2000

July 23 - 28
Riviera Hotel Conference Center,
Las Vegas, Nevada USA

Papers will be presented in all energy disciplines including fossil fuel, carbon sequestration, oil recovery, natural gas, biomass, geothermal, solar, photovoltaics, hydrogen, fuel cells, wind, coal and nuclear.

Energex 2000 will co-locate with NTS Development Corporation's Global Energy Exposition to produce GlobeEx 2000. The Intersociety Energy Conversion Engineering Conference and the NAPM/NPI Purchasing Green Energy Workshop for State and Local Government.

For further program details or to receive further information, contact Suzanne Ulrich (sulrich@ntsdev.com) or Cheryl Lydon (clydon@ntsdev.com) GlobeEx 2000, 2330 Paseo Del Prado, C101, Las Vegas, NV 89102, USA, ph:+1 702 317 0777, fax:+1 702 257 7999.

Thermal energy storage conference

28 August - 1 September, 2000
Stuttgart, Germany

Terrastock 2000 aims to provide information on state-of-the-art thermal energy storage systems.

Contact: Prof Dr-Ing E Hahne, ITW, University of Stuttgart, Pfaffenwaldring 6, 70550 Stuttgart, Germany, ph:+49 711 685 3536, fax:+49 711 685 3503, email: terrastock@itw.uni-stuttgart.de, www.itw.uni-stuttgart.de/terrastock

Renewable energy seminar

November 2000
Brighton, UK

Will review the role of renewable energy systems in meeting the world's growing electricity demand, focusing on modern manufacturing and operating technologies.

Contact: Robert Pinheiro, ph:+44 1865 302 704, fax:+44 1865 557 368, email: robert.pinheiro@britishcoulcil.org

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

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.icms.com.au/solar2000

WA Environment Centre events

The Environment Centre has a web site where many of their events are listed.

Contact: http://www.iinet.net.au/~ecwa/

Wind Energy Basics: A Guide to Small and Micro Wind Systems

Author: Paul Gipe, Chelsea Green Publishing Co. 1999. Distribution GEMCRAFT Books (03)9888 0111 gemcraft@hotkey.net.au RRP $43.95 (PB) ISBN: 1 89013 2225

It has been a pleasure reading such a clear and optimistic book on one of my favourite subjects, wind energy.

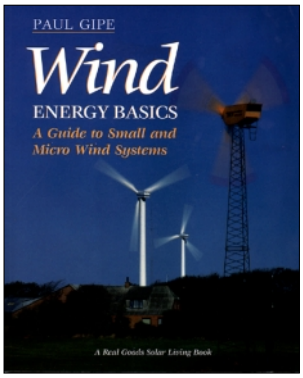
Paul Gipe has over 20 years experience in the wind industry as a practitioner and a commentator. This is evident in the no-nonsense way he covers the various aspects of wind systems for the small user.

This book is a wonderful primer for all but the professional wind enthusiast; in which case the companion volume *Wind Energy for Home and Business* (1993) weighing in at over 400 pages is the book of choice.

It covers everything from the fundamentals of wind energy, including lots of maths, through to the actual installation, operation and maintenance of the author's own wind system. In between are chapters on estimating the performance of the proposed wind system, on- and off-the-grid applications and, of course, what to look for when buying a wind turbine for your home, weekender or boat.

A very important chapter has been included on siting and safety. After all, what is the point of having an environmentally responsible wind system if it is behind a tree or if you injure or kill yourself trying to install or operate the thing?

Throughout the book the reader is constantly treated to excellent photographs from the author's extensive global travels with his wife and companion



Nancy Nies in search of wind turbines. You have access to the inside of manufacturing premises and to the top and bottom of towers and wind turbines around the world.

In conclusion I recommend this book to anyone who has an interest in the environment or renewable energy. Wind is the perfect companion to solar power and together they are changing the future for the better.

Reviewed by Trevor Robotham of Sun Wind And Power SWAP

ecospecifier: A guide to sourcing environmentally preferable materials

Centre for Design at RMIT and EcoRecycle Victoria, in association with the Society for Responsible Design. November 1999, ISBN 08645 90318

Well, the title of the book really says it all. This book is basically a compilation of companies, both suppliers and manufacturers, of building materials, including composites, such as cork flooring, concrete, masonry and plaster, engineered wood and alternatives, finishes and adhesives, glass, metals, plastics and rubbers, textiles, and salvaged and recovered materials.

Each material has an environmental attributes checklist that covers such things as recycled material content, recyclability, toxicity, reduced greenhouse gas impacts, sustainability and biodegradability of materials. There are also full contact details for the suppliers of each product, including web sites, where you can check out the materials without having to buy them.

To make the job of finding the right materials a bit easier, there are also chapters dealing with the value of using environmentally friendly alternatives, dealing with suppliers, environmental improvement trends among suppliers and the assessing the life cycle environmental costs of materials.

We have found this book to be a very handy source of information, and indeed we have used it to source materials for our own projects here at the ATA head office.

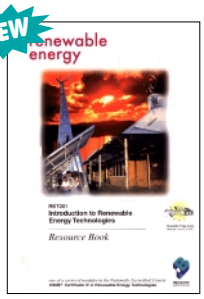
If you are thinking about building or renovating, and you want to do it as sustainably as possible, then this book is a great place to start when looking for the right materials for the job. While this book has been produced with the sponsorship of EcoRecycle Victoria, the materials listed are from all over Australia, so it should be useful to builders and renovators anywhere.

Lance Turner

ATA books by mail order

Superb sustainable technology books available from the Alternative Technology Association

NEW



INTRODUCTION TO RENEWABLE ENERGY TECHNOLOGIES

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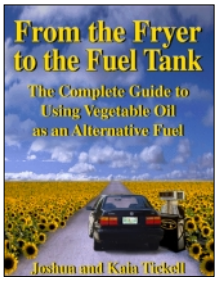
One of the Resources books from the Certificate IV in Renewable Energy Technologies, this book contains a wealth of information on renewable energy systems, their sizing and design.
Item code: IRET



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.
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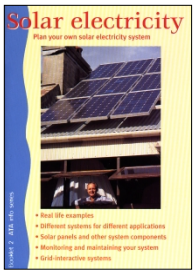

ATA Booklets

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Available titles include Solar electricity, Solar hot water, Solar workshop, Building a Savonious rotor wind turbine, Solar fruit drying, Low-voltage appliances and Green cleaning.

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Author: Hugh Piggott
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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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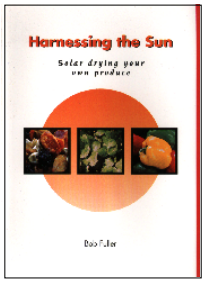

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In this book Bob Fuller explains how to successfully prepare and dry many types of foods for preservation. Also includes six different plans for making your own solar food dryers.
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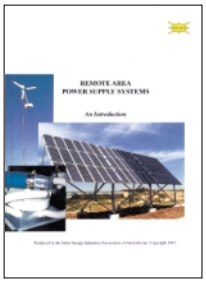

REMOTE AREA POWER SUPPLY SYSTEMS: An Introduction

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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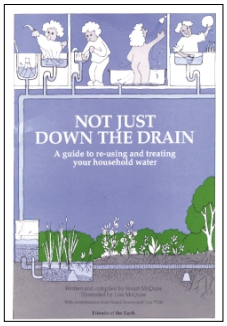
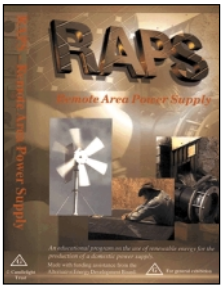


NOT JUST DOWN THE DRAIN

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*



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Price $43.95
This 28 minute video is a concise introduction to the operation of RAPS systems, including detailed explanations of energy production, energy storage and energy conversion, as well as detailing the importance of energy efficiency.
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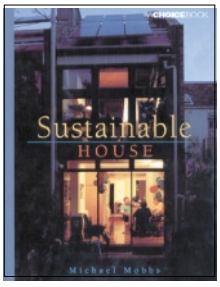

SUSTAINABLE HOUSE

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.
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Price: $16.50
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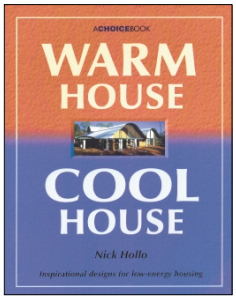
Price: $43.90, Softcover, 234pp
This book covers many different composting toilet systems, including those available in Australia and thorough general information about composting toilets. Includes a chapter on greywater.
Item code: CT



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.

Soft Tech Issue 41
Wind power buying guide; Build a window box greenhouse; rammed earth housing; Global warming quiz; 'Alternative' lifestyles in the country and city; Water saving shower roses; Electromagnetic radiation; Green cleaning products; Vanadium redox battery.

Soft Tech Issue 46
The Solar Grand Prix; A $5000 recycled house; Environmentally friendly loos; Getting started with windpower; RAPS battery buying guide; Do-it-yourself solar in the city; Water powered railway; Build your own solar water purifier, 12V fluoro inverter; 'A smart' regulator; Heating with your fridge.

Soft Tech Issue 47
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[The Pears Report]

Government finally gets serious about greenhouse?

Alan Pears assesses the Commonwealth Government's likely policy step as it prepares for the next international climate change forum

There now seems to be a chance that the Australian government will, before November this year, announce its commitment to ratify the Kyoto Protocol.

A number of factors lead me to this view.

First, the scientists have stopped pussyfooting around. They are now bluntly telling anyone who will listen that global warming *is* happening, and that human activity is a major cause. Now, 15 years since scientists first publicly voiced concerns that global warming might be a problem, intense research has confirmed their fears. This means the Kyoto Protocol *will* be just the first step towards large reductions in fossil fuel use over the next few decades.

