soft technology

Technology for a Sustainable Future No 45 Spring 1993 $4.50*

Inside:

- Central heating with hot water
- The joys of a passive solar house
- Micro-hydro in the rainforest
- A pedal-powered generator
- Regulating solar pumping
- Power from hot rocks

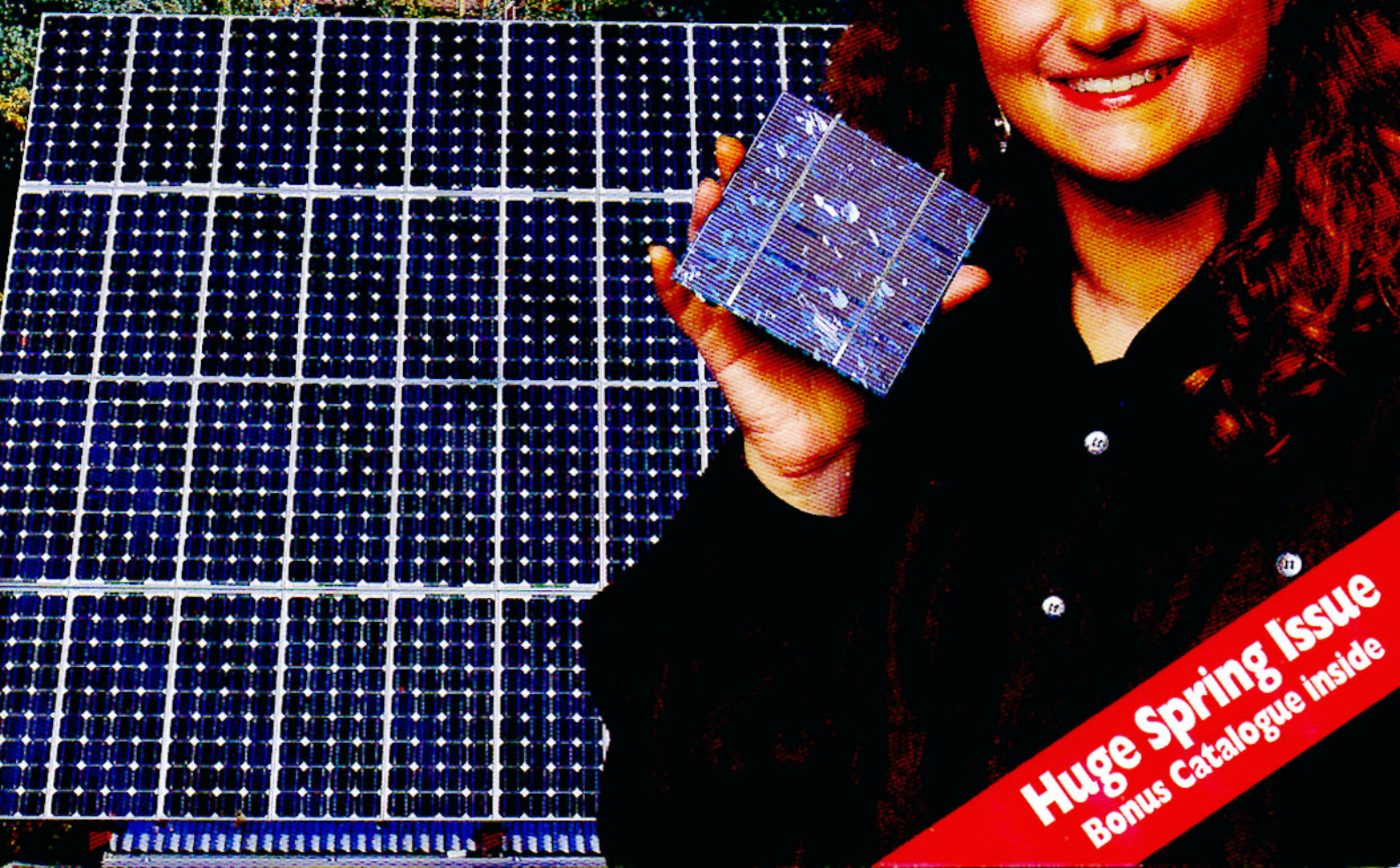
...and more inside...

Solar in the city

The Steam Powered House

Solar Hot Water Buying Guide

Backyard Biogas



Huge Spring Issue
Bonus Catalogue inside

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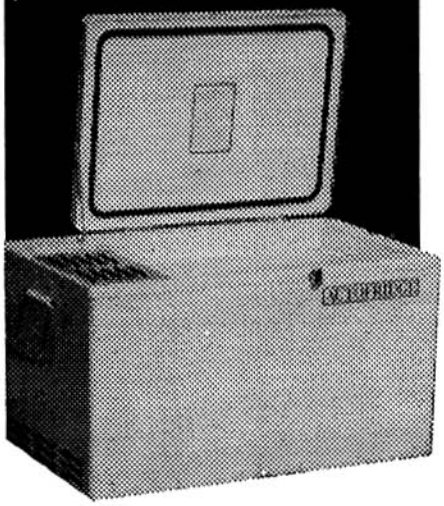

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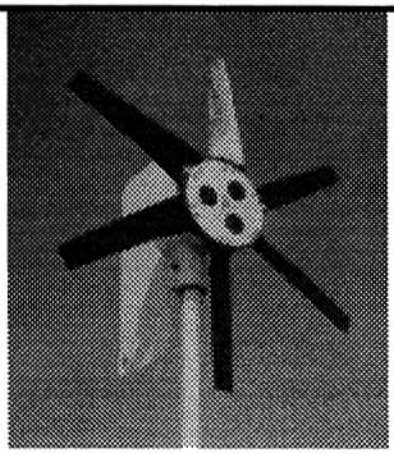

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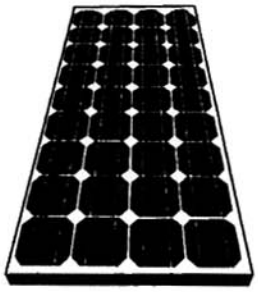

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Technology for a Sustainable Future
No. 45 Spring 1993 $4.50 (rrp)

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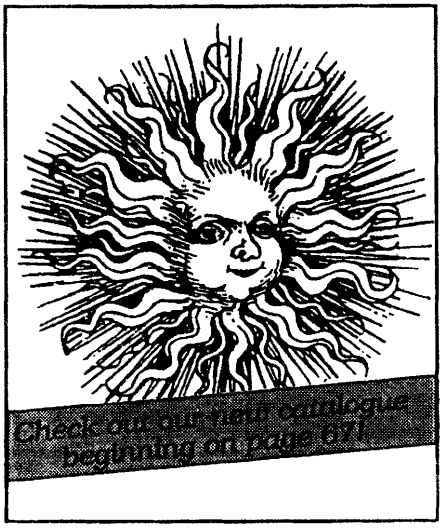

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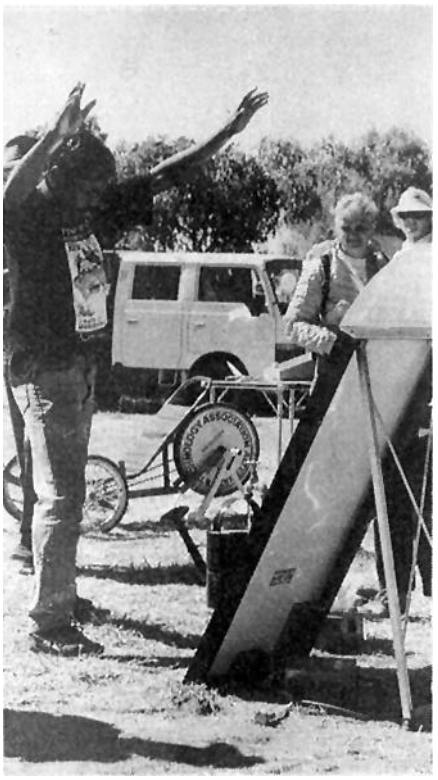
Practical



Technical section

Regulars

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The publishers of Soft Technology take great care in selecting and verifying all material that appears in the magazine, but do not necessarily share the opinions expressed in articles and letters, nor do they accept responsibility for the accuracy of statements made by the many contributors.

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an ATA publication

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Hello!

I'm sitting at my desk and for the first time this winter a slim ray of sunshine has penetrated between the city buildings and lightened up the office.

Spring may not yet have sprung but something is definitely in the air. Yesterday Andrew (our trusty wood heating writer) burst into a meeting to announce he had a solar car model doing laps of a patch of sunshine next to the stairs.

Meanwhile Margaret is threatening to cultivate one of our bay windows with a miscellaneous collection of strange plants and living things.

At the other end of the room Claire wants to set up a solar garden of PV powered spinny things that whiz and whir whenever our slender ray of sunshine strikes them.

The only dark cloud on the horizon is that Imelda is in magazine mode. Magazine mode strikes once every three months...about a week before we go to the printers. It is accompanied by late nights bent over a computer screen, outbursts of bad language (in particular "Oh Blast!!"), and threats that "if that is not written by tonight..." (I won't detail the consequences!)

If fact those threats of physical violence are just what have inspired me to get this "Hello!" written.

Yesterday we got the cover photos of Nikki, our trusty assistant editor, 'back from the film lab. We stood around looking at them, going Ooh! Aah! while Nikki sat cowering at her desk with her head buried in her arms. We made her do it. PVs always make a good cover but it's nice to add a human dimension, and Nikki was the most human thing we had in the office.

Some of you might have guessed we have moved to a bigger brighter and lighter office. We can have living plants, working solar things and fresh air (well as fresh as you can get in the city). It's a great improvement.

By now you might be getting confused about all the names I've been throwing at you, so here is the 'Who's who" of who's at the office.

Mick Harris

Mick (the thinker) Harris.....Co-ordination
Margaret (the Boss) . . . . . Office Admin
Andrew (lets have fun) Blair.....Education and writing
Claire (is it doughnut time yet?) Beaumont.....Publications
Imelda (moody but cute) Evans.....Soft Tech editor
Nikki (they made me do it) Brand.....Assistant editor
Suelette (lets do lunch) Dreyfus.....Magazine associate
Margaret (corporate planning) Pilopich . . . . . .Strategy and Education
Tiziana, Maria, Adrian, Denise, Alexandra, James, Pauline, Karen, Paul and Doug (the real workers).....Our marvellous volunteers.
Ross, Adrian, Stephen, (the mobile mechanics).....Energymobile

ENERGY FLASHES

AUSTRALIAN SOLAR CELLS LEAD THE WORLD

In the 1600km Dallas to Minneapolis 1993 Solar 'Sunrayce', nine of the first ten places were won by cars using Australian solar cells.

Entrants were able to use any commercial cells available worldwide yet 75% of entrants chose buried contact solar cells developed at the University of NSW and manufactured by BP Solar.

The cells are about 15% efficient compared with 12% efficiency for conventional cells.

In recent months, the University of NSW's Centre for Photovoltaic Devices and Systems have achieved a world first - 20% efficient cells.

University of NSW Media Release, July 29, 1993

Forfurther information, contact Jenny Hansen, ph: (02)697 4018

CUTTING FUEL IN HALF

A firm called Oz Smart Technologies have invented an engine-modifying device which they claim will double to triple car fuel economy and decrease car pollution. The Oz Smart "box" or "ozone safe induction" system was designed to replace the fuel injection and catalytic converter in a Holden Commodore. The ozone safe induction is explained to be an evaporative fuel induction system that combined air, fuel and ignition spark more effectively than the conventional carburettor and fuel injection systems.

Oz Smart Technologies are looking for Australian investment to develop the system for the national and international market.

The *Age, July 13, 1993*

TOORA WINDFARM

A $20 million windfarm is to be constructed near the South Gippsland township of Toora. Australian Defence Industries Ltd (ADI) will build, own and operate the 10 megawatt windfarm and sell the power to the SEC. The electricity will be fed directly into the State's grid producing the annual power requirements for about 5000 homes.

The wind turbines will be supplied by Vestas-Danish Wind Technology A/S. The windfarm is expected to be in operation in mid 1994.

SEC Media Release, June 3, 1993

PROJECT AURORA

The Melbourne suburb of Brunswick is leading the way in their use of alternative technology. Using electricity from a solar array and wind turbine they are feeding the grid, allowing people all over Victoria to use solar and wind power regardless of where it's generated. Brunswick's *Project Aurora* is a fine example of what can be done but, to make solar and wind energy more effective, other systems such as this need to be developed and supported. Project Aurora is a joint venture of the Brunswick Electricity Supply Department (BESD) and the CERES Environment Centre.

BESD is setting up schemes to allow community involvement to increase the solar array. One of these allows members of the Brunswick community to purchase a solar module, or part of one (individuals can purchase 1/4 of a module to reduce capital outlay) and add it to the system. The energy generated by that module will then be calculated over each billing period and credited to their account at the rate they normally pay for grid connected electricity. People not living in Brunswick can buy a module and receive an annual cheque.

The BESD will be publishing a booklet explaining such schemes.

For more information, contact Peter Zwack, BESD, ph:(03) 389 4130

GNB BATTERY RECYCLING

A huge battery recycling scheme is being undertaken by GNB Industrial Batteries (a subsidiary of Pacific Dunlop Limited). The scheme will involve GNB's Resource Recycling Division collecting and recycling 93% of all expired lead acid batteries, greatly reducing the past problem of inappropriate disposal of these batteries.

GNB will recover and recycle 100% of the lead and plastic used in automotive and industrial batteries for use in the manufacture of new batteries. They will neutralise the acid contained in the batteries and dispose of it as safe trade waste.

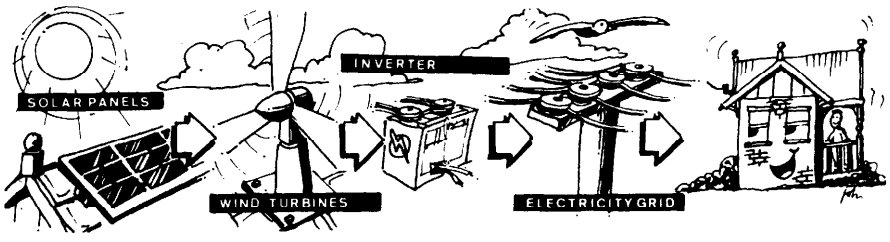
GNB Media Release, May 24, 1993

SAWDUST POWER

Mr Ian Pearce of Orbost has come up with the idea of generating electricity from sawmill waste. His hope is to turn the 70 000 tonnes a year of sawdust into electricity for the 3000 customers in Orbost and surrounds. The scheme would improve the electricity supply to the shire which Mr Pearce says has been unreliable in the past. An alternative means of generating and distributing power would meet the needs of the area, something which the SEC was unable to do. The plan would also create jobs for the rural community.

A financial analysis of the plan is being carried out by the recently formed Orbost Power Cooperative. Its success depends on cost and on the Orbost Power Cooperative obtaining the distribution rights for the area from the SEC.

The Age, July 19, 1993



UNDERSEA WINDMILL

The world's first tidal current turbine is about to be submerged in the sea off the coast of Britain. The turbine, similar in principle to a windmill, uses the flow of the sea's tidal currents to drive the turbine. The test model is a small machine - a 10 kilowatt turbine with a four metre rotor which will drive a generator in watertight casing. The output from the generator will charge a battery bank housed in a buoy. Larger examples in the future would be linked to the onshore electricity grid by marine cables.

The pilot scheme is intended to show that such a system can reach levels of efficient power output and that larger, more cost-effective systems will be achievable in the future. If these turbines are fully developed and employed, Britain's offshore tidal currents (with an energy potential of thousands of megawatts) could be a pollution free, renewable source to provide a significant proportion of Britain's electricity needs.

The project is being developed by a consortium made up of Scottish Nuclear, the IT Power company and NEL (the UK mechanical engineering testing and research laboratory).

Electrical World, July 1993

THE ELECTRIC BALL

Attempts to harness the power of the sea go back to early this century. An early Australian experiment with wave power was the "electric ball", which was installed in 1909 near the pier at Sorrento, south of Melbourne. Little is known about the mysterious "electric ball" other than that it generated electricity as it rose and fell on incoming waves.

The plaque that accompanies the ball, on display at Sorrento, sheds a little more light on the story. It reads, "the sphere was tethered in the sea and its movement transferred to a dynamo housed near Sphinx rock. However severe wave action damaged the system and eventually the project was abandoned although at one stage an electric light globe was lit for a time"!

Solutions, Energy Victoria Newsletter, Spring, 1992

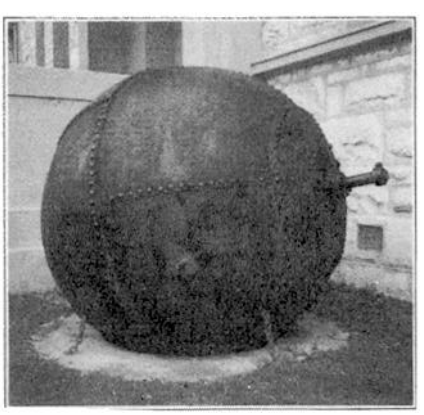
POWERSMART IN SYDNEY

Sydney Electricity has launched a new energy program called *PowerSmart*, aimed at educating Sydneysiders on the way they perceive and use electricity

Sydney Electricity is offering its customers a subsidised PowerSmart Pack which can be obtained for $79, rather than the $149 retail value of its contents. The pack contains a movement sensitive lamp kit, a compact fluorescent Smart Lamp, a 24 hour powerpoint timer, an energy saving shower head, two 30% discount vouchers for cooking classes, a plug in night light and a packet of toddler-proof powerpoint safety covers. They claim that apart from the broader energy saving benefits to be had, using the PowerSmart Pack alone can bring savings of $60 per year on your power bill.

Sydneysiders wanting a PowerSmart brochure can phone 131363.

For more information, contact Ian Hamilton, ph: (02) 269 2172



The electric ball at Sorrento

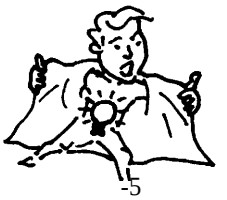
SOLAR LIGHTING THE WAY

The weekly markets at Mindel Beach in Darwin are lit up by solar powered street lights. The system consists of two 18 watt low pressure sodium street lights.

Further afield in Sendai, north of Tokyo, street lights supplied by BP Solar Australia are operating with twin 11 watt fluorescent lights for 6hrs/day. The street lights use BP Solar's street light pole and underground battery box.

BP Solar News, July, 1993

BATTERY NEWS



Electric vehicles and battery technology are continually developing. In France an industrial agreement between battery maker, Saft Nife and PSA Peugeot Citroen will see two assembly line electric car models introduced in 1995.

Saft Nife is also beginning a multimillion dollar research program in the US and Europe for battery development. In their new pilot plant in Bordeaux, France, the challenge is to cut the costs of mass production of the recyclable STM nickel camium battery. PSA will use these batteries in its Peugeot 106 and Citroen AX. To meet PSA's market requirements, the battery cost must be reduced from about US$1000 to around $400, still about twice the price of lead acid batteries, but competitivedue to their much longer life.

In Australia, Saft Nife are introducing a battery recycling program. Used batteries will be shipped to Sweden for the recycling process which will recover more than 90% of battery materials and a proportion will be reused in battery manufacturing.

SAE-Australasia, May/June ,1993

Dual Water Supply

A dual water supply system carrying both potable and recycled water will be servicing residents of a new western Sydney housing development. This development is in the environmentally sensitive Hawkesbury Basin, requiring consideration of wastewater disposal because of the potential damage sewage run-off could cause to the Hawkesbury River.

The dual system will distribute two grades of water through separate, distinctive colour coded pipe networks. One will supply high quality potable water for drinking, cooking, personal hygiene and other household uses. The other grade of water will be recycled wastewater used for toilet flushing and external uses such as watering of gardens, washing cars and external surfaces.

Plumbing & Mechanical Connection, May-July, 1993

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- **Mega Series greater than 38 watts was 10 year limited warranty . . . now 20 year limited warranty.**
- **New MSX-83. The largest commercial module manufactured in Australia.**
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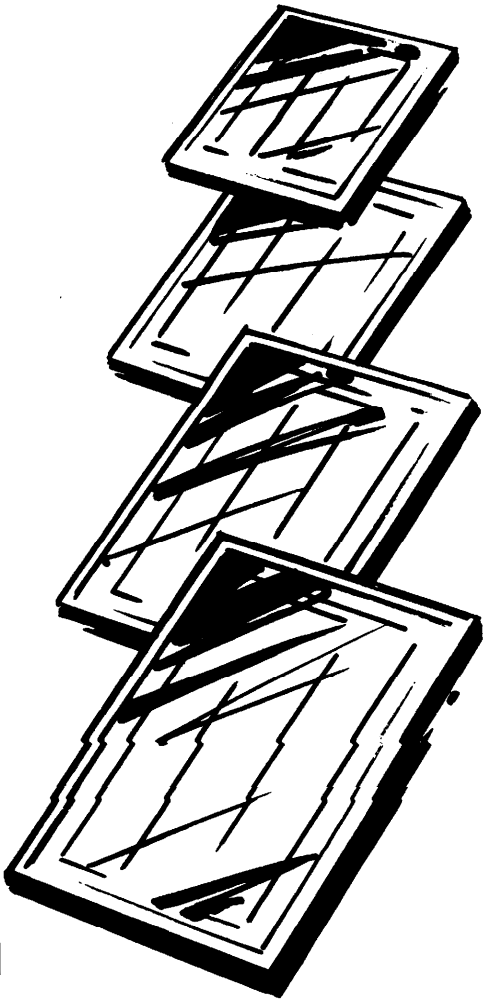

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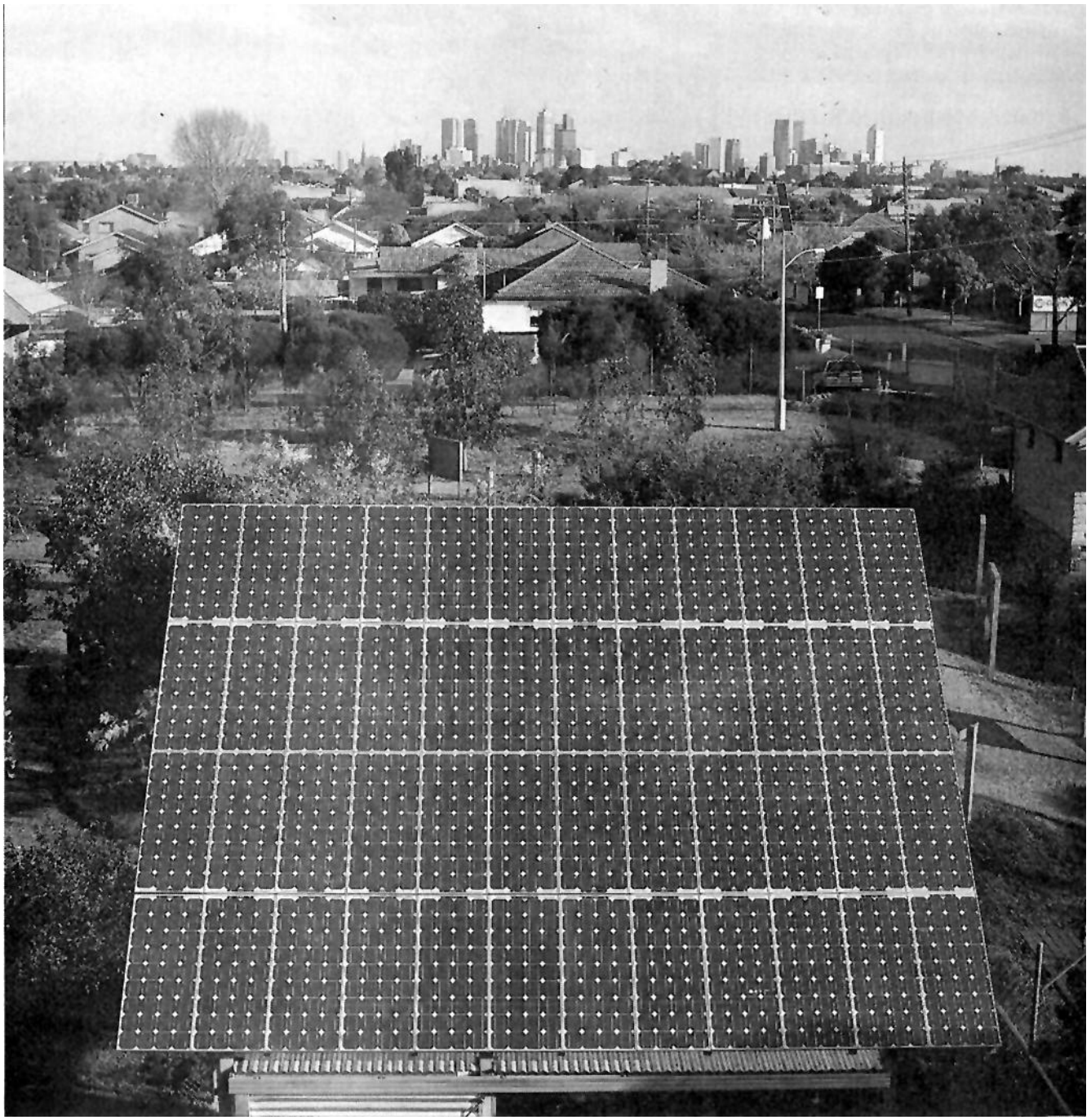
Solar in the City



Mick Harris

A quiet revolution is taking place. Renewable sources of electricity are sneaking into our backyards. And it's not just in the country. It's starting to happen in our biggest cities.

The picture on the previous page (also featured on our cover) shows the array of photovoltaic panels which is part of the Brunswick Electricity Supply's *Project Aurora.* For more information on Project Aurora, see the box an page 13.

Phil's house in Sydney, with the Dunlite wind generator in the background

Sydney, Melbourne, Brisbane, Adelaide and Perth, they all harbour examples of this new generation of renewable energy systems. Systems that defy the conventional economic wisdom. Systems that according to our power utilities should not exist. And these systems are becoming increasingly common.

So why, when cheap, convenient, easy electricity is available to those who live in the city, are people starting to make the switch? What's motivating them? There is one very simple answer. People believe in it. They like the idea of using an energy source that is clean, renewable, and environmentally friendly. They like the independence it gives them.

They are sick of hearing about the energy source of the future. They want to have a slice of it for themselves and they want it now!

The city based renewable energy systems are similar to their country cousins, but with one notable exception. Instead of using a generator set as a backup they use the grid. All of the city systems we found still made use of the grid for powering some of the appliances in the house, or had the capacity to switch part or all the house back to grid connection if required.

Many of the systems provided power to a selection of lights and some power points. The biggest variation between the systems was in the percentage of power provided by renewables. In some cases, all power was provided for much of the year, with the mains being switched on occasionally in winter. In others, only a small percentage of the household's total electricity consumption was supplied by renewables - perhaps just a few lights.

These three solar panels, on Peter and Claire's Melbourne roof are used to run some of their lights and power points

Sydney

There are several solar and wind systems in Sydney. One example we came across uses a number of photovoltaic panels and a small LVM wind generator to supply most of the needs of a small house.

The biggest system we found uses a 750 watt Dunlite wind generator mounted on a 40 foot windmill tower to supply the bulk of the owner's lighting needs.

Phil, the owner of the Dunlite, used some sneaky wiring to allow the batteries to be charged in low wind conditions. When winds are light, the 24

Photovoltaics in Adelaide. An automatic system switches the house back to the mains power supply when the battery gets low. Note the solar powered path light.

volt, 560 amp hour, battery bank is switched over to two, 12 volt banks wired in parallel by a heavy relay. That way the batteries continue to charge when normally no charging would occur.

The inverter is a modified, 960 watt Uninterruptable Power Supply type. Two kilowatt hour meters are used to monitor the electrical input from the wind generator and the mains.

Phil's house is large. In fact large enough to have two phases supplying it. When wiring the system in, he installed a changeover switch which allowed one phase of the lighting circuits to run on the wind power system.

One nice innovation in this system is a power winch, which is used to feather the windgenerator and close it down when winds get too strong. A readout from an anemometer is located inside the house, so it is possible to start and stop the windgenerator without going outside on a cold and stormy night.

Melbourne

I was able to track down quite a few systems in Melbourne. Two were owned by people who sell renewable energy systems. They like to use the technology they sell in their own homes so they can try it out for themselves.

Another ran all the standard 240 house wiring off batteries through an inverter and used a changeover switch to convert back to grid power as required.

Yet another system used duplicate 12 volt circuits for some lighting and power needs.

The picture at the bottom of the opposite page shows part of this system which makes use of the simplicity of a 12 volt system and the efficiency inherent in many 12 volt appliances. Three photovoltaic panels and a Rutland wind generator are used to provide the electricity to run some of the house's lighting and power needs.

This was the only system I found where the grid was not used to top up the batteries if they went flat.

Peter and Claire, the owners of this system, have another power source; a bicycle generator which allows them to combine exercise with battery charging. I tried it out, and of all the bike generators I've tried, I'd rate it as the best.

Unlike most of the systems around, this one quite deliberately sticks to 12 volt power. The theory is that, if you have conventional, 240 volt, lights and power points, you will be tempted to use conventional, energy inefficient, 240 volt appliances. Most low voltage appliances use much lower wattages than their 240 volt equivalents. By using the 12 volt appliance, you automatically get some limits on your energy consumption.

Quite a range of appliances are run from this system. Low voltage fluorescent lights are used in the lounge, kitchen, back room and workshop and 12 volt halogens are used as reading lights. Appliances include small power tools such as a drill, saw and a soldering iron. Also run off the system are a radio/cassette stereo, a computer, a nicad battery charger and the security system.

Adelaide

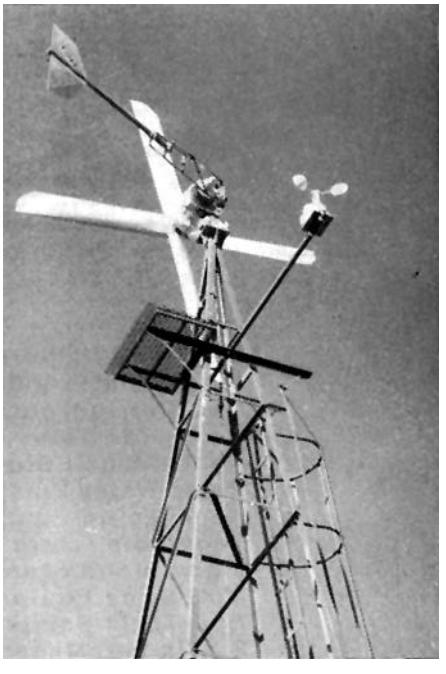
There are several houses using renewables for electricity in Adelaide Sandy's house uses two, 60 watt Solarex panels, a Sonnenshein 12 volt, 180 amp hour battery and a 200 watt Selectronics inverter to run his lighting needs and operate two ceiling fans. To make this possible, Sandy cut down his energy usage by replacing his conventional incandescent lamps with compact fluorescents. Wotan lamps are used throughout.

The regulator is made by Pecan Engineering and includes a low voltage cutout. However the inverter also has a low voltage cutout, so the cutout circuit on the regulator is used to operate a relay which reconnects the mains wiring as soon as the battery gets too low. 'It works so fast that you can barely see the lights flicker", Sandy said.

Sandy has another solar panel, a **BP SOLAR** self regulating panel, which he will add to the system when he has time.

Perth

There are several suburban systems in Perth. At least one uses a combination



The wind generator and anemometer at Phil's place in Sydney.

Brisbane's fully council approved backyard wind generator

of solar and wind but most use solar only.

Charlie's system uses 18, 55 watt Arco panels on a tracking system to provide all his electricity needs. Energy is stored in a 36 volt, 1,200 amp hour battery bank.

A dual voltage electrical system is used. Lighting, pumping, a compressor and a grinder are powered directly from the 36 volt battery bank. The rest of the appliances are run at 240 volts by a 1,800 watt Wind Energy Australia inverter.

A standard range of appliances is run from the 240 volt system, including a microwave, TV, stereo, kitchen appliances and power tools. The vacuum cleaner had to be slightly modified, due to an electronic control system which did not get on well with the inverter.

A recent model Simpson washing machine is also powered from the system. Charlie pointed out an earlier model Simpson washing machine did not work as well with the inverter.

Like many of the systems, the house can be connected to the grid via a changeover switch.

Charlie worked on another system where connection to the grid was even simpler. He simply had a lead which allowed you to plug into the grid or the inverter. Simplicity itself, safe, foolproof, and SEC approved.

Brisbane

I was only able to track down one example of *Solar in the City* in Brisbane, but that system was very impressive.

This is a serious system, which is well and truly capable of supplying the power needs of most people. Peter uses a 750 watt Dunlite wind generator, on top of a 23 metre tower, in conjunction with about 20 photovoltaic panels to provide power for almost all his family's needs. Peter uses four different types of photovoltaics "to try out the different types". Once generated, power is stored in a set of four battery banks with a total capacity of 50 kilowatt hours.

Three inverters, (Gayrad 1 kilowatt, Santech 1 kilowatt and a 400 watt Honywell Rotary Inverter) supply power to appliances which suit each inverter's characteristics. For example, the rotary inverter is used to run the washing machine because it copes well with start up loads and its lower ef-

ficiency is not a problem, due to brief running times.

Although the system is complicated, with four different types of solar panels, three different types of batteries and three different types of inverter running different power circuits, it is very easy to operate. The whole system has been put together to a high standard. All the appropriate permits were obtained for the wind generator, (a whole story in itself) and the system is fully insured. We hope to do a detailed report on it in a future issue of Soft Technology.

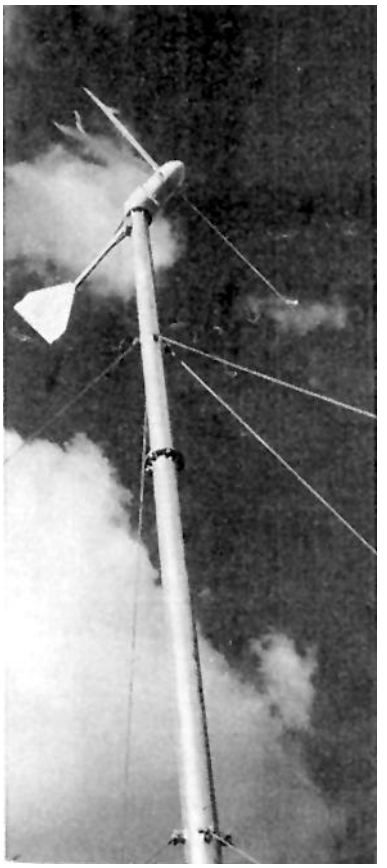
In the next issue of Soft Technology we are going to have a look at the technical details of how these people integrated renewable energy sources into houses with existing 240 volts grid power. And we are going to explain how you can do it safely and within the law, so if you're tempted to use Solar in the City for yourself, stay tuned to find out how. If you know of any other city based examples, especially if they have some unique features then please contact us. ☼

Project Aurora

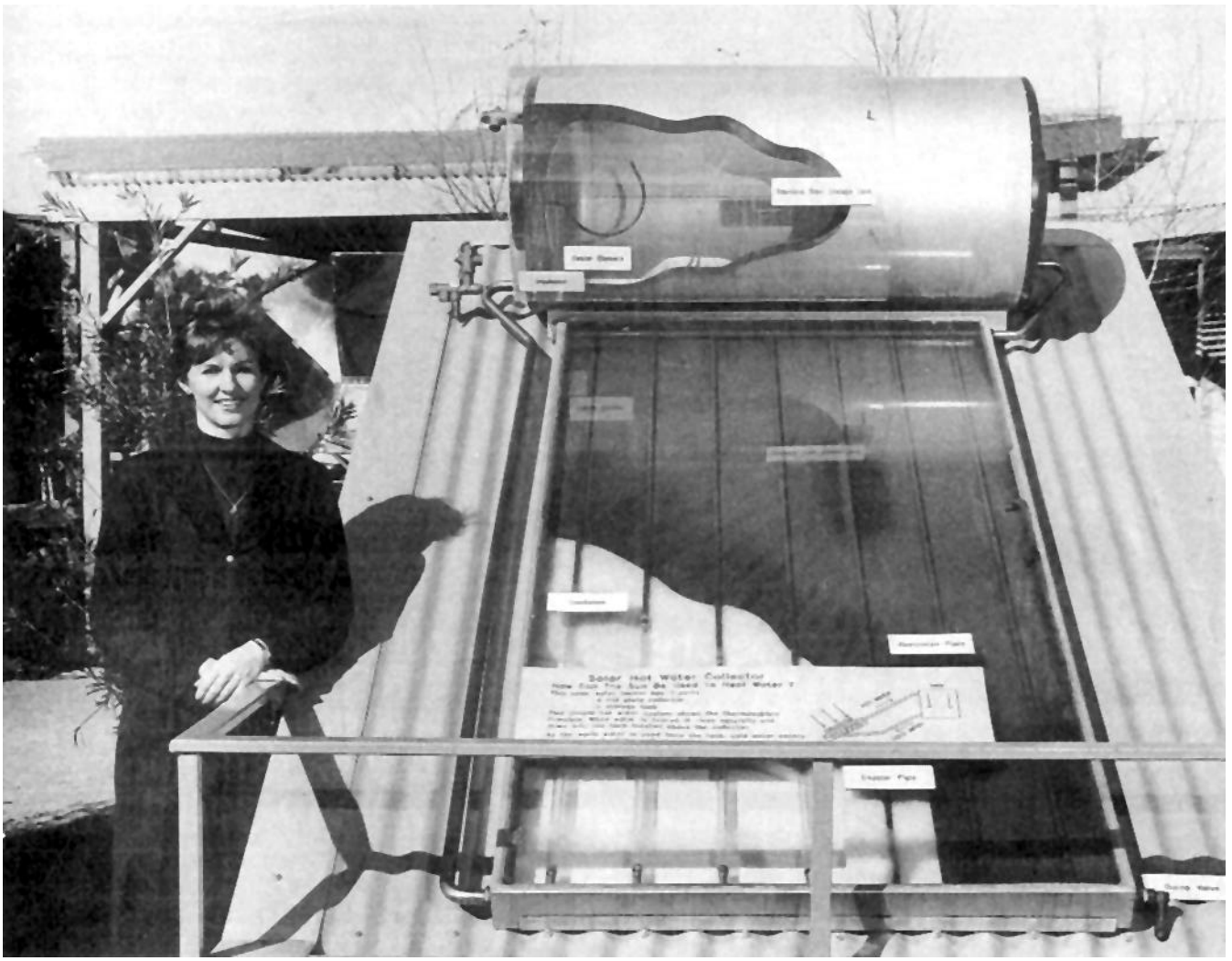
Project Aurora is a grid-connected wind/solar system located just 5 kilometres from the Melbourne GPO. It was established by the local council power utility, the Brunswick Electricity Supply. Power from the 3.6 kilowatt BP SOLAR photovoltaic array and the 10 Kilowatt Bergey/ Westwind wind Turbine is fed into the local grid. A Butler Solar/ Siemens Sunsine, three phase, grid-interactive inverter is used to make the grid connection.

