soft technology

Technology for a Sustainable Future No 49 Spring 1994 $4.50*

- Great Untapped Energy Sources competition
- Solar Hot Water: a cheaper way to D-I-Y
- Make a model solar boat
- Inverter buying guide

...and more inside...

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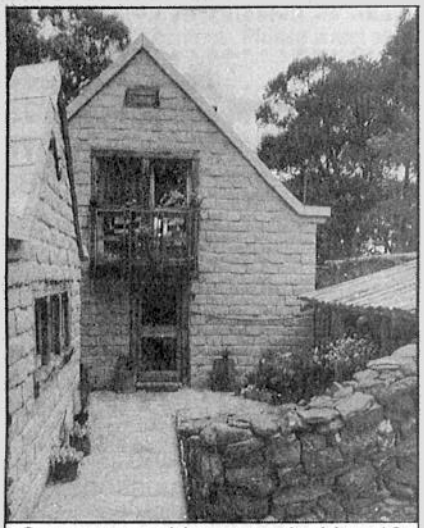

Compact outside, roomy inside 19

Environment-and-people-friendly products . . . and you don't need to do this! 29

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Technology for a Sustainable Future
No. 49 Spring 1994 $4.50(rrp)

CONTENTS

FEATURES

PRACTICAL

Cruising on an electric boat 53

Further 'round the S-bend 49

TECHNICAL

ISSUES

REGULARS

Soft Technology

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Hello!

The Soft Technology office is suddenly full of 'Net nuts'! Recently we at ATA were introduced to the delights of the Internet. At the moment we receive only about a dozen e-mail messages each week from Soft Technology readers, but we are confident that this number will continue to grow as more people find out about our e-mail address.

The Internet is a great hit in an office of 'communications junkies', and cyber-friendships have already developed between staff members and other Internet users around Australia. (There is no cyber-romance yet, but we'll keep you posted on any further developments!) I won't go into any more detail about the Internet, because it's all covered in our article on page 47.

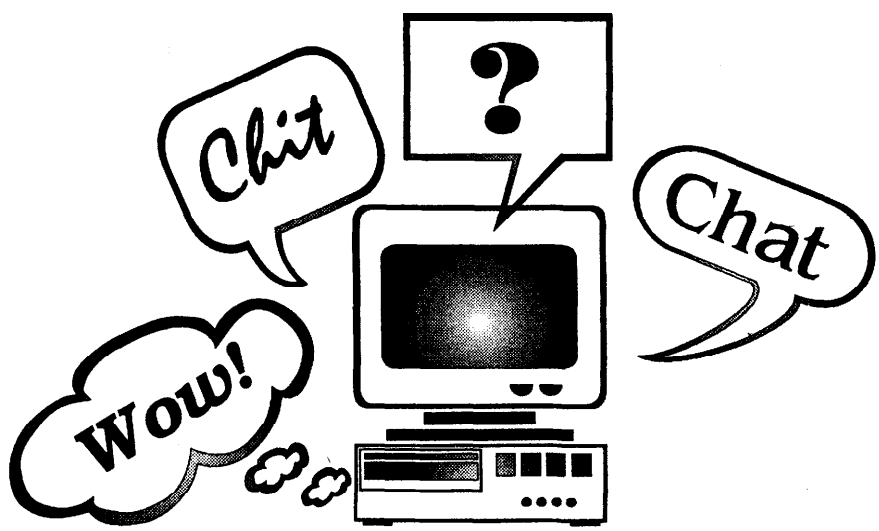
One of the most exciting things about the Internet is of course the information that can be gleaned from it. The other day we read about a project from the US, where researchers US have combined plastics technology with photosynthesis to develop large organic molecules that convert sunlight to electricity in much the same way as plants turn sunlight into energy. If the project is successful, one day we may be able to buy rolls of photovoltaic plastic film.

What a great idea, if it ever gets off the ground! Some of the ideas we have read about on the Internet are from people with the most astounding imagination and creativity. . . which reminds me of the Great Untapped Energy Sources Competition, and the imagination and creativity of Soft Tech readers. Entries received so far have been a mixture of interesting practical ideas and just plain hilarious. You can see our favourite of those received thus far on page 16. But don't miss out! There's still time to send in your entry and be in the running for the fantastic prizes donated by our generous sponsors.

At this point I think I should tell you about our new Assistant Editor, Lance Turner. Many of you will recognise his name from some of our recent technical articles. Lance is a real 'tech head', with particular interests in renewable technology and electronics. One of Lance's tasks will be to make sure that no more technical 'bloopers' slip through.

I hope you enjoy reading this issue of Soft Technology. We're off to start work on the NEXT issue. . .our fabulous 50th (we can hardly wait).