Second, the next round of international greenhouse negotiations later this year will focus on setting the rules for including carbon sinks (for example, tree planting) in national greenhouse inventories. Australia could achieve its Kyoto target with much less difficulty if it could include a wider range of sinks in its inventory. However, many countries are reluctant to include sinks, on the grounds that they could be manipulated and that they are really only a short term buffer. What's more, some countries are not very keen to give Australia an easy ride on sinks after our 'poor little rich country' performance at Kyoto. So, if Australia is to stand a chance of gaining agreement on widening the range of sinks included in our inventory, we need to demonstrate that we are serious about limiting greenhouse gas emissions. What better than a public commitment to ratifying Kyoto, combined with a flurry of funding for emission reduction strategies (courtesy of the funds extracted from the government by the Democrats as a trade-off for the GST)?

Third, opposition to greenhouse response seems to be fragmenting, as some industries realise they could benefit from the situation, while others are beginning to accept that global warming won't go away. For example, the gas industry has left the anti-greenhouse Australian Industry Greenhouse Network, while companies such as Shell and BP Amoco are repositioning themselves. The advocates of emissions trading are lobbying for early action.

Evidence being presented to the Senate Inquiry into Global Warming is also undermining the case against greenhouse response. In its presentation, the Sustainable Energy Industry Association revisited the Australian Bureau of Agricultural and Resource Economics (ABARE) 1997 greenhouse study which was, at the time, interpreted as showing that greenhouse response would seriously damage Australian business. SEIA pointed out that the ABARE study actually showed that the services sector (60 per cent of the economy) would not be affected, and that manufacturing and agriculture (a quarter of the economy) would actually increase their economic output under the ABARE greenhouse response scenario! And ABARE failed to consider the range of strategies that the adversely affected industries might use to limit or avoid negative impacts. Summaries of the hearings can be read at www.greenpeace.org.au.

Another sign of change was the speech presented by environment minister Senator Robert Hill at a greenhouse conference in March 2000. Senator Hill praised the efforts of companies acting in response to climate change. He went on to say 'So there is no doubt we will be facing constraints of some sort on carbon emissions in the future…' He noted that if Kyoto failed it would be replaced—and that any new process might not take into account Australia's 'national circumstances in the way we were able to achieve at Kyoto'.

An important warning to business was his comment on the likely workings of an emissions trading scheme. He said 'I am not inclined to reward [through allocation of free permits] those who would make Australia's national abatement task more difficult in the coming years'. Senator Hill also flagged a desire to reward early action by business.

Of course, Senator Hill must push this agenda in a Cabinet where several ministers are very antagonistic to the mere idea of the UN influencing activities within Australia, whether they relate to mandatory sentencing for crimes, environmental impacts or anything else.

Biomass and its environmental impacts

Jill Redwood's article in the *ReNew* issue 71 highlighted the tensions between many environmentalists and some supporters of energy from biomass. There are some very important issues here.

First, it is clear that Australia will need to rely heavily on energy from biomass in any serious renewable energy strat-

egy. A third of Australia's energy use is for transport, where bio-fuels will be critical, almost half of our energy use is heat—again, bio-fuels have an important role here. And if we are to have reliable renewable electricity supply, the storage role of bio-fuels will also be important.

Second, it is clear that most traditional supporters of renewable energy also have high environmental expectations, especially with regard to impacts on forests. However governments, as architects of schemes such as the Regional Forest Agreements (RFAs), want to use renewable energy programs to legitimise their environmentally-dubious forest policies.

The situation is complicated further by the existence of Green Power schemes, which involve voluntary payment by subscribers of a surcharge on their electricity price in return for renewable electricity. Clearly, customers who pay extra for Green Power should have a say in the sources from which their electricity is drawn. Otherwise they will simply stop paying extra and the schemes will fail. This is well understood by most electricity retailers, and by the government agencies that administer these schemes. But it is not understood by some politicians and bureaucrats from other agencies. Indeed, SEDA and Energy Efficiency Victoria are being labelled by some as 'greenies' (which is a very bad thing in bureaucratic circles) simply because they are trying to maintain the market credibility of Green Power.

It is in everyone's interests to publicise the details of sourcing of energy for each Green Power scheme. It is probably also useful to establish some kind of eminent committee of people trusted by environmentalists and the community to review proposed new sources, and to issue comprehensive opinions on their environmental credentials. Otherwise, it seems inevitable that each environmental group will publish lists of Green Power products in order of environmental acceptability, but potentially using different criteria and adding to the confusion. And SEDA and EEV will come under increasing bureaucratic pressure to 'toe the whole-of-government line'.

Maintaining high environmental standards for renewables used in compliance with the two per cent target or where they're cheaper than conventional energy is much more difficult. We can argue that this is an opportunity to set high environmental standards and achieve multiple environmental objectives as we introduce the energy supply infrastructure of the next millennium. But governments can argue that they have been elected to negotiate compromises that reflect the broad views of society—including those exploiting forests. And proponents of biomass energy solutions can ask why they should be targeted, when companies damaging the environment by building coal-fired power stations and mining oil shale near the Great Barrier Reef receive government support.

Personally, I believe that the energy infrastructure of the 21st century *should* reflect the highest possible standards of ecological sustainability, but we will need to work out what this means in practical terms. And we will need compensating mechanisms for sustainable energy projects to cover additional costs associated with meeting higher environmental standards than competitors. We can also support increases in royalties and removal of subsidies for exploitation of forests, and seek clear statements on which biomass projects are truly environmentally acceptable.

[Kid's stuff]

Noel's Treasures from Trash

A couple of years ago I was amazed to see a packet of animal seeds in the Capetown Museum. Of course, I bought a packet to see what they were. Inside were some little capsules with the instructions 'Place in warm water…'.
You can make some of these amusing seeds yourself with a few basic items you will find around the house.

To make your own animalseeds you will need:

- Some old medicine capsules, such as aspirin
- some light density, soft sponge rubber foam, such as from an old cushion
- a small pair of sharp scissors
- some waterproof textas in different colours, including black
- a small prodder, such as a ballpoint pen refill

With completely dry hands, take one of the capsules and gently twist the ends so that the capsule comes apart. Empty the contents into the sink and flush it away with water. DO NOT eat any of the capsule's contents, or it may harm you! Set the two halves aside and do the same to as many capsules as you want to make seeds.

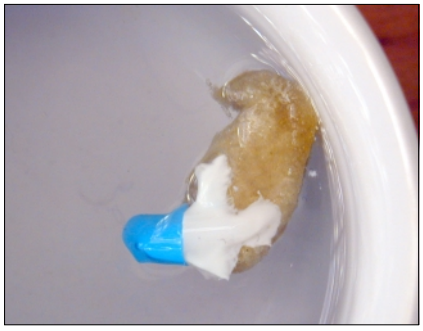
Take the sponge rubber, and using a black texta, draw out small animal shapes, such as frogs, ducks, dolphins, lizards, elephants, crocodiles, horses and even mermaids. Now, using the coloured textas, colour in these animals. Don't make the animals too big or they won't fit inside the capsules. About 70 x 20 x 10mm is about the largest that will fit.

The next step is to push each animal into its own capsule. Take a long capsule half and carefully push the animal into it using the prodder. This requires a bit of patience and care not to break the capsule. When the animal is inside, fit the other half of the capsule. Repeat this for the other animals and capsules.

Now your animal seeds are finished, it is time to test them out. Get a glass half filled with warm water, and drop in an animal seed. Now you have to wait until the capsule starts to dissolve, but soon you will see your animal starting to break out of the capsule. A minute later, and it will be completely free.

These are great for kids of all ages, and the animals can be dried out and used over again.

Seed goes into the water.



Animal starts to break out.

Animal is free and capsule has broken up.

Insulation buyer's guide

Thanks for your excellent Home Insulation Buyer's Guide.

However, the unnamed author is quite mistaken when he/she says that reflective sides facing down on ceilings or inward on walls won't do much in summer. It is a common misconception that foil can only achieve its insulating effect by reflecting. In fact it can achieve it equally well by 'failing to emit'.

If the reflective surface of single-sided foil faces inward, then in summer when the outer wall heats up, sure the outer side doesn't reflect the radiation, it absorbs it and the foil heats up. But the reflective side of the foil refuses to radiate that heat to the inside of the house. If a surface reflects all but five per cent of the far infrared radiation falling on it, then it will also only radiate about five per cent of the far infrared radiation that an ordinary building surface would radiate at the same temperature. So, purely on this criterion, the direction that the reflective surface faces is irrelevant, provided it faces an air gap of at least 25 mm.

The consideration of which side will get dirty or dusty faster is far more important. For this reason an upward facing reflective surface above a ceiling or under a tile roof will soon become useless. So will an outward facing reflective surface behind brick veneer (but it may take much longer).

Significant differences between summer and winter R-values do occur in ceilings or under floors when foil is used without bulk insulation. No such difference occurs in vertical walls. This is because, with foil only, convection losses still occur, and convection is reduced when heat flow is in the direction of gravity (ceiling in summer, floor in winter), and assisted when the direction of heat flow is opposite to gravity (ceiling in winter, floor in summer).

I'm also surprised that you didn't come across 'breathable' foil. It is finely perforated. I think it may be made by Dupont.

Something else for the insulation buyer to beware of is the American R-value. Our R-values have units of square metres degree kelvin per watt (m^2 °K/W) but theirs are in square foot degree Fahrenheit hours per British thermal unit (ft^2 °F Hr/BTU)—eek! To convert American R-values to ours, divide by 5.705. So beware of imported products or American websites claiming fabulous R-values.

David C Keenan,
d.keenan@uq.net.au

You are not the only person to point out the mistake in the insulation buyer's guide, and I must admit it was something I learned way back in high school, or maybe university but had completely forgotten. Interestingly, if you need only one reflective side to foil insulation, how much is to be gained in terms of efficiency by having reflective surfaces on both sides?