The system is expandable and Brunswick Electricity Supply is inviting interested people to buy a solar panel, or part of a solar panel, for inclusion in the grid-connected system. They will then pay the owners for the electricity contributed by the their solar panels.

If you would like more information on Project Aurora ring Brunswick Electricity Supply on (03) 389 4100.



Right: The Bergey/Westwind wind generator at the Project Aurora site



Solar Hot Water
BUYING GUIDE

Ross Horman

Remote coupling, collectors, cylinders, boosters, pipes. What do all these things have in common? Well put them together and you can have yourself a nice hot shower the environmentally friendly way. Solar water heating has been around for over 100 years and is improving all the time. Our last review of this technology was in 1989 (Soft *Technology* 32/33), so we thought it was time for an update.

At the moment there are fifteen manufacturers that I know of in Australia. Some produce similar units while others have some interesting variations. In this article I will endeavour to explain the basic cornponents of the various systems with their particular applications and give some pointers about things to consider when buying. I have also included a list of manufacturers and a sample of their products.

The basic system

There are several different types of solar hot water systems and ways to connect them - close coupled, remote coupled, gravity feed, mains pressure etc. - but all basically consist of a solar collector, an insulated storage cylinder,

The photo above shows Corrine Leadbeater, from Energy Victoria's Energy Education Centre (Burnley, Vic), with a cut away of a solar hot water system, which is on display at the centre.

Make	Model	Capacity (Litres)	Pres-sure	Tank Material	Insulating Material	Collector Area (m^2)	No.	Material	Glass	Boost-ing	Where made	Cost ($)	Company Contact Details
Aquaheat	315SF&R	370	G	Cu	P'styrene	4	2	Cu	Low Fe	Elec	SA	2000	Aqua Heat Australia P/L PO Box 19, Highbury, SA, 5090 Ph: 008 882 125
Astra	TA7	315	G	Cu	Rockwool						VIC		Astra Hot Water 1/17 Teton Ct, Highett, VIC, 3190 Ph: (03) 555 2940
Beasley	26S 300 5MSC 370 175SC 280	300 370 280	M G G	SS Cu Cu	P'urethan P'styrene P'styrene	4 4 4	2 2 2	Cu Cu Cu	Low Fe Low Fe Low Fe	Elec Elec Gas	SA " "	2254 1912 2022	Beasley Industries Bolton Ave, Devon Park, SA, 5008 Ph: (08) 340 2299
Edson	SP 315	360	G	Cu	Rockwool	3.7	2	Cu/Al	Prism	Elec	VIC	1932	R Edmonds and Son PO Box 1358, RMDC Clayton VIC 3168 Ph: (03) 548 1133
Edwards	L 305 BM	300	M	SS	P'urethan	4	2	Cu/Al	Low Fe	Elec	WA	1940	Edwards Hot Water Systems 109 Vulcan Rd, Canning Vale, WA,6155 Ph: (09) 455 1999
Enviroflo	Enviroflo	315	M	SS	P'urethan	4	2	Cu/Al	Low Fe	Elec	VIC	2180	Sunpak Solar P/L 28 Pevensy Pl., Echuca VIC 3564 Ph: (054) 826 820
Freeheat	300	300	M	S/Pol	P'urethan	4.4	4	Cu	Std	El/Gas	WA	2390	Morris White P/L PO Box 33, Bentley WA 6102 Ph: (09) 351 9699
Gra-mall	315	370	G	Cu	Rockwool	3.7	2	Cu/Al	Prism	Elec	SA	1927	Gra-mall Hot Water Systems P/L 1&2/7 McGowan St, Pooraka SA 5095 Ph: (08) 349 6688
Quantum	Pacific Split	340	M	MS	P'urethan	4.2	3	Al	N/A	(Elec)*	NSW	2945	Quantum Link Energy Systems 109 Smith St, Smithfield, NSW 2164 Ph: (02) 725 2944
Rheem	52F300	300	M	MS	P'urethan	3.8	2	Cu	Tough or Low Fe	Elec	NSW	2130	Rheem Australia Ltd 13 Rachael Cl., Silverwater NSW 2141 Ph: (02) 748 5400
Solco	Sunsaver	185	G	P'eth	P'urethan	2	1	P'eth	Acrylic	Elec	WA	899	Solco International Ltd 7 Vulcan Rd, Canning Vale WA 6155 Ph: (09) 455 1399
Solahart	302L 302K FD15	300 300 300	M M M	MS MS MS	P'urethan P'urethan P'urethan	3.72 3.72 3.72	2 2 2	Cu/Al Steel Steel	Low Fe Low Fe Low Fe	Elec Elec Gas	WA " "	1860 2340	Solahart 112 Pilbara St, Welshpool WA 6106 Ph: (09) 458 6211
Sunbather	4-315C	360	G	Cu	Rockwool	3.7	2	Cu/Al	Prism	Elec	VIC	1924	Sunbather Hot Water Systems 2174 Frankston/Flin Rd, Hastings VIC 3915 Ph: (059) 792 7777
Wilson	SF315	350	G	Cu	Rockwool	3.7	2	Cu/Al	Prism	Elec	VIC	1920	Wilson Hot Water Systems P/L 11 Argent Pl., Ringwood VIC 3134 Ph: (03) 874 4222

About the table

There are many different types and sizes of solar hot water systems on the market. For purposes of comparison, our table lists the **300** litre (or nearest equivalent) model, as this is a commonly used size for the average family of two adults and two children. For details on other sizes and products in a particular range, contact the manufacturer directly at the address listed in the table.

Key

Al = Aluminium
Cu = Copper
Elec = Electric
G = Gravity feed
Low Fe = Low Iron
M = Mains pressure
MS = mild steel and glass
P'styrene = Polystyrene
P'urethan = Polyurethane
SS = Stainless Steel
Std = Standard glass
S/Pol = Steel and Polyurethane
Tough = Toughened

* Not a booster- see text under **Heat pumps**

a booster and the interconnecting pipework. The collector is the part of the system which gathers the heat of the sun to heat the water. The cylinder is usually located above and behind the collectors, either on the roof or in the roof space.

In most systems the only thing that moves is water. As the water is heated by the sun, it rises to the top of the collector. From here it flows upwards into the storage cylinder.

Where the collectors are above the storage cylinder, a circulating pump is required to bring the hot water down to the cylinder.

There are also some systems which use a tracking mechanism to move the collectors so they follow the sun. They usually consist of parabolic reflectors which concentrate the sun's rays and hence provide higher water temperatures. But since it is a mechanical system with moving parts, there are greater chances for system breakdown.

Variations

Close and remote coupling

Close-coupled systems are those which have the tank mounted on the roof immediately adjacent to the collector(s). Beasley, Edwards, Freeheat, Rheem, Solahart and Sunpak all make close-coupled systems. They are generally mains pressure systems, although all of the above manufacturers' close-coupled systems can also be used as gravity feed systems. Solco makes a close-coupled unit for gravity feed systems only.

Remote-coupled systems have a storage cylinder remote from the collector(s), usually in the ceiling space or a cupboard lower than the collectors.

Where the storage cylinder is higher than the collector(s) the system relies on convection currents (thermosyphon) for its circulation. However when the tank is at a lower level than the collectors, the circulation is achieved by the use of a small pump. This method is described under **Retrofitting existing systems (see** box, next page).

Storage cylinders

What capacity is required? A typical storage cylinder holds between 1.5 - 2 days supply of hot water for the size of household it is serving. For the purpose of comparison, we are taking as a sample a family of four, which would generally require about 300 litres of storage capacity.

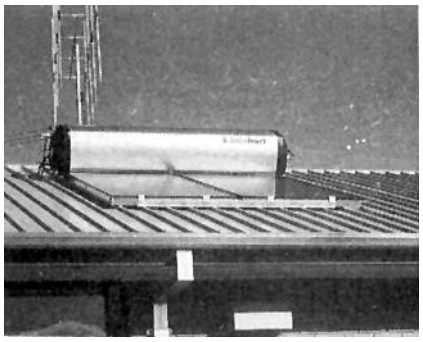


Photo by Andrew Blair

Close-coupled systems, like the Solahart above, are what many people think of as the 'traditional' solar hot water system.

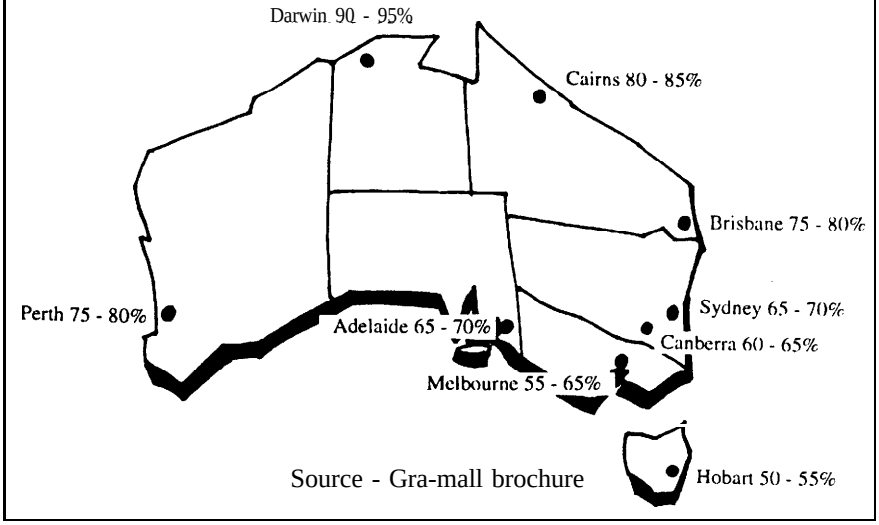
Gravity feed solar hot water systems generally use solid copper for the storage cylinder, as copper has excellent resistance to corrosion. A relatively recent variation from this is the use of polyethylene, as in the Solco unit.

Mains pressure cylinders are made from stainless steel, from mild steel with a vitreous enamel lining (sometimes called "glass-lined"), or from mild steel with a polyethylene liner.

Stainless steel tanks are made from marine grade 316 metal, which can reasonably be expected to last in excess of 20 years under ideal conditions - that is, if the water quality is good.

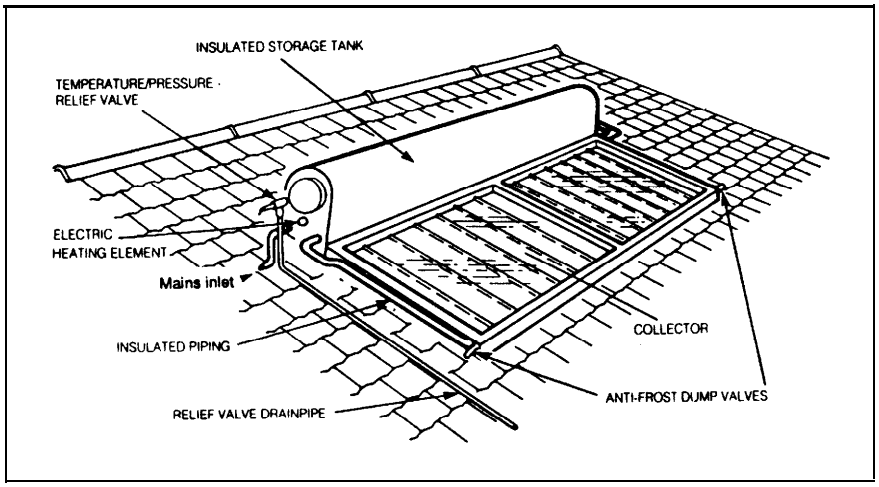
Glass-lined (vitreous enamel lined) mild steel tanks are fitted with a sacrificial

In most parts of Australia between 65 and 80% of domestic hot water can be supplied by a solar hot water system. Figures for the average annual solar contribution to a flat plate collector system are shown below.



Source - Gra-mall brochure

Diagram taken from "Technical Guide to Domestic Hot Water" by the SECV



An example of a close-coupled solar hot water system

anode which is designed to be eaten away by galvanic action in preference to the steel tank, which may be exposed through cracks etc., in the vitreous enamel lining. This anode should be removed, checked and replaced (if necessary) every five years. If this is done then the life expectancy is extended.

With advances in plastics technology two manufacturers (Freeheat and Solco) are producing cylinders which are lined with polyethylene. Freeheat is usually run as a mains pressure system while Solco is a low cost gravity feed system. One advantage of the polyethylene cylinders is that they will not corrode, regardless of your water quality.

The insulation material used to surround the tank is polyurethane for all of the mains pressure units, with some manufacturers stressing that their product is CFC free. In the gravity feed systems there is some variation between rockwool, fibreglass and polystyrene beads.

As a matter of interest, one method of providing mains pressure hot water from a gravity feed cylinder is to use a calorifier coil in the top of the cylinder. For more information on this technique, refer to the hydronic central heating article in this issue. The method does not lend itself particularly well to solar hot water systems.

Auxiliary heating & boosting

In most areas of Australia (even Darwin) a solar hot water system will need a booster to supplement the hot water in times of insufficient sunshine.

Boosting usually involves an electric element, but gas is also available on solar hot water systems from Beasley, Solahart and Freeheat (Morris White).

Some people prefer the idea of gas, as its use produces less CO_2 than the equivalent amount of electricity. Gas boosted systems are also attractive where you don't have the option of a cheap off-peak electricity rate. This is offset by the fact that they are more expensive initially.

A gravity feed system can be directly connected to the hot water jacket of a slow combustion cooker. If correctly sized and installed, this method of heating can be an excellent back up during the winter months. (See ***Soft Technology*** 44 for a detailed article on this technique.)

Freeze protection

Where night-time or winter temperatures drop to 4°C or below, water can freeze and expand in the collector(s) and damage the piping. If frost is a possibility in your area, your unit will need freeze protection.

Most manufacturers offer thermostatically controlled anti-freeze valves which open at around 4°C to let a trickle of water flow through the panel, thus preventing freezing. This method is wasteful of water but seems to be quite reliable.

Another method is to fit a thermostatically controlled electric heating element in the bottom tube of the collectors.

Solahart use a heat exchanger system where an anti-freeze chemical is added to the heat transfer fluid. This method would seem to be particularly appropriate where water quality is doubtful (eg. bore water). The heat transfer fluid level should be checked every five years according to the manufacturers instructions.

In a pumped circulation system, hot water can be reticulated through the

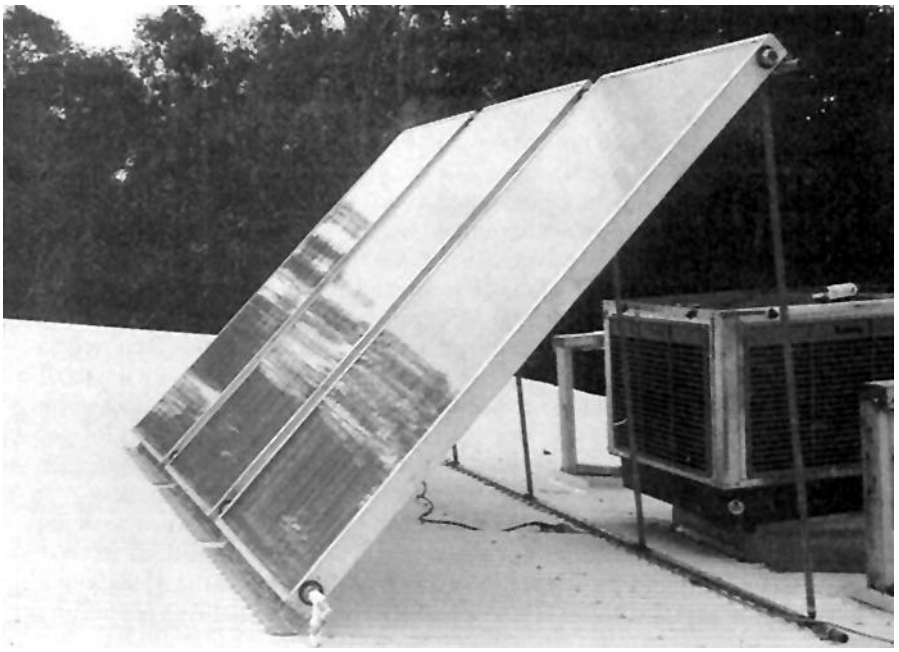


Photo by Andrew Blair

Collectors tilted to face north (in the southern hemisphere) at an angle of latitude plus 5°, for better winter performance. Note the brass frost protection valve at the bottom of the collectors, where the water is the coldest.

Retrofitting existing systems

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

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

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

It is not really advisable to connect solar to gas storage hot water systems because they are designed for the gas to reheat the water as soon as some is used, so the sun can't really contribute any heat. Preheating the water with a solar hot water system before it goes into the gas storage system is a possibility.

collectors under instructions from the temperature-sensitive controller.

The last method is to drain down the panels whenever a frost is imminent. Rheem use a system which isolates the collectors and drains the water from them when temperatures approach freezing. When the temperature rises normal operation is resumed.

Types of collectors

Flat plate collectors

Flat plate collectors (tube and fin) and flooded collectors are the most commonly used type of collector.

Flat plate collectors consist of a flat blackened plate to which a number of tubes (usually copper) are bonded. This plate is backed by insulation and enclosed in a sheet metal case with a clear glass cover. The most common configuration has one tube across the top and one across the bottom (upper and lower headers) connected by a row of smaller diameter tubes (risers). The risers have plates of metal linking them to increase the surface area of metal which can pass heat into the water. These were traditionally made from copper, like the tubes, but many manufacturers are now using aluminium webs between the risers instead of copper to reduce costs. One manufacturer has used a serpentine single tube instead of the headers and risers.

Solahart uses a sandwich construction on its more expensive models, which consists of layers of steel which are pressed to make water ways and then bonded together to make the complete panel. These are called flooded collectors.

The flooded collector design is also used by Solco which makes an all plastic collector, manufactured as one with the storage cylinder. It has no pipes as such, but simply a very shallow panel filled with water and directly connected to the cylinder.

The absorber surface of the flat plate collectors is coated with a flat matt black surface to improve the absorbance of heat. Most companies use a selective surface which has a high absorbance but low emittance of heat which maximises the unit's performance. This is in contrast to, say, black paint, which has a high absorbance rate, but also a high rate of re-radiance.

Low iron glass is the most commonly used for the collector cover, due to a greater ability than standard window glass to transmit heat. The purpose of the cover is to greatly reduce heat loss from the plate to the surroundings. Some manufacturers make collectors with special toughened glass which will resist hail damage and other mechanical impacts.

Heat pumps

Quantum is an innovative Australian design which uses a heat pump with solar evaporators (collectors). The system works on the refrigeration principle, by which heat is drawn out of the food in the cabinet and dumped into the air via the condenser coil on the back of the fridge. In this hot water system the heat is pumped out of the open air/wind/rain and is then transferred into an insulated tank of water which has the condenser coil wrapped around it.

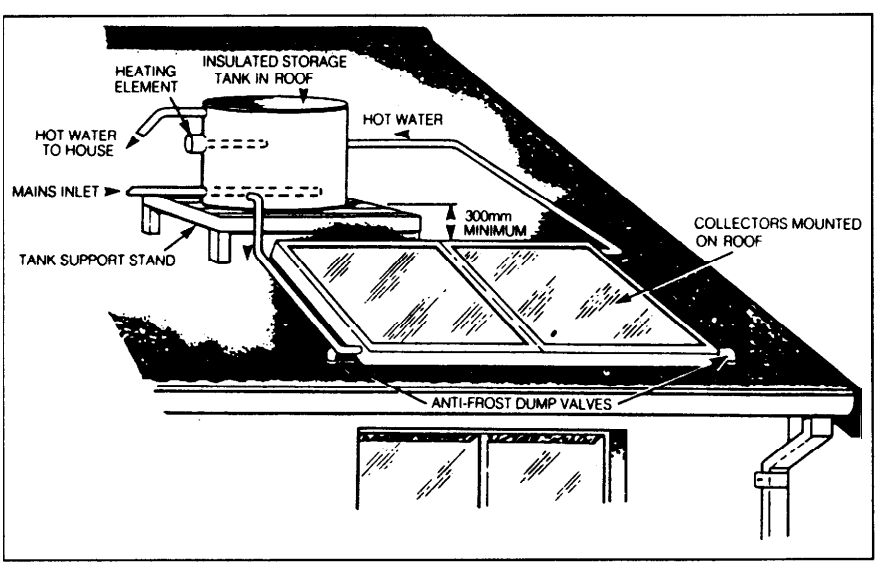


Diagram taken from "Technical Guide to Domestic Hot Water" by the SECV

An example of a remote-coupled thermosyphon system, with the cylinder above the collectors, but inside the roof.

A normal electric hot water service will produce roughly 1kW of hot water for every 1kW of electricity it uses. A heat pump will produce, on average, about 3kW of heating for every 1kW of electricity it uses.

The catch, in Victoria at least, is that the off-peak night-rate electricity tarriff (charge) is about one third of the day rate tariff. The Quantum unit uses a third of the power of the standard electric system, but since it runs on the day rate tariff, which costs three times as much, there is no overall money saving.

Evacuated tubes

Thermomax tubes are evacuated tubes which have a central, Freon-filled tube with collector fins. As the Freon is heated, it rises to the top of the tube, where the heat is transferred to a jacket of water. The cooled and condensed Freon then runs back to the bottom of the tube to be re-heated. This system originated in Great Britain and never found strong favour here. The importers, Roe & Cook, Shepparton, Victoria, now only keep limited spare parts for existing systems. They can be contacted on (058) 292 506.

Making a choice

Gravity feed or mains pressure?

One of the most common questions about hot water systems is whether to use a gravity feed (constant pressure) system or a mains pressure system.

A mains pressure system operates at the same pressure as that provided by the water mains. This can be higher than 700 kilopascals, (700kPa) and requires a tank, usually made of steel, which will withstand this pressure.

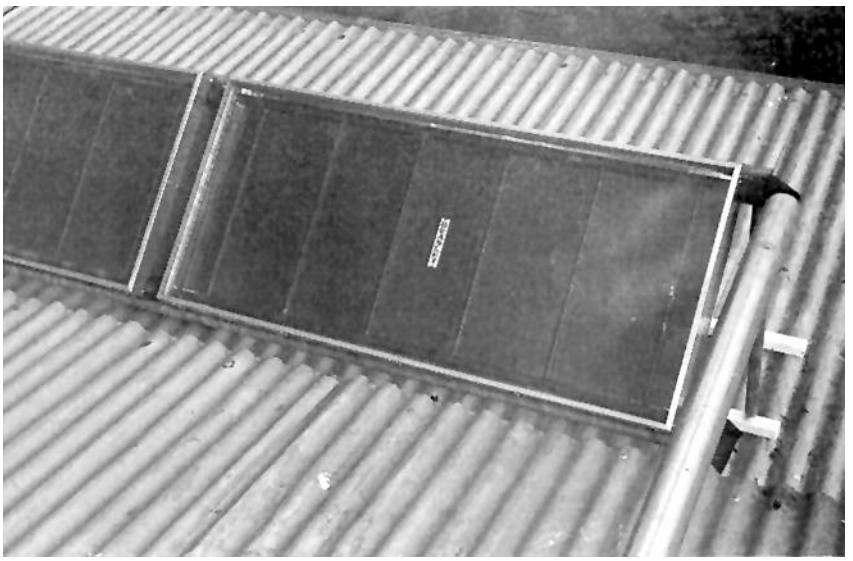


Photo by Andrew Blair

A standard collector showing top and bottom headers connected by vertical riser pipes attached to a copper plate to absorb the sun's heat. The collector is covered with glass and insulated under the black plate. This is an early collector (1972), which clearly shows the construction methods.

Gravity feed systems are isolated from the mains water supply by a float valve. They are under no pressure except that due to gravity, and hence the pressure at any outlet is entirely determined by the height of the tank above that point. In a single storey house this is about 20kPa, and in a two storey house, about 40kPa.

The low pressures allow gravity feed systems to be made out of structurally weak but durable materials like copper, which means that gravity feed systems last significantly longer than mains pressure systems (20-25 years versus 10-15 years).

The lower pressure also means that gravity feed systems need more thought put into the plumbing. To allow sufficient water flow, lines to the outlets should be at least 19mm diameter, with 12mm being used for only the last few metres of pipe, closest to the outlet.

Some people find the pressures provided by gravity feed systems too low for their taste, so some manufacturers have recently introduced devices which increase the output pressure of their products.

Edson are marketing a hot water booster pump which is connected

directly in line with the outlet of the tank. It is electrically driven and only operates when a hot water tap is turned on.

Gra-mall have developed a device they call a pressure transfer module, which is a piston-operated water pump that is driven by the incoming cold water and which transfers hot water at the same pressure to all outlets.

One frequent complaint from users of gravity feed systems is that it is often difficult to adjust a shower when the hot water comes in at constant pressure (from the gravity feed system) and the cold water pressure (from the mains) fluctuates - the shower swings from too hot to too cold. However this problem is easily overcome by connecting the shower cold water supply to the gravity feed supply tank. Fluctuations in the cold water supply to the tank then have no effect on the shower.

If you would like to run your hot water system off your combustion cooker in winter, it is worth noting that gravity feed tanks can be directly connected to a slow combustion cooker or heater, whereas mains pressure systems must be connected through a heat exchanger.

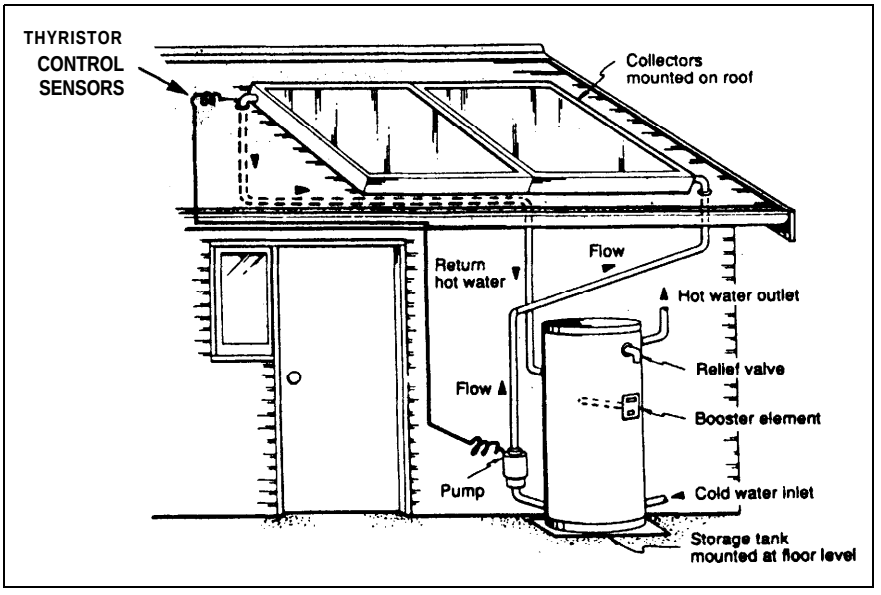
People who are concerned about conservation of resources are often attracted to the low pressure units because of their lower water consumption.

Water quality effects

Consideration should be given to the quality of the water which will be connected to the system. If the water supply has a high silica or calcium content then the manufacturer should be consulted to ascertain possible effects on their system and/or warranties. They may be able to recommend some appropriate remedies and/or configurations.

Stainless steel does not like chloride ions in the water.

Bore water can cause problems through deposits building up in tanks and piping.



An example of a remote-coupled, pump circulated system

Diagram taken from "Domestic Solar Hot Water Heating" by Energy Victoria

Warranties

At this point we should look at the warranties offered by the various manufacturers and we should note that warranty periods and life expectancy are rarely the same thing. Warranty periods are set by the makers for an exact duration, whereas life expectancy is a far more nebulous concept, which depends on water quality, usage patterns, operating pressure and so on.

Warranties on copper cylinders seems to vary between 2 years and 10 years while stainless steel is most often quoted as 7 years. Mild steel glass-lined tanks have a warranty of 5 years which in some cases can be extended to 10 years with the payment of the equivalent of an insurance premium.

Collector warranties range from 2 years to 7 years while anti-freeze valves carry only a one year cover.

It should be noted that there is an Australian Standard, AS 2712, which covers the design and construction of solar water heaters and it is expected that all manufacturers comply with this standard.

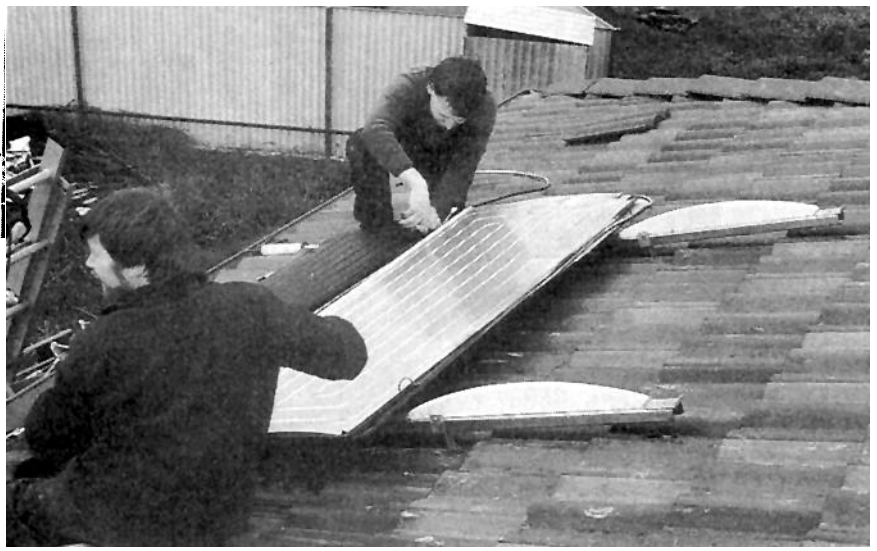


Photo by Andrew Blair

Securing the evaporator plates of a heat pump system. These plates get cold as they take heat from the air. The heat is transferred to the water in the cylinder.

Economics

With the cost of a solar hot water system being in the general vicinity of $2000, a payback period of approximately 12 years is often quoted when compared to a conventional system. What is often overlooked in this comparison is that many conventional systems would have al been replaced in this length of time.

You need to consider your water quality and usage and make an educated guess about the life of your system and the alternatives. The cylinder life is the major variable and this is largely dependent on water quality.

Remember that any economic calculations must take into account the electricity, gas or firewood for boosting.

Installation

The installation of any system should be carried out by appropriately qualified and experienced tradespeople. Gravity feed systems have suffered greatly over the years due to either ignorance of the correct methods of installation or so-called cost saving short cuts which have given these systems a totally unjustified bad name.

For all systems, due consideration should be given to roof orientation, roof pitch, possible shading and the ability of the structure to support the system. ☼

Energy-Saving Hints

FOR MICROWAVING

Michael Gunter

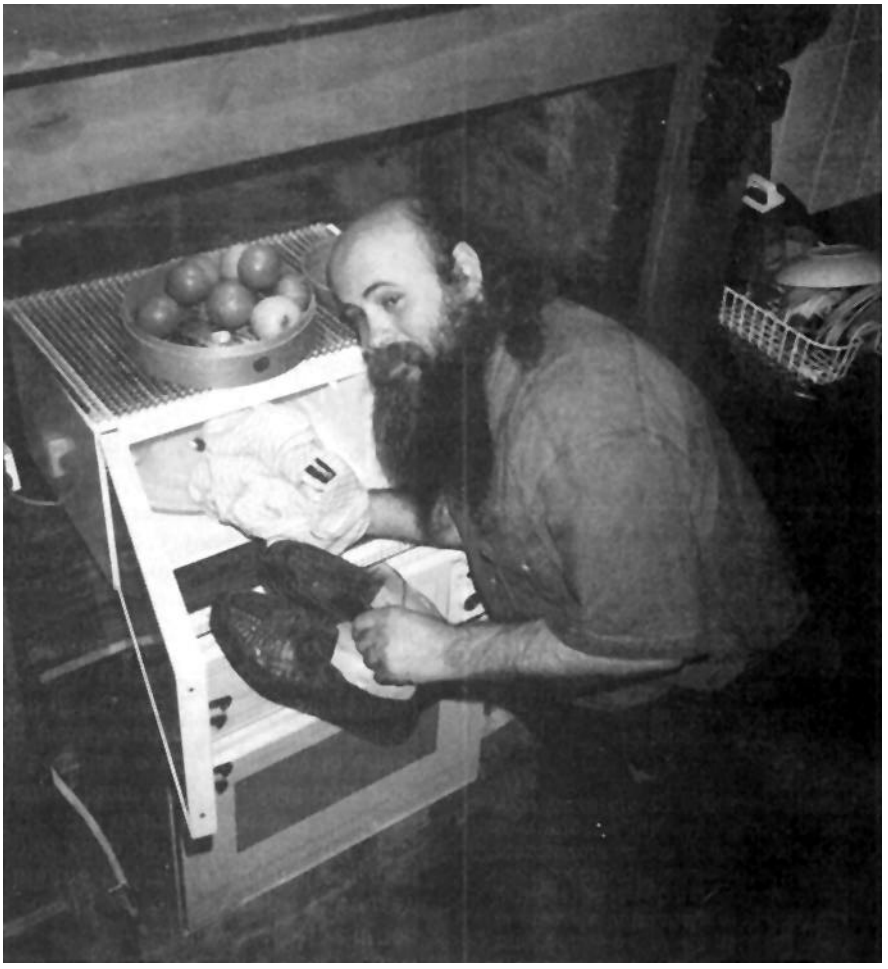
Lots of households are now blessed with the presence of a microwave oven. These fascinating gadgets have been highly successful in "penetrating the market" in the last decade and sit proudly atop the fridge (or in some other convenient nook) in the kitchen.

But are they paying their way? Are they yet another bit of technological wizardry that we just have to have because everybody else was buying them? Or are they the most 'efficient, convenient, wonderful, indeed perfect cooking machines ever invented? As with most technology, the answer lies in how ***appropriately*** the technology is used.

In trying to figure out a practical message for the appropriate uses of microwaves, we need to consider them alongside the traditional alternatives. The traditional radiation (eg toasters), convection (eg ducted heating) or conduction (eg frying pan) methods of heating are generally powered by gas, electricity or wood (or coal in some countries). Each of these has a dollar cost and a CO_2 emission cost.

Mains electricity generated from fossil-fuels has the highest cost on both counts. Wood is better, if it is sourced renewably, but could not be a significant part of the urban scene due to pollution problems. Gas is best for dollar and CO_2 costs, and approaches electricity in convenience. It is definitely the heat to beat, and although I have not done a quantitative comparison, I suspect that at best microwaves can only match gas for efficiency in terms of dollar and CO_2 costs.

The main benefit of microwaves is that they can cook foods quickly because microwaves can penetrate quite deeply into a lump of food, heating it from within. But they are only convenient, fast and energy efficient for cooking ***some*** foods. Common sense is a good guide as to how to use your microwave efficiently, as the foods that they don't cook efficiently also tend to be those which are inconvenient or slow to cook in a microwave oven.



Please...do not try this at home

It is worth noting here that the power consumption of a microwave is generally about twice the power output. So if you have a "500 watt" microwave, it will probably use between 1000 and 1100 watts of electricity. If you want to check this, look for the consumption rating on the body of your microwave - they are required by law to state it, in watts or amps.

General Guidelines

① The lumps of food should ideally be no smaller than a golf ball and no bigger than a grapefruit. Microwaves will not penetrate very well to the centre of anything much larger than a grapefruit, and things outside that size range can be heated right through just about as quickly by traditional methods.