Claire Beaumont



ENERGY FLASHES

Too many laws

A recent ACF report advocates looking to New Zealand when it comes to resource management, planning and environmental laws.

At the moment we have a confusing array of environmental protection, planning and resource management legislation.

As an example: Australia has 58 acts covering air pollution, NZ has 5; we have 78 for solid waste disposal, NZ has two; we have 290 acts covering nature conservation, NZ has 27.

ACF claims that Australia's complex, overlapping and sometimes conflicting laws have resulted in confusion, delays, inaction and poor environmental outcomes.

ACF Conservation News May 1994

Clean, safe . . . nuclear!

The Japanese government recently endorsed nuclear power as a 'clean energy' source. The endorsement was a a follow-up to the Rio 1992 Earth Summit, when Japan pledged to produce a national sustainable development plan. Rio's Agenda 21 makes no mention of nuclear power as a sustainable energy alternative.

Earth Island Journal, Spring 1994

Will Britain ever rule the waves?

When Britain's Department of Energy began to promote wind power in the mid-70s as the country's best alternative source of energy, it was merely attempting to protect the nuclear-power lobby, claims *The Ecologist*.

By identifying wind power as the most attractive renewable source, the nuclear industry was able to draw funding away from proposed wavepower plants. As a result, funds for wavepower research dried up and the nuclear lobby reigns supreme.

Earth Island Journal, Spring 1994

The world's first wave-driven electrical power plant is to be built off the British coast near Dounreay, but the financing will come from Brussels. The new UK Energy Minister, Tim Eggar, is not a renewable energy fan. He was formerly a director of the Chartered Petroleum oil company.

Earth Island journal-Spring'94

Golf-free Olympics

The decision of the International Olympic Committee (IOC) to drop golf from the 1996 Atlanta Games was applauded by environmental and human rights groups around the world, but an application has been submitted to the 2000 Sydney Games.

The more than 24,000 golf courses on earth consume 6,000,000 acres of land, disrupting ecosystems, poisoning water and displacing villagers.

A spokesperson for the Global Anti-Golf Movement (GAGM) says, 'Golf is no longer a sport. It is nothing but a big business. . . . Golf course development cements the unjust and unequal economic relations between the North and the South'.

For more information, contact GAGM, 19 Kelawei Road, 10250 Penang, Malaysia, fax:60-4-375705.

Earth Island]ournal-Spring '94

The electric 'beetle'. . .

Volkswagen plan to produce their classic 'beetle' as an electric car. The 'Concept 1' should go on sale in the US in 1997.

Earth Island Journal, Spring 1994

. . . and an electric lemon!

The Chrysler Corporation recently announced that it would build a new mini-van that nobody will buy!

Chrysler is required to build the vehicle to comply with a California standard requiring that by 1998, two per cent of the vehicles offered there by major car makers emit no pollution.

Since the standard was introduced in 1990 by the California Air Resources Board, the major car manufacturers have said that affordable high-performance batteries could not be developed in time.

The price of the batteries will be so high, Chrysler contends, that each electric van would cost at least $21,000 more to build than a standard mini-van.

The Age 9-5-94

Ultimate clean racing car

Chrysler also announced that it will launch the ultimate clean racing car at Le Mans in 1995. The car will run on liquefied natural gas, which produces far fewer combustion emissions per unit of energy than petrol.

The gas drives a gas turbine, something like an aeroplane engine, only much smaller. The gas turbine will run a generator, providing electricity to power an electric motor to drive the wheels. However, unlike a conventional car engine, the turbine's output will not go up and down as the driver's demand for power goes up and down.

When the generator's output is more than the car needs, the surplus electricity will be used to accelerate a high speed flywheel.

When the car needs more power than the generator can provide, it takes energy out of the flywheel to keep the electric motor going at full output.

Energy from the regenerative braking system is also put into the flywheel when the car is braking.

An electronic controller makes the best use of the various sources of energy and ensures that the flywheel energy store never runs out just when you need it.

Clean Slate #13, Summer'94

Fuel from garbage

A garbage processing plant in Bombay is turning the city's garbage into fuel pellets. The plant presently produces 30 tonnes of fuel pellets daily, but has an estimated daily production capacity of 80 tonnes.

It is claimed that the pellets have a calorific value almost equal to that of coal. The ash content of the fuel pellets is only five to ten per cent, compared to 35% for most coals used in Indian boilers.

Down to Earth 15/02/94

Energy-efficient fridge

Sunpower (USA) has developed a Stirling cooler for a 200 litre domestic demonstration refrigerator with ultra-low power requirements. The refrigerator consumes on average only 8 watts and is powered by a single 50 watt photovoltaic panel without batteries. It creates its own 24 hour ice store for temperature stability during the night.