Lance Turner

Diesel rebate

I wish to comment on the Pears Report page 52 of *ReNew* issue 70. Mr Pears states 'politicians falling over each other in the rush to pour money into rural areas through diesel fuel rebates'. Country people per se do not receive diesel rebates, only farmers involved in primary production. These farmers are a small minority of country people. They use diesel in production of cheap food for export and for domestic consumption, for the benefit of all Australians, the majority of whom are city dwellers. If rebates were to be withdrawn then surely the price of food should rise.

Mr Pears also stated 'Country people would no longer be heavily cross subsidised by city dwellers'. In the case of fuel the reverse is true. Country people subsidise the price cutting of fuel in the city. In my town fuel prices are often up to 16 cents per litre dearer than in the city. Further, country people have no local public transport and are forced to use their own vehicles. They subsidise the hundreds of millions of dollars cost of public transport in the cities; public transport powered by diesel and electricity which most city dwellers will tell you is clean—but ask the people of the La Trobe Valley living near the coal-fired generators how clean it is. These people pay the same for electricity as city dwellers despite the costs of transmission. It could be said these country people subsidise the city people.

No mention is made of the costs and effects of diesel used to transport all food and raw materials from country to city. Much more diesel is used this way than by farmers. Should transport companies pay more for fuel to force them to seek greener fuel? Would city dwellers bear the higher cost of almost everything they buy?

'A bonus benefit would be that rural employment would grow,' says Mr Pears. Where is the justification for this statement? History shows that companies prefer to locate in cities where they enjoy cheaper telephones, cheaper transport and owners and employees have access to the best schools, amenities, public transport and government services that have been withdrawn from the country.

'Country people's unsustainable energy use': How many city dwellers grow their own fuel for heating or cooking as many in the country do? How many city dwellers collect their own water rather than relying on huge dams with their energy costs and environmental damage? How many city dwellers recycle waste water as is common in the country?

There are cross subsidies from city to country as there are from country to city. Suggesting that the small minority of Australians living in the country should

pay more for diesel used in primary production in order to finance and develop the renewable energy industry is absolutely ridiculous. This is a burden which should willingly be born by all Australians. Mr Pears' article is blinkered and superficial and shows a lack of understanding of the issues involved.

Bob Gardener, Camperdown VIC

I sympathise with country people with regard to the pricing of petrol and diesel fuel by oil companies. I also recognise that subsidies go both ways, and that most urban energy use is unsustainable. However, these issues were not the focus of my article. My point was that politicians desperate to attract the rural vote would be likely to extend subsidies in simplistic ways that would continue to encourage increasing use of non-renewable energy sources and work against the take-up of renewable energy in the markets where it is most cost-effective. My article did not advocate removal of subsidies and making the lives of rural Australians even more difficult. It advocated 'win-win' solutions.

My column in this issue shows that my fears may have been confirmed in Victoria, but that the Democrats are showing the way in developing positive new approaches to helping country people through creative revision of the diesel fuel rebate scheme.

With regard to rural employment, the labour required to grow and harvest energy crops, to process local renewable fuels, to maintain renewable energy equipment, et cetera, would be substantial. Use of renewables and energy efficient technologies under the right conditions should improve the economics of some rural-based industries (for example food processing), making it more likely that industry could locate in rural areas.

Alan Pears

DC lighting efficiency

I have been reading *ReNew* for a while now and have noticed several times discussion on electronically ballasted lighting. However, all of these discussions seem to overlook one thing—the first thing that most of these electronic lighting ballasts do is rectify the AC power to DC. The second point is that most of these ballasts quote their supply as 240 volts AC/DC. When nominally 240 volts AC mains is rectified, you get up to 380 volts DC. In other words (and this is the case on all the units that I have tried so far) you can run electronic ballasts quite happily off anywhere from 240 volts DC to 380 volts DC. The efficiency of DC to DC converters is normally around 98 per cent at any percentage loading. When you compare this with the data for sinewave inverters, they become quite attractive for the light loads (pardon the pun) that lighting demands.

The only thing against running lighting off 240 volts DC is that it usually needs to be switched by normal light switches. As most people in this industry would be aware, DC is far harder on switches than AC. However, normal light switches are capable of switching 10 amps at 240 volts AC, so in theory should be able to handle switching 1 amp at 240 volts DC (240 watts). I admit to having little experience switching DC at these voltages.

However, you can switch square-wave AC with the same considerations as sinewave. The use of a square-wave inverter has an additional efficiency advantage. Since these electronic ballasts only draw current on the peaks of the waveform, a square-wave or modified square-wave inverter would allow the ballast to draw current for the duration of the wave (flat top). This improves loading efficiency. In addition, square-wave inverters seem to generate AC power more efficiently than sinewave inverters.

For small systems, I have switched the low voltage to a small DC to DC converter per lighting group. I have a couple of installations where this arrangement has been in daily use for over a year without problems. For this purpose a 110 watt converter kit is available from Oatley Electronics (their first generation converter had some problems, but the new design seems a lot better).

Other suppliers provide 'industrial' DC to DC converters (both step-up and step-down) in a variety of wattages at quite reasonable prices. Most of these units draw only a few milliamps or less unloaded while maintaining the required output voltage.

In *ReNew* issue 71 there is an article on illuminating road safety signs. This was the catalyst for my writing. They have used a good sinewave inverter to supply electronically ballasted fluorescent lights. While they may have a good reason to use a sinewave inverter in this application (I am not familiar with the lights they used), I would have thought that this was an ideal application for DC to DC conversion.

Am I ignorant of some important considerations, or is this something that is considered too unconventional? I would be very interested in hearing from anyone who has used high voltage DC for lighting with electronic ballasts in 'serious' applications.

A final word of caution with using autostart inverters with electronic ballasts. The loading on the sense detection placed by electronic ballasts is usually insufficient to start the inverter.

James Massey, Launceston TAS

James, we have been aware for some time of the advantages of using dedicated DC to DC converters to run conventional 240 volt AC fluoros, including compact fluoros. We have one of the Oatley Electronics inverters and are currently testing it for a product review in a later issue.

As for the reason for the use of a sinewave inverter in the road sign system you mentioned, we contacted the installer who explained that they did consider the DC to DC converter op-

tion, but decided against it for several reasons. These included simplicity of wiring and the difficulty of obtaining suitable converters with 24 volt DC inputs.

Cars versus cycling

On reading his article on Power Assisted Bicycles (PABs) in *ReNew* issue 71, I got the impression that Mr Calais considered that these machines are merely a stepping stone in the path to renewable transportation, with electric cars being the ultimate goal. I feel that a similar view is widely held in the 'sustainable community'.

I disagree with this view for a number of reasons. It would seem to me that, while electric cars have their place, the solution to urban transport is cycling, and the PAB makes it all the more attractive. While electric cars may solve the problem of air pollution it cities, they do not solve a host of other car-related problems, which could be diminished by greater usage of cycling.

Everywhere in our cities we see massive road construction and maintenance projects on an ongoing basis to cope with ever increasing car usage. This would not diminish (it may even increase) with the introduction of electric cars. Cycles, on the other hand, could make better use of roads. In addition, cycle-ways use far less construction materials and energy than motorways of the same capacity, due to the cycle's lower weight.

Although most cars have a seating capacity of around four, they seem to be mostly utilised as a single occupant vehicle, so you have one person taking up a road space that could potentially hold two or more cycles. Thus, if everyone started cycling instead of driving, the capacity of a road system could be nearly doubled.

Parking facilities present a similar problem to that of roads. Ten or 20 bikes might be parked in the space of three cars. This point may be diminished, however as there may be more cycles used in this hypothetical situation than cars used currently.

Cycling also has numerous personal benefits, some of which Mr Calais pointed out. Just a few weeks ago, we saw the Heart Foundation supporting Cycle Weeks in Tasmania. General health would be greatly benefited by cycling. There is also the financial incentive. With today's petrol prices what they are, motorists could make huge savings by getting out their bikes.

Electric cars and the like do have their place, but designers should be aiming more towards the longer distance transport requirements. With cycling and public transport, there should not be nearly as much need for cars in the cities. I can see no reason why the majority of inner city commuters using cars today cannot cycle to work tomorrow, including some readers of *ReNew*! The only way cycling can gain greater recognition in urban planning is to put increasing pressure on existing facilities.

I hope to see more developments in the PAB field in the future.

Tony Fenton, Longley TAS

Nice to feel useful!

My new home was designed and built by my husband and myself. It is solar powered with 12 BP panels, wind generator, nicad storage batteries, backup generator, SA21 inverter, wood fired stove with wetback on 300 acres in the bush.

We have used lots of information from your magazine, *Grass Roots*, *Earth Garden*, *Owner Builder* and other sources to build our house. It has lots of features designed in it to make it solar efficient and user friendly, and (hopefully) safe from bushfires and termites.

Thanks for a great magazine.

Phillipa Jarrett, Bathurst NSW

Another sustainable house

Now that we have moved into our new home, I thought I'd write and tell you a bit about it. Although we didn't have the resources to do a full solar design, it has turned out rather well anyway. We installed a solar hot water system, a Sola-Kleen 240 litre unit with quite a wide collector panel and an electric booster (which we have only used once after the second cloudy day in a row).

The area we live in is semi-rural, being about 60km south of Perth, and about 30km inland. About one kilometre to the east we have the start of the Darling Ranges, which run for several hundred kilometres south of Perth. Therefore we get a nice early morning 'breeze' and a good afternoon sea-breeze. I haven't yet done any measurements, but judging by the number of windmills and turbines in the area, I'd say our wind resource is pretty good.