② If you can change the shape of a lump of food from ball-shaped to disk-shaped, it will almost always cook more quickly and more evenly, provided it is covered. You can even try arranging your disk of food in a "doughnut" shape, i.e., with a space in the middle,

to enhance this effect. I have evenly reheated semi-frozen leftovers using this technique with power set to "high" - much quicker than the defrost cycle.

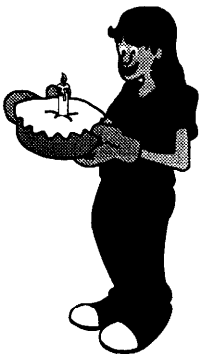
③ High power is the most efficient. This is because the fan is constantly draining heat out of the oven (the fan is necessary to control condensation).

④ Large volumes (over one litre) of runny or gluggy liquids, eg, soups, are not efficiently heated by microwaves - it is much better, and often quicker, to use a stove, stirring occasionally over a low to medium heat.

⑤ Large volumes of meat, ie, lumps of food that cannot be flattened-out for cooking, still seem to do OK, provided that you turn them at least once at evenly spaced intervals during the cooking time.

⑥ The translucent containers from Chinese take-away shops are made of a heat-resistant plastic that I have yet to melt in a microwave. Great for storing frozen leftovers for subsequent reheating and scoffing.

⑦ If you want to cook vegetables in a microwave, they should always be steamed in a covered dish containing only 2-3mm of water (or less) in the bottom. Submerging them in boiling water will cook them more slowly than boiling them on a stove and use at least twice as much energy. The vegetables also lose vitamins into the water.



⑧ Any foods cooked in covered dishes can be cooked faster or at a lower power setting by wrapping the container in an old hand towel or teatowel. This insulates the cooking vessel and prevents heat-loss to the fan-forced airflow through convection and to the inner walls of the oven by radiation. If your oven walls are getting hot then you are not cooking the food as efficiently as possible.

⑨ If your microwave oven dies, it can usually be repaired. This is much better for the economy than throwing it on the tip and buying yet another imported product.

⑩ Use large doses of scepticism when reading microwave cookbooks: many foods are NOT suited to microwave cooking. If you have to open the door more than twice during the entire cooking time, then forget it.

Recipes & other ideas

There are many things a microwave oven can do, not all of which fall into the category of cooking.

"Must remember that one!"

Microwaves are great for all of the following purposes:

- ☼ brewing tea in a china pot - half min. on high - no need to preheat the pot
- ☼ preparing fat-free pappadams and prawn crackers. This is a great one; sandwich 2 pappadams or 7 prawn crackers between 2 sheets of kitchen paper laid flat on the turntable and cook half to one minute

on high. The prawn crackers can burn, go brown and lose flavour if done too long

- ☼ warming candied honey
- ☼ drying slices of fresh bread to make "stale" bread. The bread needs to be on a rack to allow air circulation all around.
- ☼ reheating baby's bottle
- ☼ making stale bread fresh. Baste it with a little water and gently warm it for 10 to 20 seconds, but be careful. Too much microwaving will result in "rock loaf" - not very appetising!
- ☼ cooking jacket potatoes. Put two medium potatoes in a covered Pyrex bowl with 25 ml water, wrap in a teatowel (see point 8, above) and cook 8 minutes on high power. Wait 5 minutes before testing if cooked then add cheese or pesto-yum!

Unusual

Adventurous readers may wish to try some of the following "experiments".

Rendering fat from lamb, beef, or pork: trim fat from chops or roast, place in small pyrex bowl and heat 10 to 20 minutes to produce very clear fat and edible shrivelled fibrous bits. The fat is useful for making soap.

Preserve jam without mould on top: make jam, put 25ml hot water in each empty jar and place in the microwave. Put lids loosely on top and cook on high until boiling vigorously. The super-heated steam in the jars quickly kills all the bugs. Remove and drain, pour in your hot jam and loosely cover with the lids. Allow to cool then tighten lids for mould-free jam. If lids are not plastic, they will have to be boiled in a saucepan and you can use a small cloth on top of the jars to trap the hot steam.

Sterilise smelly dishcloths: wet the cloth till it is soggy, rub it with a bar of soap and massage it until it is a frothy ball of lather. Place it in takeaway container with the lid loosely on and cook on high till the boiling lather pushes the lid off your container - about one minute usually. This is best done while watching proceedings through the window, as it will not do your microwave any good to fill the oven and fan ducts with boiling foam! Allow to stand for 5 mins, then rinse thoroughly in cold water - all odours are gone and the cloth may have a mottled bleached effect.

Warning!

I have tried drying children's clothes and shoes in a microwave - please don't try it. You can scorch the clothes and the leather. Also the soles of plastic shoes can bubble and blister. How do I know? - because I've done it! Even if the clothes don't scorch, they just get hot and steamy, but not actually dry. I once accidentally sterilised a baby's bottle with the teat screwed on tight, and the teat blew up like a balloon with the force of steam pressure inside the bottle - lucky it didn't explode !!

Although my microwave oven has survived repeated abuses in the manner described above, I may have been lucky. Check your manual regarding the recommended minimum volume of food to be placed in the oven. I have heard that the magnetron life can be reduced by not having sufficient mass or volume of food, especially watery food, present in the oven. Apparently the microwaves are reflected back into the magnetron and overheat the filament. ☼

The Steam Powered House

From its genesis in the industrial revolution to its remnants, most obvious as museum piece locomotion, steam power has been surrounded by romanticism. But steam's romanticism is only matched by the inspiring individuals who keep it alive today. Nestled in the hills around Harcourt, Victoria, is Lou Osborne's living legacy, his steam powered house.

Ben O'Loughlin

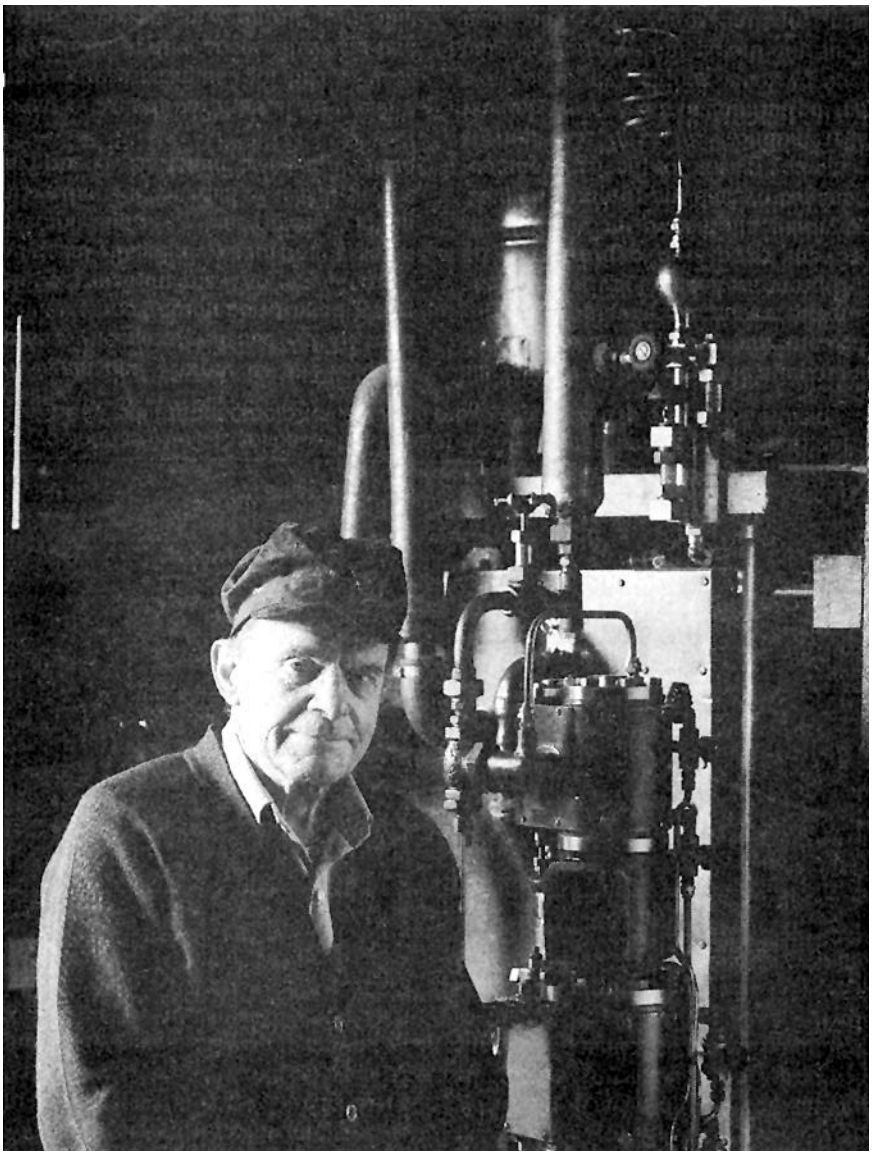


Photo by Adrian Braun

Lou Osborne with some of his steam powered equipment

Lou Osborne seems more like an anachronised watchmaker lost in his craft rather than a retired electrical and mechanical engineer. Yet in the installation of his unique power plant and water storage facility, he has accomplished what many of us have only dreamed of doing. Recycling and restoring redundant equipment, employing long-established technology and using an onsite renewable resource as burning media, Lou has created an efficient and economic vehicle of power generation.

Beginnings

Son and grandson of engineers, Lou graduated in 1942. He commenced his career in the Bendigo gold mines, working as a winding engine driver on the steam plant. Throughout his career, he has been involved in nearly every aspect of large scale power generation, from design to installation and maintainence of steam, hydro and diesel power plant throughout the Northern Territory and Papua New Guinea.

Sixteen years ago, Lou retired to 'Warragai' outside Faraday, near Harcourt. Before construction could begin on the house, water and power were the first priority. Receiving a quote of $20,000 from the SECV to connect to the mains (one kilometre away), encouraged Lou to rekindle a long-held dream of self-sufficiency.

During construction, he used an air-cooled diesel 'Lister' set and installed two, 23,000 litre, rain water storage tanks. After the completion of the house, he installed the boiler plant. The original boiler was a standard underfired multi-tubular oil burner with automatic feed water control. Its first home had been at a chicken works at Brooklyn, but when Lou found it, it was no longer being used, and he was able to buy it for scrap value.

Some modifications of the boiler ensured that it could be used in the system and freed him from a dependency on oil. He replaced some of the fire tubes, converted the boiler from oil burning to wood burning, designed and made the patterns for the fire door and grate and installed new fire bricks.

Power Supply

240V AC Supply

The 32V battery voltage is converted to 240V AC by a 1.5kW static inverter. This enables the house to be wired for normal 240V AC supply. There is also a small 250W rotary inverter.

A backup emergency supply is provided by 'Lister' air-cooled diesel set which can also supply 240V AC, 50 Hz at 3.5 kVA to lights and power points in the house, garage, shed and swimming pool. Another source of 240V supply is the steam driven alternators. Separate power to the shed can be provided from any of the 240V supply units, however, parallel simultaneous supply is physically prevented by the use of a four position dipole switch in conjunction with common key operated switches which cannot be closed at the same time (see circuit diagram). The 240V AC system also supplies a piston-driven garden water pump in the garage.

32V DC Supply

The 230 amp hour, 32V battery bank in the garage supplies:

- the rotary inverter (250W, 32 volt DC to 240 volt AC, 50Hz).
- the static inverter (1500W, 32 volt DC to 240 volt AC, 50Hz).
- the boiler feed piston pump (½hp, 32 volt DC)
- associated boiler water level controls
- domestic water supply piston pump (¼hp, 32 volt DC)
- the swimming pool heat exchanger pump (1½hp, 240AC)
- two 32 volt DC safety lights

Charging the 32 Volt Battery Bank

The batteries may be charged alternatively by:-

- a 25 amp, 40 volt DC generator, driven by the diesel engine cam shaft
- a 35 amp, 40 volt DC generator, belt driven by the 'Reader' steam engine
- an 800W, 38 volt DC generator, belt driven by the 'Steeple' steam engine
- a 3.5 kVA, 240 volt AC, 50 Hz Diesel alternator to the 240 volt AC to 32 volt DC 'Westinghouse' rectifier
- the 5 kVA, 240 volt AC, 50 Hz alternator driven by the 'Reader' steam engine via the rectifier.
- This number of charging systems is not necessary, but grew over the years as second-hand equipment became available.

24 Volt DC Supply

The 24 volt DC, 80 amp hour battery bank is an integral component of the diesel set and directly supplies:-

- the 24 volt DC diesel engine starter motor
- the triggering mechanism for the static exciter of the diesel driven alternator
- the 'Davey' water supply system in the garage

Charging the 24 Volt DC Battery Bank

The 24 volt DC battery bank is usually charged by an AC to DC rectifier type 24 volt battery charger. Alternate charging is made possible by way of a change over switch near the generator which switches on the 25 amp, 40 volt generator, driven by the diesel set cam shaft. An adjustment is made to the field rheostat so that, if the 24 volt battery bank becomes flat, the diesel engine can be crank started by hand and the generator used to recharge the battery bank.

Without a DC supply from this generator, the static exciter cannot be activated if the 24 volt battery is flat, disabling the generation of AC supply from the diesel engine driven alternator.

Initially, the boiler provided hydronic (hot water) central heating for the house and heating for the swimming pool.

Steam Power

The installation of a 'Reader' steam engine enabled the harnessing of electrical power, converting the thermal energy expressed as steam to DC electricity. It also reticulated the exhaust steam through heat exchangers to provide domestic heating and hot water and swimming pool heating. The 'Reader' steam engine originated in the bowels of an ex-Harbour Trust dredge, providing hydraulic power to the steering mechanism.

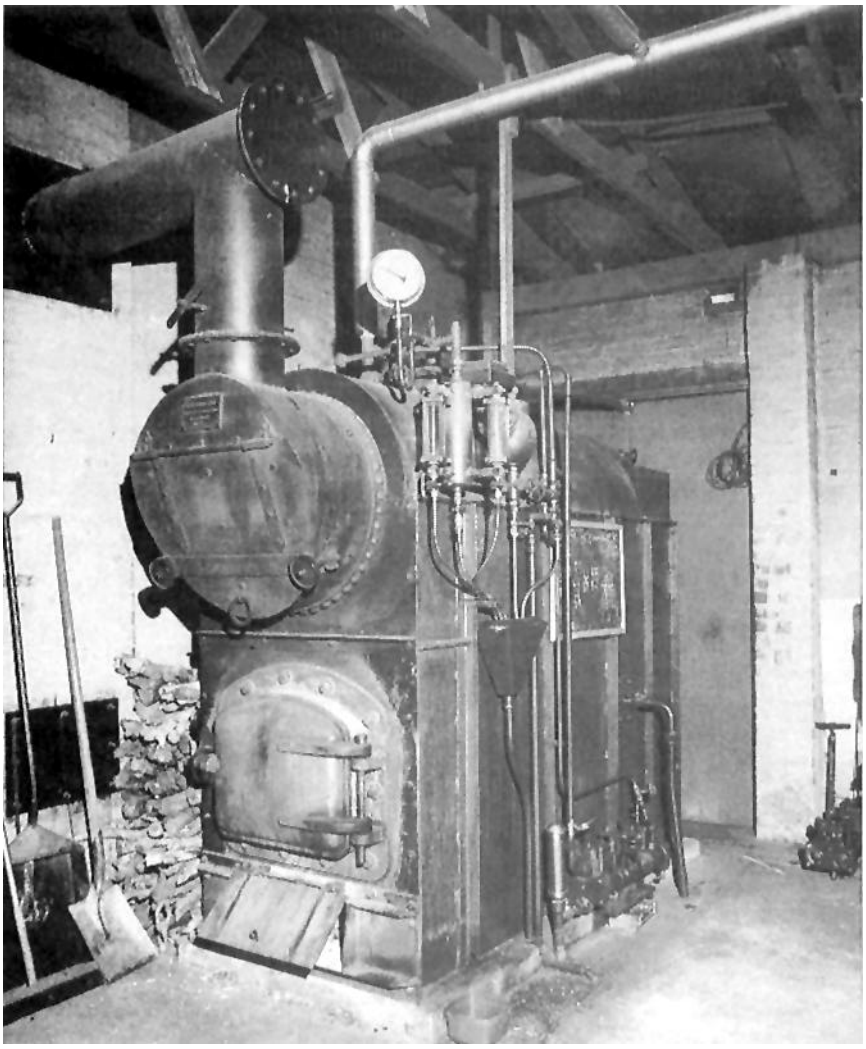
Another, smaller, steam engine, made by modifying a small, 2-stage air compressor, was installed, but because of water seepage into the crank case, Lou replaced it with his 'Steeple Compound' steam engine, which was a type commonly used in the 19th century. Lou designed the engine, made patterns for the castings, and made all the other components on the lathe he built as an apprentice in the 1920's. The 'Steeple' engine drives a 32 volt DC dynamo which charges the 32V battery bank. The engine exhausts into a condensate tank which houses two heat exchangers (car radiators), one of which heats the domestic hot water tank, while the other provides domestic heating.

Under winter load conditions, the boiler consumes about a cubic metre of timber per week, providing enough electricity to recharge the batteries and enough heating to last into the next day. In summer, the boiler is only fired up once a week to recharge the batteries and to heat the domestic hot water, so the consumption of timber is considerably less. Firewood is not the *most* environmentally friendly fuel source, but this system is economic and efficient. It is far more ecologically sound than the highly wasteful, highly polluting coal-burning generators supplying the grid.

House Heating

House heating is provided by a hydronic central heating system which

Photo by Adrian Braun



The boiler

uses skirting board heaters. The water flows through ¾" finned copper piping enclosed in the skirting boards. The water is heated either by exhaust steam from the steam engines in the garage or by manual control, direct from the boiler, via heat exchangers in the upper section of the condensate tank. It is circulated by a small electric pump.

Domestic Hot Water

Hot water for the bathroom and laundry is provided by a normal system, taking its water from a 100 gallon (455 litre) tank above the condensate tank. This hot water is heated in the same way as the water for the central heating system.

In case of emergency, a LPG bottle feeds an instantaneous hot water system outside the kitchen which can supply the whole house.

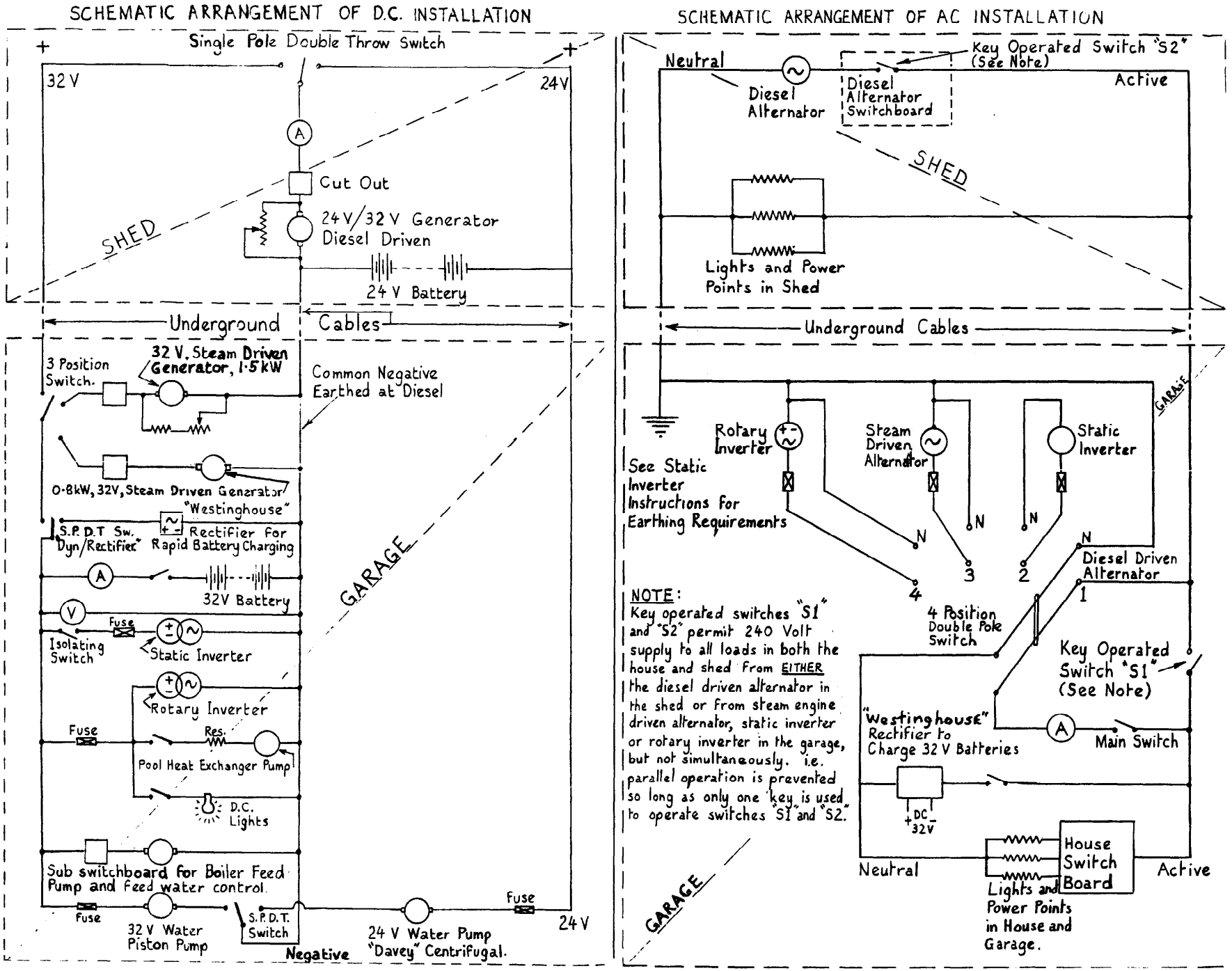
Drinking Water

Two 23,000 litre tanks, one behind the garage and another behind the shed, are used for drinking water. Both collect rainwater' from the roof catchments. Pumps enable the transfer of water between tanks.

The water is distributed to the taps by an automatically controlled pump and pressure tank. This system is activated by the incremental decreases in pressure caused by use of the taps. The main piston pump is driven by the 32 volt battery bank. An alternative pump is activated by the 24 volt batteries associated with the diesel generator set.

Swimming Pool Heating

The swimming pool heating is provided by a heat exchanger using exhaust steam from the 'Reader' engine or, alternatively, by steam taken directly from the boiler.



Circuit diagrams by Lou Osborne for his Alternating Current (AC) and Direct Current (DC) power systems. The DC schematic installation diagram is at the bottom of the page, and the AC is at the top of the page.

When the exhaust from the 'Reader' engine is used to heat the swimming pool, some of the exhaust steam also heats the domestic hot water tank. If the circulating pump is operating, it also heats the house via the house heating system.

Garden water supply

The garden is watered via a dripper system and standpipes, which are provided with water pumped by a 'Cooper' petrol engine driven piston pump located beside a dam in a gully some 70 metres below the house. A 1800 gallon (8183 litre) storage tank also provides a water supply when the pump at the dam is not running.

A portable 'Briggs and Stratton' petrol-driven centrifugal pump and an electric piston pump, both located in the shed, take their supply from the 1800 gallon storage tank.

These, and the 400 gallon (1818 litre) elevated galvanized iron tank, which supplies a reticulation system of stand pipes and drippers, form the garden's irrigation system.

Three-quarters of a gallon of petrol enables the 'Cooper' pump to give five hours of continuous watering.

Building on Success

It seems unlikely that Lou would build again from scratch. If he were to do so though, he said he would rebuild a very different system. When he began his system, the level of sophistication of solar, wind and micro-hydro systems was not as great as it is today, which is one reason why he discarded those options in 1975. Now, he would use a combination of solar and wind generators to supply heating and electricity, and a conventional wind pump to elevate water from a catchment dam to

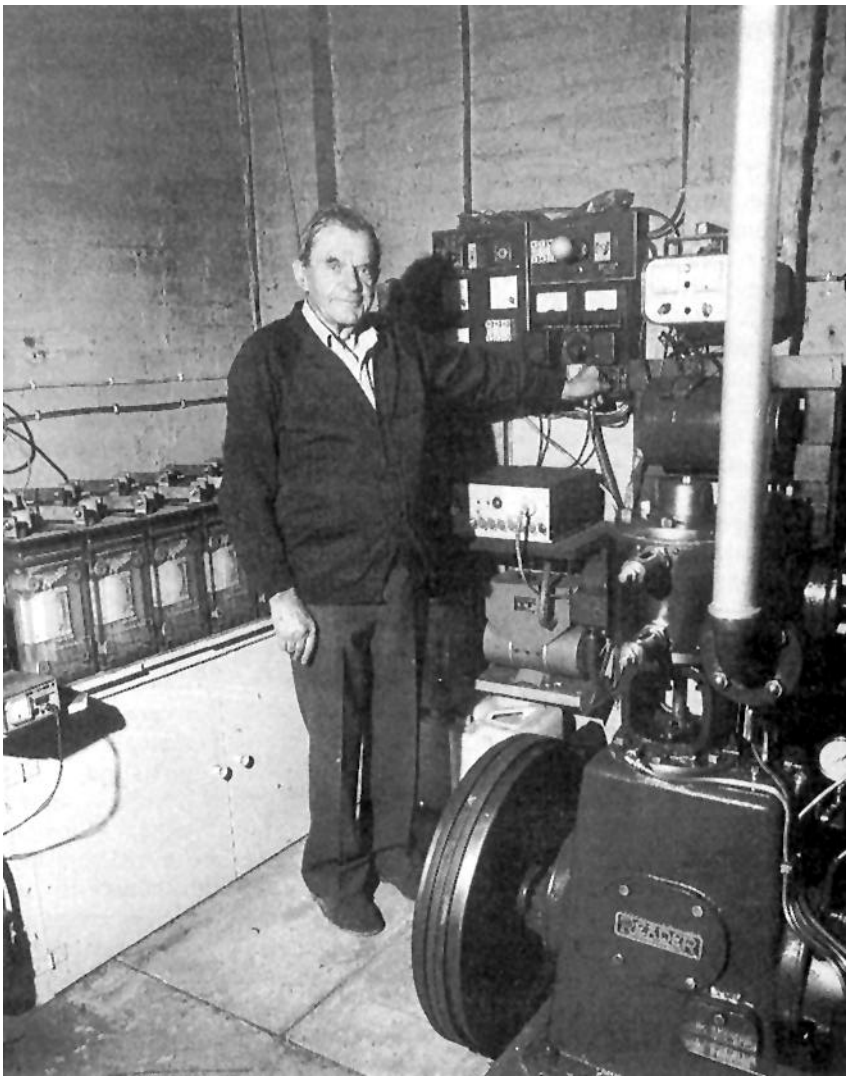


Photo by Adrian Braun

Lou Osborne with his Reader steam engine, batteries, inverter and control board

Technicalia

Here is a brief overview of the power, water and heating facilities installed at 'Warragai'. The system includes:

- ☼ A wood-fired multi-tubular boiler with automatic feed water control
- ☼ Steam engine driven electricity generating plant consisting of:
  - The 'Reader' steam engine, a totally enclosed automatic lubricating 6 inch bore 3½" stroke single cylinder. Operating speed: 370 r.p.m. driving a 1½ kilowatt 32 volt dynamo, and 4 kilowatt 240 volt AC alternator.
  - The 'Steeple' steam engine. A totally enclosed self lubricating high pressure cylinder, 2¼" bore, low pressure cylinder 4" bore stroke 3½". Operating speed: 250 to 300 rpm. Working steam pressure: 120 psi driving a kilowatt 32 volt dynamo.
- ☼ Central heating and domestic hot water supply, utilizing exhaust steam from the steam engines
- ☼ Back up diesel generating set
- ☼ Storage batteries
- ☼ Inverters to convert the battery voltage (32 volt DC) to 240 volt AC 50 Hz
- ☼ Rainwater storage tanks and associated pumps
- ☼ Garden irrigation

a holding tank, to run it back through a micro-hydro system whenever he needed power. This would free him from dependency on the 'weak link' in the system - the batteries. Since 1975 he has gone through three sets of batteries, one set lasting only twelve months. The present set is two years into the three year guarantee period.

One would assume that the 19th century technology employed by Lou would be inefficient and need a lot of maintenance. But he spends little time and money maintaining his system; half an hour a day is enough for setting up and shutting down the system. The system largely looks after itself and during its 15 year life, the only maintenance cost has been replacement of batteries.

As we walked around his garage, Lou related the stories surrounding every piece of equipment. The dedication that created a unique form of power generation points to an obvious love for his equipment, every piece lovingly restored, polished and precisely maintained. Obvious by its absence is any degree of chaos - often associated with enthusiasts - and the grime, billowing jets of steam and noise associated with steam engine rooms. Apart from the gentle whirring of steam engines and dynamos, the plant is exceptionally quiet, with no noisy exhausts. Lou's 'steam house' will endure for many years to come as a powerful inspiration to all those who dream of generating their own power, and a unique testament to one man's genius.

In an age where compliance to the power grid is an accepted norm, the generation of power and supply of water is seen more as an indication of eccentricity rather than a demonstration of ingenuity and self reliance. Lou Osborne's steam plant is more than this - it stands as a constant challenge and inspiration to anyone who has dreamed of complete self sufficiency. ☼

Coming Soon

☼

Micro Hydro buying guide

Solar in the City II: how to do it yourself

Build Your Own Solar Still

Big RAPS systems

Build Your Own Add-on Solar Greenhouse

Do It Yourself Energy Audit

☼

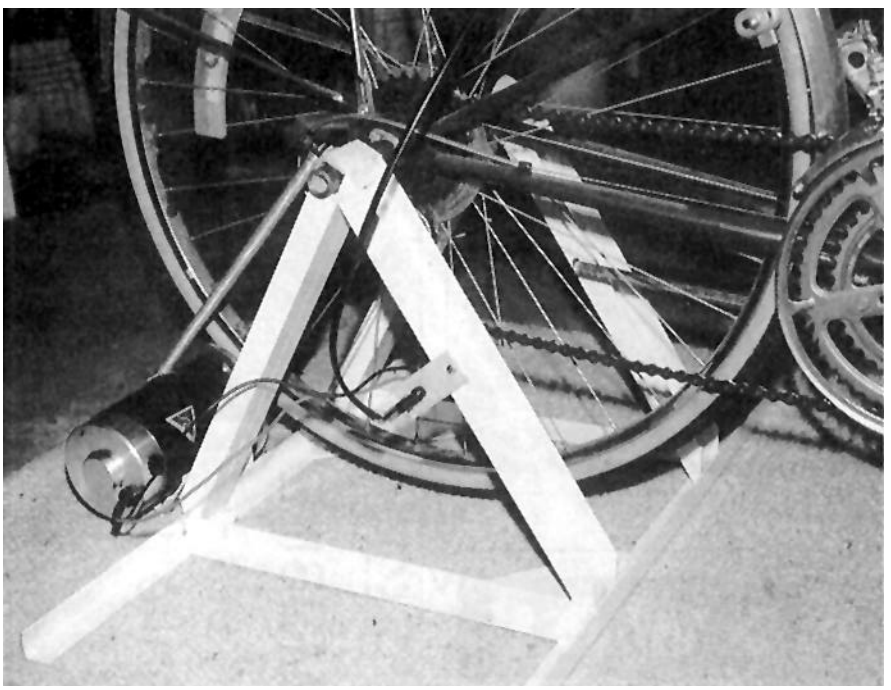
BUILD YOUR OWN
Pedal Powered Generator

Mick Harris

Generating power while you pedal a bicycle makes sense. Not only can you generate electricity to top up your batteries, but it is also a great way to get some exercise. Can you imagine the potential energy available from all those sweaty bodies working out in health centres?

Many home made bicycle generators are poorly designed, unstable and inefficient at generating electricity. But the one built by Peter of Melbourne (from the "Solar in the City" article, pgs 9- 13 in this issue) works very well. I test drove it myself and it's the best I've tried to date.

Peter started with an ordinary bicycle. He visited a bike shop and examined a standard, off the shelf, stand (which cost several hundred dollars). Faced with this incentive to ingenuity, he realised he could make his own with a few bits of steel and a bit of welding. The frame he made is basically two steel triangles welded onto a base frame, with two bolts clamping the wheel into position. The bicycle can be removed when it is required for use outside.

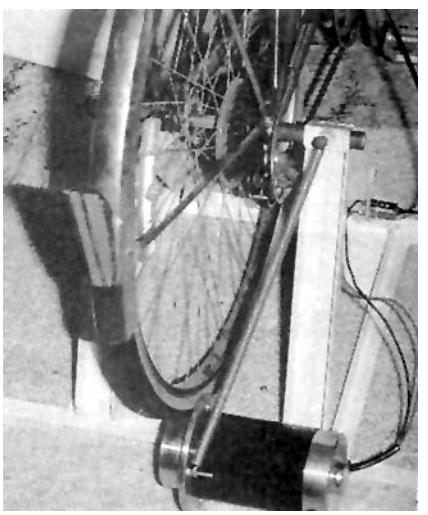


Construction details for the stand and generator mount. The stand is basically a copy of an off the shelf bike stand.

The generator was the critical part of the design. A 24 volt, ½ horsepower, permanent magnet motor was used. This motor was actually manufactured for use in small electric vehicles, such as golf buggies, and is likely to have an efficiency of around 80%.

Peter busy at work in his workshop.

Peter bought it from Electric Motor Power, in Bayswater, Victoria. The company was very helpful and, once the requirements were explained, was



A rear view of the bike generator with the aluminium contact wheel, generator and tension spring visible

able to help Peter to select a motor to suit the application.

The generator Peter used was probably oversized for the job, but is likely to give a lifetime of good service. The motor could also be used in a range of other applications. So, if Peter gets tired of pedalling, it may have a future as a wind or water powered generator.

These types of motors are expensive and you could pay $300-400 for a new one. But some hunting around electric motor, electric vehicle, or even scrap metal retailers could land you a second-hand equivalent at a much lower price.

An aluminium wheel which slips over the shaft of the generator was turned up on a lathe. This wheel is kept in contact with the bicycles tyre by a spring which maintains the pressure.

The generator was wired via a 15 amp diode to a small panel which sits on the handlebars. The panel consists of a voltmeter and ammeter. If you are using your bike to back up a solar power system, you need to fit a reverse current diode back at the solar panels to prevent the products of your hard work from disappearing as reverse current through your PV's.

The bike generator is connected into the electrical system by simply plugging into the nearest 12 volt power point.

A very fit person can produce 15 amps, or about 200 watts. The rest of us could generate between 2 and 5 amps (30 to 70 watts) continuously. This could be quite useful for a small system. It's also great for dinner parties. Invite some friends over and insist they all make their contribution to the evening's energy consumption before they eat. When they finally get around to the meal they are sure to be hungry! ☼

Set up and ready to go. All we need now is the dinner guests!

Just a Little Ray of Sunshine

THE JOYS OF A PASSIVE SOLAR HOUSE

When June and Dieter Plate began to design their home, they decided that they wanted a house which worked in harmony with the sun. They now live in a house which is attractive and comfortable all year round and which, best ***of*** *all, saves them money on their energy bills.*

June Plate

This is to give you some idea of the advantages of living in a passive solar house. I'm not connected with any builder or building company. I live in a wonderful house - just a little different from the conventional house - and I'd like to see others do the same, saving money and helping the environment.

Solar passive design

First, let's get some terms straight. The "solar" part of solar passive is simple. It means letting the sun work for you - for example, warming the house by shining in in winter.

"Passive" means that there are no moving parts to the system. An active solar heating system could involve forced air, oil or hot water moving along expensive pipes that eventually need replacing. They work, but they cost a lot of money to build. Things such as pipes on the roof to collect hot water, solar electricity generation and underfloor rock piles for thermal storage all require complicated control systems and are expensive to install. Our house is made of brick, wood, slate and glass - lots of glass to let in light and the winter sun.