A conventional refrigerator of equivalent size consumes about 300 kWh per year, compared to the 70kWh per year achieved by the demonstration unit. It is expected that energy consumption can be reduced to 50kWh per year when vacuum insulated panels are installed in the cabinet.

The demonstration refrigerator, which uses neither CFCs nor other environmentally harmful gases and requires no oil to operate, was sponsored by a European consortium including several governments as well as utility and private sector organisations, including Greenpeace and the World Wildlife Fund.

CADDET No 2, 1994

Microwave clothes dryer

A small-scale commercial microwave clothes dryer will soon be field tested in a Hawaii hotel. The temperature of clothes in the dryer will rise to only 45°C in comparison to 70°C for traditional dryers.

Early tests show energy savings of thirteen per cent compared to conventional dryers.

Power Lines (Hawaiian Electric Company) March'94

RAPAS is back

The NSW Remote Area Power Assistance Scheme (RAPAS) will be continued. The scheme has been frozen since March, due to allegations of contractor fraud.

Measures introduced to minimise the scope for abuse of the scheme include non-price-dependent grants, an accreditation scheme administered by Solar Energy Industries Association of Australia (SEIAA), compulsory post-installation inspections, and linking grants to properties.

NSW Office *of Energy press release*

Solar aircraft

Looking like a large flying wing with a span of around 30 metres, and sporting eight 1.5hp electric motors on the leading edge, the ***Pathfinder*** may well represent a new era in environmentally friendly transport. The aircraft generates all of its own power using the array of solar cells embedded in its top surface.

Although a pilotless aircraft, Pathfinder has many possible uses, such as weather tracking and high-altitude surveillance. While only capable of fairly slow speeds, the Pathfinder will be able to cruise all day at up to 80,000 feet.

The next aircraft to come from the team of engineers at ***Aero Vironment*** Inc. in Simi Valley California will be called the ***Helios.*** This incredible 60m span plane will not only sport eight motors and a solar array like its predecessor, but will also be fitted with specially designed hydrogen fuel cells. These will allow the Helios to stay aloft indefinitely, as the cells are charged during the day using excess power from the array to provide power for night time flight. The exciting thing about the Helios is that it is expected to be able to carry a 150 pound payload, making it capable of carrying all types of equipment for weather and other research.

Popular Science, April 1994

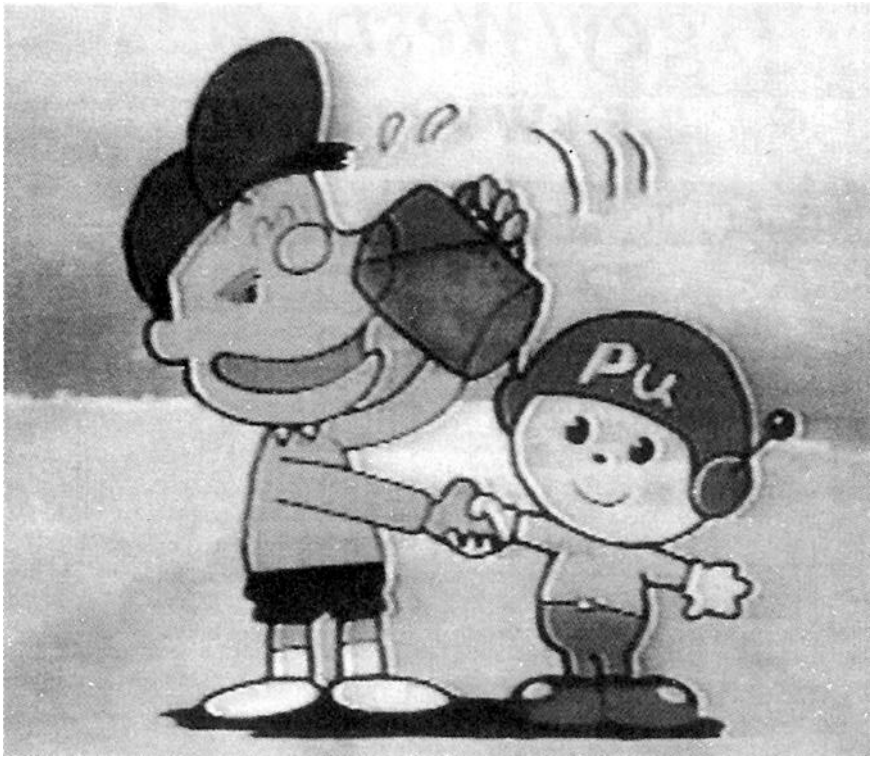
Deadly toons

A plutonium-friendly cartoon character has been enlisted to assuage public concern over the plutonium fueling a nuclear reactor in Monju, Japan.