Since the area is somewhat low lying, and bounded by high hills to the east, it forms a natural water catchment area, and in fact it is a major part of the Peel Region Water Mound (as our water authority calls it). This keeps the daytime temperatures a little lower than the surrounding areas. It also means that there is no deep sewer, and very strict requirements on the onsite sewerage systems permitted by Council. Since the Ecomax system has been approved by the local Council, we chose to install it for our house at a cost of about $7500. This is slightly higher than the normal installation cost, since we were unable to obtain gravity feed for the system, and had to install a sump-and-pump. This was mostly due to the nature of the soil, and the general environment.

My wife and I have planted over 150 native trees on our block, which is 2000 square metres (½ an acre), so when they grow in the next few years we should

have a nice leafy green source of clean air and natural shade (especially since the air is already so clean to start with, being so far away from the big smoke).

We have also had about six truckloads of fresh mulch delivered over the last month or so (we know a tree-lopper with a big truck), so our garden retains lots of moisture and stops the soil from burning in the summer sun. We also have a bore but no pump yet, I'm looking around for a good low voltage system and solar panel, but I have been watching the *ReNew* articles about alternative pumping, so I might get experimental in the next few months.

Now, to the house, and the accidental solar design. Our block has a wide southerly frontage to the road and so our house is oriented with the long axis running east-west. It's basically a long thin rectangle with the main bedroom at the north-east corner, and running westwards on the north side the ensuite, kitchen, dining, laundry, toilet, kids' bathroom and bedrooms. On the south side there are three more bedrooms, the lounge and formal dining room.

The northerly aspect is great, and our eaves and verandahs are just the right length for maximum thermal comfort in summer and winter. When we find the time, we will complete the tiling in the house (all floors will end up being tiled), and the terracotta colour will be a good heat collector in winter. Of course, our solar hot water system is on the roof over the kitchen with a nice northerly aspect. It's mounted flat on the roof, but the roof has a relatively high pitch, so we decided that the extra cost of a mounting frame to get an extra couple of degrees tilt wouldn't be worth the benefit (or the risk, given the winds we sometimes get). Because of the kitchen roof, the panels are slightly behind a ridge in the roof, which means they miss the first half an hour or so of the morning sun, but the whole system is also protected from the wind (and therefore doesn't dissipate heat quite as fast) due to the same ridge.

The house itself is of a Hardi-clad, steel frame construction (it was built by Ross Squire homes, and is a variation on one of their standard homes), and we opted to put a bit more money up front, and insulate the house during construction. We have foil sisalation to the roof and external walls, and R2.5 batts in the ceilings and R1.5 batts in the external walls. Just lately the night-time temperatures have been as low as 10 degrees from about 8pm to about 8am, but the house is still a lovely warm 22 degrees or so in the morning.

Since we moved in after the peak of summer, I can't say how comfortable it is in the heat, but if the Autumn performance is anything to go by, it should be quite nice. I've had a couple of ceiling fans installed, and we did get one or two days over 30 degrees, during which the fans performed admirably, and combined with the insulation, it was still relatively comfortable.

We have a wood stove that we inherited, and are still debating whether and how to install it for maximum benefit (it does conform to the recommended standard, and has all the knobs and buttons and controls to ensure a clean burn).

I have read with interest, the series of articles on this subject, and have decided that if we do install it, it has to be in the best position in the home to maximise its efficiency (and therefore minimise the amount of fuel we use), and that the wood has to be properly dry and the heater properly run to minimise smoke particles.

There are many other houses in the area that have wood stoves, so whether we put one in or not probably won't make a huge difference, but I've already shown people in the area the *ReNew* articles about proper use of the heaters, and some people have sat up and had a think about things, which must be good!

David Emrich,
demrich@ihgtech.com.au

The ATA finally goes solar!

After many months of waiting and planning, there are now not one, but two solar power systems operating at the ATA's office in East Brunswick. We take you for a quick tour of the systems, and introduce those who helped put them together

When the ATA head office was moved from inner city Melbourne to the Solar Workshop at the CERES environment park in East Brunswick, we had all sorts of delusions of grandeur regarding our renewable energy systems.

The hope was that we would be self-sufficient in electricity a few months after the move, but that was not to be.

Grid interactive system

We initially decided to go grid interactive, as this would involve the least amount of time and resources to get a system up and running. Unlike independent systems, grid interactive power systems have no batteries or regulator, instead a special inverter takes the raw power from the solar array and converts it directly to 240 volt AC power for feeding back into the mains grid. This system eliminates the maintenance of a battery-based system.

We purchased a 2500 watt grid interactive inverter from Solar Energy Australia. We already had a solar array attached to a fixed frame at the rear of the workshop. This array consisted of six 64 and two 83 watt Solarex panels which used to feed into an old and now defunct 24 volt battery bank.

These panels were donated to the ATA by Solarex some years back, and had done very little service, but unfortunately had suffered some damage at the hands of a less than careful ATA volunteer with an oxy welder—welding spatter melts the plastic coating on the rear of the panels very nicely, thankyou!

Anyway, that 24 volt system had long been disconnected and removed, so the six smaller panels were fitted to a Davy Industries tracker in place of the old fixed frame. This was done by long time ATA member and volunteer Adrian Oakey with the help of Stacey, another volunteer. The setup can be seen in the photo above. Notice that it is all mounted on a large steel platform attached to the back of the workshop. This helps keep prying fingers away from the equipment and lessens the chance of anything being damaged.

The six 64 watt panels were wired in series to make a nominal 72 volt array. However, this is where work stopped for a while, as magazine production and other projects took priority.

We eventually got back to thinking about the system, and around that time Adrian Oakey turned up again and helped us get the system closer to completion by running the cables from the array to the foyer and mounting the inverter on the wall.

The next step was to get the 240 volt AC side of things wired up. This was done by another volunteer, electrician Dieter Liebrich, pictured elsewhere in this article. He fitted a circuit breaker box on the DC and AC sides of the inverter, as well as a separate kilowatt-hour meter to allow us to monitor power going back into the grid.

The system was eventually finished, and the ceremonial throwing of the switch was held in mid March 2000. Since then we have put back over 50 kilowatt-hours into the mains grid to offset our electricity use.

While this doesn't seem like much, and indeed, it is only around 1 kilowatt-hour per day, this will soon increase

Chief battery shed builder, Herman Out (left) with volunteers Chris Pam and John Hooper. The large pole in the middle of the shed is a support for the platform above.

Hard at work! The finished shed is strong and looks very professional.

dramatically when we add another solar array to the system.

Some time back we purchased seven Canon Econoflat panels which have been sitting in a box here in the office for almost a year (this seems to be a recurring theme with this power system!). These will be mounted on the front solar wall of the solar workshop in place of the grape vines, which attract too many birds that drop poo all over the place. This array will total over 400 watts, bringing our power output to about 2.5 kilowatt-hours per day, on average.

We will also be adding more panels to this array as time and money permit, until we reach the inverter's limit of 2500 watts. We will eventually set up monitoring systems on each array to allow us to determine the performance of each type of panel.

Independent power

The grid interactive system is only one of the power systems installed at the workshop. We more recently had donated to us some 650 amp-hour, 2 volt cells by Geoff Collins of Lateral Technology, so we set about installing an independent power system to act as a backup system, as well as for powering some of the smaller office equipment.

The two spare 83 watt Solarex panels were mounted below the Davy tracker on the platform. Underneath the platform we had several volunteers build us a battery shed. This was made from recycled hardwood for the frame and Colorbond sheeting for the rest. The finished result is quite neat and professional looking, and also very robust.

The batteries were mounted in one corner of the shed on top of two 40mm thick planks of plastic lumber from Repeat Plastics (see 'Products' in issue 71 of *ReNew*). This reduces temperature differences inside the cells caused by the cold concrete floor, and thus helps eliminate electrolyte stratification. The batteries were then encased in a plastic box made from more recycled plastic, this time from Unimould. This material is sold in 1200 x 2400 sheets up to 32mm thick, and is great for projects like this as it is easy to work with and is totally acid proof. The box is, of course, vented to the outside with a pair of vents in the back wall of the shed. The ventilation will be increased in the near future using a pair of brushless DC fans which will activate when the batteries are equalised.

The power from the two Solarex panels are fed to the battery bank via a Trace PC250 charge controller unit. This was another piece of donated equipment, and made the installation very simple and neat. It contains not only a PWM (pulse-width modulation) 60 amp charge controller, but also circuit breakers for the inverter and the DC inputs, as well as a shunt for current monitoring and negative DC buss bar—a great piece of equipment.

We improved it a little by adding a buss bar for the positive DC connections, as well as an LCD voltmeter, which can be seen at the top left of the unit.

The power from the battery bank is not doing much at present, just running the light inside the shed as well as some outdoor security lights. However, the Solar Workshop was wired with some extra-low voltage DC sockets when it was renovated before we moved in, so these will be connected in the near future, hopefully to power some of the office's equipment.

Heating and hot water

As can be seen from the lead photo, the workshop's old solar water heater has been replaced by a new 180 litre unit donated by Solahart. This has performed very well despite having no booster connection. Water temperatures approaching 90°C were recorded in summer, though the tempering valve limits the temperature at the taps to a safe 55°C. This unit provides hot water for the ATA office and the adjoining toilet block.

While the passive solar design of the workshop works well in most cases, there are some days that provide no heating effect at all (well, it is Melbourne). To allow us to keep working without each wearing two jumpers, a coat and gloves, we installed two small radiant gas heaters. These are fuelled from a large LP gas cylinder at the back of the workshop, as there is no natural gas onsite.

Radiant heaters were used rather than convection heaters, as it would have been almost impossible to economically heat all of the air in the workshop—15 foot ceilings make it quite difficult! The radiant heaters warm objects directly, without heating the air around them, and so are much more efficient in draughty building like this one.