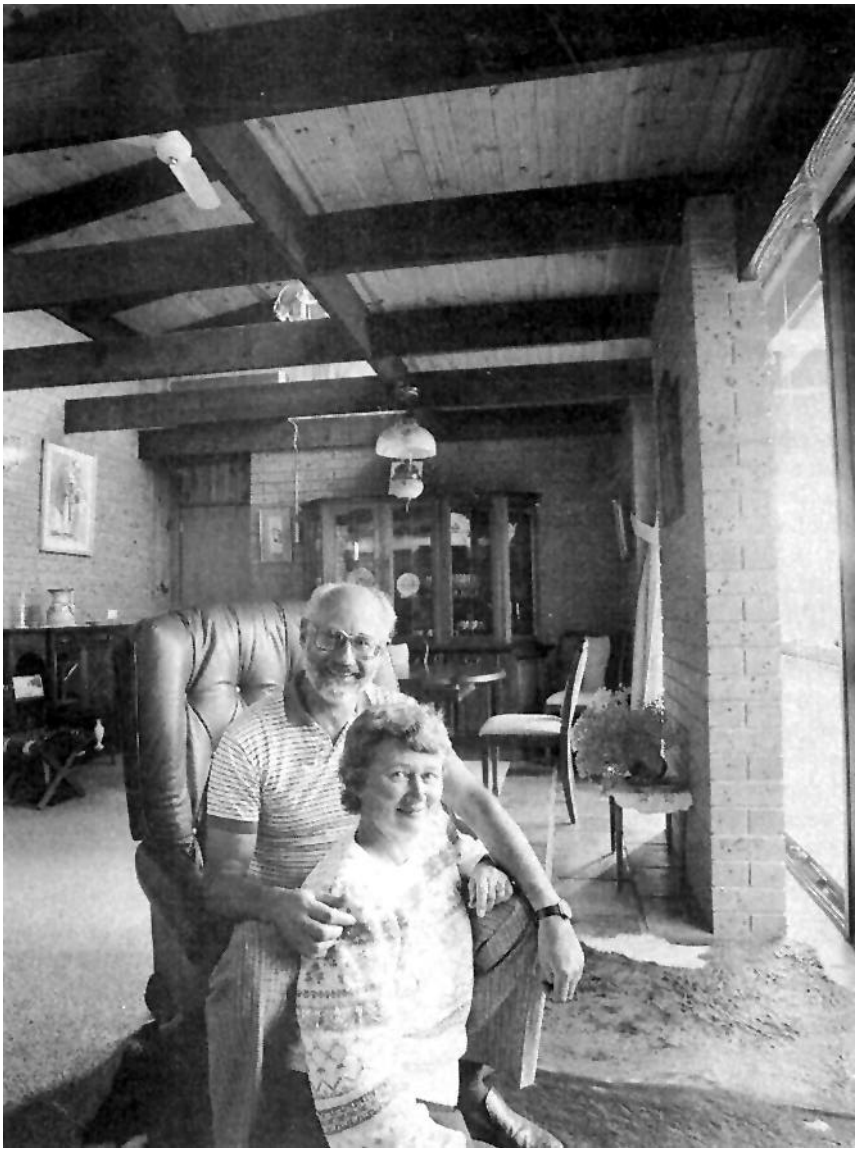


Photo by George Stawicki

June and Deiter Plate sitting in their lounge room near one of the brick, thermal mass, heat storing pillars inside the glass north wall

A passive solar design requires, first of all, large glass areas facing north, with correctly designed eaves to allow the sun to warm the house during the winter months, but to keep it out during summer. However, to make it really efficient it also requires lots of thermal mass and good insulation in the areas that are to be heated. Examples of thermal mass are slate covered concrete floors and brick walls and pillars that can store heat during the day when the

sun is shining and then slowly release it during the evening. By alternatively storing and releasing energy they prevent both excessive heating up when the sun is shining and rapid cooling after sunset.

A conventional house built in the 1960s had no eaves, no insulation and windows often in the wrong places and of one size. Compare this to the features of solar passive design:

- ☼ living areas with windows on the north side
- ☼ insulation in the outer walls, ceiling and internal walls around living areas
- ☼ eaves to utilise the solar arc
- ☼ use of deciduous trees and vines to provide shade in summer and let sun through in winter
- ☼ heat absorbent flooring
- ☼ thermal mass
- ☼ windowless west wall
- ☼ roof with full insulation
- ☼ north facing high-light windows, double-glazed
- ☼ lined curtains
- ☼ solar space.

The "solar arc" describes the movement of the sun throughout the year. In Victoria, in mid-summer, the sun rises south of east, climbs sharply to be nearly overhead at noon, and sets to the south of west. In mid-winter the sun rises to the north of east and travels low through the northern sky to set north of west. At the equinoxes (March 21st and September 23rd) the sun's path is between the winter and summer paths. The pattern changes as you travel north or south.

Why passive solar?

Why do we build houses? To make a comfortable dry place to live and store our possessions.

At its simplest, a house has four walls, windows, doors, a floor and roof. So where do most people go wrong with their designs? They put in their wants before they consider what their block of land has to offer.

Architects tell me that you can build a passive solar house on any block of land. There was a special subdivision in Melbourne where all the houses had "Solar Space" - it was free of high buildings and no tall trees were to be grown to shade neighbouring houses. Roads and lanes gave access, but they were not laid out in the usual rectangular pattern. Instead, they twisted and turned to get the best use of the land for each house.

Before we even consider the plan for a house, we stand on the site and observe the sun. What's the month? Where will those mid-summer and mid-winter arcs be? What's the climate like? What are the prevailing winds? It may help to talk to a few locals if you are new to the area. How many houses do you see on the south coast of Australia with balconies on the south side? Our prevailing wind comes from the Antarctic and is never warm - it's a chill wind, so all those balconies seldom get used.

Consider the slope of the land, drainage and type of soil. Once you know the placement of the services, then you can look at the view. It is possible to build a solar passive house with a view to the south. You can get the best of both worlds.

Planning

To plan your passive solar house, you first decide how many living areas you want. They are placed on the north side. We planned a three bedroomed home with a family and a lounge room with a kitchen in-between them. These living areas were the ones we wanted to heat and we designed them so that, apart from the north walls, they had all internal walls, which were nevertheless insulated. This gives more protection from the cold south winds. The outer walls are also insulated, as are all ceilings. There is a door between the kitchen and the lounge, for times when only one of the rooms is required. If you want to have an "open plan" house, a few sliding doors can save you money in winter by allowing you to shut off the areas that do not need heating.

The inside of the lounge/dining room, showing the way the pillars and windows look from the inside. Notice the dark slate edging on the floor near the windows for absorbing the sun's heat during the day.

Flooring should be heat absorbent, such as slate or tiles. In the living room we compromised and put four rows of slate along the north wall to capture the heat of the sun and carpeted the reminder of that room. The family room, kitchen and wet areas are all slate.

Inside out walls

The best feature of our house is the combination of a completely glass wall facing north with solid double brick pillars built about 20cm inside the glass (see the photo of the cross-section opposite). These supply thermal mass as well as structural support. They absorb

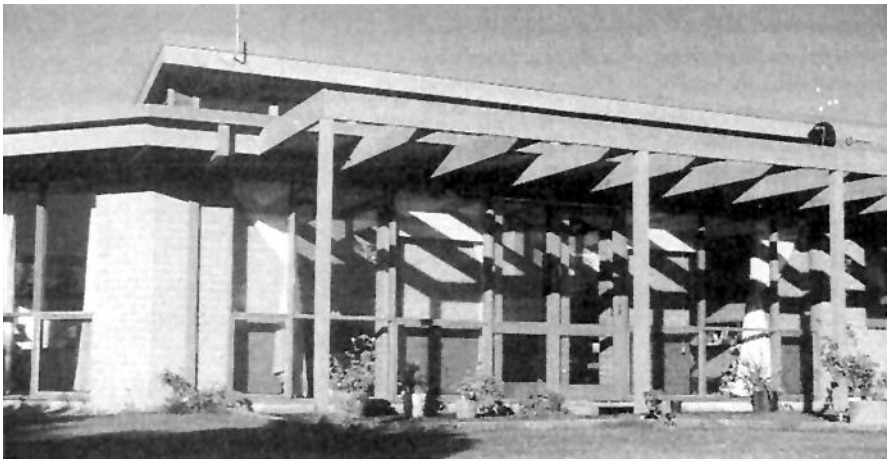
the sun's heat on a sunny winter's day - we get quite a few! Half a day of sunshine in, say, July, will heat the pillars so well that we do not need to turn on a booster heater - they act like a heat bank.

The family room has one pillar, 5 bricks wide and 2 bricks deep, filled with mortar to give the heat transfer, and two side pillars, 3.5 bricks wide by 2 bricks deep. The lounge has two main and two side pillars. The gaps between the pillars form the door spaces and windows. Fixed between the pillars and glass are roller blinds, with lined curtains covering the remaining windows and doors.

These brick pillars are variations on the idea of Trombe Walls, an idea originally from the United States. A Trombe Wall is a solid wall inside a window which provides a thermal mass heat store. We liked the concept, but did not appreciate losing our view, so we came up with the idea of making gaps in the wall for doors and windows - hence the pillars.

Another interesting feature of the house is the west wall of the other bedrooms. This is windowless and "reverse" brick veneer. When you think about it, conventional brick veneer, while it does have some advantages with respect to maintenance, is not very good from an energy efficiency point of view. Brick has high thermal mass, but is a poor thermal insulator. Wood, by contrast, is a good insulator but has very low thermal mass. An energy efficient wall should have the thermal mass on the inside and the insulation on the outside - and that is what we have done on the west wall. We have an insulated, cedar lined stud wall on the outside and a brick wall on the inside, and it is surprising how even it keeps the temperature in these two rooms.

The rear (internal) wall of the lounge is also brick, to absorb the heat through the clerestory windows that run the length of that room, midway across it. These high windows are double-gazed so that they did not need curtains. Even six years ago, the cost of remote controllers was prohibitive in a low cost house. Remote handles for the four opening windows were priced at over $200 each. We use a light ladder.



The north-eastern end of the house, showing the brick pillars inside the windows. Notice the holland blinds between the bricks and the glass on the two central pillars, and the curtains pulled back to let the sun onto the bricks.

The house has a flat roof supported by exposed beams throughout and the ceilings are lined with pine.

Dealing with windows

Some people say they don't want curtains. They cost too much, hide the view and are not necessary. But, if you look at the statistics and graphs that Energy Victoria (or the equivalent body in your state) publish, you might be persuaded to think again. Better still, on a cold winter's night, as you lock up to go to bed, pull back a curtain or put your hand near the window and feel the coldness seeping through the glass. There is a huge loss of heat in winter in a room without adequate curtains. By that I mean heavy material that traps the air and stops the warm air reaching the cold glass. A good quality lining completes the barrier. Sorry, no Venetians according to my research. The criterion is "does it form a barrier?'. I ended up with a variety of lined curtains and roller blinds. Pelmets are also necessary. Trying to be true to the Passive Solar principles does restrict you in certain cases, curtains being one. But when I look at my electricity account and hear what others have to pay, I gloat.

Saving money

As a matter of interest, I give in the table over the page the figures for our electricity bills for the two years after we moved into the house. When you look at these it is important to realise that we 'have a fully electric house, including our heating (reverse cycle air-conditioning).

Note that there was a price increase in the second year - our usage went down, but the cost still went up!

It is hard to find comparative figures. The S.E.C. has lots of information on how to save money using its products, but I struck a blank when I asked if there were average figures for the electricity consumption for various sized households. A lot can be learned, however, by comparing our electricity usage figures for the summer and winter quarters - the difference is remarkably small.

The hot water cost is reduced in summer because we have a solar hot water system (with an electric booster). It is excellent, but the initial cost is too high. At installation, we paid an extra $1000 difference between it and a normal electric system. The solar collectors help in winter, I'm told, but again it is difficult to get figures. At even $30 per year saved, it will take 30 odd years to recoup the cost. How long will the system last?

When we first moved into the house we had a reverse cycle air-conditioner in the family room and no heating in the lounge. Nevertheless there were many winter days where we had enough sun during the day to keep the lounge at a comfortable temperature all evening. On the overcast days we found we

	Units	$	Units	$	Units	$	Units	$
	Mar 87		*June 87*		*Sept 87*		*Dec 87*	
General	980	99.74	1180	118.37	1420	141.14	790	87.63
Hot Water	150	4.71	460	14.44	580	18.21	50	1.63
		104.45		132.81		159.35		89.26
	Mar 88		*June 88*		*Sept 88*		*Dec 88*	
General	930	100.30	1160	122.41	1270	133.37	750	86.43
Hot Water	90	2.93	460	15.00	530	17.28	130	4.35
		103.23		137.41		150.65		90.78

could easily keep the 32m^2 room warm with a little 2kW electric fan heater. Obviously the insulation was working!

The low energy requirement did limit the type of heating we could install. We had considered a slow combustion wood heater, but these become energy inefficient and polluting at the low heat outputs which we require and a pot-bellied stove required too much attention. We finished up installing another reverse cycle air-conditioner. They are expensive to buy, but very energy efficient and cheap to run. You put in 1kW of electricity and get out 2.5kW of heat - I still don't understand how that works! *(It works because the air outside the house always has some heat in it, even on cold days. The 1kW of energy is used to gather up the low-grade heat from outside, concentrate it, and dump it on the inside, where you want it. It is the same kind of process which collects the heat from the food inside your fridge and dumps it on the outside through the condenser. Ed.)*

Results

I think I've covered most of the differences between my dwelling and the normal home. A house is not something that just appears at the waving of a wand. These days it costs a lot of money, and even with lower interest rates, you still pay many tens of thousands in interest before the mortgage is paid out. Building with passive solar principles you might not save money in the building (ours cost the same as a conventional home to build), but you certainly save on the running costs over the years.

Besides, it has such a wonderful atmosphere - plenty of light, and stable temperatures all year 'round.

As we see it, the main benefits of passive solar housing are:

- ☼ savings on heating costs
- ☼ stable inside temperatures
- ☼ savings on heating costs can be used to pay off the mortgage.

Once passive solar principles are incorporated into the design, your house itself becomes the heater and cooler. But, passive solar principles are design features, not appliances or decorations.

There are plenty of more extreme passive solar techniques, such as walls made out of bottles filled with water, drums filled with water and water-filled aluminium cans. Whilst they work quite well, they do not need to be used to follow passive solar principles.

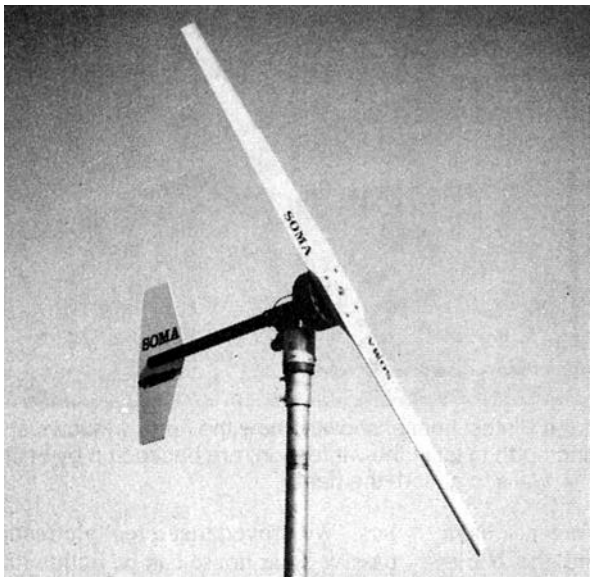
Conclusion

If you build a home or an extension, please think about what I have said. Don't just plonk your house on your block. I hate plonked housesbecause they are usually anti-solar. Read about solar houses - the newsagents have magazines for $5.00, and the bookshop, libraries and Energy Victoria (or equivalent in your state) all have lots information to start you thinking.

A cross-section model of the Plates' house, showing how the north windows and clerestory windows, facing north to let in the winter sun, are backed up by brick walls to absorb the heat.

What really annoys me is that I have been enthusing about passive solar for six years and I have never convinced anyone to build that way. A few people have used some principles - siting, eaves and insulation. I'd love to see someone else use the thermal mass pillars. We proved that a really effective passive solar house can be built with a view and look like a conventional house.

I never knew about solar houses until twelve years ago. It is obvious that I'm converted. It's never too late to learn. In winter, on a sunny day I work or relax in my solar-heated home and think, why aren't all houses built like this? ☼



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Drumming Up Biogas

Callum Morrison

Just when you thought all the biogas enthusiasts had blown themselves up or died of horrible diseases like gas gangrene or tetanus - biogas returns to the pages of *Soft Technology!*

Though biogas is environmentally friendly and can be classified as "soft" technology, close examination reveals it is the "nuclear" of the alternative technologies and should only be experimented with by experts.

Biogas has that distinctive 'rotten egg gas' (methane) odour to warn us of its deadly aspects. Not only are there the deadly bacteria to watch out for, the gas itself is extremely corrosive and often eats its way out of containers. Biogas can cause suffocation and should only be approached with a canary at arm's length as they used to do in coalmines. If your canary does fall off the perch, don't panic and light up a smoke or cause a spark because biogas is also explosive. To top it off, under the right conditions you don't even have to light it because it can spontaneously combust into St Elmo's fire.

With a write up like that nobody is going to be crazy enough to experiment with it, but here is a disclaimer clause anyway !

The author and the Alternative Technology Association Inc. accept no liability from the use of the following information. This article is for general information only. If you live in Victoria and are interested in developing this technology, let the ATA know, as they are trying to set up a group of members interested to experiment with a safe and practical experimental digester at the solar workshop in Brunswick.

In Brief

In short and simple terms, I began this project by stuffing my compost heap and any other organic material (the smellier the better) into a drum. I covered this with water and allowed it to get really smelly, so smelly that I could light the gas which bubbled out. I then repeated the process with several more drums. Some of my drums continued to produce gas for over a year without being fed. Not enormous quantities, but each drum of organic matter makes a drum of gas every four months or so. To make a larger quantity of gas,

The picture above shows Callum using his biogas in a manner we do not recommend!

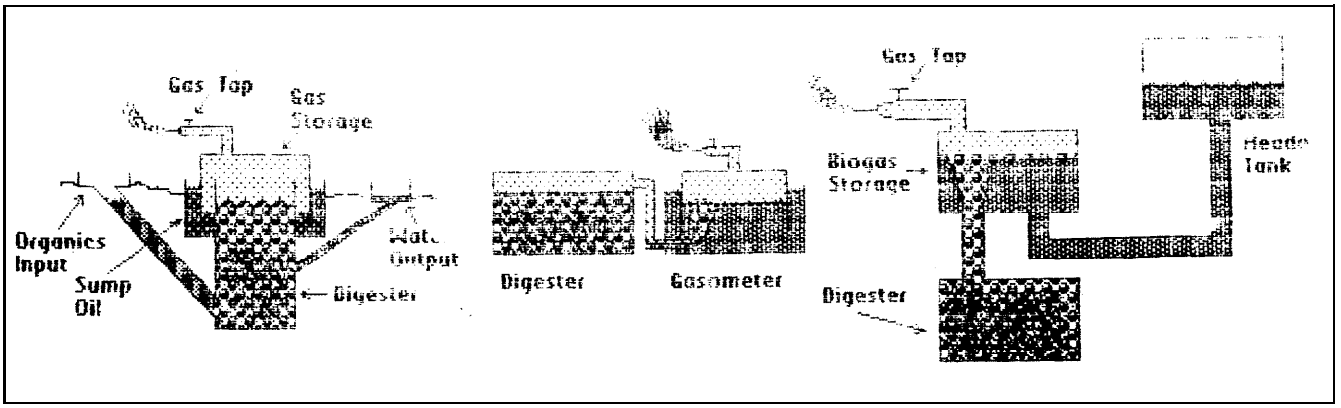


Fig. 1. Original digester design with overhead gasometer

Fig. 2. Modern digester with gasometer

Fig. 3. Digester with "hydro-gasometer storage"

you simply need more drums, space and fuel.

When the gas stops coming out, the liquid containing the flatulent little bacteria is drained into another newly filled drum full of more food for them. The solids or sludge of the old drum are left to drain and dry out. The sludge fills about two thirds of the drum and stinks to high heaven, but rotary composting converts it to the sweetest smelling compost in a few weeks. Each 200kg drum of household organic waste produces several concentrated buckets of fresh smelling compost and three or four drums of biogas.

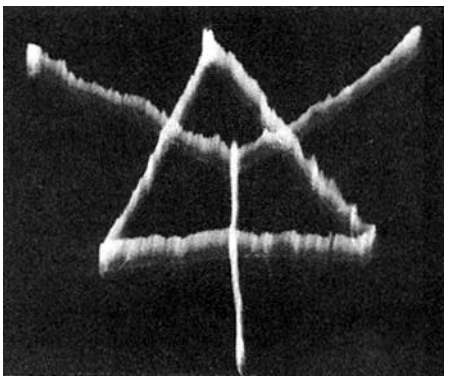
Why Biogas?

Most environmentally friendly neighbourhoods are able to have some success recycling glass, plastic, aluminium and paper, but how effective are we at removing organics from our waste streams? You might manage to compost some of the organics and collect the nutrients but the energy is lost. The majority of people fill half of their garbage bin with organics and send it off to landfill. If you are very lucky your local landfill may be constructed to collect the biogas energy released, but the nutrients lie there locked up in a toxic cocktail.

Rather than transporting half a garbage bin of organics to landfill each week, wouldn't it be better to put this in a separate container to feed a neighbourhood methane digester? A good day's weeding of the garden is enough to fill a 200 litre drum, but on average, the organics put out in the garbage bin of an average household would fill a drum in one to two months.

Another application for this technology may be in national parks in place of septic systems. One sheet of newspaper is used per "crap" (I think that's the official S.I. Unit) which is then rolled up like a bonbon and posted into a drum. Each drum could accommodate at least 200 "craps" and then be hooked up to a digester bank. This would then provide lighting and maybe even heating for the toilets. Imagine having warm water to wash your hands and other improvements to sanitation, like the protection of water supply. Excess gas could be used for cooking and the compost be used to grow plantation fuel to supplement the bugs' diet of faeces, urine and food scraps.

The immediate sanitation advantages may also be useful for the disposal of wastes in emergency public health management for crowds of displaced persons - or other, similarly crowded, situations. Chemical toilets are not always available but 44 gallon drums and newspapers are cheap and common.



A symbol of an alternatively powered future?

In developing countries many people have become dependent on old digesters which have not advanced in design for many decades. Any improvement 'in design or performance would mean a lot to these people and the environment in general.

The advantages of community biogas systems look obvious but so do the problems. Time for some applied soft technology !

The Bugs with Biogas

A whole series of problems present themselves when trying to develop a useful biogas system for processing community household organics. My objective is to try to make and demonstrate the full potential of a safe, user friendly and practical western community biogas system. Quite a challenge, but also a lot of fun.

I am in the process of upgrading the design of a primitive village digester model used in India and China, where they provide valuable energy and nutrients from organic wastes. It appears to me that if the western world is going to become more environmentally friendly, then we are going to have to use more advanced biogas systems and processes. The first steps towards this are advancing the old village type digesters up to western safety standards and then demonstrating the use of this technology to western society. Once recycling household organic waste is demonstrated to be successful on a small scale, I am sure industrial scale units would make much better use of

western household organic waste streams. Advanced, cheap and simple design of many different sizes and applications could then be exported back into developing countries to encourage the use of this environmentally friendly technology.

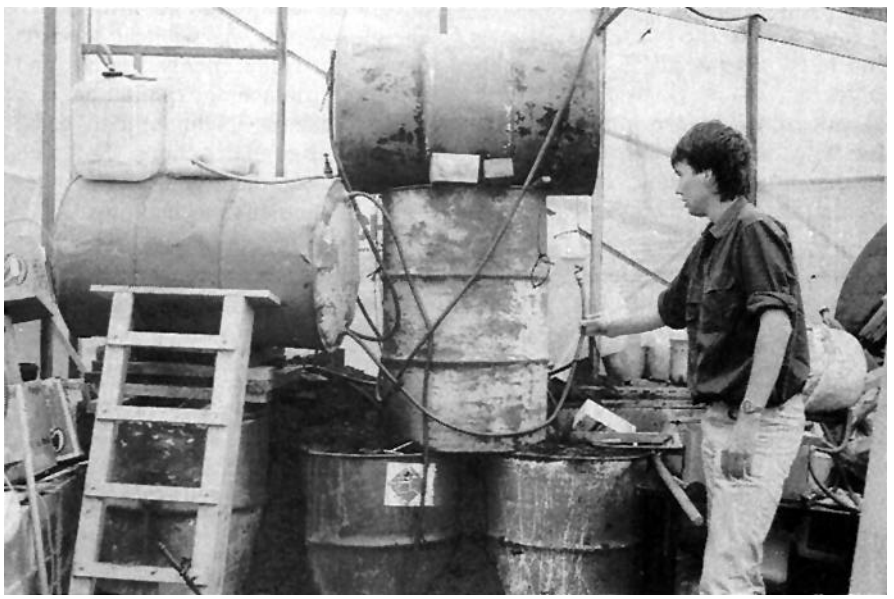
The traditional Indian or Chinese digester makes wonderful use of the technology and materials available, such as mud and straw, but the designs have several health and safety problems. These are tolerated in developing countries because they actually improve sanitary conditions, but in the west they would be a health and safety nightmare.

So far, in my attempt to westernize this technology, I have ended up with a batch system based on 200 litre (44 gallon) drums. The batch system has the advantages of being cheap and simple. It still needs proper health and safety assessments, as well as further performance trials, but I think it will be useful for demonstrating biogas generation from household organic waste.

Ironically, most of the materials used to build my digester were recovered from the local landfill. All I had to purchase was some poly watering system 'T' pieces, taps and hose joiners. I filled each drum with assorted organic material from around the hobby farm with no attention to the carbon/nitrogen ratios normally of concern to composters. Thistles, assorted manures, food scraps, snails, weeds and dead snakes from the side of the road were all posted into each drum through the large bung hole. The drums were packed so tightly it only took a few buckets of dam water to fill them and exclude the oxygen. Each drum was then connected up to my "hydrogasometer".

The writing is on the...air?

I developed the "hydrogasometer" from scratch and have been unable to find anything similar in biogas textbooks. The concept is extremely simple and was developed out of frustrations with conventional floating gasometers. It is basically a conventional gasometer with a few modifications so the water moves, instead of the floating drum - so there are no moving parts. The gas is trapped in an airlock and -stored under pressure from a header tank. It has several major advantages over the old gasometer but it still has not had proper safety assessments.


Callum with his prototype methane generating system made from 44 gallon drums.

Trials

Unfortunately I was unable to monitor how long the system took to start or exactly how much gas was produced. On average, each drum produced about twelve litres of biogas each week for well over a year without any refuelling. Some drums were more active than others at different times. Based on the performance of my pilot plant, 28 drums (4 rows of 7) would provide about one drum of gas a day. This is enough for the cooking needs of one extended Chinese family using a little wok, but I have not tried to run an Aussie B.B.Q. yet. Cogeneration (the gas bottle) may be necessary.

When gas production stopped the liquid was drained out and used to seed a new drum of fuel. The solids usually settled to one third their volume and were left for a week to drain and dry. The drum was then transferred to a rotary compost bin, in which the foul smelling sludge was transformed to several buckets of fresh earthy compost.

The importance of feeding the drums a balanced and well-chopped diet became very obvious the other day when I opened a drum closed for eighteen months. If found a squashed snail so

well preserved that it looked like I had put it in there yesterday. Gas was generated for a while, but then this drum had mysteriously pickled itself. It might have been overfed, or some toxic weed could have released some antibiotic which killed all the flatulent bugs, or maybe the non-farting bacteria had had enough and mangled the methanogenics!

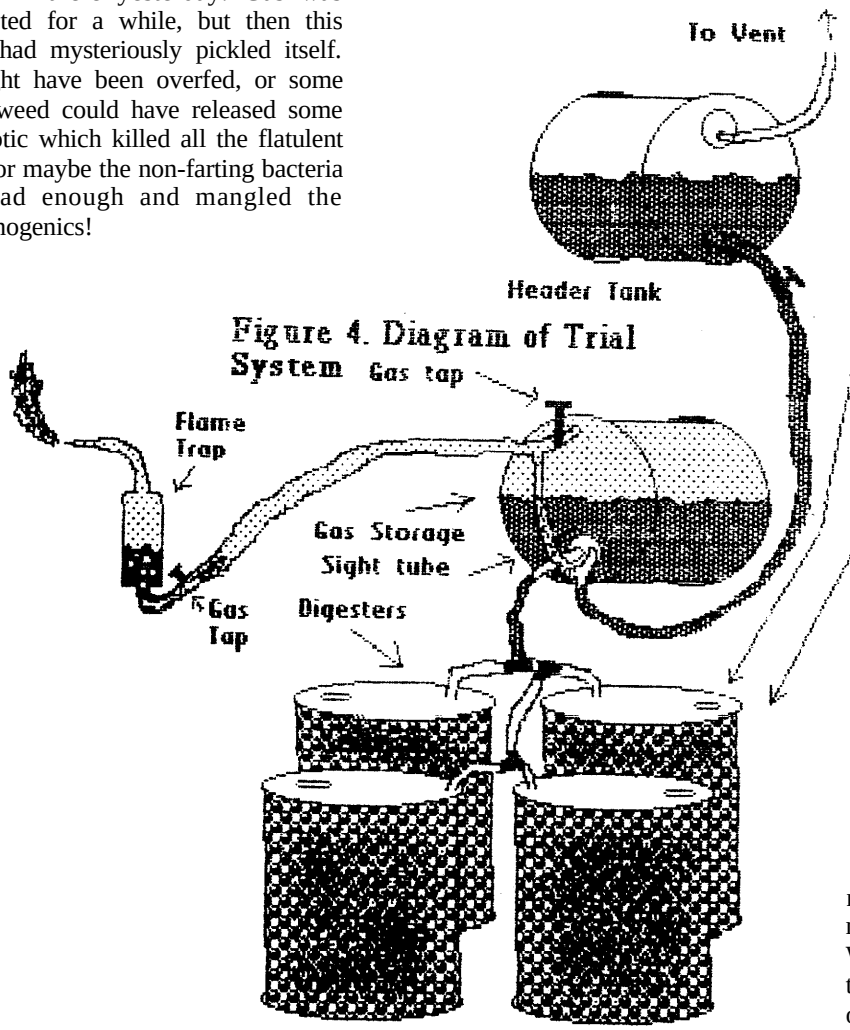


Figure 4. Diagram of Trial System

Drums were rammed with dog faeces, dead animals, 2 trailer loads of thistles, garden weeds and assorted animal manures over a year ago and fed nothing since. A drum of biogas is produced every 2 to 3 weeks for over a year.

Biogas Bank of Digesters.

My prototype was so rough and abused that I am sure major improvements in performance and application can be made. By taking care with the carbon/nitrogen ratio, pH levels and chopping and mixing of fuels, I hope to reduce the refuelling frequency to yearly and boost the volumes of gas generated. Using plastic drums with larger bung holes will also help.

I am excited by the prospect of integrating the digester into greenhouses. Plastic drums of liquid could act as thermal mass, warming the plant trays at night and raising them to workbench height.

I think I am on the way to demonstrating how useful some soft tech biogas technology may be. I have constructed the basic prototype but more trials will have to be run in order to get some accurate performance and safety assessments.

It's only when you dabble with alternative technology systems that you realise just how much energy Westerners use and waste. Just getting together the energy to run the simplest of household appliances is often an enormous challenge to alternative energy systems. As we head towards the end of finite energy sources and finite environmental exploitation, it is going to pay for neighbourhoods to be more aware of their actions. Soft tech biogas will be there with all the other forms of alternative technology. ☼

Micro Hydro in the Rainforest

Neil Cowin

Deep in the rainforest of 'Kolombangara, a cone-shaped volcanic island in the Solomon Islands, a micro hydro system is serving the electricity needs of the village of Iriri.

It was installed by APACE, a group of Australians whose charter is to develop environmentally and socially appropriate technologies, and who specialise in micro hydro.

Most of the island's rainforest was clear-felled in the 1970s but the Voko people, who live in Iriri village, refused to allow logging on their land.

Instead, the Voko maintained that the forest resource was theirs to use in a sustainable way, by small scale forestry and value adding. Ten years on, the Iriri community derive income from such forestry, and at the same time their land remains the only sector of the island still of international botanical significance.

Environmental issues

The world has become familiar with hydro power through the enormous schemes which tap the power of waterfalls and large rivers. These big hydro schemes use renewable energy, but can come at a high environmental and social cost. In the developing world the trend to huge schemes has resulted in people being displaced from their lands to make way for the enormous lake created by the dam, and environmental costs associated with fundamental changes to the river flow.

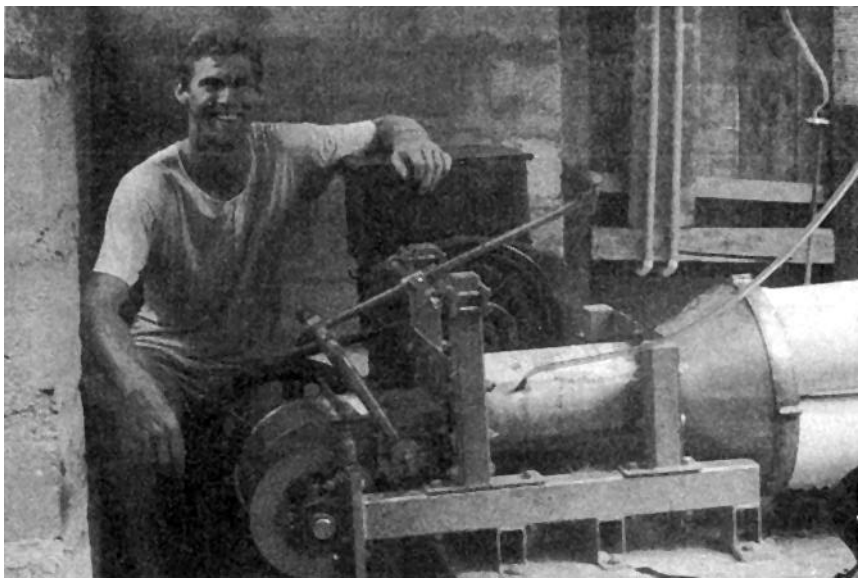
In the last 20 years, there has been a trend back to the original idea of water power - small village-size systems on small rivers that provide just enough power for local people. These micro hydro systems not only avoid the damage associated with the big schemes, but can actually have a positive impact on the local environment.

Villagers tend already to use electricity in the form of disposable batteries to power radios, torches etc. These contain mercury and are often disposed of in such a way that they are a significant hazardous pollutant, e.g. disposal in the lagoons from which people catch fish. The use of such batteries can be expected to decline with hydro-powered village electrification, because it is cheaper from the user's point of view to use the hydroelectricity. The weir required for the hydro has no erosional effect on the watercourse; rather it is similar to the checkweirs used on streams for erosion control.

Social and economic impacts

In contrast to petrol or diesel generators, micro hydro electric systems do

The photo above shows some of the villagers measuring the weir flow of their system.



Ian Scales, a member of the APACE team, (and ex editor of Soft Technology) pictured with one of their micro hydro turbines in Kolombangara this year.

not require ongoing outlay, for fuel and the consequent temptation to non-sustainable resource exploitation.

Appropriate technology transfer can prevent excessive exploitation by providing alternative income sources managed by, and for, resource owners.

One key reason for the "environmental friendliness" of APACE systems is that the building of the system is largely done by local people, who also have input into the design - particularly the dam, pipeline route etc. The local people often know what environmental effects are involved in different options, and as far as we have experienced, usually favour a low-impact choice of options. In addition, the limited amount of time people have to spend on building the systems precludes schemes that require large earthworks, dams etc. Locally available materials are used in preference to imported or purchased materials where possible, mainly for ensuring replaceability, but also to minimise environmental impact.

A typical APACE system

APACE micro hydro systems are built to provide lighting and small scale power for local industry. Typically the system will generate about 5 kilowatts (5kW - about 7 horsepower), enough to service basic electricity needs in a small village of, say, one hundred people. The technology can range to over 100kW but such a capacity would rarely be justified in rural contexts.

First, a site on a stream near the village is found for a weir. Ideally the river neither runs dry in dry seasons, nor is it so big that it is hard for a small weir built with basic materials to survive floods.

The weir is built on about the same scale as a big log caught across the river and is usually made with rocks put inside big, strong wire baskets called gabions. Then a wall is put inside the weir to make it waterproof. Usually it is both difficult and inappropriate to close the stream off completely; there will always be some leakage to sustain downstream river flow.

That proportion of the river trapped behind the weir is taken off either through pipes or an open channel which is built to accept just enough water for the hydro to use, so that excess flow and floodwaters continue down the river and do not affect the system.

APACE systems are run-of-the-river; they do not store water in a dam. In dry seasons the power from the hydro falls off, because there is no water stored up from wet weather. This design is simple to build and no dam means not having to disturb the watercourse significantly.

After the intake, the water either travels along a canal that threads around the hillside for up to 500 metres, or goes straight down a pipe to the turbine. A canal is a very cheap way to take water a long way, and is very useful if the river being used does not fall very much. Hydro systems work best if there is a lot of vertical height between the weir and the turbine. If the canal travels along almost level around the hillside, while the stream is continually falling, eventually there will be quite a drop from the canal to the turbine. Then the water is carried in pipes from the end of the canal down to be fed straight into the turbine, where it squirts onto the turbine blades and spins them around. If a canal is used, it is typically about 1 metre across and 0.5 metre deep. The pipes used are six to nine inches in diameter.

The-turbine shaft is connected to a generator which provides electricity at 240V. All this happens inside the 3 by 3m turbine house. The water from the turbine is fed back to the river through a tailrace. Nothing else happens to the water - nothing is put into it, and nothing is taken out of it. All that is used is the energy that is released when things fall to the ground - the same energy you would feel when you stand under a waterfall.

From the turbine house the electricity is taken in wires to the village. This might be up to 3km away, but usually it is much closer.

When the electricity gets to the village it goes first to a switchbox that includes a variety of conventional electrical components wired for extreme reliability and repairability. There are also particular safety design aspects, including Earth Leakage Circuit Breakers that obviate the possibility of electrocutions. An Electronic Load Controller automatically regulates the power. From the switchboard, which is put inside a locked shed called the power house, the electricity is run underground around the village inside tough conduit.

Each of these components of the power systems has experienced an evolving design process over ten years of site operational experience, and incorporate a myriad of detailed design modifications aimed to enhance environmental, technical and economic sustainability. ☼

SOLAREX
SEPTEMBER ISSUE No.2

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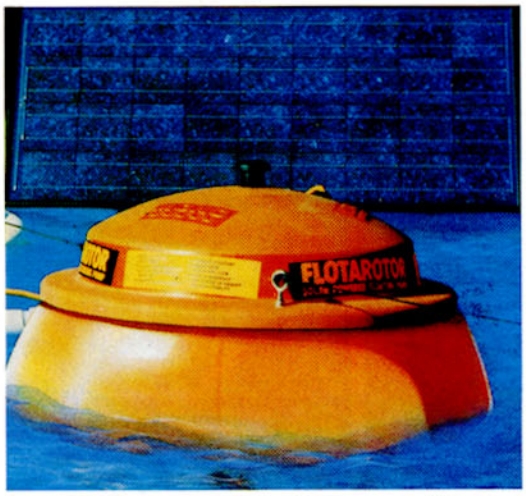

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SUBMERSIBLE PUMP suitable for deep wells and bore holes, or as an alternative to the floating pump where a larger volume of water is required and/or higher discharge heads are encountered. Constructed from stainless steel, both the pump and the motor are available to suit most requirements.

BASE PUMP this pump is normally located near the water source or in line in the case of transfer pumps. It includes a wide range of systems from small domestic water pressure pumps to large positive displacement and helical rotor type pumps.

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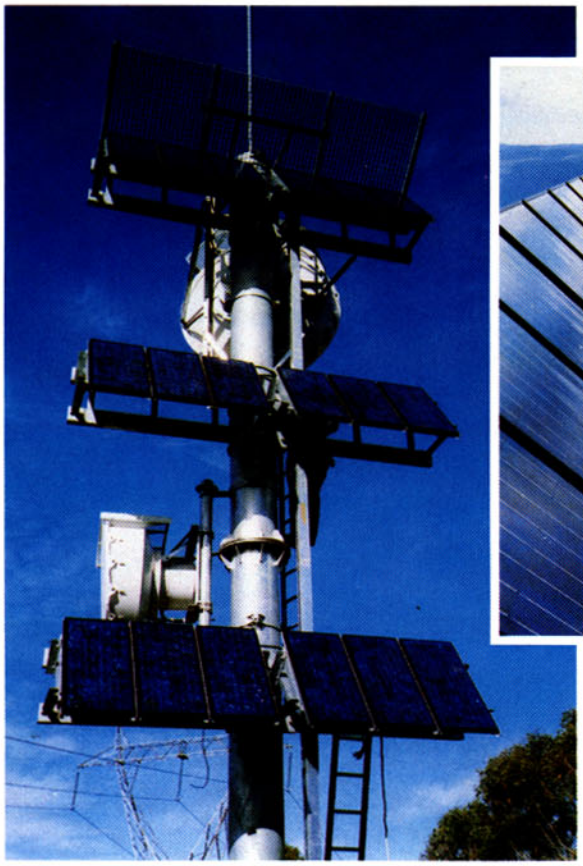
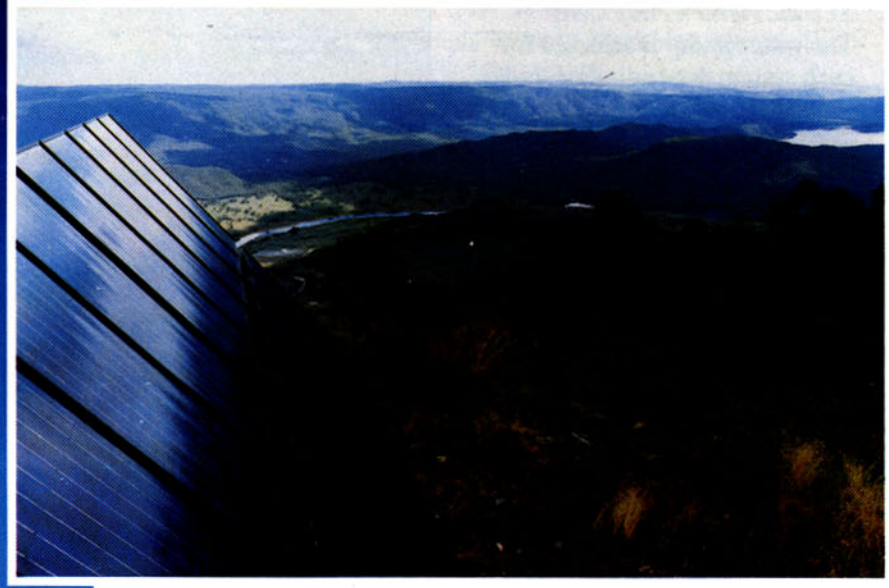
Solarex systems were installed and commissioned on four mountain tops within the Authorities operational charter and these systems are remotely interrogated from the Cooma base station via telephone modem links coupled to the Solarex microprocessor solar regulators installed at the sites.





The need to eliminate noise and other pollution generating power devices were the prime concern for the authority whilst still maintaining an optimum source of reliable power in these remote areas.

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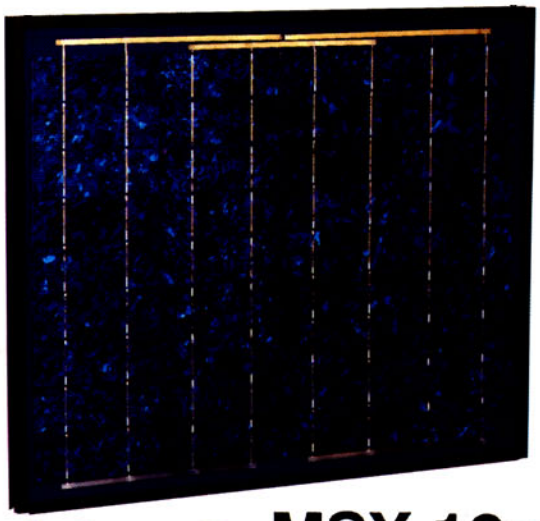

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Feeling Warm Inside

CENTRAL HEATING WITH HOT WATER

In the last issue of Soft Technology (No.44) we looked at providing household hot water from a combustion cooker. In this article, we continue the hot water theme with hydronic central heating.

Andrew Blair

There's nothing quite like central heating for giving a house a special feeling of cosiness in winter. It's handy, too, because with central heating you can heat a large area from one central point.

Hydronic heating systems use hot water to transfer heat from a boiler to radiant heaters in each room. It is also possible to heat a concrete floor this way, using pipes set in the concrete at the time the floor is poured.

The boiler in the heating system can be fired with a variety of fuels, but since many people who use alternative technology are interested in heating using firewood, this article will concentrate on this method.

Sizing the system

Heating systems work by replacing the heat that is lost to the atmosphere through the floor, windows, ceiling and walls of a house. To work out an appropriate size for a heating system, the householder needs to calculate how much heating capacity is required to replace the lost heat and maintain a comfortable temperature inside the building in the coldest weather.

A rough way of deciding how much heat is required is to know the size of area to be heated. A house of 150m^2 (a bit over 15 squares) will require about 15 kilowatts (15kW) of heating if it is a well insulated house with only moderate sized windows and 2.4 metre (standard) ceilings. A house that is poorly insulated, is draughty, is in a very cold windy area, has large windows, or high ceilings, will require more heating. It may be 30kW, or even more. In general terms at least 1kW of heating is required per 10m2, and more for living areas in most houses. These estimates assume winter minimum temperatures of about 0°C.

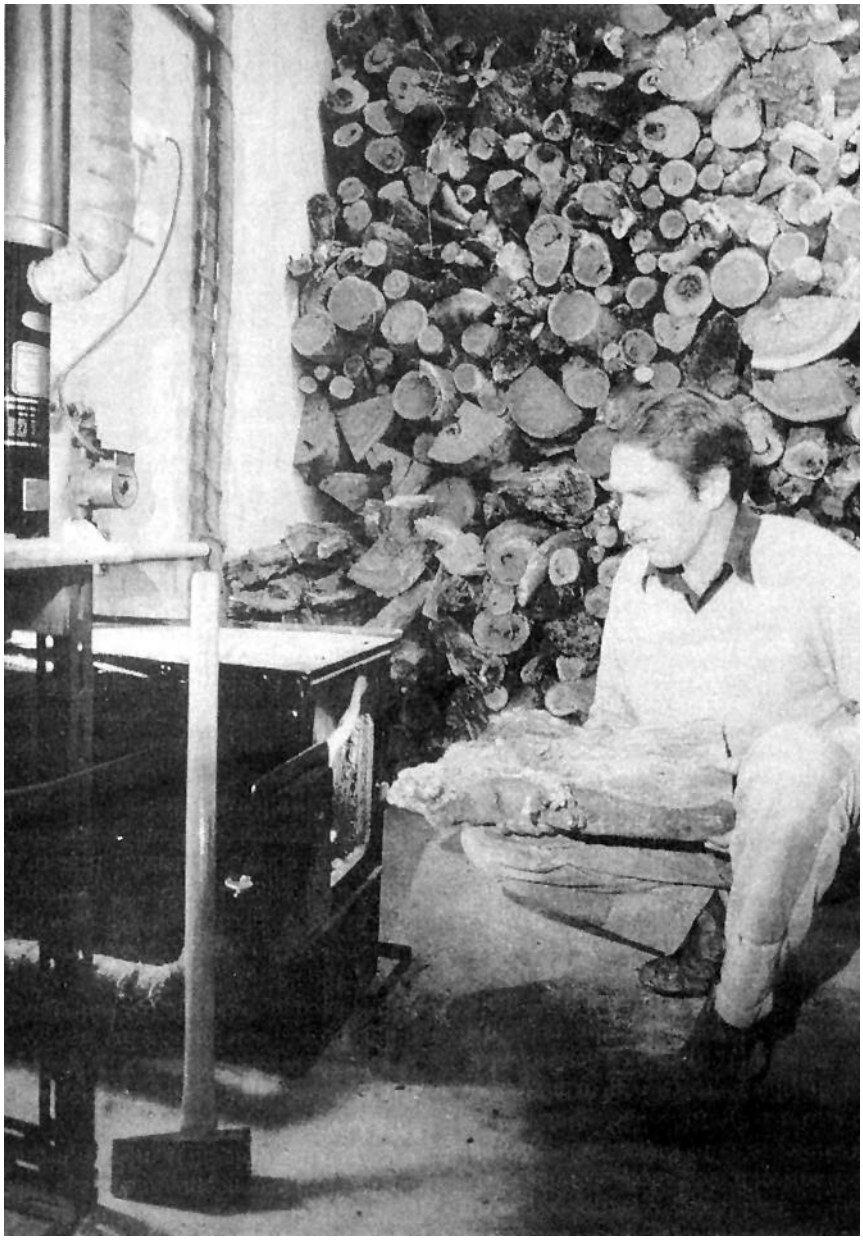
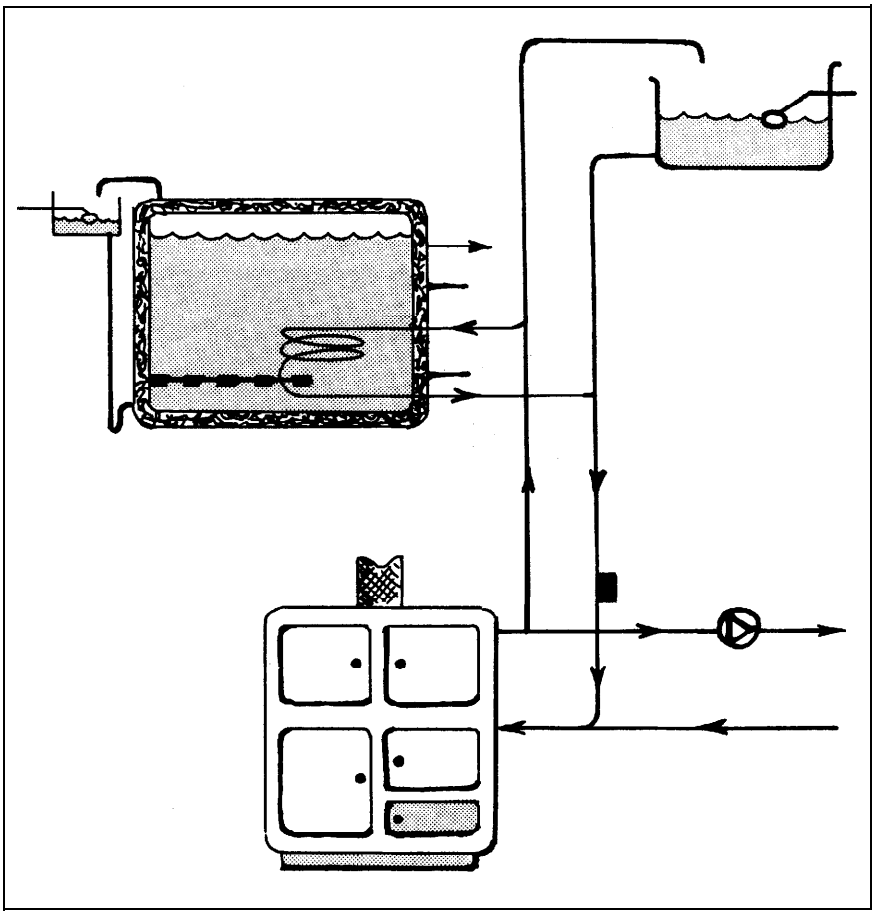


Photo courtesy of Andrew Blair

Firewood must be dry for maximum efficiency. With large boiler fireboxes, splitting of firewood is not a chore as large unsplit wood can be used.



The connection between boiler, hot water cylinder and the house heating system. The coil in the bottom of the cylinder heats the contents of the cylinder. This water goes to household taps. This configuration is my preferred installation.

Within the house, each room has its own characteristics and a heat loading calculation must be done to determine what size room heater is required. A good dealer will do this for you if you buy the equipment from him. Add about 20% to the total heat load of all the rooms, to allow for losses in the system, and about 3kW for domestic hot water (see below). This will give you a total heat load. The boiler you select must be able to provide this heat output. If your house is large and loses a lot of heat, you may have difficulty in finding a large enough boiler.

Choosing a boiler

Having decided on the amount of heating you need, you need to decide on a boiler. There is a large range: it may be a gas-fired boiler, oil-fired, coal-fired, electric, or, as we will concentrate on in this article, wood-fired.

Wood-fired boilers are not the same as coal-fired boilers, although some importers sell coal-fired boilers for use with firewood. Some coal-fired boilers tend to clog up with tar because of the moisture in firewood.

Firewood boilers are of two popular types: boiler-room units, or units for inside the house - which can be either boiler-cookers or heater-boilers.

Boiler-room boilers are designed to be situated outside the house, in a store room or boiler room. They come in a variety of sizes. Boiler-cookers are used for cooking, domestic hot water, and central heating. You can also get some room heaters with a heating boiler that provides central heating for a remote part of the house.

Boilers are rated according to their output and whatever you choose, you should be sure that its output matches your needs. Unfortunately some boilers are over-rated. Once you have had a look at a few you will be able to judge by the size of the fire box. If the volume of the firebox and the area of boiler on a highly rated boiler seems small compared with others of a comparable rating, be cautious.

If you have poor firewood in your district you will probably get close to the boiler's rated output for only a short period of time after each stoking, so you will need a boiler with a larger firebox - otherwise you will be loading the fire all the time. Too small a firebox also means that the boiler is unlikely to run all night without needing stoking.

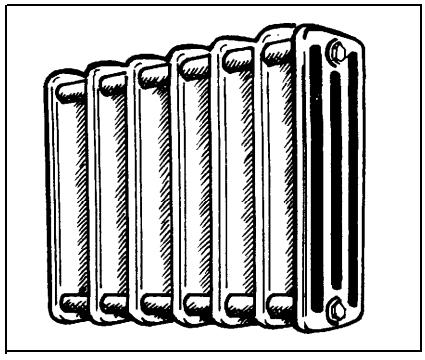
The bigger the boiler the more it will cost, but it is important to get a boiler that is appropriate for your house and for your firewood. A good dealer will help you here. If you go to one who seems uncertain, or is keen to sell you a boiler that is not going to supply the kilowatts this article suggests you will need, change dealers - or at least get a second opinion, before you find yourself with an inadequate system.

Domestic Hot Water

The hot water for showers, laundry, washing dishes, etc. can be heated from the central heating system. A cylinder is incorporated in the system for the hot water storage. During the summer, when the central heating is not on, the domestic hot water can be heated with an electric element in the storage cylinder, with gas, or with solar collectors.

Boiler-cookers

A boiler-cooker is a unit which appeals to a lot of people. A cooker that can handle all the cooking (in the way that only a wood cooker can) provides hot water and heats the house as well -



A traditional cast-iron panel radiator.

it sounds too good to be true. What are the drawbacks? Why doesn't every country house have one?

Cost is a major factor. The firebox of a boiler-cooker is not large enough to heat a big house (over 250m^2) without having to be loaded frequently. Also, when the weather is mild, and no heating is required, they tend to produce too much hot water. Boiler-cookers have firebox plates or other methods of reducing the size of the firebox in warmer weather, so that less hot water is produced, but it has been my experience that even under these conditions they produce more hot water than most families can use. The boiler boils uncontrollably, making noise and eventually damaging the plumbing, boiler, or storage cylinder. Most families normally have another form of cooking for the summer time, such as LP gas or electricity. This avoids heating up the kitchen with the wood cooker. Some only light their boiler-cooker every second or third day and get all the hot water they need.

A boiler in a boiler room remote from the house keeps the dirt and mess outside by dispensing with the need for bringing firewood into the house and removing the ash. Also, boiler room boilers are available with large fireboxes that require less frequent loading. They are my preferred option. Keep in mind that they must be installed so that they are protected from the weather.

Photo courtesy of Andrew Blair

The wood-burning boiler-cooker (left) handles all the cooking, provides hot water and heats the entire house. In the summer the LP gas cooker on the right is used.

Firewood for central heating

Environmentally, firewood is more desirable than many fuels because it is renewable. Once trees are cut down and burnt, more trees can be grown in their place - but firewood should still be used efficiently.

It is important that firewood be dry. This means wood that is not wet and not green. The firewood should be in the shed under cover prior to the winter. Green wood should be sawn into lengths two to three years before it is used, so that it can really dry out.

Few people believe this rule, and even fewer follow it. It is common for country people to cut down a dead standing tree in the middle of winter and use it straight away. The wood seems reasonably dry, but compared with wood that is really dry, and has been stored under cover for three months, it has the following disadvantages:

1. The moisture in wood has to be heated, to drive it off as steam. This heat is just wasted and is not available for house heating. If the wood is very wet or green, half of its heat can be lost just drying itself off.

2. Moist wood is hard to burn. It is hard to get it to start burning in the first place and when it is burning it is very likely to go out unless it is burning strongly. It also wastes your energy, as it needs to be split into small pieces, whereas big pieces of dry wood will often bum gently for hours or even days.

3. Moist wood is likely to cause corrosion in boilers and flue systems when they are closed down and only burning slowly. The tarry condensate is acidic and the acid attacks metals. Most people will have noticed stained roofs below heater flues. The stains are caused by tar dripping off flue rain caps. This staining and roof corrosion is accentuated by the burning of moist wood.

4. Moist wood creates smoke and this is a big turn-off for your neighbours if your smoke drifts into their houses. It also gives wood heating in general a bad name.

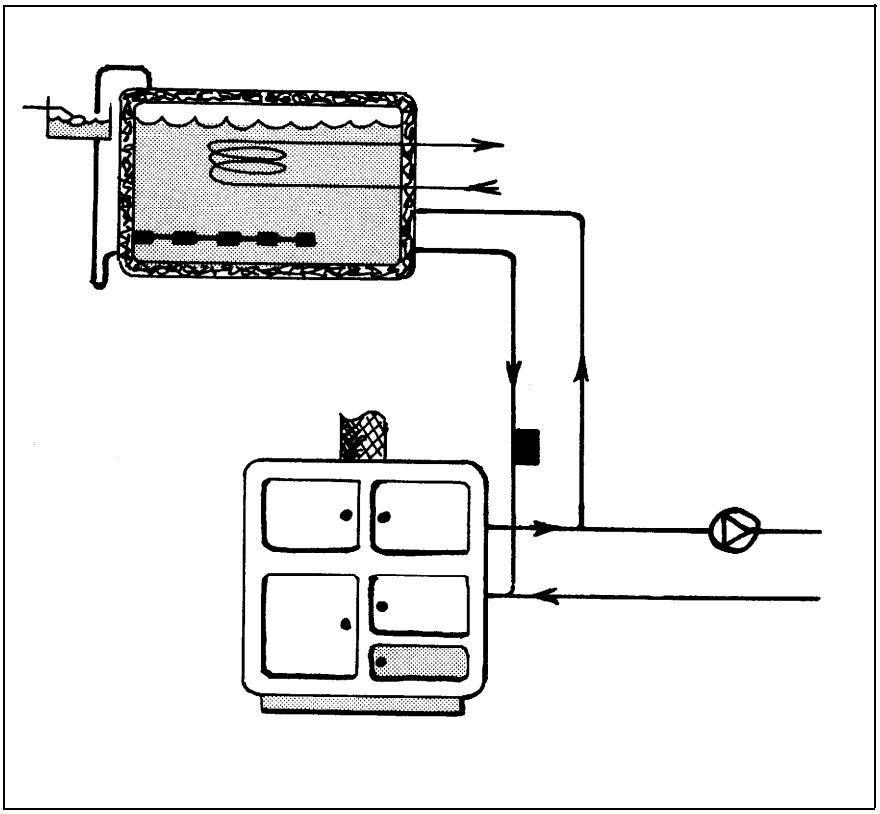
Flues

The flue makes the fire in a boiler draw. The longer the flue, the harder it will draw. The flue must be kept warm when the boiler is closed down, otherwise it will not draw and the fire will go out. Insulated flues that conform to the Australian Standards are available and I think should be used on most boilers. The only flueing that conforms to the Australian Standard is stainless steel or enamel. Black steel is no longer permitted. Again a knowledgeable dealer will help you to select a flue that is appropriate to your boiler.

Corrosion Inhibitor

Most boilers are made of steel, with the circulating pump made of cast iron, and the panel radiators of steel. To prevent rusting of these components a corrosion inhibitor is added to the water. This means that the boiler cannot be connected directly to a domestic hot water cylinder. The water in the cylinder is heated through a heat exchange coil in the bottom of the cylinder. This is a major difference from the way a combustion cooker is normally connected, as was explained in ***Soft Technology No.44.***

It is possible to heat the entire contents of the cylinder and have a coil in the top of the cylinder to provide hot water at the same pressure as the cold water. While the boiler is operating these systems are OK, but the minute the boiler goes out, the water in the cylinder gets cooler and cooler. As the water in the cylinder must be about 15°C hotter than the water that comes out of the tap (due to the heat transfer to the coil not being 100% efficient), the water available at the tap soon gets unacceptably cool. I do not like this type of cylinder but some installations require it. In these situations, I would not use one less than 400 litres capacity. I would not use one at all for a solar hot water service.



The water in the cylinder surrounds the coil in the top of the cylinder and heats the cold water as it passes through on its way to the taps. This is a cheaper installation than the one with the coil in the bottom of the cylinder and is suitable for houses without an appropriate ceiling space for the cylinder, as hot water can be delivered to a height above the cylinder. Hot water is at the same pressure as the cold water. Two disadvantages are that if the boiler is not alight, the water can get too cool, and that solar connection is not possible. I do not recommend this system.

An external heat exchanger can be used to heat the contents of an existing cylinder or a mains pressure cylinder.

Heaters

There are 3 main types of heaters.

☼ 1. Panel radiators, made from steel, come in hundreds of different sizes. They vary in height, length and thickness. The size and shape is determined by the heat output required and the space available for the heater. Although imported, they are the cheapest heaters. Old style cast iron radiators serve the same function. They are often available from building wreckers.

☼ 2. Skirting heaters replace the skirting board and put out about half a kilowatt per metre length of the skirting heater.

☼ 3. Fan convectors have a radiator core (like the radiator of a car) with a fan blowing air through it and into the room. The water temperature in a wood-fired system often gets low and under these conditions fan convectors do not work very well. The benefit of fan convectors is that they occupy little space for the

amount of heat they put out. They are quite expensive.

Circulating Pump

To circulate the water to the heaters a small electric pump is used. Switching the pump is a way of controlling the room temperature. A thermostat turns the pump on when the temperature falls and off when the room is up to temperature.

Piping

The piping used is usually copper, though there are various new plastic pipes that will handle hot water. It is important that you speak to a knowledgeable supplier if you are considering plastic pipes.

The size of the pipes is determined by the amount of water that has to flow through them. Again, an experienced dealer will provide the sizes that are required for your particular heating system. For most houses up to about 20 squares, appropriate pipe sizes are likely to be 15mm - 25mm in diameter.

Controls

Modem boilers have an air supply thermostat controlled by the water temperature. When the water reaches a set temperature the air to the fire is reduced and the fire dies down. When the temperature of the water falls the thermostat allows more air into the fire.

There should also be a low-limit thermostat which will allow the heating circulating pump to turn on only when the water is up to temperature. This low-limit thermostat is often left out of poorly installed systems, but is important because it prevents the boiler getting too cool. A cool boiler will have the acidic smoke precipitate on the walls of the boiler and this liquid will corrode the boiler away. If the firewood is really moist this revolting black condensate will run out of the bottom of the boiler and onto the floor.

The low-limit thermostat also makes the system automatic. When fired up, the heating only comes on when the water is hot enough. If the fire goes out, the heating turns off again.

It is possible to put a thermostat on each room heater so that each room is able to be controlled separately. This is a strength of a hydronic heating system that no other system can match. ☼

Coming Up

Hot air from a firewood furnace can also be used to centrally heat your house, using the same type of ducts that are used in Natural Gas ducted central heating systems - and they cost about half the price of hydronic heating systems. Look out for our article in a future issue of Soft Technology. ☼

Power from Hot Rocks

The energy stored in the heat of the Earth's crust could be the fuel ***of the*** *future for Australia.*

Dr Doone Wyborn

Among the alternative energy sources, geothermal power is generally not considered applicable in Australia, since, unlike New Zealand, there are few surface indications of geothermal systems. However another source of geothermal energy is natural heat stored within the Earth's crust.

This potential source of energy, known as hot dry rock geothermal energy (HDR) is available everywhere, but areas of high geothermal gradient are the most favourable economically, because the depths from which usable heat can be obtained is closer to the surface. For electricity generation using present technologies a temperature of over 150°C is necessary. Rocks of this temperature are present at depths of over 5 kilometres in areas of normal geothermal gradients (25°C per kilometre), but in areas with high geothermal gradients, immense volumes of rock in the 150-250°C range are present at depths of 3-5 kilometres. Such areas are potentially a source of almost inexhaustible energy on the human scale. For every cubic kilometre of rock the energy equivalent of about 40 million barrels of oil (15 per cent of Australia's annual oil production) could be obtained, if the rock was cooled by 100°C from say 250°C to 150°C.

Elsewhere in the world geothermal energy has traditionally been exploited in complex geological areas where relatively young volcanic activity has produced hot rocks close to the Earth's surface, and the hot waters naturally circulating through the rock formations have been utilised. However such geothermal energy sources have some major drawbacks.

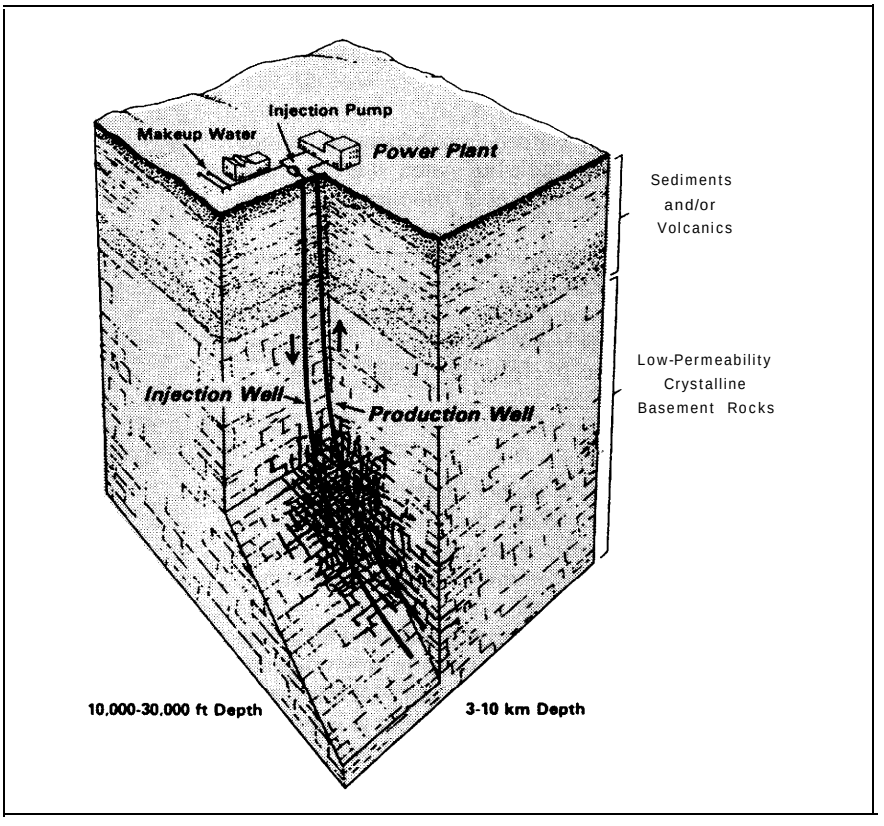


Figure 1. Hot dry rock (HDR) geothermal system for low permeability formations such as granites.

(1) The supply of hot formation waters in highly permeable rocks is limited, and volumes and flow rates are not easily estimated.

(2) The rocks are hard and complex, and often subject to active faulting, resulting in difficult exploration and drilling conditions.

(3) The volcanism and associated groundwork convection systems give rise to high levels of dissolved salts in the formation waters, and precipitation of these salts decreases the life of piping systems.

(4) Utilisation of the hot water resource commonly liberates large amounts of CO_2 and pollutants such as sulphur.

HDR is an alternative clean source of heat that requires more initial capital investment than traditional geothermal extraction systems but if employed would contribute to future reductions of CO_2 emissions. The essence of a production system is shown in Figure 1 and consists of an injection well, down which water is pumped, and a production well, up which superheated steam flows.

The HDR Method

In energy extraction by the HDR method, rocks at the required depth are artificially fractured by conventional hydraulic pressurisation used in the oil industry in order to establish connection between the injection and production well, and to produce as large a permeable zone as possible. The USA and UK have been experimenting with small-scale systems for some years

AUSTRALIAN HDR TARGETS	CALIFORNIAN HDR TARGETS
Depth 4-5km	Depth 2-3km
Simple geology, homogeneous rock	Complex geology, many faults
Radiogenic heat source	Magmatic heat source
Heat source widespread	Heat source localised
Temperature 200-250°C	Temperature 200-300°C
Drill penetration rates 10m/hour	Drill penetration rates 3-5m/hour
Simple hydraulic fracturing	Difficult hydraulic fracturing
Low seismicity	High seismicity

now, and more recently Japan, France, Germany and Russia have commenced significant HDR research programs. The Los Alamos National Laboratory (LANL) of the University of California in conjunction with the United States Department of Energy has been experimenting with HDR geothermal energy at its Fenton Hill site in New Mexico. At Fenton Hill two wells have been drilled to 4 kilometres, where the initial rock temperature is over 250°C. Artificial hydraulic fracturing has produced a stimulated zone approximately 0.3 cubic kilometres in volume, and pump tests have produced a nominal power output of 10 megawatts. At this output rate, heat capable of generating electricity would be available for a minimum of 250 years continuous production, assuming no inflow of heat into the 0.3 cubic kilometres volume from the surrounding rock. The technology required to establish a complete production system has been proven at Fenton Hill, in a an area rather unsuitable for economic energy extraction because of the difficult drilling conditions. LANL is now working on a more ambitious project near Clear Lake in California, where temperatures of 200°C occur at depths of 2km.

Favourable Sites

It may well be that Australia has one of the most favourable sites in the world for a large scale HDR energy extraction program.

In much of the area of South Australia, western Queensland and the Northern Territory, an area known as the Central Australian Heat Flow Province, the geothermal gradient is commonly over 50°C per kilometre. In particular, conditions are most suitable in the sedimentary basins through northern South Australia and western Queensland, where Australia's potential originates from a possibly unique set of geological conditions:

(1) The high heat flow is probably caused by a high abundance of radiogenic elements in the crust in that area.

(2) Homogeneous heat reservoirs such as granites are buried by insulating sedimentary basins at just the right depth to generate temperatures required for electricity generation.

(3) Drilling through these sedimentary basins is relatively inexpensive compared to drilling in the complex

geological environments in geothermal areas in other parts of the world.

Production is relatively unobtrusive, and is not dependent on climatic or temporal factors, as is wind and solar energy. Compared to the LANL program of HDR development in California, targets in northern South Australia have a number of advantages which could outweigh the economic disadvantages of having to drill to greater depths. Differences between the two areas are summarised in the table above.

With the growing awareness of this potentially valuable resource, the Australian Geological Survey Organisation (AGSO) is organising an international conference on hot dry rock geothermal energy potential in Australia. The conference will be divided into four main sections:

(1) HDR systems and developments in overseas countries. AGSO is inviting key researchers from the US and European programs to deliver addresses.

(2) Heat flow data for the Australian continent and potential Australian sites.

(3) Technologies required for exploitation. Drilling, hydraulic fracturing and electricity generation including the new Kalina Cycle technology, which is claimed to improve the efficiency of power output from low temperature fluids by up to 50%.

(4) Government assistance.

The cost of the conference, including dinner and lunches is $225, or $50 for students (conference only). ☼

For further information contact Dr Doone Wyborn (AGSO, 06 249 9386, fax 06 249 9983). Secretariat, Annette Collet, (06 249 9208, fax 06 249 9970) See advertisement below.

QUESTIONS & ANSWERS

Hydronic heating

Can I run a hydronic heating system with panel radiators off my electric hot water system?

Alternative, Melbourne

It is possible to heat a house from an off-peak electric hot water system, but it is best to keep it separate from the domestic hot water supply. A large storage cylinder (about 2000 litres is a common size) is required and the electric mains usually have to be upgraded to provide the power required. For information on hydronic heating using firewood, see the article on page 47 of this issue.

Welding with batteries

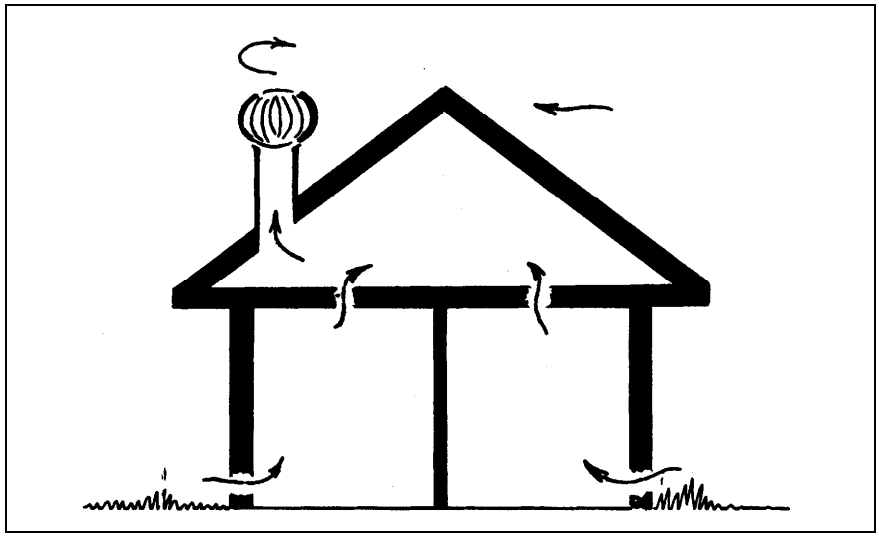
Is it possible to use my 24 volt battery bank to do welding of small items rather than having to start up my big AC welder?

John Allott, Wolvi

Generally welding requires a higher voltage than 24 volts. It would be hard to strike an arc with only 24 volts. In the ATA Alternative Welding course a carbon resistor is used to regulate the current. Without this there would be very limited control of the welding process.

If you do give it a try, keep the welding away from the batteries to prevent the hydrogen given off by the batteries when being charged from exploding. Also be aware that continued welding would reduce battery life because of the high currents involved.

Soft Technology No.35 (February 1991) contains an article on battery welding.



The proposed wind cooling 'system

Wind-driven cooling

Could a wind-driven air vent system be used to cool a house in summer by drawing hot air out through the roof and cool air in, perhaps across a wetted concrete path?

Chris Spencer, Golden Square

As with so many of these questions, it is a case of putting some figures on what we are talking about. In this case it would be air volumes and temperatures. However, without resorting to mathematics, I would make the following suggestions.

I suspect that to move enough air to be really significant, the vent system would have to be huge. If the wind was strong enough to move a reasonable volume through the house and out of the roof space using a wind driven fan, then I think that it would be easier simply to have a vented roof space and have some of the house windows open and let the wind blow through.