It should be mentioned here that the workshop already had a heater in the

The battery box and battery bank. The recycled plastic board makes for a nice finish to the job, and is completely acid proof, unlike wooden boxes. Stainless steel connecting bolts and box hinges are also a must, as are the vents, visible at the top corners of the rear of the enclosure.

The Trace PC250 controller (on the right) mounted above the battery box on another sheet of plastic board. The smaller box to the left is the DC load circuit breaker box. Also note the safety sign on the left, placed to be easily visible.

form of a wood burning stove, but this was removed due to the high pollution levels these heaters produce.

In the future

As mentioned previously, there are further additions to be made to these systems. More panels will be added to both power systems, and an Air 303 wind generator, upgraded with new regulator and blades courtesy of Air Marine Australia, is soon to be mounted atop the 15 metre tower behind the workshop. This will feed power to the battery system, and will hopefully provide enough power to run the lights in the workshop.

We will also be adding an inverter to the battery system so that the entire workshop can be powered during blackouts, or when there is a surplus of solar power.

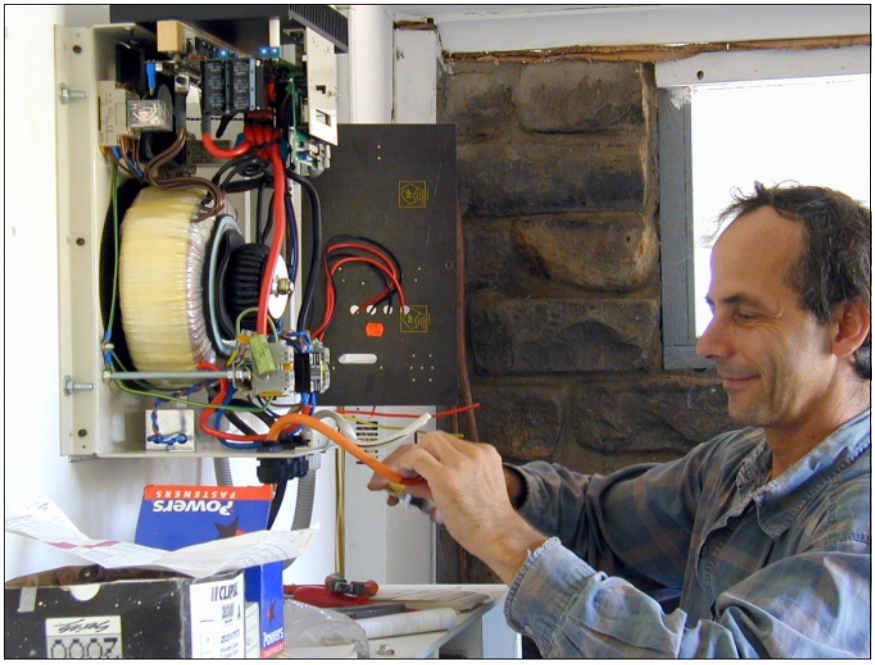
For the coming summer, we will have pull-down awnings below the Econoflat panels on the outside of the north-facing wall, with Astrofoil insulation (donated by Astrofoil Australia) on sections of the inside to reflect any heat radiating from the back of the panels.

The digital display on the SEA inverter provides a lot of information. Rotating the knob on the top left sequences the display through five different displays, three of which are shown below.

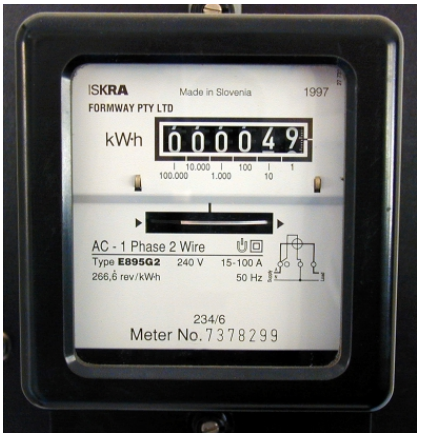
Grid voltage and instantaneous power entering the grid

Solar array voltage and current.

Total logged energy that has entered the grid since installation



Dieter Liebrich hooks up the SEA grid-interactive inverter. This inverter can handle up to 2500 watts of solar array.



Also fitted in between the grid-interactive inverter and the mains grid is a separate kilowatt-hour meter. It is interesting to note that the inverter's meter and this one do not read the same! This meter lags behind the inverter's by about 10 per cent.

Rainwater quality

I have plastic rainwater tanks fitted to my house, and these are connected to the house via plastic downpipes. I am unsure what type of plastic these are made from.

How big a health threat is the use of plastic in this way? Can one test water for the relevant contaminants? If so, what would you suggest be tested?

Lots of foods are packaged in plastic—doesn't this same issue apply to foods as well as water? Are there filters that would take out the relevant contaminants?

David Miller
djmiller@dlwc.nsw.gov.au

Your water tank is most likely made from either polyethylene or polypropylene, both of which seem relatively safe for water storage. However, your plastic downpipes are more than likely PVC, which is the plastic that should be avoided if possible.

Fortunately, however, in most systems the water is only in contact with the PVC piping for a very short time while it flows to the water tank, so the contamination should be minimal, except for the initial flow of water from the roof. However, this water should be diverted from

Simple power conversion

I have a little problem which I have been looking to solve for the past 15 months.

I have one 44 watt amorphous solar module which produces 54 volts at 900mA, and a 12 volt, 75AH deep cycle battery. I have connected the panel directly to the battery, which is charged only at 900mA during bright sun, with the panel's voltage being pulled down to the battery voltage.

I think I am losing almost 30 watts of power because I don't have the proper DC to DC converter which can convert 35 to 55 volts to 14 volts to charge the battery. A DC to DC converter would also boost the charging current by almost four times that of the solar panel—over 3 amps.

I want to make my own DC to DC converter (switching buck regulator) which converts the voltage down and boosts the current up, but there is not much technical information available in Nepal. I have a toroid soft ferrite ring with an internal diameter of 15mm, an outer diameter of 30mm and a height of 12mm.

However, I do not have a proper circuit to make it. Could you please supply me with a schematic diagram of such a converter to charge my battery at full power and with minimal loss. I would be grateful to you if you could help me with this problem.

Muni Raj Upadhyaya,
muniraj@wlink.com.np

There are many sites on the internet with circuit designs, however, National Semiconductor make a range of switchmode power supply chips that are designed to greatly simplify the construction of switchmode converters. To make things as simple as possible, they have created a program called 'Switchers made Simple', which will run on any DOS computer. You just type in the parameters, such as input and output voltages, current and temperature range, and it will provide you with a list of components, circuit specs and a circuit diagram.

I tried your requirements and it came up with a circuit with no modifications needed. The circuit diagram and specifications list (edited for printing) can be seen here.

The switching controllers are available as samples from various electronic suppliers' web sites, linked from the National Semiconductor site. If you go to the National site at http://www.national.com/appinfo/power/ and click on the 'Simple Switchers' page, you will find your way to the information and links from there.

Lance Turner

```
Circuit Parameters
Vinmin:          35.00 V
Vinmax:          55.00 V
Tamax:           70.00 C
Tamin:           0.00 C
Vout:            14.40 V
Ilmax:           3.00 A
Diode:           Fast

Misc calculated information
Mode:            Continuous
Peak current:    3.45 A
ESRmax:          0.13 Ohms
ESRmin:          65.42 mOhms
Vripple:         0.17 V
Crossover Freq:  6.96 kHz
Phase margin:    21.51 Deg

Component List
Cout: 330.00 uF, Vmax: 35.00 V
Cin:  100.00 uF, Vmax: 78.00 V
L:    330.00 uH
R1:   21.50kOhm, 1%
R2:   2.00kOhm, 1%
D1:   6.00A, Vmax: 66.00 V
U1:   LM2576HVT-ADJ
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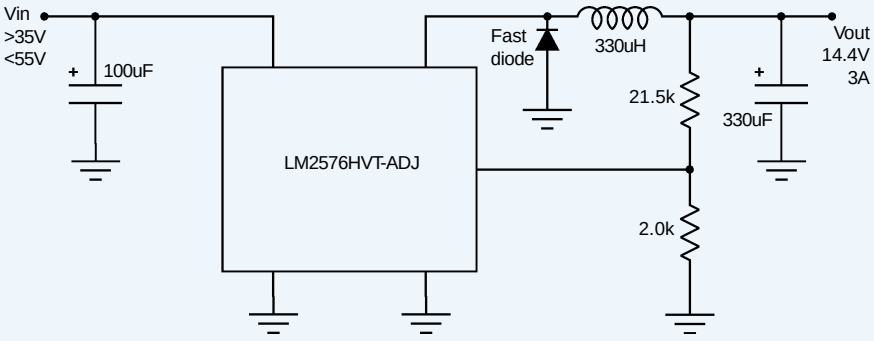


Switchmode power converters don't get much simpler than this! The 'Simple Switchers' range of switchmode converter chips make designing a switchmode power converter easy.

the tank anyway, as it will often contain other contaminants from the roof and guttering, including bird and other animal poo, leaves, and possibly lead from flashings, settled pollution and paint.

There is also the possibility that your water tank is actually made of fibreglass, and there is evidence that the resins used to make these tanks can release quite toxic chemicals into the water over time, so you might want to check this.

If you are worried about contaminants of the chemical kind, you can run the water through a good quality activated carbon filter, these can remove virtually all of this type of contaminant. As for testing of the water, this would be expensive, and probably unnecessary. I suggest that if you have concerns, you should use a filter for all drinking water.

Regarding food containers, this is an issue in my mind, there are just too many doubts about some plastics, including PVC and polystyrene. I avoid any containers made from these plastics, especially when they are used to hold hot food, as they are much more likely to release toxins when heated. We tend to stick with glass, polyethylene or PET (polyester), as these are also fully recyclable in most areas.

Lance Turner

An old genset

I have an old 32 volt petrol generator (crank start) that I would like to use in my 12 volt power system. Is this possible, and if so, what do I need to do to the generator?

Dave Smith, Mintaro SA

If the generator has a separate adjustable field winding, you can regulate the output voltage of the generator by adjusting the current that flows through this field. This could be done using a series resistor or rheostat (a large variable resistor), or another resistive element such as a light bulb.

I have successfully controlled the output of a large DC generator by varying the field current using a pulse-width-modulated speed controller like the one published in issue 55 of ReNew.

If the generator has no adjustable field, then you will have to convert the voltage down, most likely using a switchmode power converter. An automotive 24 volt to 12 volt DC to DC converter may be able to handle the extra input voltage, but there are no guarantees.

Lance Turner

Washing machine queries

With respect to the decision to have a front or top loading washing machine, I guess that it all comes down to factors like familiarity and upbringing. However, I have a few questions:

What are the models of front loading washing machine that use DC motors? Are the washing stones or ecoballs any good? Is rinsing necessary when using them? If not, I could wash one cycle on less than 10 litres of water!

Also, my Gorenje Pacific washer uses 200 watts for the wash cycle and 500 watts during the spin cycle. The spinning speed can be varied from 400 to 800rpm. If I turned it down to 400rpm and only half loaded the machine, could I get away with 500 watt (1000 watt surge) inverter from Jaycar, priced at $400?

Alexander Cranford, Hay NSW

I have only owned two front loaders, both of which used the DC system. These were an older Hoover machine, which used a 32 volt DC motor, and my current Asko machine. Peter Pedals, of Rainbow Power Company, ph:(02)6689 1430, should be able to supply more information on the subject.

As for the washing stones, they do seem to work, though not on heavily soiled clothes. We have kids and we need something a bit stronger, so we use a basic detergent.

The only way to tell if your current washer will work on the inverter you mentioned is to buy the inverter and try it out. Just make sure you can take it back if it is unsuitable.

Lance Turner

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.**

Is there an echo in your office?

PET (polyester) is one of the most widely used plastics in the modern world. It is used to hold almost every form of beverage imaginable, from soft drinks to juices, and vast quantities of this plastic are produced every year.

PET is easily recycled, and is very suitable for spinning into fabrics of many sorts. Echo screen fabric is made from 100 per cent used drink bottles that have been washed, chipped and spun into polyester fibre, then woven using a crepe weave. It is designed for uses such as divider screens in offices, but would have many other uses, including clothing and decorating.

The fabric is available in a range of colours, and is supplied 1.88 metres wide at a fabric weight of 235 g/m^2. Each lineal metre of this fabric uses over 8.5 plastic drink bottles.

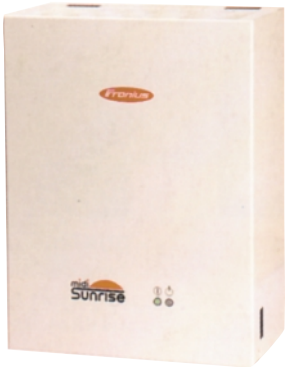
rrp: $22.90 per lineal metre for under 200m, $18.90 per lineal metre for 200m or more.

Echo screen is available from Woven Image, ph:(03) 9681 3211, fax:(03) 9681 3246, www.wovenimage.com

Go grid-interactive

With the PV rebate scheme in full swing it is now easier than ever to start producing your own power. Grid interactive systems eliminate the need for equipment such as regulators, batteries and their associated maintenance.

Choice Electric are now the distributors of the Fronius range of Sunrise grid-interactive inverters from Austria. There are two models available, the mini (capable of handling arrays up to 1550 watts) and the midi, which can handle arrays up to 2200 watts. The Australian PV rebate scheme provides rebates on the first 1500 watts of a PV system, making these inverters ideal for these systems.



Available options include datalogging, large digit remote display, a modem interface that allows remote monitoring of a system, and Sunrise software (for Windows) that allows graphing and archiving of the downloaded data. The units come with a two year guarantee with a 10 year guarantee of spare parts availability, and are designed for a 20 year lifespan.

rrp: $2490 for the mini, $2990 for the midi. Prices don't include tax or freight.

Distributed by Choice Electric, PO Box 2296 Fortitude Valley Business Centre, QLD 4006, ph:(07) 3252 4909, fax:(07) 3854 1038, email: choice@choiceelectric.com.au, www.choiceelectric.com.au, www.fronius.com

Around it goes again

It seems the products that are made from recycled plastic just keep increasing in number and versatility. Australian Recycling Technologies produce a wide range of heavy-duty products made from recycled plastics designed to replace less environmentally sound materials such as hardwood and concrete.

Products include hydrant and valve covers and surrounds, traffic control devices such a speed humps and curbing, outdoor furniture (like the park furniture at right), antiskid decking, domestic products such as letterboxes, bird baths and planter boxes, and many other great ideas. We have seen some of these products and found them to be very robust and at least as strong as the traditional equivalents without being as heavy, though they are certainly not lightweight.

Manufactured by Australian Recycling Technologies P/L, 50 Elsworth St, Ballarat VIC 3350, ph:(03) 5333 2883, fax:(03) 5333 4303, email: info@replas.com.au, www.replas.com.au

Distributed by JRL Sales & Marketing Pty Ltd, 8 Margaret St, Moorabin VIC 3189, ph:(03) 9555 8337, fax:(03) 9555 8347, email: sanders@vicnet.net.au

Solar soap

Most soaps are full of synthetic fragrances, dyes and other chemicals, and have the glycerine content removed for use in other cosmetics.