If there was no wind or only a slight breeze, large open windows would be more effective in getting the air through than a fan which required the wind to blow.

Wetting a concrete path would help cool the air if the path was shaded. If the path was in the sun, it would make the air very warm and humid. It would be cooler than if the air was blowing in straight off the concrete, but probably less comfortable, because of the steamy humidity.

A much better idea would be to have thick vegetation outside the open windows. If more cooling was required, fine misting sprinklers spraying over the bushes would bring the temperature down by increasing the humidity. Insulation in the ceiling would also significantly reduce heat getting into the house from the roof.

BP SOLAR, manufacturer of solar cells, modules and systems for 8 years in Australia, have offered to add their skills and experience to ours to help answer your questions about solar power systems.

So now is the time to send in all those questions about solar modules, batteries, inverters and regulators that you've always wanted answered.

Our regular Question and Answer columnist, Andrew Blair, will still be here to answer your general technical questions, so keep them coming in, too.

We will do our best to answer all questions sent in, but space is limited, so please try to keep your questions short.

You can send your questions to:

Questions and Answers
Soft Technology
247 Flinders Lane
Melbourne VIC 3000

Double Glazing

A glazier told a friend that 6mm glass was as good as double-glazing and a lot cheaper: Is this true?

Chris Spencer, Golden Square.

The short answer is NO, it is not true.

I have friends who were told the same story and installed huge windows of 6mm glass. The result was a house which was unpleasantly hot in summer and in need of lots of heating in winter.

The longer answer is no, too, but for heat gain from direct radiation (sun through the windows) there is not much difference between single and double-glazing.

The advantage of double glazing is that the pocket of air between the panes acts as insulation, slowing the transfer of heat in and out through the widow.

Pilkington Glass provided the following information. Double-glazing with normal glass will reduce heat transfer by about 45%. With Low E (low emissivity) glass in the double glazing, the heat transfer will be reduced by about 65% compared to single glazing. Low E glass is not used in single glazing because it has a coating on it which would lose its effectiveness if it got any dust on it.

Battery Mysteries

I enjoyed David Clarke's recent article about batteries, but it didn't explain some peculiarities I have experienced.

I bought a set of 500AH ex-Telecom batteries, When they arrived they put the hydrometer in the green, but they had no charge! I was mystified. We connected them up but they would not drive the inverter more than an hour or so. After a week of massive charging, though, they were able to keep the ship afloat with normal demand (but no charging) for over 8 days.

After a while I got the sinewave itch and changed inverters and also from 32V to 24V So the 500AH jobs went and another bunch of 200s came. These were only three years old, but had been left out in the rain for a year (can you believe it?). Unsurprisingly, the hydrometer almost wouldn't float. They did charge up, but they took much longer than I expected them to. I charged them for unknown hours at 100 amps and still they were in the red. They weren't gassing. Eventually they got up to the white and have ,behaved themselves very nicely ever since.

So, my questions are:

a. How can a battery look fully charged when it's flat?, and:

b. How can a 200AH battery absorb 1000AH?

Garry Richardson, Colac

David Clarke, of Wind Energy Australia, offered the following information.

To answer your first question: on their own, Specific Gravity (SG) readings can be misleading if the history of the cell is unknown. For instance, the cell may have been in a totally flat state (low SG readings) and the electrolyte may have been tipped out and replaced with new acid with an SG reading of about 1.300. This would account for SG readings showing the cell to be fully charged even though it is obviously flat, as the load test proves. The problem outlined really shows that a comprehensive cell test must include both a load test and a test for correct SG readings after the cell has been charged for long enough to make it gas for several hours (see David Clarke's article 'Better Batteries' on page 55, *Soft Technology* 43).

In answer to your second question: your 200AH batteries had been flat for a long time and may have been suffering from 'plate sulphation'. If this has happened, they can take much more energy than usual to recharge. You are lucky that the batteries have behaved so well since. When battery plates sulphate, the normal chemical bonding state within the cells, 'ionic bonds', can convert to 'covalent bonds' which are almost impossible to recover.

Solar Heating

Is it possible to have a solar/hydronic central heating system?

Jeanenne, Melbourne

I have been asked this question many times. I expect that it would be possible to build a solar heating system, but it would cost an incredible amount. To be effective it may cost nearly as much as the rest of the house.

The practical answer however is "No", because:

1. The time when heating is required is the time that the sun is not shining.

2. Solar water heaters in southern Australia using flat plate collectors produce water at perhaps 35°C and the operating temperature of a heating system is normally 80°C. It would not get the water hot enough. Concentrating collectors would achieve higher temperatures, but again the cost would be high and the volume of hot water required would be limited.

3. To heat enough water for a whole house, an enormous area of heating collector would be required, far bigger than the entire roof area of the house. A far more effective method is to use passive solar design to assist in winter heating.

Do you have a great idea, or interesting project that you have been working on, or a puzzling problem that you would like help with? Drop us a line at *Soft Technology* and share your experience!

Rebuilding Batteries

I have a number of ex-Telecom batteries which have reached the end of their life. These are the plastic case, 200AH type of 12V cells. I am told that they can be rebuilt but do not know how to achieve this.

John O'Grady, Frankston

We asked around at a couple of battery service centres in Melbourne, but we couldn't find any who rebuild the plastic case type of batteries. If any reader knows of any place that does do it, please let us know.

Please keep in mind that every situation is different, so the answers given here may not necessarily be perfect for you. If you are in any doubt, we advise that you seek the services of a qualified person who can come to you.

The Meaning of R

UNDERSTANDING HEAT TRANSFER

John Hermans

This article attempts to give an understanding of how to mathematically evaluate the efficiency of various building materials with regard to heat loss.

Different types of building materials will allow heat to pass through them at different rates, as is obvious when comparing, say, 100mm of concrete with 100mm of rock wool. Even different masonry materials have different rates of heat transfer as do different insulating materials. The most heat conductive masonry bricks are around 100 times more conductive than the best insulation material. This leaves much scope for thermally efficient design.

When referring to heat transfer, or resistance to heat transfer, most of us are familiar with the term "R" value, which is an abbreviation of "resistance value". The units for "R" values, though are rarely referred to. I shall attempt to explain the units for resistance, "R", and the units for conductivity, "k", and hopefully you will see how they can be used.

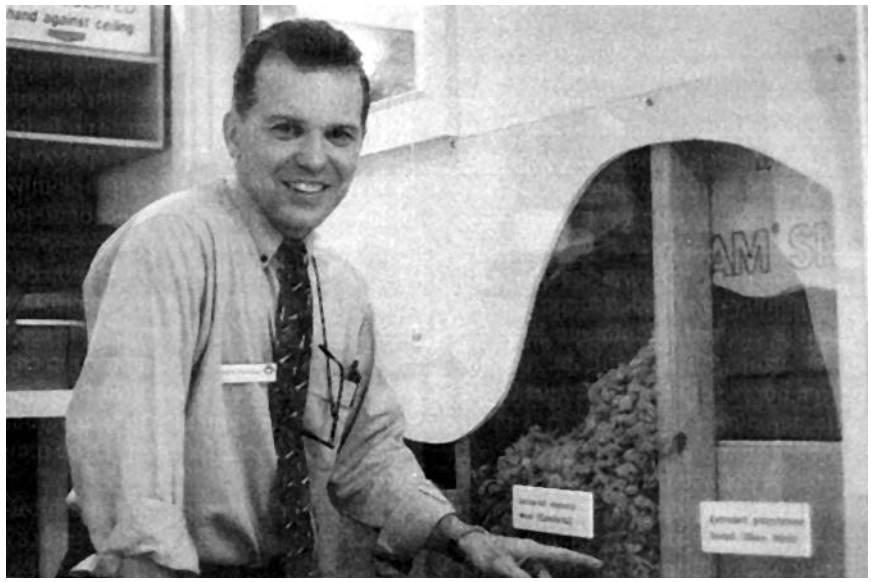
The units for "R" can be expressed as:

$$\frac{°K \cdot m^2}{W} \qquad \frac{°\text{Kelvin} \times \text{metre}^2}{\text{watts}}$$

for the listed thickness of the material in question.

When R=1; 'metre²' in the equation above refers to one square metre of the insulating material, '°Kelvin' refers to a temperature difference of one degree Celsius between one side of the wall and the other, and 'watts' refers to one watt of heat passing through the one m² of wall.

Let us say we have just purchased an insulating material of R2 to be placed in the walls of our house. What this really means, technically, is that with a 2° Celsius temperature difference (AT= 2) between one side of the insulation and the other, we will lose one watt of power continually for each m² of wall (as 1 watt = 1 joule per second).



Bernard Desormeaux, from the Energy Information Centre in Melbourne with one of the Centre's displays of building materials and insulation

But to determine a more realistic heat loss, in watts per metre², we need to correct for °K. (We can use °C, as it is easier and gives the same result). The temperature difference (AT) between inside the dwelling and outside, is more likely to be around 10°C: eg., in winter, 18°C inside and 8°C outside.

So if R2 allows a heat loss of 1 watt per metre², for a temperature difference of 2°C, then a 10°C temperature difference (ΔT=10) will cause a heat loss of 5 watts per metre². As the temperature difference (ΔT) increases, so does the heat loss through the walls. What this tells us is that for any given airtight building with a constant internal temperature of 18°C, the amount of heat which is needed to keep the temperature at 18°C will double when the outside temperature is -2°C (ΔT=20), as compared to an external temperature of 8°C (ΔT=10).

k Values

Now that you have mastered the units of the "R" value (you have, haven't you?), it is time to totally confuse you with the "k" value. (Not to be confused with °K, °Kelvin). The k value is also referred to as the "thermal conductivity value", or the conductivity constant.

It is important to understand that resistance to heat flow, "R", and conductance of heat flow, "k", are reciprocals. That is:

$$R = \frac{1}{k}$$ so as R increases, k decreases.

Conductivity values are most useful when comparing the relative heat flows through all types of building materials, both insulative and non-insulative. The main difference between the units of R and k is that values given for R do not take into account the thickness of the material. When a value for k is given, on the other hand, it refers to the ability of heat (watts) to pass through a one metre thick wall of the material in question. This then gives us the ability

Thermal Properties of Building and Insulating Materials

Material	Density (kg/m^3)	Thickness (mm)	Thermal Conductivity (k) ($W/^oK.m$)	Thermal resistance (R) ($^oK.\ m^2/W$)	Specific heat capacity (J/ kg.k)
Air	1.2	N/A	0.026	N/A	1012
Aluminium	2680	1.2	210	5.7×10^{-6}	880
Brickwork	1900	90	1.15	0.078	≈ 900
Carpet underlay	N/A	15	0.039 - 0.62	0.41 - 0.24	N/A
Cellulose fibre - 1	42	N/A	0.039	N/A	N/A
- 2	83	N/A	0.047	N/A	N/A
Concrete - Cellular - 1	320	100	0.084	1.19	960
- 2	800	100	0.2	0.5	960
- 3	1600	100	0.65	0.15	1050
Crushed rock 1:2:4	2400	100	1.44	0.069	880
Copper sheet	8790	1.2	385	3.12×10^{-3}	400
Cork-board	144	22	0.042	0.53	1800
Eel grass	21	N/A	0.046	N/A	N/A
Glass - Single pane	2510	6	1.05	0.006	840
- Double pane	2510	6 - 12 Air - 6	0.50	0.012*	840
Glass fibre batts	24	50	0.034	1.47	880
Granite	2650	N/A	2.9	N/A	900
Gyprock wallboard	850	25	0.16	0.16	N/A
Lead sheet	11400	1.8	34.6	5.2×10^{-5}	126
Linoleum	1300	3	0.22	0.014	840
Paper	1090	0.2	0.14	0.001	1340
Polystyrene	16	50	0.035	1.43	340
Foamed Polyurethane New	24	50	0.016	3.13	450
Aged	24	50	0.025	2.00	450
Rockwool (batts)	32	75	0.033	2.27	920
Sand (Building)	1500	N/A	0.30	N/A	800
Sandstone	2000	N/A	1.3	N/A	920
Sawdust	200	N/A	0.059	N/A	
Slate	2950	N/A	1.53	N/A	750
Steel	7850	6	47.5	1.26×10^{-4}	1050
Straw (compressed, wired slabs)	213	50	0.041	1.24	N/A
Timber - Jarrah	862	25	0.2	0.13	2090
- Pinus radiata	506	25	0.1	0.25	2090
- Stringy Bark	712	25	0.14	0.18	2090
Water	1000	10	0.6	0.017	4190
Wood particle board	640	18	0.12	0.15	

The information in this table is taken from a larger table put together by the CSIRO and published by Bradford Insulation in their ***Building Insulation Design Guide*** booklet.

* It is the air gap in the double glazing which provides the extra R value. The extra pane of glass has negligible effect.

to compare building materials directly against one another.

Units in the table

Since: taking the inverse of this will give

$$R = \frac{°K.\ m^2}{W} \qquad \frac{W}{°K.\ m^2},$$

But because values for k refer to a material of one metre thickness, we must multiply these later units by lm, which gives us: which simplifies to:

$$\frac{W.\ m}{°K.m^2} \qquad \frac{W}{°K.m}$$

as shown in the table.

Testing the table.

If 150 mm of mineral fibre insulation has an R value of R2, as taken from the table, then for 1 metre thick of the same mineral fibre:

$$R = 2 \times \frac{1000}{150} = 14 \text{ or } R14$$

Alternatively, the same 150mm has a k value of 0.035:

since $R = \frac{1}{k}$

$$R2 = \frac{1}{\boldsymbol{0.035}} = \boldsymbol{28}$$

R **= *14*** or R14

Please note that these units are metric. Values for R for American insulation are given in °F **x** Ft^2/Btu, and are therefore much larger figures.

The last row of figures in the table is for specific heat capacity, which tells us of the ability of a material to store heat energy per kilogram weight of that material. This is an important factor when considering the effectiveness of thermal mass. Note that water gives the highest value.

Following are a few interesting comparative figures from the table.

1. At the same thickness, glass fibre, rockwool and polystyrene have almost equal insulative value, but new polyurethane has twice the R value for the same thickness. This makes it an ideal insulation for refrigeration, although it should be noted that polyurethane loses some of its insulating characteristics as it ages.

2. The R value for 1.2mm of aluminium (as commonly used in aluminium window frames) is 0.0000057 °Km^2/W. As good as a hole in the wall.

3. Pine lining at 15 mm thick on a ceiling would only add an extra R value of 0.15 °$K.m^2$/W. Hardly worth considering as an insulating material.

4. One kilogram of water at 20°C holds twice as much heat as 1 kg of wood at 20°C, and 4 times as much heat as 1 kg of steel at 20°C.

Find out a few facts for yourself! ☼

Batteries - more dos and don'ts

Henry Wiebell

In Soft Technology number 42, David Clarke of Wind Energy Australia wrote an article about setting up a battery room. At the Renewable Energy Centre of the Northern Metropolitan College of TAFE (Victoria) we read this article with interest and found it prompted us to think of a few other points about battery rooms.

Temperature

First, we'd like to add a little to what David said about not placing batteries directly onto concrete floors. As well as the problems of acid spillage, there's a good technical reason for not placing batteries on any large cold surface.

As you have no doubt discovered on cold mornings when you have gone out to start your car, the battery discharge reaction works best when the battery is warm. This has a lot to do with the slowing down of movement of reacting components in the fluid as battery temperature drops. So if you put your battery onto a cold surface, it draws the heat from the bottom of the battery and the bulk of the work done by your battery is done at the top, because that's where it's warmest. The result is that your battery capacity is reduced, because the only effective work going on is at the top of the plates. The battery's lifespan is also reduced because the tops of the plates are working so much harder than they would under uniform heating conditions. Neither result is what the battery bank builder wants.

So place your batteries in a warm (not hot) place that keeps them at a uniform temperature.

Inside your battery

Batteries comprise two plates, a positive electrode, known as an anode, made of lead oxide (peroxide more exactly) and a negative electrode, known as a cathode, made of lead. Both electrodes react with an electrolyte fluid (sulphuric acid). This reaction is reversible. When the battery discharges, the lead peroxide at the anode reacts with the acid to form a salty deposit (lead sulphate) and releases one atom (a positive ion) of oxygen. At the cathode, the lead reacts with the acid to form more

lead sulphate salt and releases two hydrogen atoms (negative ions).

Ions are charged atomic particles and, as such, seek to combine with something. Since they are in a solution, they move about to find ions of opposite charge to combine with. When two hydrogen and one oxygen find each other they combine to form water. So the sulphuric acid forms sulphate salt on the plates, and water. This explains why the specific gravity (SG) goes down as the battery charge reduces. The SG is a measure of the weight of the acid and it goes down because water is lighter than sulphuric acid.

During charging, the deposited sulphate salt on the anode causes water to give up its oxygen atom to form lead peroxide again. The left over part of the water is free hydrogen. At the cathode, the lead sulphate salt changes back to pure lead and causes the two hydrogen atoms in the water molecule to combine with the sulphate to form sulphuric acid. The left over oxygen from the water molecule forms free oxygen gas. This is why charging batteries bubble. At the cathode, oxygen is given off and at the anode, hydrogen is given off.

Safety

This explains two things about batteries. Firstly, it explains why they need topping up with water. So it pays to follow David's advice about leaving plenty of access to the top of your batteries.

It also explains David's concern for ventilation. Hydrogen will combine very violently with oxygen. Fortunately this doesn't happen normally - it takes a spark to start the reaction. However it does point to a need to make sure that gases can escape quickly and that there are no flames, hot objects or sparks near by.

Gassing rates

As we've seen, it is necessary for charging batteries to bubble but don't overdo it, or you'll seriously damage your investment. Excessive bubbling due to too high a charge rate will knock the newly forming lead and lead peroxide off the plates. They will fall to the bottom of the battery and sit there forming useless salts. If you do this often you'll gradually destroy your plates.

Even more dangerous to your batteries is the heating of plates caused by high currents. If the charging rate is faster than the sulphate reaction can handle, the excess charging breaks the water in solution into oxygen and hydrogen directly. This creates a lot of heat and will buckle the battery plates. This reduces their effectiveness and can cause internal short circuits. If you buckle them badly enough you'll cause them to burst their cases and then you've got trouble! So it pays to follow guidelines for charging rates and keep an eye out for signs of heating.

Finally, keep in mind that there is an Australian Standard for Battery Installations, which should be adhered to.0

Henry Wiebell is a Senior Industry Training Consultant at the Northern Metro College of TAFE

A Simple Solar Pump Regulator

Alan Hutchinson

Designing a simple regulator for our solar pump display wasn't simple at all.

We had decided to include a solar pump display as part of the equipment on the ATA's mobile display unit, the 'Energymobile'. It was to feature the little power booster circuit described in Soft Technology No 43. and have two solar panels to power it, so that it would work under all conditions. Sounds simple enough? Well it is until you think about it a bit. Therein lies this tale.

The problem which presented itself was this: the display had to be bomb proof (easy), idiot proof (harder) and school kid proof (nigh on impossible). The two 50W panels also had to be able to operate the pump successfully under light levels from almost dark to the full strength of the sun at midday in central Australia.

It was anticipated that the second panel would only be connected when the light level was low/overcast/somebody holding a candle. However, it was soon realised that the two panels would be connected when it was overcast and then, when the display operator had his or her back turned, the sun would come out and the poor little pump would get fried.

So we needed to regulate an input current from the solar panels which could vary by at least a factor of ten. However we had to let all the energy from both panels through under low light conditions (so there was to be no series voltage drop through the regulator). We also needed to be able to limit the power into the pump under bright sun conditions without needing a huge heatsink for our regulator,

Shunt Regulator

The simplest solution would have been to use a shunt regulator to limit the panel voltage to about 14-15 volts.

A local attempting (unsuccessfully!) to shade out the solar pumping display while the Energymobile was in Alice Springs. Note the load dump behind the panel.

This would stop the pump from being overloaded, and if properly designed would not waste any power or drop any voltage under low light conditions.

The difficulty with this approach is that the shunt regulator would have to dissipate almost all the solar panel output under full sun conditions. This is about 100W. How could we dissipate 100W at 15V?

The first suggestion was to use a 100W, 12V light globe. The light globe would be turned on by a transistor when the panel voltage got to 15V volts. Good simple solution. Yes . . . if you are not circumnavigating the continent, if the display doesn't have to survive being dropped, kicked or vibrated to death . . etc. The humble light globe was rejected as too vulnerable, too unpredictable and inconvenient.

Reject that idea.

Transistor based regulator

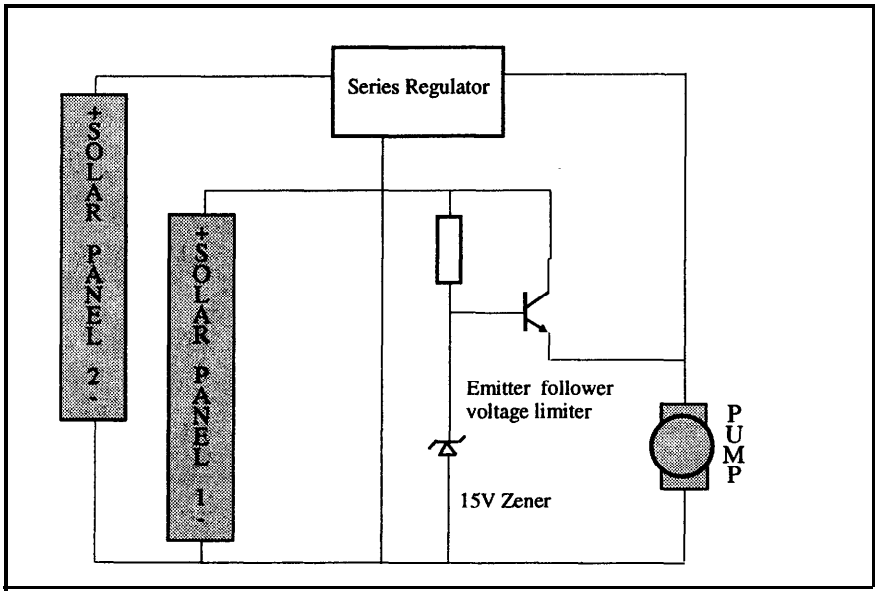
Our next idea was that the 100W could be dissipated using a simple transistor based shunt regulator. However, a transistor is limited by its internal temperature. If a common TO3 packaged power transistor such as a 2N3055 was used, at 100W power dissipation the case of the transistor would have to be kept below about 40°C.

Since the ambient temperature in which the display was to be operated could exceed 40°C, this approach would never work. One possibility was to split the regulator so that there was one transistor for each panel. This is a better idea. Each transistor then has to dissipate only 50W, and so the case temperature can now go up to about 120°C. If the worst case ambient temperature was 60°C, this requires a total heatsink capacity of 60°C + 100W = 0.6°C/W. This is a large, but quite obtainable heatsink. So we could do it this way, but the heatsink would be expensive, might get covered and so not work, was not small enough to fit in the space behind the solar panel and it was a hazard for little fingers which might just get a nasty burn from touching a hot heatsink. Reject that idea.

Power resistors

Next idea. We could use a transistor to switch on a bank of power resistors to dissipate the 100W (eleven 27Ω, 10W power resistors in parallel). A cover over the resistors could keep fingers off and it would be cheap and easy to make. The problem with this is that it leads to 'bumpy' control.

To see what I mean, imagine that the light level has been low so that the resistors are turned off. As the light level rises, eventually the panel voltage will rise to 15V and the resistors will turn on. The sudden extra load will cause the panel voltage to fall again and this will cause the resistors to be turned off again. Once off, the load is reduced, the panel voltage rises again and the cycle repeats itself. So the whole system oscillates, and this interacts with the power booster and the pump and interferes with every radio set close by. Instead of being a nice smooth limiter which an observer is unaware of, it produces quite an unstable little **mess.** I could have used proportional control to get around this problem, but it would require too much effort to build the circuitry. Reject that idea.



The regulator actually used

Voltage Limiter

Next idea. I decided to reject all forms of on/off type control because of the oscillation problems listed above. If a small compromise was made, so that a little voltage drop was allowable, an emitter follower type voltage limiter could be used. This reduces the power that the regulator has to dissipate, because the regulator only sees the difference in voltage between the pump voltage (15V) and the panel voltage at that current (up to 20V).

Hence, the power required to be dissipated by the regulator was no more than 8.5W [1.7A (the max pump current) x 5V (panel voltage - pump voltage) = 8.5W]. This is a lot less than 100W and could be done with a small heatsink.

This was OK at the bright end of the problem, but it lost about 2 volts at the dull end. The 2 volts are necessary to supply the base current for the transistor to operate. Reject?

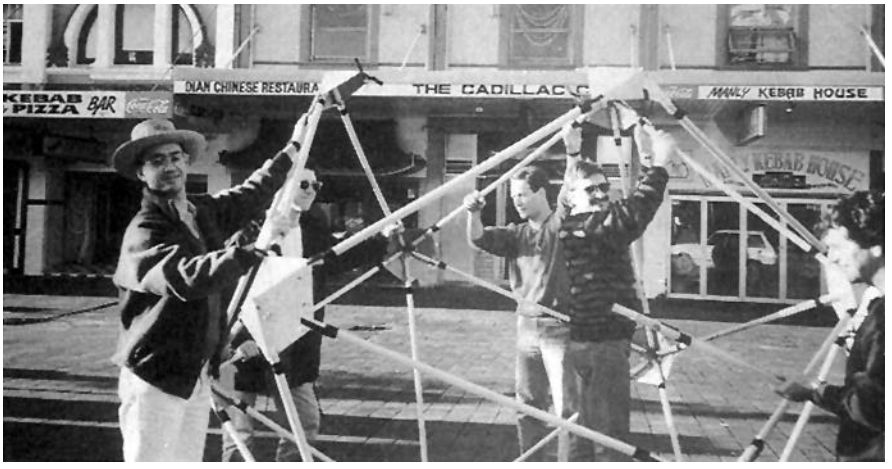
No! It was the best option so far. Resort to cunning stunt.

The actual regulator I came up with used the emitter follower limiter decribed above on the first panel. So if only one panel was connected, the only regulator was the limiter; it works well in good light, but will cease to operate a little before it should at the dark end of the range, because of the voltage wasted supplying the base current. The cunning stunt was to use a small switched series regulator on the second panel. By adjusting the series regulator to turn off about 14V, the second panel would always be disconnected before the voltage limiter began to limit at 15V. However, because the series regulator has no forward voltage drop (to speak of) when it is on, the second panel loses no voltage at the low end. Voila. Achieved just about all the requirements, with little power to be dissipated, smooth control and a compact design which could be made with simple components.

Postscript

The solar pump display actually worked very well. On the day the Energymobile left, we had it operating in slightly overcast conditions just at the start of winter. It worked so well that we had it going most of the time with the panels facing AWAY from the sun ... ie, running on the diffuse light rather than the direct beam. And like all PR, we aim to convince people that the concept works . . . and if there is a bit more to the display than meets the eye, well ... your average punter won't know or care. ☼

BEHIND THE SCENES



Sydney ATA people assembling "the globe" for the Environment Fair at Manly

The ATA Rollercoaster

Well we've been through a period of ups and downs at the Alternative Technology Association lately. Fortunately the ups have been higher than the downs have been low. Initially a blanket of calm descended upon us with the long awaited departure of the Energymobile on its mammoth tour of Australia. Then, when its engine blew, both panic and severe financial strain (owing to the cost of replacing the engine) took hold of the ATA. Since then, thanks to all the generous members who together donated around $2000 towards the repair costs, things have greatly improved. Thank you to all who contributed!

The Energymobile is now running better than ever before and, as you read this, is on its way back across the Nullabor. It is not coming home empty handed, either. Yes, the Energymobile won some awards while on its grand tour. It won 1st prize for Best Stand at the Katherine Show, and 2nd prize for Best Commercial Stand at the Alice Springs Show. Aside from all the alternative technology on show, part of the general display involves a geodesic globe, designed by our own Stephen Reardon as an attention grabbing information stand and sales point. The accompanying series of pics shows the piecing together of the frame and the assembled structure in use.

Stephen at work inside his globe

Another downer that has now taken the upwards climb is the wind generator tower at the Solar Workshop. After quite literally being dropped rather than lowered, it now stands tall, resurrected and resplendent.

Sydney ATA Goes On The Roof

July 18th was fine and crisp as a dozen or so Sydney members set out to visit a very different suburban home. From the street it looked just like any other double brick Hurstville house, but when we got around the back we saw what we came for - perched on the rear roof, facing due North, was a very different solar collector. This one was the special high efficiency, high temperature collector designed and developed by David Mills from the University of NSW.

It uses evacuated tube collectors with a low-reflection coating and a quasi-parabolic trough reflector designed to give optimal performance in the cooler months without sacrificing summer performance.

More of "the globe" in Sydney

The family who own the house had offered themselves as guinea pigs for David to test out the performance of the system in a real life situation. Pacific Power, who are sponsoring the project, are interested in promoting the concept.

The performance of the house is being monitored by a series of data loggers linked back to the University over Telecom lines. It's relatively early days yet for assessment of the experiment, particularly as consumption patterns are never constant, even in the best run households, and adjustments are still being made to the system, but things are looking promising. The system has the potential to provide heat for cooking and some space heating as well as keeping the family in hot water.

A nice little sideline is that the fridge, that under-estimated thief of power, has not been forgotten. A high efficiency refrigerator, Sunfrost, has been imported from the USA to further reduce consumption. This refrigerator, if it were to be rated on the star system we use here would not be a humble 5 Star but a 15 Star! It goes to show what you can do if you try.

As I said, it's early days yet, but this house shows that there are ways to reduce energy consumption and that people are beginning to seriously search them out.

It was a very pleasant day and we were made very welcome by this modern pioneering family. Geoff ***Tory***

For more information on the Alternative Technology Association in Sydney please ring :
Angus Campbell (02) 546 2577
Godfrey Davies (02) 436 0 173
Peter Moore (02) 683 5605
Wolfgang Spranz (02) 560 8643
Geoff Tory (02) 981 4536

ATA Canberra Update

The Canberra group's first "official" meeting was held on June 30th at the Environment Centre Library in Canberra. Solar Energy engineer, Andreas Luzzi, entertained members with an excellent audio-visual presentation on world-wide solar power generation, followed by an extended, and very detailed, question and answer session. Andreas proved to be an expert on all aspects of solar energy, from large scale and domestic photovoltaic systems through to thermal differential wind towers.

The next meeting is scheduled for 7pm on Wednesday 29th September, so any members in the area should come and join in the fun.

For more information about the Canberra group contact:
Ron Tito on (06) 235 9172.

JOIN THE ATA NOW!

Become a member of the ATA and enjoy all the benefits that go along with it. For details phone the office on: (03) 650 7883.

A.T. Retailers Gather

August saw the largest ever meeting of renewable energy retailers and manufacturers. The event was the meeting of the Appropriate Technology Retailers Association of Australia (ATRAA), an annual get together to catch up on recent industry developments and new products and exchange information and ideas.

A range of interesting new products came to light during the meeting. They included: a high efficiency, water-powered pump that far outperforms existing ram pumps, space age regulators and inverters, solar lighting systems and wood fired central heating.

Discussions took place on many subjects including promotion of the industry, industry ethics, political lobbying, and the respective roles of organisations representing the industry.

The meeting was held in close co-operation with the Solar Energy Industries Association (SEIAA), and was followed by the first of the remote area power systems designers and installers accreditation courses.

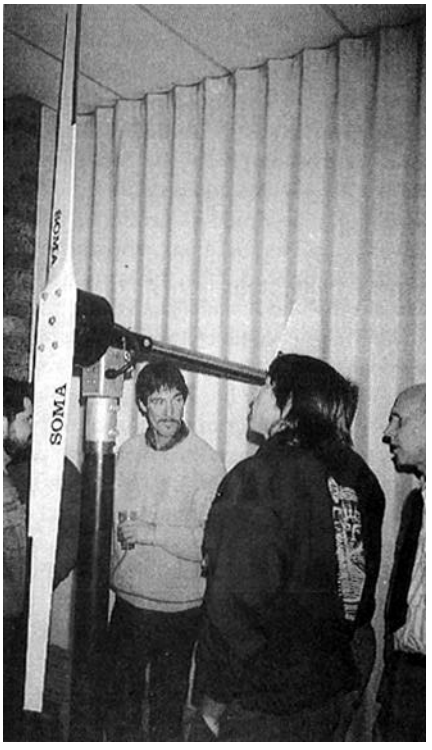
The next combined ATRAA and SEIAA meeting will be in August 1994 in Canberra.

Stephen lngrouille has offered himseIf as a contact point for further information. You can reach him at Going Solar, 320 Victoria Street, North Melbourne, 3051.
Ph: (03) 328 4123

SURVEY AND NAME GAME UPDATE

Thanks to all the readers who responded to our survey in the last issue of *Soft Technology*, and for all the entries in "the name game" offering ideas for the magazine's new name.

Your comments and ideas are really valuable and we would love to hear from anybody who hasn't yet responded. As we're still considering your responses, the results of both the survey and "the name game" should be published in the next issue.



One of the products featured at the ATRAA conference

REVIEWS

The Compost Book

David & Yvonne Taylor
Illustrated by Helen McCosker
Reed
Chatswood, NSW, 1993

Review by Andrew Blair

The Compost Book is set out as a reference book with terms associated with cornposting and plant growth presented in alphabetical order. Beautifully illustrated, the book makes an ideal gift for anyone who is seriously interested in getting to know what composting is all about.

One of the most interesting entries is "fast fourteen", a recipe for making compost in only fourteen days. The photograph on the right shows "fast fourteen" about to be tossed on the fourth day. The temperature is 65°C and steaming like mad when opened up with the fork. A clear description of the making of "fast fourteen" is included in *The Compost Book*, as are many composting secrets.

For the reader who thinks that he or she knows about compost already this book has lots of new tips that will result in an increased knowledge and a better compost. It outlines the difference between compost, manure, fertiliser and mulch. It discusses pH, pidgeon manure, photosynthesis, phosphorus and potassium; sawdust, seaweed and stinging nettles; eggshells, enzymes and elephant manure; chelates, comfrey and cooking oils; and much more.

For those who have tried compost and found that it takes months and still gives only mediocre results, *The Compost Book* will explain the reasons in an interesting and attractive way.

RRP:$12.95

Boatowner's Energy Planner - How to make and manage electrical energy on board

Kevin Jeffrey with Nan Jeffrey
Seven Seas
Camden, Maine, 1991

Review by Michael Harris

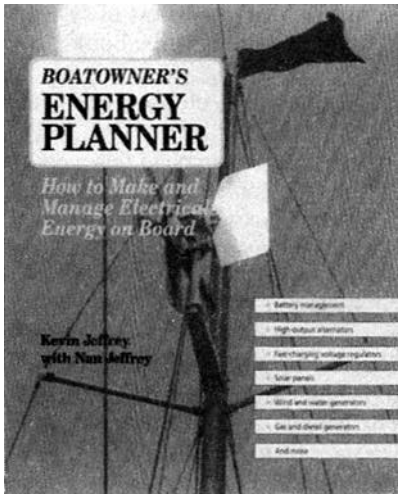
This book describes the ways in which you can design your own energy system for boats, primarily sailing boats. It provides information on which to choose from solar, wind and water alternatives. In addition, it covers gas and diesel generators, high output alternators and voltage regulation. It covers all the available components, how they work and how you can use them. However, this is an American book and therefore the list of available components is not fully applicable to the Australian reader.

Boatowner's Energy Planner gives information on how to estimate your electrical load and, from there, how to size the energy system that will be appropriate for your boat. The book is well illustrated and well presented. It contains a lot of detail, including instruction for different methods of wiring etc.

I think that what deducts from the strength of the book is that, firstly, being an American book it is not totally relevant to the Australian market. Secondly,, it is a little too polished for me. I like to see pictures of the *real* thing in *real* people's boats showing how it works in practice. Yet in *Boatowner's Energy Planner* the photos tend to be provided by manufacturers, all very flash, in a showroom situation rather than actually installed in the boat.

Boatowner's Energy Planner is written by two people who have extensive experience with boating. This is reflected in the quality of the book. This book would be quite valuable for people who are looking at installing or upgrading an electrical system that runs on renewable or unrenewable sources in a boat. Apart from the obvious disadvantage of using an American text in an Australian situation, it is a comprehensive book worth investigating.

RRP: $37.95



Micro-Hydro Power A guide for development workers

P Fraenkel, O Paish, V Bokalders, A Harvey, A Brown & R Edwards
Intermediate Technology Publications
London, 1991

Review by Ross Horman

This is the second in a series produced by I T Power and was produced to serve a need for up to date practical information for development workers. As such it does a very good job with many examples of low tech solutions to the problems of design, installation and operation of a micro-hydro system.

It defines 'micro-hydro' systems as those which generate up to 300kW and as such many of the designs may seem over engineered for those contemplating a system to operate their single dwelling out in the sticks requiring only 300W.

The book tries to provide guidance on stream evaluation (head and flow available), design and/or selection of system components, cost analysis and ongoing maintenance requirements. The text is easily read and is peppered with diagrams and calculations accompanied by worked examples which demonstrate how to use the formulae. One or two typographical errors seem to have crept into the section on penstock design which raise serious questions dimensionally about the given figures and formulae.