Redgum Soaps produce only pure olive oil based castile soaps contain essential oils and a high glycerine content which help stop skin from drying out. The soaps are all made by hand using the traditional cold pressed method and are aged for at least six weeks.

There are quite a few fragrances to choose from, including unfragranced 'Just Soap', Rose Geranium, Lime and Coconut, Lavender and Calendula, Cedarwood and Macadamia, Orange and Wheatgerm and Mandarin Baby Soap.

And, unlike most soap factories, the tiny home-based factory at Redgum Soaps is completely solar powered, and the soaps are made with rainwater collected onsite.

rrp: $9.95 each, discounted gift packs are available from their web site.

Manufactured by Redgum Soaps, PO Box 22, Bega NSW 2550, Ph:(02) 6492 7202, fax:(02) 6492 7270, email: vicki@redgum.au.com, www.redgum.au.com

Cement-based paints

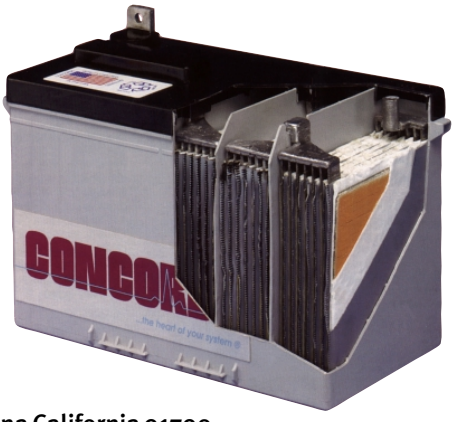
We have looked at environmentally friendly paints in past issues of *ReNew*, but have only recently discovered the Murobond range of water-based cement paints and washes.

There are several paints in the Murobond range, including Murobond for dimensionally stable surfaces (not suitable for surfaces that flex, expand or contract, such as wood), Murowash, suitable for both interior and exterior use on most surfaces, high gloss Aqua Glaze, which has a slight lavender scent, and Pimento Limewash, a flat interior finish. There is also a range of sealers and acrylic clear coats to protect the finished paintwork in high grime areas.

rrp examples: Murobond—$48 for four litres, $103 for 10 litres; Murowash—$71 for four litres, $152 for 10 litres; Aqua Glaze—$94 for 4 litres, $196 for 10 litres.

Manufactured by Murobond, 81-83 Dickson Ave, Artarmon NSW 2064, ph:(02)9906 7299, fax:(02) 9439 7593. Distributed in Victoria by Eco Pebbles, 481 Glenferrie Rd, Kooyong VIC 3144, ph:(03)9822 0699.

Sealed lead acid batteries



There is much debate about the type of battery most suited to renewable energy systems, but in many instances, such as in mobile installations, or systems in confined areas, a sealed battery is the only really safe option. With sealed batteries, you have the option of gelled electrolyte or absorbed glass matt (AGM) type.

Concorde Battery Corporation makes the Sun Xtender range of AGM batteries designed specifically for solar power installations. They can deliver high instantaneous current, such as are required for starting large loads, while providing long cycle life and deep discharge ability.

The batteries are available in sizes from 2 volt, 390 amp-hour to 2 volt, 630AH, 6 volt, 100AH to 6 volt, 220AH, and 12 volt, 33AH to 12 volt, 255AH (all at the 20 hour rate).

Manufactured by Concorde Battery Corporation, 2009 San Bernardino Rd, West Covina California 91790 USA, www.concordebattery.com. Distributed in Australia by BP Solarex, ph:(02) 8762 5777 for your closest dealer.

Building with straw—the easy way

Whether you are building a new home or renovating an old one, straw is a great building material. It has excellent insulating properties, both thermally and acoustically, and is a very environmentally sound material with low embodied energy and virtually no toxicity. However, strawbales are not always the ideal shape.

Ortech Industries produce a range of building boards made entirely of straw compressed and heated to form solid panels. They come in many finishes, including plain Kraft paper for painting, or coated with various finishes including sound absorbents, cement sheet, textured paints, vermiculite, woodchips and shredded straw. Boards are supplied 50mm thick x 1187mm wide in lengths up to 4.8 metres. A special walling board, Easywall, is supplied 58mm x 1187 x 3m. Also available is the Easybeam system of rolled steel sections that, when used with Easyboard, allow entire buildings to be assembled in a matter of days.

Trade price examples: Plain finish (50mm thick)—$14.90 per m²; clad with 4.5mm cement sheet—$31.70 per m²; Easywall—$16.90 per m².

Manufactured by Ortech Industries, Unit 18, 1-7 Canterbury Rd, Braeside VIC 3195, ph:(03) 9580 7766, fax:(03) 9587 1628, email: ortech@ortech.com.au, www.ortech.com.au

Dim the light fantastic

Gas discharge tubes are everywhere, and are most predominantly used in factory and street lighting. However, they are usually run at full power, even when this is not necessary.

The Autolux system is a fully electronic lighting controller for the regulation of single-compensated gas-discharge lamps. According to the manufacturers, the Autolux can save up to 60 per cent of lighting costs, most of this being electricity savings, and the rest in reduced maintenance due to longer lamp life.

The distributors of the Autolux are currently looking for dealers worldwide.

Distributed by erfinder.at Patentmarketing GmbH, Schillerstrasse 30, Techno-Z XIII, A-5020 Salzburg, ph:+43 662 45 3876, email: office@erfinder.at, www.erfinder.at

Low cost sinewave inverters

Jaycar Electronics now has two sinewave models, a 350 watt and a 750 watt unit. The 350 watt model features include a 1000 watt surge capacity, input over voltage protection, low battery protection, input short circuit protection, battery reverse polarity protection, overload protection, output short circuit protection, over temperature protection and no load shutdown protection, which we assume means autostart! It also has a 'Soft Start' feature, which, according to Jaycar, allows the inverter to start difficult loads, such as TVs and computers, which may demand up to 10 times their running power to start up.

The 750 watt model has similar features to the 350 watt unit, but also includes an 1800 watt surge capacity, dual cooling fans and a wall mounting case. The inverter has indicators to show input power, output availability, half load and full load condition. One important point to note is that these inverters must be wired up as a floating system,with no earth connection.

rrp: 350 watt model is $399.50, or $799.50 for the 750 watt unit.

Distributed by Jaycar Electronics, PO Box 185, Concorde NSW 2137, ph:(02)9743 5222, order freecall: 1800 022 888, www.jaycar.com.au

Bubble, bubble, less toil and trouble

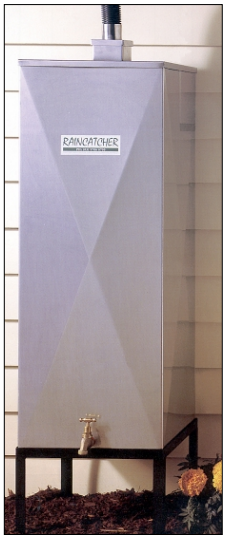
There has been a bit of interest generated in *ReNew* on the subject of washing machines recently, so we thought we would add to it with the latest offering from Omega Appliances, the Omega Air Injection 8000.

This top loading machine is unique in that it doesn't have an agitator but instead uses air pumped into the bowl combined with an almost flat impeller to agitate the clothes. According to Omega, this allows the machine to wash a large load without the mechanical damage to clothes from a normal agitator.

Other features of this machine include a lower height to allow easier unloading, a 7kg capacity, water usage of just 112 litres for a full load, a noise reduction system, a two-year warranty and a 20-year warranty on the stainless steel bowl. The machine is rated at three stars, and power usage is 648kWH per year. However, the motors are rated at 200 and 100 watts, with a maximum consumption of 420 watts, meaning it should run on most sinewave inverters with a reasonable surge rating.

rrp: $1435

Manufactured by Omega Appliances, ph:(02) 9384 5678, fax:(02) 9666 5529. Omega has distributors in most states and territories.



Compact rainwater tank

If you want to reduce your water bills, a good place to start is to catch your own rainwater. However, it is a good idea to divert the first water runoff from the roof, as it will contain pollution, bird poo and other impurities.

The Raincatcher is a stainless steel rainwater tank designed to be mounted against the wall of a house and has its own internal water diverter to dump the first 18 litres of roof runoff. It also features an internal mesh screen to filter any solids from the water, thus reducing sludge buildup in the tank.

The tank measures 460 x 460 x 1500mm and has a capacity of 230 litres. It comes complete with stand, with a leaf diverter available as an option.