At the back there are some useful appendices covering product sources and an up to date bibliography. Thanks to *Soft Technology* we actually know of at least five local producers of systems but understandably this book only covers one in a range covering the entire globe and that selection was made in 1989/1990.

Overall I can recommend this work to those looking for a design manual for their own system where they wish to use commercially available components. It has good descriptions of the equipment used including selection criteria that should be applied. The economic evaluation is more suitable for small communities in developing countries but the basics still apply anywhere.

Distributed by Astam Books
Ph:(02)550 3855 RRP: $43.95

Remote Area Power Supplies

Energy Victoria, SEC, 1992

Review by Andrew Blair

This new edition of the SEC RAPS book is significantly upgraded and comprehensive. Few stones have been left unturned in an effort to include all the concepts and ideas that need to be considered in the design and installation of a RAPS system.

It deals with lights and other appliances, their power requirements, and explains how to determine what size system is needed to handle our individual requirements.

The production of power and the various sources are described. Photovoltaics, wind, micro-hydro, diesel and petrol generators are all considered in detail. Batteries, inverters, controls and safety are considered as well as tips for purchase and installation.

For the beginner, there is a useful glossary of terms. Colour photographs as well as advertisements of suppliers of RAPS systems provides more valuable information for the reader. This book is an absolute must for anybody who is contemplating a remote area power supply system.

Available from Energy Victoria, Flinders Street, Melbourne or the SEC Marketing Unit, GPO Box 2765Y Melbourne 3001.
RRP: $15.00 plus $3.00 for Postage & Handling throughout Australia.

Energy Efficient Australian Housing 2nd Edition

J Ballinger, D Prasad & D Rutter
Australian Government Publishing Service, 1992

Review by Alexandra Oke

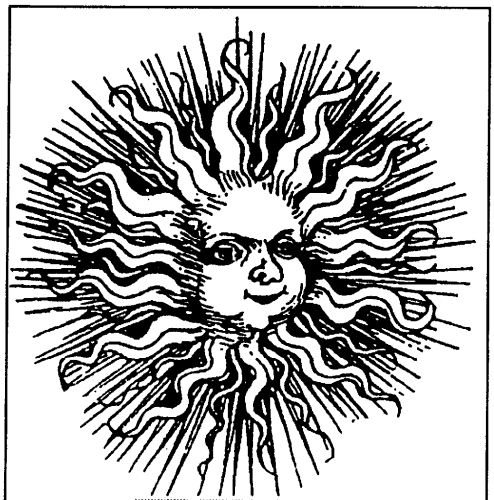
As a textbook or manual, ***Energy efficient Australian housing*** is excellent. In the first two sections it takes the reader through energy and its use, the principles of climate and design, thermal comfort and the building as a thermal system. The third section shows the application of these principles to passive design strategies, building and renovation, and covers appliances, solar active systems and RAPS.

The book is well laid out with illustrations, graphs and tables which, in many cases, are accompanied by comments. There is a large number of appendices of useful information, a reference and a further reading list.

Thankfully, there is also a glossary and index. The authors use very formal language and pack a lot of information into a small space. A summary at the end of each section in lay terms would have made the book more accessible.

As with most energy-saving approaches though, the underlying principle is one of common sense. The reader is given information on siting the house to exploit or confound local weather and solar conditions, using the principles of thermodynamics in the choice of design, materials and construction, and thinking past simply the cost of the house to the future cost of running it. ***Energy efficient Australian housing*** can help you along this path, but be prepared at times to wade through stilted language and almost incomprehensible formulae and diagrams. This is an excellent reference book but definitely not bedtime reading.

Available from Australian Government Publishing Service
Ph: (008) 02 0049 (24 Hr service).
RRP: $24.95



ATA
Energy resources

Some months ago I was lucky enough to take the Energymobile up the east coast of Australia, as part of its 'epic' four month tour of the country. During that time I came across many people who are concerned about our environment and looking for practical ways to do something about their concerns. I'd like to thank those people – and all ATA members and *Soft Technology* subscribers – for their enthusiasm for the work we are doing.

The ATA is constantly striving to improve standards in all aspects of our organisation. The support of our subscribers and members is one of the most important things that helps the ATA to grow and allows us to publish a better magazine.

We all hope that you will find this issue of our ATA Energy Resources Catalogue useful. In addition to the publications that you are used to seeing, we have included a number of gadgets and educational kits that have proved popular at our displays around the country. Everything from battery chargers and torches to toys that are fun and educational – items that provide a real alternative to conventionally powered products...and conventional presents!

Thanks again for your support.

Mick Harris

The Green Technology House & Garden Book

You can make your home more energy efficient and a healthier place to live. ***The Green Technology House& Garden Book*** provides practical information on minimising environmental impact and choosing the right materials for the job, whether you're building, renovating...or just having fun in the garden.

Articles on solar design in housing, building with natural materials, low-cost heating alternatives, and hundreds of energy-saving ideas.

* real-life experiences of people living with the alternatives
* practical do-it-yourself projects - solar power your fish pond!
* comprehensive list of suppliers, information sources and books
* permaculture, selecting a kit home, alternatives to chemical paints, eco-gardening...and more!

$23.00

Build your own Green Technology

Ideas and inspiration for everyone interested in environmentally friendly technology and energy self-sufficiency. Practical do-it-yourself projects covering solar energy, wind and water power, building construction, transport, home appliances, and simple projects.

'provides valuable resource material on subjects where there is presently a dearth of good practical information. Buy this book now.'

- Stephen Ingrouille, Going Solar

$25.00

*** ALL PRICES INCLUDE POSTAGE - ALL PRICES SUBJECT TO CHANGE ***

soft technology

Soft Technology BACK ISSUES

Practical information on a host of subjects including renewable energy, building with natural materials, environmentally responsible buying, living with alternative energy, permaculture, energy-saving renovations and alternative forms of transport.

$4.00 per issue up to issue 42 $4.50 per issue from issue 43
or the set of all ten issues listed below for $40.00
(this offer expires 28.02.94 or while stock lasts)

These back issues are selling out very quickly, so don't put off ordering or you may miss out! Those listed here are the only ones still available - please don't order any earlier issues as they are out of print. If you have missed out, don't despair-the best articles from Soft Technology can be found in the books on page 1 of this catalogue.

Subscribe and have Soft Technology delivered to your door. It also makes a great gift! Just $18.00 for an annual subscription of four issues. See page 8 of this catalogue to order.

Soft Technology 1 to 35 SOLD OUT!

Soft Technology 36

* Energy efficiency: possible developments in **energy saving**
* Compact fluorescent lights: how much should we be paying?
* Conventional house powered by renewable energy
* Driving with a wood-powered gas producer: is it viable?
* 12 volt sewing: converting a sewing machine to run off a battery
* Biogas: domestic waste recycling
* Simple techniques for reusing plastic bottles

Soft Technology 37

* Holistic housing: housing more, consuming less
* Inverter buying guide
* Governments in the spotlight: an energy planning review - part 1
* Cross-flow water turbine
* Heat shifters: a low-cost heating alternative
* Recumbent bicycles

Soft Technology 38

* Living with alternative energy
* Beautiful mudbrick house incorporating recycled materials
* Holistic housing - part 2
* Government energy planning - part 2
* Recumbent trikes
* Build a ram pump: no welding required
* Clever cooking: the Thermajig

Soft Technology 39

* Tasmania: the politics of power
* Cornposting toilets
* Energy efficiency appliances: how do they rate?
* Inexpensive owner-building
* D-I-Y solar water heating ideas
* Solar Energy Information Centre, Perth

Soft Technology 40

* Permaculture house & garden
* Energy-saving hot rock heating
* Fireplace upgrade
* Solar power your fish pond
* Compact fluoro buying guide
* Build your own cornposting toilet
* Eco-cleaning: the safer alternative

Soft Technology 41

* City and country alternatives
* Save money & water: low-flow shower roses
* Build a window-box greenhouse
* Windpower buying guide
* Building with earth: a low-cost method
* Gassing the planet: are you guilty?
* Electromagnetic radiation: the risks

Soft Technology 42

* Mudbricks, wind & solar: one family's success story
* Race your own model solar car: international challenge
* House painting making you sick? Alternatives to chemical paints
* The Energymobile heads north
* Setting up a battery bank: DOs and DON'Ts
* D-I-Y double glazing
* Transport options: the way forward

Soft Technology 43

* Solar panel buying guide
* Eco-gardening the non-toxic way: managing garden pests
* All stoked up: the new steam car
* A cashless community
* Earth-covered housing
* Stay warmer: seal out draughts
* Longer life for your batteries
* Build a solar power booster
* Conservation: appropriate technology
* Better batteries: keep your cells in top condition

Soft Technology 44

* Build your own 12 volt computer for under $1000
* Secrets of the sun: solar art
* The polystyrene house
* Renewable energy courses guide
* Low-voltage lighting buying guide
* Slash your fridge's energy use with some simple changes
* Firebox retrofit for a warmer winter
* Getting into hot water with your combustion stove
* A sun-smart school
* New micro-hydro turbine

Soft Technology 45

* Solar in the city
* The steam-powered house
* Solar hot water buying guide
* Backyard biogas
* Central heating with hot water
* The joys of a passive solar house
* Micro-hydro in the rainforest
* A pedal-powered generator
* Regulating solar pumping
* Power from hot rocks
* Energy resources catalogue

INFORMATION LEAFLETS

These information leaflets provide a basic introduction to the subjects they cover. They are ideal for the classroom as they open up to make A3 size (297 x 420mm) wall charts.

$2.00 each, or $7.50 for the set of five leaflets

Wind power

Wind is a source of free power, and it doesn't pollute the atmosphere! This fact sheet puts forward factors to consider if you are considering using wind power - amount of wind, choosing a site, tower height, home-made windgenerators and calculating the amount of power required. (For a more detailed coverage of this subject, see the booklet *Planning a windgenerator system* opposite.)

Water power

There is a wide variety of water-power generators, all with different applications. This fact sheet outlines details of a number of these different types, tells you how to assess a Site to see whether water power is a viable option, and gives a list of suppliers.

Recumbent cycles

The 'recumbent' cycle takes its name from the position of the rider, who rides in a hammock-like seat with legs reaching forward to the pedals instead of down. This leaflet is a good introduction to the special properties of these human-powered vehicles.

Do-it-yourself plans for a Solar fruit dryer

Our most popular information leaflet ever! Drying fruit and vegies using the sun's power is simple and inexpensive. This leaflet gives plans for two different fruit dryers, both of which can be made with recycled materials.

Do-it-yourself plans for a Solar cooker

Solar cookers use the sun's heat for a clean, non-polluting method of cooking food. Plans for three different solar cookers: a solar kebab cooker, a solar oven, and a reflective cooker.

POSTERS

Energy sources

A visual representation of the different sources of energy - natural gas, methane, coal, wave platforms, nuclear, etc. Four colour poster.
740 x 495mm (posted rolled in cardboard tube) $9.00

School project folder & poster

Introductory level reference material suitable for upper primary or lower secondary level. The full colour poster inside each folder may be used as a wall display or cut up for project work.
570 x 440mm $4.50, or $7.50 for both project sets

Environment

Covers natural and built environments, fresh air, healthy soil, clean air, wilderness areas, mining, etc.

Energy

Covers sources of energy - wind, water, electricity, nuclear, solar and wood.

BOOKLETS

Do-it-yourself plans for constructing a Savonius Rotor wind turbine

In addition to a brief history, and a description of how it works, this booklet provides information and detailed plans for building a Savonius Rotor. To minimise costs, the design is based around the use of basic and scrap materials - the main rotor is constructed from a 44-gallon drum. A great project just for fun, but can also be used to generate power!

$6.00

Everything you ever wanted to know about Solar Electricity

Solar electricity is now a reliable working reality in thousands of homes across Australia. This no-nonsense, comprehensive guide provides all the facts on solar electricity: how solar electricity works, what it can do for you, designing a system to suit your needs, putting a system together, and finding supplies.

$6.00

Solar workshop

A detailed description of the ATA's Solar Workshop, including information on the windgenerator, solar electric system and the building's passive solar design. This booklet includes detailed explanations and diagrams of each feature. It also outlines materials used, including their costs and sources.

Low-voltage appliances

Due to popular demand, the course notes for ATA's 'Low voltage appliances' workshop are now published in booklet form. The booklet covers a whole range of appliances - motorised and electronic equipment, heating appliances and lighting - and how they can be modified at minimum cost. Includes information on commercially available low-voltage appliances.

$6.00

Solar greenhouse workshop notes

Notes for designing and building a solar greenhouse. Covers design options, orientation, shape and size, materials and construction, suppliers and useful publications.

$7.00

Planning a windgenerator system

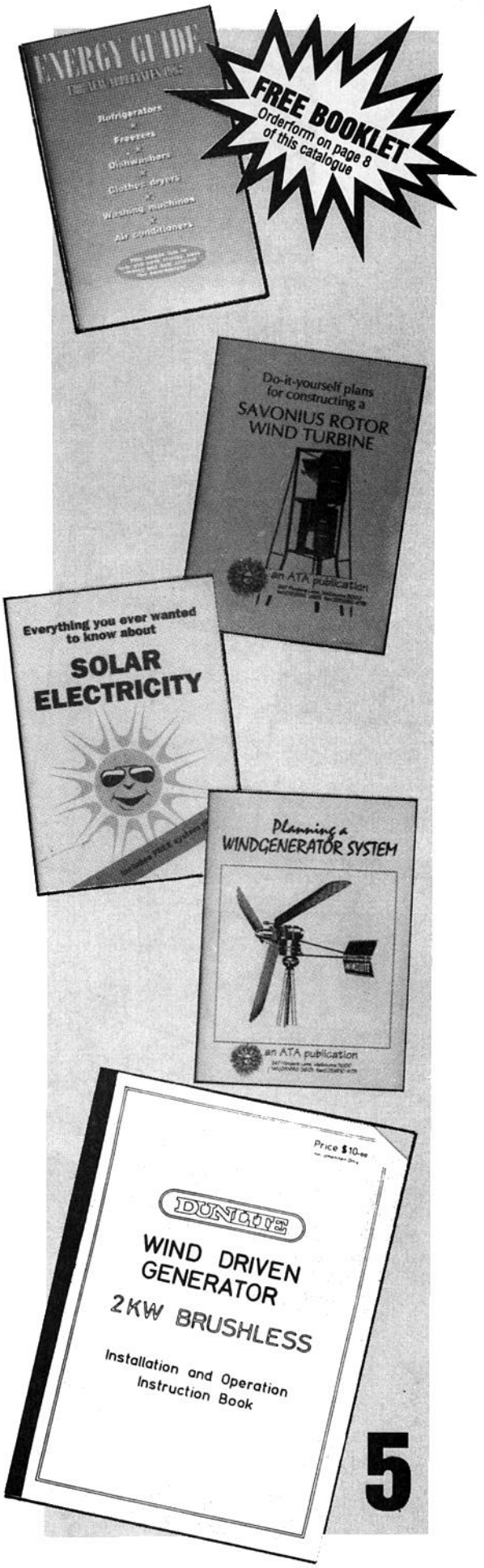
The original Dunlite manual which covers the way a wind-powered electrical generating system works, windgenerator systems and their components, site evaluation, estimating power requirements and putting the system together.

$6.00

Windgenerator instruction booklets

These booklets are a must for windgenerator owners or anyone trying to recondition an old machine. Operating instructions, and service and assembly information for the following windgenerators:

Dunlite 400 & 750 watt $8.00
Dunlite 2000 watt brushless $11.00
Rutland windcharger $8.00 **Windco windcharger** $9.00
Dunlite 1000 & 1500 watt brushless $8.00



* Please specify choice, but all models may not be available.

Commercial grade mini solar panel

Serious cells! This miniature version of the real thing puts out real current and does real work. This strong, durable cell is powerful enough to run any of the models on these pages under low light.
140 x 140mm $33.00

Mini solar power. pack

This mini solar power pack will recharge two Nickel Cadmium AA batteries in just four hours of full sun. The power pack can also be used to run 3 volt personal stereos and other small equipment.
78 x 148mm (not pictured) $30.00

Solar power booster kit

A simple kit that will boost the performance of solar-powered pumps and motors. This improved version incorporates a commercial-grade circuit board and components which differ slightly from the version that appeared in *Soft Technology* number 43. $28.00

Plant moisture tester

This handy gadget tests whether plants have enough water. Just insert into the plant soil and if there is sufficient moisture, the tester plays 'music' of the high-pitched tinny variety. Includes two button batteries. $7.00

Solar educational kit

This educational kit is designed to be a basis for solar models. Kit includes: solar energy information booklet, solar cell module, mini DC motor, screws and nuts, wire with motor clips, coloured spinner discs, paper models, four turntables (different sizes), plastic fan spinner. $17.00

Wooden solar energy model kits

These solar energy models don't fly or race across the water, but when the solar cells are placed in direct sunlight, the propellers or wheels *will* spin! Windmill, waterwheel, aeroplane, helicopter.* $35.00

Foam solar energy model kits

Made from soft, colourful foam, these kits are easy to assemble for ages 8+. A practical demonstration of solar power in action! Locomotive, hovercraft, aeroplane, windmill or helicopter.* $22.00

Wind-powered flying machine

Even a beginner can make this propeller-driven toy soar and swoop! Fly solo, do tricks or play games. Stack them on top of each other for further effect. Fluoro colours.
$4.00 for one, $2.00 for each additional prop-top ordered

Solar-powered mosquito repeller

What a bargain. Not only do you get a little keyring that scares away every mossie within 5 metres, but you get the instruction/explanation card that goes with it! Read all about how the pregnant mosquito is 'very disgusted at the approach of the male mosquito' ... and that's only the beginning. $9.00

Solar torch

Keep this torch in a sunny spot and it will recharge its own batteries without chargers or adaptors. Provides up to an hour of powerful light at night from a full charge. (Includes two Nickel Cadmium AA rechargeable batteries.) We have seen this torch offered elsewhere for $45.00!

$35.00

Sundial watch

Fred Flintstone had a watch like this, and now you can have one too! Not just a unique way of telling the time, this sundial watch with built-in compass is a great conversation piece. Sundial can be folded down when you're not telling the time.

$29.00

Solar exhaust ventilator

This ventilator can be positioned to either blow fresh air into a room or to blow hot or steamy air out, and because it has no wiring it is easy to install. Works in direct sunlight. (On sale elsewhere for $59.00!)

$42.00

Solar car ventilator

Keep your car cool in summer. Built-in rechargeable circuit stores extra energy so the ventilator will work day or night. Both the exhaust fan and the solar panel can be adjusted to different angles for optimum operation. Can also be used as a battery charger.

[NOT PICTURED] $23.00

Solar AM/FM speaker radio

The rechargeable battery in this pocket-sized radio will provide up to five hours playing time when fully charged. It includes a pocket clip and a stand for adjusting the angle of the solar panel for optimum sunlight. Can also be used with two standard AA batteries.

[NOT PICTURED] $38.00

Solar and dynamo AM/FM radio

Choose from three different power sources to charge this radio - solar DC 3V backup, or dynamo electric (manual winding). It also takes ordinary AA batteries. And yes, the dynamo really does work!

$38.00

Solar cool cap with built-in fan

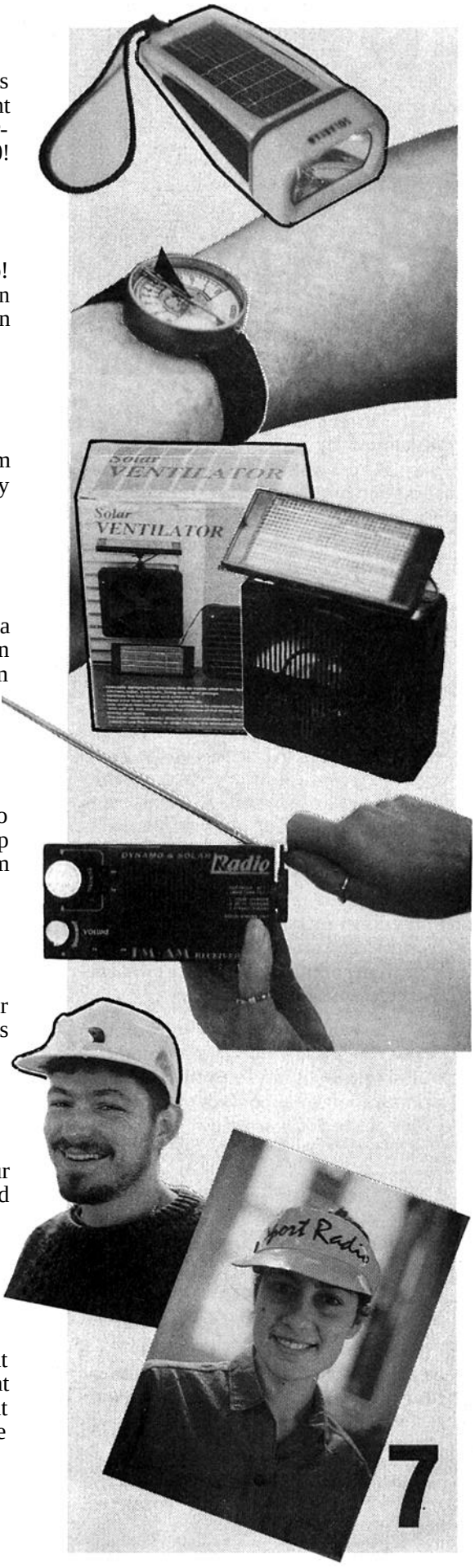
A solar panel on top of the cap powers a fan to blow cool air over your forehead! A detachable foam pad can be soaked in water and placed behind the fan for evaporative cooling. Lightweight openweave co struction with adjustable headband. Also has battery backup.

$35.00

Sunvisor AM radio

And finally, a lesson on the dangers of buying from catalogues that aren't the ATA Energy Resource Catalogue. We tried it and look what happened to us! The only 'solar' thing about this sunvisor radio is that you wear it in the sun, but it would be perfect for wearing when you're trying out your solar models or playing with your solar model car.

$15.00



The Energymobile, designed and developed by ATA, is a travelling display of renewable energy, energy conservation and alternative technology. It encourages people of all ages to experience alternative technology in a 'hands on', interactive way, using real equipment and working models.

The Energymobile has attended a variety of events throughout Australia including rural shows, science displays and conferences, and school visits.

We need to charge a fee to cover fuel costs and other overheads of the Energymobile. As a non-profit community group with little to sell, we cannot subsidise the cost of of our attendance at events by sales of equipment as commercial companies do. However, our main objective is to spread the renewable energy message. If costs are a problem, please contact us and we may be able to negotiate a lower fee under special circumstances.

If you would like more information about the Energymobile, or would like to make a booking for your school or organisation, just contact our national office at the address below.

The Alternative Technology Association (ATA) is a national non-profit group involved in promoting and using appropriate technology. ATA has over 2000 members Australia wide, with local groups in many parts of Australia.

Members get together regularly for a range of activities including meetings, film nights, practical workshop courses, and field trips to places using environmentally sound technology.

Alternative Technology Association
247 Flinders Lane, Melbourne 3000
tel: (03) 650 7883.

Order form

Name .....
Address .....
..... Postcode .....
Daytime phone:(.....) .....
[In case we have a question about your order.]

Gift order or delivery address (if different from above)
Name .....
Address .....
..... Postcode .....

Item	Quantity	Price $	Total $
Energy Guide for new appliances		**FREE**	00.00
Soft Technology subscription [$18] (commencing with issue .....)			
Soft Technology gift subscription to the address above [$18] (commencing with issue .....)			
ATA Membership [$30, or $22 concession]			
Donation to ATA			
TOTAL			**$**

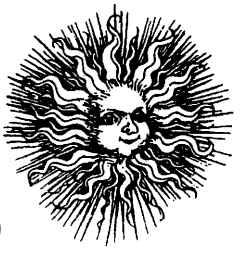
OPTIONAL – 'memory joggers' only

Please make cheques and money orders payable to Alternative Technology Association.

[ ] Enclosed is my cheque for $.....

Date:

Send to ATA, 247 Flinders Lane, Melbourne VIC 3000



LETTERS

Dear Editor

For more than a decade now I have been dreaming of settling into an alternative semi-rural lifestyle. Last December I bought 7 acres near Kennilworth (about 30kms south of Gympie) in south eastern Queensland.

So now I spend Saturday mornings in the national library researching issues relating to house design, regeneration of rainforrest, and organic farming. I have browsed through back issues of *Owner Builder* and *Soft Technology* for articles of interest.

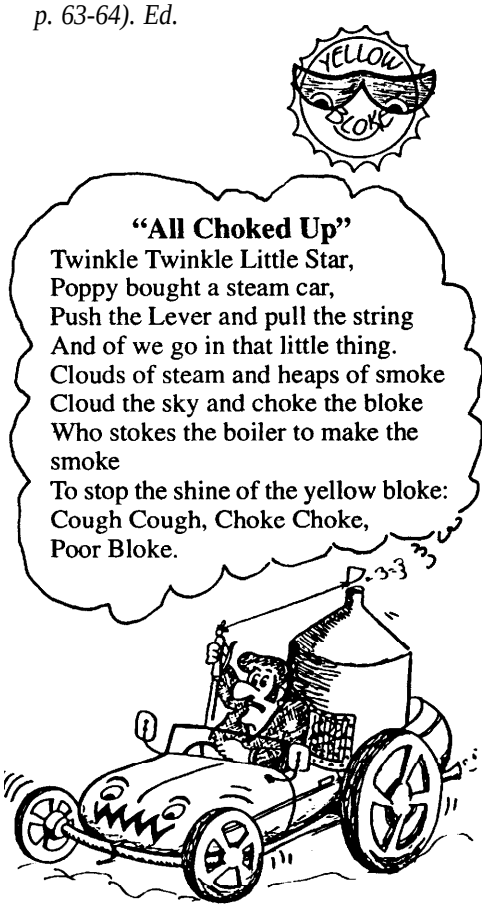
Is there a local branch of the Alternative Technology Association? Do you have a list of recommended literature?

I look forward to you next issue.

Yours Sincerely

Peter Cook, Belconnen, ACT.

Thanks for being a supportive reader: There is a Canberra branch of ATA that you may like to get in touch with (contact details in "Behind the Scenes", p. 63-64). Ed.



Actually I am interested in steam, or better still, steam electric, powering my 1986 Toyota Bunderra, and would appreciate any help and information.

John Mangan, Pascoe Vale, VIC.

Thanks for your wonderful poem - we loved it! Ed.

Friends of the ATA

It's only when you dabble with alternative technology systems that you realise just how much energy westerners use and waste. Just getting together the energy to run the simplest of household appliances is often an enormous challenge to alternative energy systems. As we head towards the end of finite energy sources and finite environmental exploitation, it is going to pay for neighbourhoods to be more aware of their actions. The Alternative Technology Association has made a great start.

When I read my first Soft *Technology* magazine I immediately bought all the back issues which were really terrific. I would like to get in touch with any ATA people around Ballarat with general AT interests or projects.

I would like to meet anyone with biogas digester experience. In particular I would like to know how long a good digester takes to generate its own volume of gas?

Yours Faithfully

Callum Morrison. Ballan. VIC

You can read about Callum's biogas activities in "Drumming up Biogas" (p.41 of this issue). Ed.

Gas Production

Dear Editor

I am writing to find out if it is possible for you to do an article on gas producers which use all the outputs from the system, ie, all volatiles driven off in the burning of the charcoal. I envisage a system which could use the hot exhaust gases to dump heat into a low-pressure boiler that drives a steam turbine or, in a worst case, a reciprocating steam engine. If the system was run at optimum efficiency, ie, constant load, the excess energy could be used to split water, thereby storing a readily usable source of energy.

If you would like to contact any of the people writing in to our letters page, let us know and we will do our best to put you in touch with them.

Brian Hocking, Morley, WA.

Producer gas was discussed in Soft Technology no.36 - June 1991. Back issues are still available. The technology has been largely rejected since World War II (50 years ago now), so most of those with hands on experience are no-longer around. This article is the best we can offer by way of information. Ed.

Concern over polystyrene

Re: "The Polystyrene House"

Houses with polystyrene insulation will be demolished sooner or later. How much will end up polluting water ways, killing marine life etc.?

Ashley Cawlell, Black Forest, SA.

Calling old wind generators

Dear Readers

I am interested in locating old wind generators. They need not be complete or in working condition. Any information would be appreciated. Please contact Phillip Haynes - (063) 356210.

Phillip Haynes, Oberon, NSW.

More on 12 volt computers

Dear ATA,

It's tremendous to regularly get *Soft Technology* and so I am pleased to be renewing my subscription.

Ian Reynolds' article in the last issue of *Soft Technology*, on the 12 volt computer, caught my eye. What an amazing fellow! It got me thinking. There is an alternative to building such a special power supply; if you can live with the other family of computers:-

My Apple 2C computer runs on an external 15 volt power supply, so is ideal for anyone who is on 12 volt power. The Apple 2C has a 5¼" built in disc drive, and runs a tremendous programme called *AppleWorks* which has an excellent Word Processor,

Database & Spreadsheet. It's now available on the secondhand market from around $300. It usually has a small green screen monitor which can also be run from 12 volts.

The 2C, like all Apples & Macs is well supported by AUSOM (the Apple Users Society of Melbourne) - whom I can highly recommend. A great deal of Freeware & Shareware software is also available through their software librarians. AUSOM's address is Box 1071, Narre Warren, 3805 Vic.

Now to the details: the power supply to the 2C is through a 7 pin female Din plug, with the +15 volts on pins 5 & 6, while the negative lead is connected to pins 2 & 3. The pins number clockwise, looking at the rear of the plug, as in the diagram 1. I cut off all the pins I didn't need and soldered the wires to each pair of pins.

I have run my machines off 12 volts in this way, using some automotive wire, red for positive volts, black for negative. It draws 1.5 amps when the disk drive is running, otherwise dropping back 0.75 amps.

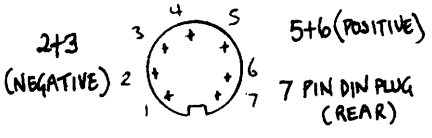
Pulling the monitor apart was a little more difficult. To completely remove the case, you will need to remove the off/on switch and the brightness control, which is not difficult when you have got the top cover off. The pair of wires (red for positive, etc) are carefully soldered across C701; then, in my case were taken out a new 10mm hole in the rear case near the 3 adjustment controls.

Ths C701 is the main filter capacitor and normally has +17 volts across it, but the monitor runs quite well on 12 volts, just having to adjust the brightness control. It draws 1.1 amps, which is pretty reasonable. I, like Ian Reynolds, felt that I wouldn't get inside the printer, but it probably isn't difficult.

Yours Sincerely

Ray Leerson, Ararat, VIC.

PS. I have not mentioned fuses, but in-line fuses of 2 amps each would be most worthwhile.



Firebox Retrofit and Getting into Hot Water

I wish to direct your readers attention to these two articles, and their precise implication for those enthusiasts who may seek to utilise the technical ideas being offered

Firstly "Firebox Retrofitting" should only be attempted by persons who are competent and qualified to undertake such upgrades. Specifically under the Building Code of Australia, now operational in all states, all domestic heating appliances must comply with Australian Standards AS2918 for safety and clearances to all combustible materials when installed.

Since the mid 1980s, domestic heating has been tested for compliance to AS 2918 which established precise appliance installation clearances and certification for each model. Any structural modification without the approval of the manufacturer, the Local Council (if a permit is required) and without retesting invalidates the compliance certificate issued for the initial appliances.

Such modification will almost certainly contravene the householders existing insurance cover unless full disclosure of the modification is made. In addition, in Victoria at least, any modification of the type suggested will invalidate the relevant Council Permit, and is required to be disclosed under the sale property requirements.

While there may be exceptions to these arrangements particularly for older appliances, in general terms if a modification of the type proposed is carried out in Victoria (and probably elsewhere) a re-installation permit to AS 2918 is compulsory, to which the modified appliances must now comply.

From 1 st July 1993, new Australian/NZ standards covering performance (efficiency) and minimum flue emissions (smoke) became mandatory on most appliances manufactured after that date. Already operational in Tasmania, these will progressively spread Australia wide in the coming months.

This information was not conveyed to your readers, and may have exposed all parties involved to an appliance modification (including your correspondent), to significant liability should a house fire result, as it inevitably will if certain safety margins are exceeded or compromised.

By comparison, Andrew Blair in his contribution "Getting Into Hot Water" carefully highlighted many of the pitfalls the Association is aware of in setting up wood fired domestic hot water options, including the relevant standards and council regulations.

Tradesmen and do-it-yourself enthusiasts alike often make the mistakes to which Andrew refers, simply because they are not aware of the technical aspects of such installations.

The message is simple; Wood-fired domestic hot water and heating options are safe, efficient and cost effective - if you set them up correctly.

I suggest to your readers that they seek out a member of our association, look for the distinctive firebox logo - to supply the correct components, the right advice and, if necessary, competent installation or technical help.

Yours Sincerely,

Kevin F Wood, Brighton, VIC.

National Executive Officer,

Australian Solid Fuel & Wood Heating Association.

Soft Technology has always published ideas that readers present which we believe be of interest to other readers. We believe that it is by experimentation that advances in knowledge and understanding come about.

Frequently it is arrogant for an amateur dabbler to think that he or she can improve on a researched, modern design. In the case of our article "Firebox Retrofit for a Warmer Winter", the heater that was modified was not a modern unit, but had some modern features added.

We would always encourage people to talk to their local building inspector if they are planning something that may not comply with the regulations. Most building inspectors welcome a project of interest and like to be included in it. To present them with a fait accomplis and then expect them to accept a non-regulation idea is not fair; and usually gets the thumbs down. Ed.

WHAT'S ON

WORLD SOLAR CHALLENGE

- **November 7th onwards Darwin to Adelaide**

While petrol car racers battle it out in Adelaide's Formula 1 Grand Prix, another 60 cars will be competing on a route from Darwin to Adelaide with sunlight as their only fuel.

The 1993 Daido Hoxan World Solar Challenge begins in Darwin on Sunday 7 November, Around 60 vehicles will take part, traversing more than 3000km of some of the world's harshest countryside. Cars representing the scientific, commercial and eductional strength of 17 nations combine in this year's field. Cars must meet a minimum speed capability of 38km/h, with the expectation that the winning car will average more than 70km/h.

Fur more information phone *(02) 337 5390 or (03) 820 3899*

International Model Solar Car Challenge

- **November 14th Prince Alfred College, Adelaide**

The 1993 International Model Solar Car Challenge is a project linking science, environmental and technical education, This event will bring together students from all over Australia, New Zealand and possibly America, in a special competition to test their model vehicles powered by solar energy.

Student designed and built models are 1/10 scale and use an 8 watt solar module as their power source.

The challenge will run in conjunction with the full scale Darwin-to-Adelaide World Solar Challenge.

For more information, contact Dodwell Keyt, ph: (03) 569 0252

Support a Solar Car

Join Going Solar in sponsorship of *Parhelion*, Monash and Melbourne Universities' joint entry in the World Solar Challenge. You can help meet the costs involved in this near completed car by simply sponsoring one of the cells for $5. In return for your tax deductable contribution you will receive a poster listing your cell number. Get behind the development of renewable energies and support *Parhelion*.

Those keen to help, contact Kate at Going Solar, ph:(03) 328 4123.

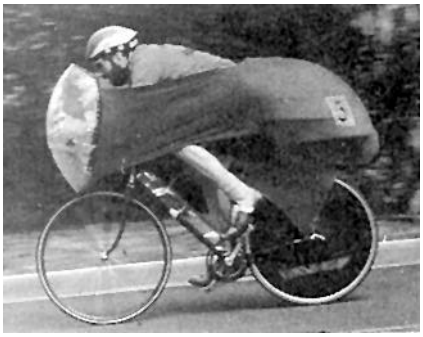
Human Powered Vehicle Challenge

- **November 6th - 7th Sutton Road driver Training Centre, near Canberra**

The fourth national HPV Challenge is on. This is your chance to see some of the most interesting pedalled vehicles in the world. To demonstrate the possibilities inherent in human powered transport, Pedal Power ACT, in conjunction with the Canberra Bike Museum and HPV Times, are conducting a series of competitions for these vehicles.

Not only can you view these futuristic bikes and trikes but, in the quieter moments of the program, it will be possible to test ride many of the cycles.

For more information, contact Wayne Kotzur, ph: (06) 241 7966



Russell Moore aboard partially faired *Audaux* bike

Ecotex '93

- **November 3rd - 5th Canberra Natex Centre**

Ecotex is the environmental technology exchange. The focus of this conference and exhibition will be the recognition of local government responsibilities in environment issues. It is aimed specifically at those who support and impact on local government and their involvement with the environmental issue.

Community Ecotex will immediately follow Ecotex and will be a community environment show for the Canberra and southern NSW region.

For more information, contact Ecotex '93, ph: (06) 288 2884

THE 1993 RACV ENERGY BREAKTHROUGH

- **November 26th - 28th Maryborough, Victoria**

Maryborough's Energy Festival will provide festival goers with a snap shot of the past and a window to the future. This year's festival will incorporate a number of exciting events along with a range of entertaining, informative displays, working demonstrations performances and information on current and future energy conservation.

The aim of the three day event is to educate people about current and future energy sources which will assist us all in achieving an ecologically sustainable existence.