rrp: $477 in Victoria and Sydney metro area only.

Manufactured by Hart to Hart Fabrications, 4 Kimberley Rd, Dandenong VIC 3175, ph:(03)9706 6700, fax:(03)9706 5670.

Hybrid toilet system

The hybrid toilet system is a human waste treatment system suitable for remote and rural areas where a septic system is not desirable (and let's face it, they never are!). The system uses primary and secondary treatment tanks, along with gravel beds to treat sewage and break it down into a safe effluent with low e.coli levels.

The toilet uses no mains power, and all waste is contained in closed plastic tanks, so no escape of effluent or external interference can occur. There are two models, a six person and a 10 person system, both of which can cope with a 100 per cent overload for an extended period if needed. No electricity is used for the toilet, other than the solar powered exhaust fan.

Manufactured by Gough Plastics Australia, PO Box 1258, Aitkenvale QLD 4814, ph:(07) 4774 7606, fax:(07) 4774 7608, freecall: 1800 069 805, email: sales@gough.com.au, www.gough.com.au

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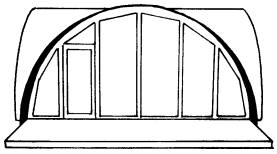

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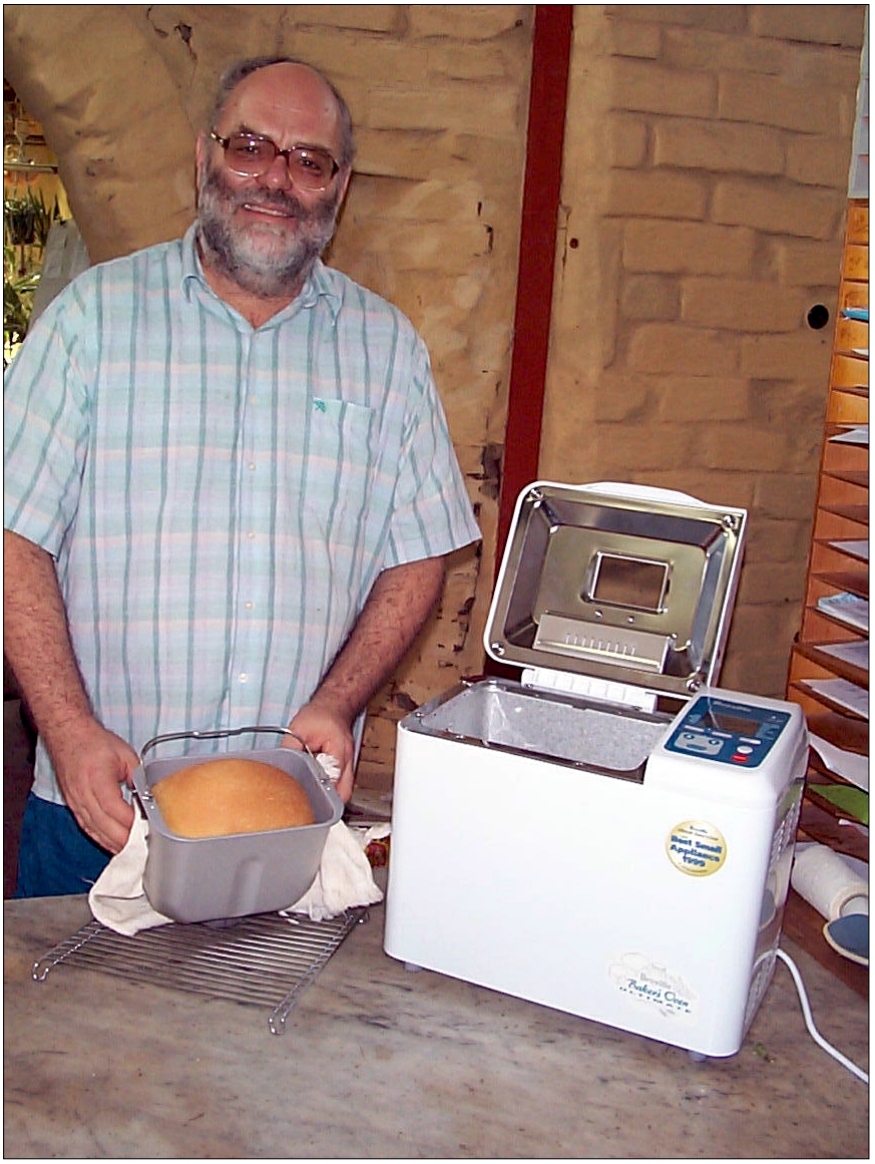

I recently upgraded my home solar system, with the help of a rebate from the Australian Greenhouse Office Photovoltaic Rebate Program. After the installation I decided to make the most of additional capacity, and purchased a breadmaker to try my luck at making the perfect loaf.

For those of you not familiar with breadmakers, I'll briefly describe what they can do. In simple terms, this product bakes your bread and requires about 30 seconds of input from the operator. All you have to do is measure your flour, water, yeast, salt and any other goodies you would like to put in your bread, select the loaf size, crust colour, flour type and completion time—and the machine does the rest! Over the next two to three hours, the unit goes through several cycles: two types of kneading, a rise, first punch down, second rise, shape, third rise, bake and an optional keep-warm cycle.

Finding the right machine

Before buying my breadmaker, I first did some research. I had a look at an Australian Consumers Association *Choice* magazine article which reviewed 11 breadmaker models and reported that all but one baked an excellent loaf of bread. They calculated the cost of a home-baked loaf (with grid electricity) at less than half that for a store-purchased loaf. The article suggested that one should look for the following features: adjustable loaf size, removable pan and lid for easy cleaning, timer, keep-warm function, crust colour selection, ability to make jam, pasta and pizza dough and a fruit/herb dispenser.

We asked the author of the article how much power the average breadmaker used, and she reported that they used between 250 watt-hours (WH) and 650WH, with an average of 330WH per kilo loaf. However, the *Choice* article didn't tell me how they'd perform using my SE12 Selectronic sinewave inverter (700 watt continuous rating). I remembered some of our Rainbow Power Company customers had given us some good feedback in this regard so I consulted the archived editions of our free email newsletter. Someone had earlier warned us that the Panasonic SD250 had problems even on a sinewave inverter.

In the December 99 newsletter, Stephen Hart had reported:

I currently have a Breville BB400 breadmaker. It works perfectly on both my previous modified square wave inverter (Selectronic Silver Series 600) and my new sine wave inverter (SEA Boxer 1500). On the SS600 it was slightly noisy, as you would expect from

any induction motor. On the sine wave it performs just like on the mains. This is a fairly expensive machine ($279 at Target stores) but has more features than any other machine, including 30 minute power failure memory protection. It also has the lowest power consumption at only 425 watts. My only complaint of this machine is that it is quite noisy when kneading. The pan fits fairly loosely in the machine, and the kneading paddle fits loosely on the shaft, so it tends to rattle and clang a bit.

I went through several other machines before getting this unit. (Thanks to Myer's stores for their flexible returns policy).

The Sunbeam BM100—this was not tried on an inverter. During the heating cycles the 600 watt element is switched on and off several times per second as the chamber approaches the cut off temperature. You can hear the relay 'fluttering' inside. My understanding is this is no way to treat a relay, and I doubt an inverter would appreciate it. I phoned the service department who said to return it to their service agent, they thought it didn't sound right, but when I took it to the service department, they said it was normal. I got two more under warranty but they did the same. Returned for refund...

The Breville BB350 was next. It worked okay on a modified square wave inverter (SS600) though was quite noisy, more so than the BB400. This model proved quite unreliable. I had three replacements under warranty, they all died mid-cycle after a couple of weeks each (on the mains, not on inverter). My sister had one of these too, which lasted about four months, the warranty replacement has lasted three months so far.

The Panasonic SD250 was streets ahead on quality. It was quiet but was completely useless on the modified square wave inverter. It wouldn't even start as soon as it was plugged in you could hear a relay clicking on and off about once a second. No other signs of life. I didn't own the sine wave inverter at the time so didn't try it on that.

Armed with this information, I visited my local appliance store. The prices ranged between AUD$99 and $279. The wattage on the compliance plate ranged between 450 and 700 watts. I found the Breville BB400 recommended by Stephen. Unfortunately it was the most expensive one at AUD$279. However, it had all the features recommended by *Choice* magazine and I knew it would work successfully on my inverter. The price included 6kg of flour and a colour book with about 100 bread recipes to tantalise me. So I lashed out and bought it, got home and a few minutes later I was baking my first 500g loaf of bread!

Performance

At a battery voltage of 25.0 volts the breadmaker drew about 100 watts while kneading. While baking it drew a maximum of 480 watts, however this cycled on and off every few minutes. The power used for a 500g loaf was 210WH (about 10WH for kneading and 200WH for baking). A one kilo loaf would use about 265WH (all measurements taken on the DC side of the inverter using the Plasmatronic PL40 regulator with shunt).

The economics of the exercise are impressive. The unit is obviously very efficient. However, having designed and sold solar PV systems for some 15 years, my general advice has been that solar PV is not cost effective for cooking and heating. Times are changing! Appliances are becoming more efficient and the cost of solar modules is coming down (especially if one considers the AGO $5.50 per watt rebate for solar modules). If I baked a loaf a day, I'd save about $400 per year compared with store-bought bread (not to mention the convenience and taste sensation of home-baked bread).

Assuming one lived in a reasonably sunny location and baked during the day, an 80 watt solar module should be able to provide the power. At a cost of about AUD$600 for an 80 watt solar module (around $150 after the AGO rebate, providing it is part of a larger system), I think my accountant would suggest that I made a wise decision, even if one were to consider the cost of the breadmaker and arguably a larger battery than might be needed!

Oh, and before I forget, the bread was wonderful!

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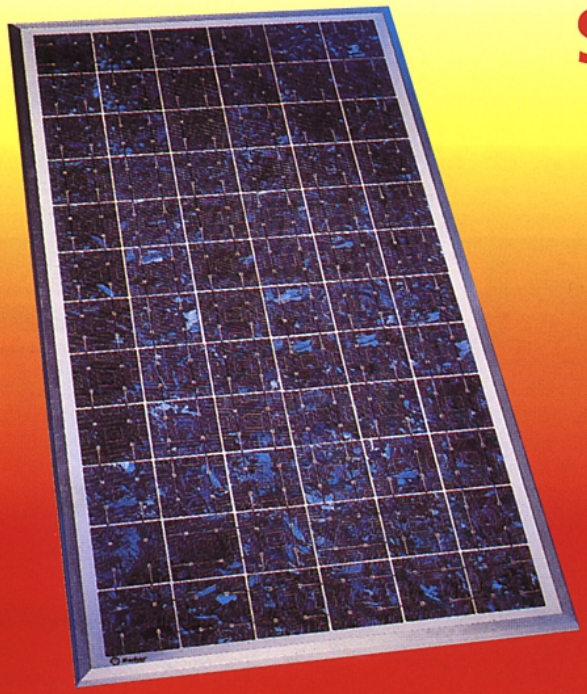

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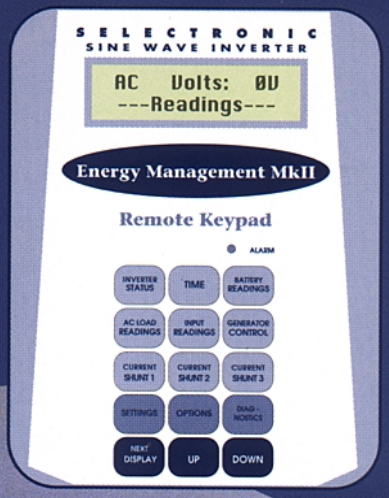

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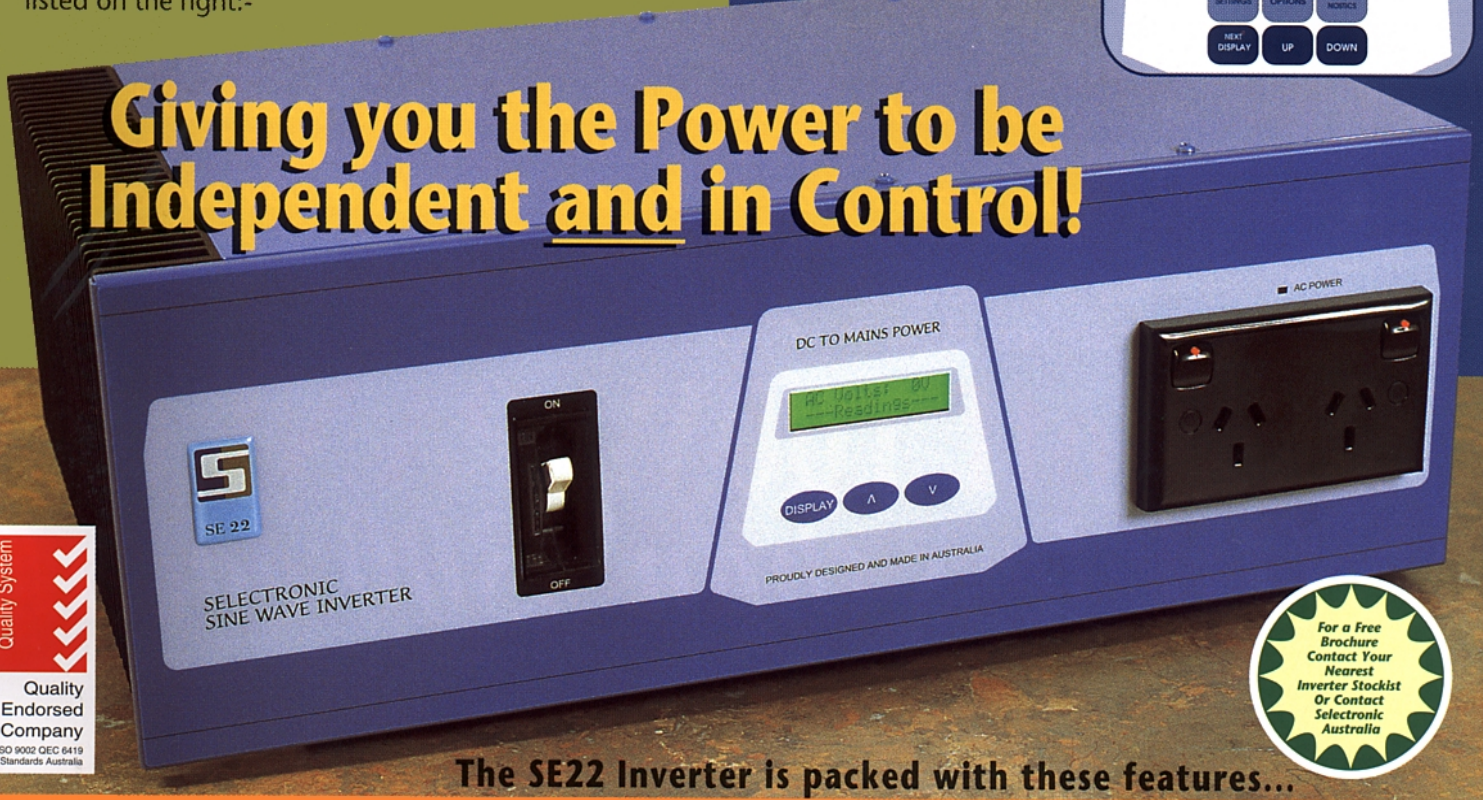

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