The RACV Energy Breakthrough is part of this festival and provides a chance for students, teachers, parents and local industry to work together to design and construct a vehicle, a machine or an innovation in technology that will represent an energy breakthough. Entrants give an oral presentation of their work and each category has an endurance or demonstration trial.

For more information, phone (03) 690 7033

WHAT'S ON

Thermacell

Anybody who is interested in finding out more about the Thermacell building system covered in the article "The Polystyrene House" *(Soft* ***Technology*** no.44) can contact Thermacell on:
ph/fax (059) 89 7431
mobile (018) 591450

NEW BUSINESSES

Illawarra Energy

Stephen Garrett (DCFX Solar Systems) and Geoff Stapleton (Southern Solar and Pumps) have formed a business parnership with Illawarra Electricity (the South Coast NSW Electricity Utility). The new business, Illawarra Energy, is a business unit of Illawarra Electricity.

The role of this new business is:
*to act as a wholesaler to existing retail outlets. (see below)
*Develop new products
*Supplier of systems for Illawarra Electricity
*Consultancy

The three businesses - DCFX Solar Systems (Pambula), Southern Solar & Pumps (Ulladulla) and Soft Options (Bega) - will act as Illawarra Energy outlets with negotiations being undertaken with other solar outlets.
For more information, contact Illawarra Energy, ph: (064) 957033 or (044) 541425

Synergy Power Corporation

The Perth based renewable energy company, Survivor Energy Systems Pty Ltd, has changed its name. The new company called Synergy Power Coporation Pty Ltd has been formed to market Remote Area Power Systems (RAPS) more effectively, nationally and internationally.

The Perth factory continues to manufacture the S-3000, S-5000 and S-20000 SURVIVOR brand wind turbines and related hardware.

SURVIVOR wind turbines have been installed at many sites around Australia and well inland where 'conventional' turbines cannot produceusable power in low level wind regimes.
For more information, contact Synergy Power Corporation, ph: (09) 330 2877

COURSES

The following two courses are taken by Dr Robert Rich and are run through the Holmesglen College of TAFE in Melbourne.

Living with Solar Energy

This is a one day (Saturday) course run several times a year. It is located at the Moora Moora Co-operative, near Healesville, so participants can inspect working examples in daily use - solar electric installations, attached greenhouses, solar efficient house designs, solar water heaters. The course is a basic introduction with a practical orientation.

The Affordable Mud Brick House

This course runs on one evening a week over 10 weeks, with about half the time being hands-on, practical experience. It covers almost everything an intending owner-builder needs to know.
For more information, contact Holmesglen College of TAFE, ph: (03) 564 1546

Permaculture Design Courses (QLD)

- September **12th - 26th**

At Crystal Waters Permaculture Community with 'Earthcare Education'.

We have developed a unique course using active and interactive learning methods, accelerated learning techniques, design exercises, field trips and much more to help you use permaculture principles to design gardens, orchards, farms, urban, financial and social systems, in fact, anything.

Other courses in Feb, June, Oct '94.
For more information contact:
Earthcare Education
Crystal Waters
M.S.16. Maleny 4552
ph: (074) 944 707

Permaculture Design Course (NSW)

- **November 13th - 27th, 1993**
  March 5th - 19th, 1994
  Far south coast, NSW

A great way to learn about permaculture design specific to cool temperate systems and species.

This is a two week, full-time residential course. The tutors are Hugh Gravestein and Andrew Sheridan. There is a limit of 20 per course, so register ASAP.
Enquiries to: H. Gravestein, c/- Wyndham Post Office, 2550 ph: (064) 942 014

Permaculture Design Service (WC)

For urban, hobby and broadacres. Designs for improved soils, sustainability and high productivity.

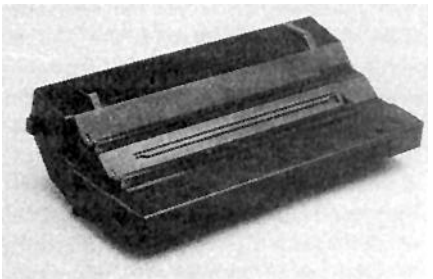
Weekend courses: Wonthaggi September 11-12, Cowwarr October 16-17, Holmesglen TAFE November 13-14, Trentham November 27-28. Short courses at Hawthorn, Box Hill and Holmesglen. Design Certificate Course: Ontos May 28 - June 6, 1994. Learn to grow food in cities, become more self sufficient and be really effective in your contribution to enhancing your environment.

Organic food deliveries to your home arranged. T-shirts and non-hybrid seeds supplied.
Design Service brochures, Grace McCaughey, ph: (03) 882 5600

PASS IT ON

What's On is a column aimed at letting people know about any new ventures, projects, businesses, conferences, festivals and events that are relevant to a sustainable future. If you have any information about what's on in your neck of the woods, please send it to:

What's On
c/- Soft Technology
247 Flinders Lane
Melbourne 3000



The Recyclable Cartridge

Hong Kong's Green Cartridge Company has come up with a solution to the ever increasing environmental problem of disposable, non-biodegradable laser printer cartridges. The product is the *Jumbo* Cartridge, an SX compatible, high yield laser printer imaging cartridge designed to be less costly both environmentally and economically.

The Green Cartridge company claim that by designing a cartridge with longer lasting parts they have managed to double the output of existing disposable cartridges while lowering the cost, and producing a fully recyclable product. All worn parts in the cartridge are replaced and units are also refilled with toner and returned to the customer.

The Jumbo Cartridge carries an unconditional guarantee. Pick-up and delivery for recycling is free.

The pricing varies according to the quantity of the purchase but for a single cartridge you will pay around $240 (minus a $20 rebate for returning your used cartridge). Larger orders can expect to pay less than this price.

For more information and to find your *closest distributor contact:*

The Ribbon Manufacturing Company,
ph:(02) 938 2100/ 905 0466
fax: (02) 905 0757

Solar Hydroponics

As urban pressures gradually contract our gardens to pocket-handkerchief proportions and the world population explosion creates increasing pressures on our soil available for food production, impetus has been given to the soilless cultivation methods of horticulture. This takes many forms, the best known being hydroponics, where artificial nutrients dissolved in water are fed to plants rooted in a wide range of sterile materials. These range from river sands and gravel to Vermiculite and specially processed, water retentive pellets.

Hydroponics is steadily gaining popularity among home gardeners, partly because hydroponically cultivated plants are easier to protect from pests and disease, but mainly because a higher crop yield, either of flowers or vegetables, is obtained from a smaller area of garden or yard space.

Recently a Victorian based company which specialises in the use of solar technology has developed a ***Solar Hydroponic Kit,*** a safe, 12 volt automatic recycling plant feeding system. The Kit uses a solar panel and battery to store energy from the sun, which then operates a pump for short intervals thoughout each day via a timer. This, in turn, delivers the nutrient to the plants. This eliminates the risk of coming home to find that your plants have suffered in your absence.

The kit is supplied complete and ready to go. It includes a solar panel and mount, battery, timer, cabinet, water pump, nutrient container and solution, planter trays, growing media, stand, polypipe, and seeds.

The Solar Hydroponics Kit costs $485 plus $30 for freight and packaging.

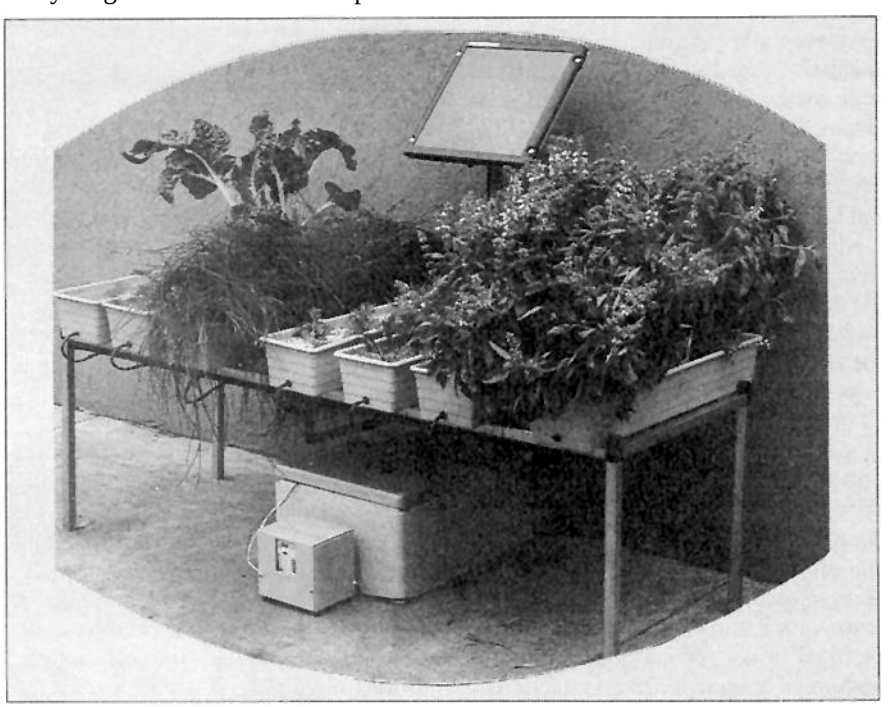
For more information, contact Renewable Energy, ph/fax: (056) 624 280

Just Watt you wanted

Solarex have recently released their MSX-83, 83 watt module for applications where a 64 watt unit is insufficient but two 50 watt units are more than required.

Using the latest technology in polycrystalline silicon photovoltaics the MSX- 83 contains the largest solar cells in commercial production. These 11.4cm x 15.2cm cells give the MSX-83 the highest power and nominal current (5.23 amps) of any 36 cell PV module on the market today. Solarex performance tests every module and then prints the true power output onto the back of every module.

For more information, contact Solarex, ph: (02) 727 4455



The Solar Hydroponics Kit

Product Reviews

Product Reviews

Survivor Wind Generator Review by Glenn Garrett

For some years now our power and heating needs have been supplied by a combination of six photovoltaic panels, a slow combustion heater and a solar hot water system, backed up with a noisy petrol generator.

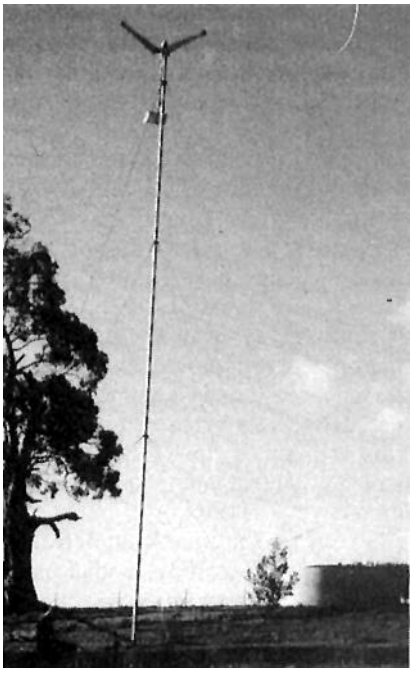
About ten months ago we began tap ping into another source of energy. Being 150km from the coast, we thought tidal energy was probably out so the next best thing was wind. Having already suffered through all the hassles of trying to cover stacks of mud bricks with plastic, lay sisalation, fitting six metre lengths of roofing iron etc, we knew there was wind!

A company I work for in Castlemaine, Butler Solar Systems, has a Survivor 800 watt (800W) wind turbine installed and I was impressed with its performance in low winds. So I ordered one with the intention of erecting it myself. However, after reading the installation manual, I opted to leave it to someone with experience. That turned out to be Brian Sala of Rustic River Pty. Ltd., who at the time had erected six Survivor wind turbines. He has worked out with an engineer a much more efficient way of laying the foundations than appeared in the Survivor manual. He has a small tractor and post hole digger that he uses to dig the holes for the five concrete pads that support the tower.

For those not familiar with the Survivor, it consists of a three or four section tubular steel tower, of which the sections are plain 4.5" (11.43cm) diameter galvanised steel tubing. Special alloy castings are used to join the sections and the bottom casting has a pivot which allows the whole tower to be tilted down for maintenance. The bottom casting also has an attachment for a gin pole which sits horizontally to the tower.

A gin pole is a levering device which is attached (usually perpendicularly to the vertical) to masts and similar structures, to facilitate raising and lowering of the structure. In this case, the gin pole also provides an attachment point for one set of guy wires. The other three sets of guy wires are spaced at 90 degrees to each other around the pole.

The gin pole is normally attached to the concrete foundation with a cable at its outer end, however when the tower needs to be lowered, a winch is attached to the outer end of the gin pole, the cable detached from the foundation and the tower is simply lowered to the ground. If the foundations have been precisely located, all the other guy wires are left attached and don't need to be re-tensioned when the tower is raised again. All in all, it is a very elegant piece of engineering.



The Survivor

The turbine itself has three fibreglass blades which are larger than normally found on a wind generator. This gives the Survivor a particularly good low wind speed performance. To prevent overspeed damage, the generator is hinged at the top of the tower and automatically tilts backwards as the wind gets stronger. During high winds it will tilt so that the propellers are horizontal. This is inherently simple, safe and failsafe.

The wind generator is fairly noisy, but it is not an unpleasant noise; although in very strong winds it sometimes sounds as if the thing is going to take off! Ours is about 50m from the house but the cable is about 100m long, after being buried in an existing water pipe trench. The cable used is a mixture of 25 and 35mm^2 aluminium ex-SEC cable kindly sourced by Mick Harris. This is probably a bit small for the job, but we still find that we get over 800W into the batteries, which means that the wind generator is putting out over 1000W - so it is pretty conservatively rated.

My only complaint with the Survivor is the load controller that was supplied with it. This is supposed to turn on a load dump to get rid of excess power when the batteries are fully charged, but it seems to be mismatched and ends up discharging the batteries. A characteristic of the BP Solar batteries we have is that their voltage goes very high under charge, so a voltage controller will cut the charging current even when the batteries are in a fairly discharged state. What is needed is a controller that holds the voltage constant at a fairly high voltage until the batteries are fully charged and then lowers the voltage to a float level. On/off controllers in my experience are useless for solar batteries. I have built as a temporary measure a shunt controller that dumps excess power as heat when the voltage goes above 31 volts. What is really needed is an intelligent controller that keeps track of battery amp hours and has a switching regulator to dump excess power into a load resistor, particularly a heating element in a hot water service.

So, is it all worth it? For the last four months we have had precious little wind or sun, so we have been burning a lot of petrol; but then, from last August through to March we had heaps, and ten months is not really enough time to fully evaluate the system. Our area (Hepburn Springs, Victoria) is not a particularly good wind area and we were rather restricted in siting the wind generator on our 1.5 acres block.

It's a bloody good landmark though!

Survivor wind generators are made in Perth and are available from Synergy Pty Ltd (Formerly Survivor Energy Systems). For more information phone (09) 330 2877

Hydro Power

Bright Auto Electrics has developed a new low head hydro design with impressive outputs.

Nett head	1	2	3	4	5	6	7
Watts	60	125	180	280	390	470	550

Previously unviable sites can now generate sufficient power to be a feasable alternative. The unit is capable of 1.5kW maximum output and the manufacturers claim it is possible to run several households from one unit. The major advances have been made through the use of the permanent magnet alternator which is highly efficient at low revs.

Features of the micro-hydro units include:

- Permanent magnet alternator
- Very low maintenance with long life bearings
- Powder coated aluminium housing
- Quick release nozzles, easy to change to suit seasonal water flows.
- Compact size
- Low head turbines use a Turgo wheel
- High head models run a pelton wheel
- Usable power is generated from as low as 1 metre nett head, ie. 60 watts
- Australian design, Australian made

Power is stored in batteries for when it is required. An inverter can supply 240 volts to run normal household appliances.

For more information, contact Bright Auto Electrics, ph:(057) 552 383

Total Absorbtion

Total Absorbtion (see PRODUCTS *Soft Technology* 44) has changed address.

The new contact details are:
ph: (03) 532 0348/532 0075
fax: (03) 532 5602

Windward Power Systems

Windward Power Systems (QLD) announces the release of 3 models of wind generator and one tow behind water generator. These generators are designed for use on boats but can be adapted for land use.

The *Series One* wind generator is lightweight (10kgs) with 2 blades and starts charging at 9 knots, producing 10 amps at 25 knots and comes with an air brake to prevent over revving.
Price: $665

The *Series Two* wind generator has 4 blades and starts charging in only 3.5 knots, producing 6 amps at 13 knots.
Price: $763 or $913 with the tow behind water generator attachments.

The *Series* Three wind generator, also 4 blades, is suited to high and low wind areas. It also starts charging in 3.5 knots but will produce 9 amps in 25 knots.
Price: Same as Series two.

The *Tow Behind Water Generator* will start charging at 2.5 knots, producing 6 amps at 7 knots.
Price: $350 + sales tax, If purchased in addition to either series 2 or 3 wind generators the price is $150.

All units come equipped with a master control box consisting of an amp meter, thermal cut out, and braking switch.

For more information phone Steve or Sharon of Windward Power Systems on (018) 879 072

Stephen Oakley with the Windward Series 2 wind generator

COMPOSTING PRODUCTS

Cornposting is great for your garden and the environment, and there are many different ways of going about it.

What follows is a very small selection of the aids to cornposting on the market. Three of these products actively employ earthworms in the composting process. This is a low maintenance method of cornposting as the worms do the work for you; feeding on vegetable and animal refuse and expelling it as casts. Vermicompost (worm compost) is a very good organic plant food and soil conditioner, working as a slow release fertiliser.

The products mentioned which use this method are all multi-sectioned and allow the worms to migrate from the area of decomposed waste into a separated section of fresh waste, keeping the cornposting cycle going.

The Vermicompost Bin, produced by Global Worming, uses earthworms and aeration (which is provided through the wire mesh top and sides) in its composting process. It has a pull out tray beneath the separated compartments designed for easy removal of the vermicompost.

The bins are made from Murray Pine, come in two sizes. The smaller bins come with 1000 earthworms and the larger bins with 2000.

Global Worming are currently setting up an Australia wide network of agents to cater for customers in all parts of the country.

Prices are as follows:
Kit form - small $150 or large $180.
Preassembled bins - small $160 or large $190.
Additional freight costs apply.
For more information
phone (057) 722 203 or (054) 329 283

The Reln Worm Factory

Reln Compost Bin and Worm Factory

The ***Reln Worm Factory*** is both a cornposting system and a simple method of breeding earthworms. This compact apparatus, made of recycled plastic, should enable users to breed worms in increasing quantities, produce worm castings (vermicompost) and collect liquid manure for use in the garden.

The Worm Factory consists of three working trays with side ventilation grills, a ventilated lid, and a collector tray with a tap fitting (for extracting the excess liquid). As one tray of waste is decomposed it can be emptied and used in the garden before being replaced on the top level to continue the rotation process.

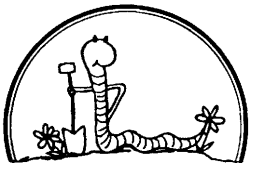
Another Reln product, the ***Compost Bin,*** is an inexpensive option for home cornposting. It has a capacity of 225 litres, is made from 100% recycled plastic, and comes as an easy-to-assemble kit.

Holes in the bin allow air to circulate but it is also necessary to turn the compost regularly over the 10-12 week decomposing period. The use of two bins is suggested so that one can be used while the other is cornposting.

Both these products can be obtained through local councils and selected nurseries around Australia.

Prices may vary between councils according to their policies (some provide subsidised bins) and from nursery to nursery, Nevertheless approximate prices are: bin $25-$30, worm factory $50-$55.
For more information, contact
Reln Plastics, ph: (03) 775 0022 in Victoria or (02) 603 5266 for the rest of Australia

Aus-worm Duo Cornposter



The Aus-Worm Duo Cornposter uses a combination of earthworm farming techniques and flow through aeration to speed up decomposition. The more worms you breed the faster your waste will be consumed.

Only certain species of worm are appropriate - Reds, Tigers and Blues are recommended. Start with around 1000-2000 worms.

When one compartment of this twin bin is full of vermicompost just lift up the side doors and shovel it out.

The Aus-Worm bin is made from treated pine and delivered in kit form for easy do-it-yourself construction. It has a total capacity of 270 litres.

Price: $139 plus $20 delivery for most parts of Australia.
For more information, contact
Aus-Worm Organics, ph:(057) 67 2329

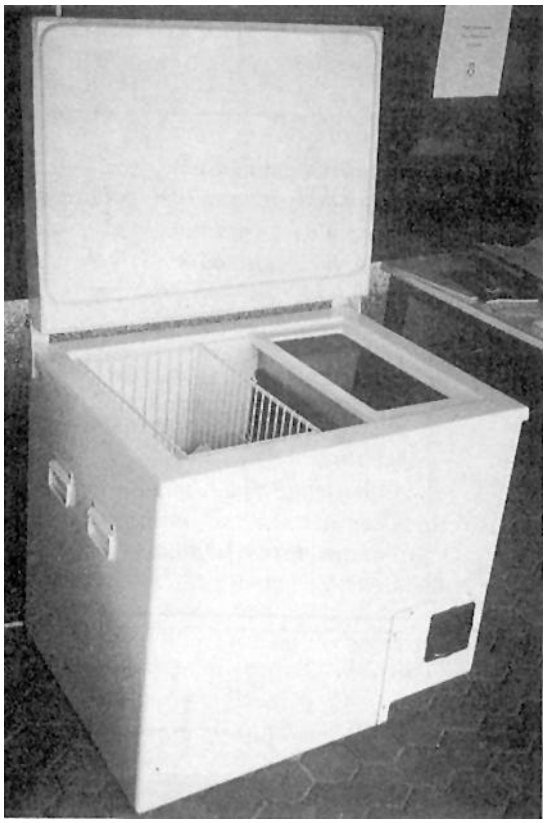
Compost Tumbler Kit

Proftech is offering a kit which allows you to recycle your old 205 litre (44gal) drum into a compost tumbler for just $32.00. This is a big saving on the initial cost (around $300-500) usually associated with this method.

Aerated tumbler-type bins can produce mature compost very quickly - you can expect to get rich compost in 14 - 30 days. Tumblers need to be turned each day and we also recommend rust proofing the inside of your drum with bitumous paint or anti-rust paint.

The Compost Tumbler Kit comes with a 30 day money back guarantee and includes everything needed to convert your own 44 gal drum into an aerobic compost tumbler, along with detailed 8 step assembly instructions. A stand is not included but plans for a low cost stand are provided.

Price: $32.00 & $7.50 for P&P (Australia wide).
For more information, contact
Proftech, ph: (03) 386 4068



One of the ICEER fridge range.

Intelligent Fridge

ICEER Refrigeration Systems is a Queensland company which manufactures a range of portable fridges. These fridges are claimed to consume half the power of **a** conventional fridge of the same volume. For people running a fridge on solar, this effectively means you can halve the area of solar panels required.

ICEER is an acronym for Intelligently Controlled Energy Efficient Refrigeration. The high efficiency of these fridges hinges on a sophisticated electronic control system coupled with efficient cabinet insulation. The control system monitors operating parameters such as ambient temperature, internal cabinet temperature, compressor performance and gas charge. System variables are accordingly adjusted to obtain optimum efficiency. It is claimed that the refrigeration effect of the units remains constant up to an ambient temperature of 45°C.

Three standard models are available, all of which operate on either 12V or 24V: The ICEER 150 is a 150 litre fridge/freezer with the option of either top or front opening. It is capable of operating at a tilt of 30° which makes it particularly suitable for installation in yachts. The ICEER 100 is a 100 litre deep freezer (-12°C). At the larger end of the range is the ICEER 320, a 320 litre upright front loading unit.

All of the units will also require an investment in panels and batteries to run. An estimated total system cost for the 320 model, including two panels and two batteries is $5375. The two smaller units would come in at about $3985. The rrp for the fridges alone is $3000 for the 320 model and $2658 for the two smaller models.
For more information, contact Betts Boat Electrics, ph/fax: (07) 203 3046

Inverter Update

CSA Energy-technique advise that the sinewave inverters mentioned in the last issue of *Soft Technology are* now being manufactured at their factory in Shepparton, Victoria.
For technical specifcations and up to date prices, contact CSA Energy-technique, ph: (058) 311518

Cornposting Toilet Advancements

Environment Equipment is about to produce their *ROTA-LOO* (composting toilet system) at a lower price than ever before. The standard *ROTA-LOO*, which includes all the components necessary for immediate installation, is soon to be sold direct to the public for approx. $2,500. This has been made possible due to some design improvements and a change over to rotational moulding.

The new development has impressed overseas - Environment Equipment has had to obtain an international patent to protect this Australian product.

Environment Equipment have also now developed a grey water system to complement their cornposting toilets. Customers in NSW and NT, where the system has EPA and Health Department approvals can now benefit from a complete environmentally safe domestic alternative to septic sewage. Approvals for the remaining states are expected soon.

Environment Equipment manufacture *BIOLET, ROTA-LOO, ECOS SOLTRAN* and *ENVIRO GREYWATER TREATMENT* systems.
For more information phone (03) 587 2447, or fax (03) 587 2082

If you have, or know of, a new product which you think would interest our readers, drop us a line or give us a ring and let us know about it!

NOEL'S TREASURES FROM TRASH

Low Cost Home Science Projects

*In number 5 **of** the series, Noel shows us how to build a Savonius windmill.*

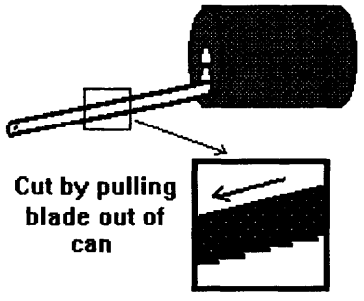
Windmill

With spring breezes blowing, it's a good time to make a simple Savonius wind mill. These can be made from some aluminium cans and cardboard, a piece of coathanger wire and a soft drink bottle.

The cups

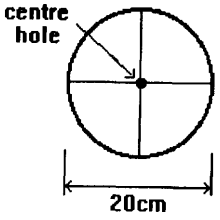
Draw a line around the middle of the can vertically, so that it is divided into two equal halves. Using a hacksaw

Fig 1.



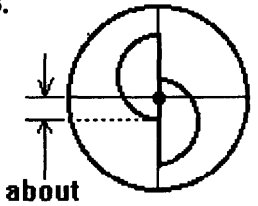
blade, cut the can in half, using the line as a guide. Start from the open side of the can. Insert the blade with the teeth pointing downwards and cut by drawing the blade out of the can (see diagram). Using a small hammer, flatten the ends of the half-cans so that the cans can be glued to a flat surface. Cut a small "V" in the top and bottom of each half can, about 1cm in from the side opposite the opening. These are the cups.

Fig 2.



Graphics by James Hamlyn-Harris

Fig 3.



The rotor

Fist make the shaft. Use the tin snips to cut a length of bike spoke or coat hanger about 30cm long.

Using a compass, draw two circles, each 20cm in diameter, on your cardboard. Now mark out where the cups are going to go. Take one of the circles and draw a line from one side to the other, passing through the hole left by the compass. Using your protractor or set square, draw a line at right angles to the first line, also passing through the centre hole.

Cut out the circles and use the shaft to poke a hole through the centre of each circle.

Now take circle with the lines on it and glue the cups to it with the epoxy glue, lining them up along one of the lines, with the inside edges overlapping, as in figure 3. It is best to have the two open sides of the can on the outside of the circle, so one half will have to be upside down.

Next, glue the other circle to the tops of the cans, making sure that the edges of the top circle line up with the edges of the bottom one.

The base

Fill your bottle with water (to make it heavy and stable), leaving enough room for the the cork to go in the top. Wedge the cork firmly into the neck of the bottle. Poke the shaft (the piece of spoke or coat hanger) into the centre of the cork.

Take the lid of the bottle and tap a hole in it from the outside in with the nail. Slide it onto the shaft, so it sits upside down on top of the cork, to make a bearing for the rotor to spin on.

Now slide your finished rotor onto the shaft, and make it spin! If the holes in the cardboard are too tight, and the rotor doesn't spin properly, wiggle the rotor gently to make the holes a little bigger.

Put a fan near the windmill, and notice that it will spin in the same direction regardless of which way the air is moving.

Good luck and have fun!

You will need:

An aluminium can
A coat hanger or a bike spoke
Epoxy glue (Araldite)
Some thick cardboard
A small (375ml) soft drink bottle
A cork

Tools:

A drill,
A hacksaw or hacksaw blade
Scissors,
A small hammer
A compass
A protractor or set square
A nail

Fig 4.

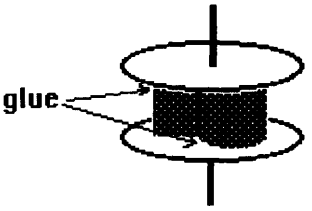
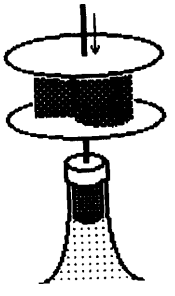


Fig 5.



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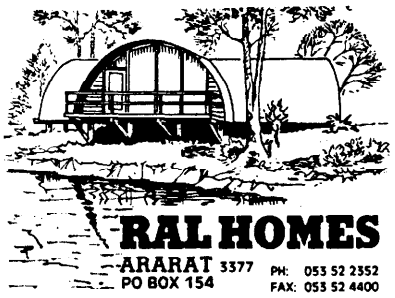

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Design, sale and installation of all remote power equipment. BP Solar distributor. Licensed electrical contractor.

Strath Steam

Trak Pull Engineering (Rod Muller)
Taylors Ln, Strathalbyn, SA 5255
Ph: (085) 36 2489.

Steam engines and boilers for standby generators, marine and other appplications. Can manufacture a range of sizes and types of steam engine to suit individual requirements.

Sunbather

2174 Frankston-Flinders Rd
Hastings, Vic 3915
Ph: [Vic] (059) 79 2777.
Ph: [NSW] (02) 688 4000.

Full range of solar hot water panels and tanks, including stove boosted systems. Leading manufacturer since 1973. Agents throughout Australia.

Sunergy

Elante Pty Ltd
380 Canterbury Rd, Surrey Hills, Vic 3127
Ph: (03) 836 9966, Fax: (03) 836 6743.

Distributors for 'Sun energy' and SIEMENS solar (formerly ARCO) products. Complete home power, water pumping, wind turbines, inverters, batteries, solar lights etc.

Sunpower Enterprises

Bruce McKenzie: Advanced Certificate of Renewable Energy Technologies
Phone: (056) 78 8270

Solar & wind energy systems - installation & sales approved RAPSIS supplier. Portable solar chargers for tractors, electric fences, caravans, boats, pumping, etc. Ex-Telecom batteries available. Free delivery to Melbourne.

Sun Ray Power Co.

Showroom and Service Centre
69 Munibung Rd, Cardiff NSW 2285
Ph: (049) 567 966, Fax: (049) 567 250.

Design, supply and installation of home, campervan, 4WD and boat power systems. Wholesale and retail sales of solar panels, inverters, batteries, DC refrigeration, high efficiency lighting, water pumping, wind turbines, battery chargers, solar trackers and generators.

Sunraysia Sun Spot

6 Jubilee Dve, Mildura, Vic 3500
Ph: (050) 230 847.

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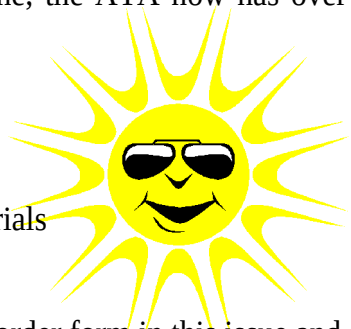
Becoming an ATA member is easy and rewarding

Established in 1975, the ATA is a non-profit community group that uses and promotes technology working in harmony with the environment. Originally based in Melbourne, the ATA now has over 2000 members all over Australia, with local groups in most capital cities.



Members receive a number of benefits including:

* annual subscription to Soft Technology magazine (4 issues)
* annual subscription to The Sun newsletter (6 issues)
* access to the ATA's extensive library of appropriate technology materials
* discounts on ATA activities and courses

To become an ATA member, fill in the space on the back of the catalogue order form in this issue and send your cheque for $30.00 ($22.00 concession) to:

Alternative Technology Association, 247 Flinders Lane, Melbourne 3000.

A PARTING SHOT

Notes from my Spring Garden

It has happened all at once. Suddenly the air is balmy, there are suspicious amounts of green stuff all over the trees and office workers step, blinking, into the light, assume blissed-out expressions and lean toward the sun, photosynthesising. Spring is sprung. You can almost see the sap rising.

And this year I actually have a garden to watch it happen in. I have been told I have a convenient, low-maintenance inner urban garden. This translates to more bricks, railway sleepers and terracotta than actual dirt, and acute garden envy. I have never seen the thrill in grass cutting and edging, so I draw the line at coveting lawns. But there are PLANNED gardens in my suburb. Expanses of green lusciousness that sit there exactly...so. There are people out there who obviously have access to daffodils that have been genetically engineered in 'small' 'medium' and 'large', so they bob and wave gracefully in layers in a small manicured corner. Mine are mutant feral daffodils that only come up if they can be bothered, and then anything up to ten feet from where I planted them, which worries me sometimes late at night. My daffodils will be inheriting the earth along with the meek and the cockroaches.

I have also invested heavily in herbs. (No, not THAT kind, this is a family magazine). The problem with herbs however, is that one is never sure exactly what one planted the damn things FOR. Was it medicinal? Cultural? Does it attract honeybees? Repel fleas? Prevent chilblains? It seems mean to want simply a bit of parsley to dress up a meal. I gave up once I realised I'd planted two together that simultaneously attracted and repelled cats. Most of the neighbourhood moggies are psychotic anyway, but it wouldn't have helped. Another thing you would do well to remember is that herbs are forever. My sister has been waging a private war with a comfrey plant that she violently uproots every time she sees a small amount of green showing above the mulch. It has a cunning plan, this plant. It lets her think she has won for a few weeks, maybe a month. Then one morning a small, dewy shoot will lie triumphant and exhausted on the earth. And so it goes on. As it has for the last three years.

It may not be going in the right direction, but I can report that my garden is decidedly organic, and I am proud to announce two new discoveries to help you keep your garden green. The first one eliminates grass that insists on springing up between your carefully-laid courtyard bricks. Obtain a couple of litres of wine. Preferably something from the more reputable wineries, but a nice cask will do. Take your wine and a cushion, sit on the cushion, take a swig, start weeding, take another swig, keep weeding, and it's amazing how the afternoon will just fly. DO NOT ATTEMPT THIS METHOD IN AREAS WHERE THERE IS MORE THAN ONE TYPE OF PLANT.

The second is a variant on the old trick of companion planting. If you are ever in that difficult situation where you aren't quite sure what is a weed and what is a prize bulb, let them grow and multiply for a bit. Whichever one flowers first wins, and you can toss all the others. If you want a patchwork effect, try the wine method.

Manicured daffodils may elude you, but it beats an afternoon in the K-Mart gardening section, agonising over nuclear weed deterrants and snail bait, hands down.

Cheers!

Alexandra Oke

Alexandra is a regular contributor to Soft Technology *and a keen exponent of the organic way of life.*

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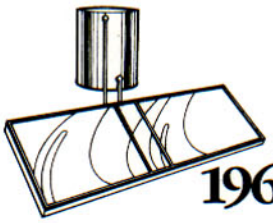
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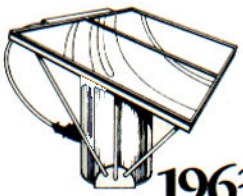
1962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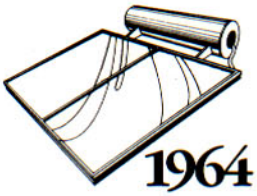
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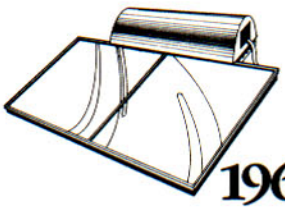
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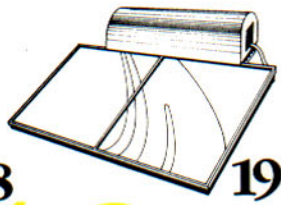
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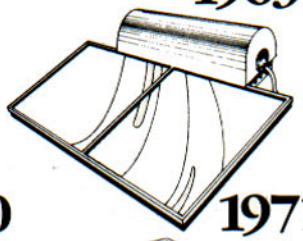
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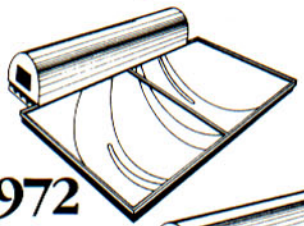
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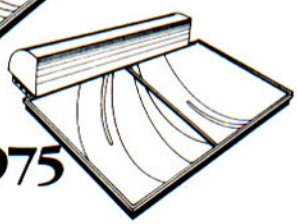
1975

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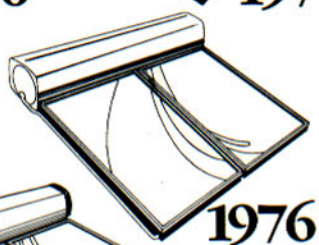
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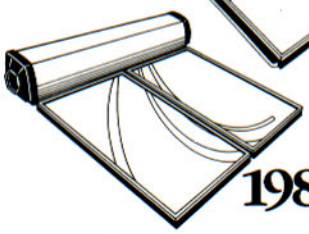
1983

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