The character Mr Pluto wears a green helmet labelled 'Pu', the chemical symbol for plutonium (one of the world's deadliest substances).

A promotional video shows Mr. Pluto holding hands with a young boy who swallows several glasses of plutonium-laced water. Mr Pluto assures viewers that 'there is no proven cause of plutonium in the body causing cancer'. He also explains that if anyone drank water contaminated with plutonium, nearly all of the element would pass harmlessly through the body.

Scientific American, May 1994
Earth Island Journal, Spring 1994



Mainichi Shimbun PNC

Drink it Freddy! Mr Pluto assures Japanese children that plutonium is harmless.

PRODUCTS

Permaculture software

Permaculture Pro is the working title for new computer software being developed for landscape and agricultural consultants.

The program searches for suitable plants using up to 90 search criteria, and can provide up to 9900 standard reports as well as customised reports and searches. Numerous features are included and the plant database provides information on over 700 plants.

Both Macintosh and Windows versions are being developed, and for a short time the developer is offering to include the features you would like to have.

If you would like to know when the software becomes available, or would like your own features included, contact Ninja Designs
ph (057) 952 573

Solar water pumping

Suntron Sunpumps™ is a new range of submersible solar water-pumping systems.

According to the manufacturers, the systems use new motors and controllers which provide a motor efficiency in the order of 90% and a system efficiency of 7.1 %. This is claimed to be higher than other systems commercially available.

In Suntron's tests, the system achieved 50.8 litres per minute at a 10 metre head and 29.7 litres per minute at a 30 metre head.

rrp $2600* for Model 23M07C400 (which uses a 0.7Nm motor and 400W controller)
$2731 *for Model 23M15C8OO (which uses a 1.5Nm motor and 800W controller.)
$2980* for Model 23M30C1500 (which uses a 3.ONm motor and 1500W controller)
****Pump prices not included***
For further information contact Suntron Power Products
ph:(03)894 2544 fax:(03)894 3370.

Sashless windows

Double-hung sashless windows provide better ventilation than ordinary sashed windows, because they allow air to circulate through both the top and bottom of the window. *Shugg* claims that it is the only manufacturer to offer double-glazed sashless windows, which improve sound-proofing and insulation. All Shugg sashless windows feature a clear PVC weather seal that can be removed to provide ventilation when the windows are closed.

Shugg double-hung sashless windows provide ventilation through the top and bottom of the window.

The windows can be installed into timber, steel or aluminium frames of almost any shape - even angular or arched spaces.

rrp $350 for a 2100 x 900mm window
For further information contact K Shugg Industries
ph:(03)544 6900 fax:(03)562 8223.

Solar Pathfinder

The Solar Pathfinder is used for determining the amount of solar radiation reaching a particular site on a year-round basis.

It has a shiny, transparent dome which reflects any shadow-casting objects in the area around the user. The user then traces an outline of the horizon's reflection onto a sunchart placed inside the dome. The traced line shows exactly the times of the day and month when obstacles will shade the site. The manual provided shows how to calculate the percentage of maximum possible sunshine received by a site over the whole year, and where to locate PV panels, passive solar buildings, etc for optimum performance.

Here's what US magazine ***Home Power*** said when they tested the Solar Pathfinder: 'Not only does [this] device work great, but it's easy to use, accurate, ruggedly built and just plain ingenious.'

Southern Hemisphere model US$234, including postage
For more information contact Darlene Estep, 25720 465th Ave, Hartford SD 57033-6328 USA
ph:0011-1-605-528-6473

Solar-powered pool blanket

The ***Solazone SR-2*** is a remote controlled and powered pool blanket roller. A battery charged by a solar panel provides the power for the motor which runs on 12 volts. The motor rolls and unrolls the solar blanket as required.

Solazone also supplies a solar pool heating system. The collector tubes have tiny fins running the length of each tube which increase the surface area available for heat collection.

rrp $1695 for Solarzone SR-2
For further information contact Ernest Gavey
ph:(03)830 4511 fax:(03)830 4511.

The *Saxonette* bicycle engine.

Bicycle engine

Saxonette by Sachs is a small, single-cylinder engine for mounting on a bicycle or tricycle. The engine runs from unleaded fuel stored in a small tank located above the rear wheel.

The control has only three positions - 'start', 'go' and 'off' and, according to the manufacturer, one pull is enough to start the engine. Ignition is electronic, and fuel consumption is very low, at one litre per 100km. The engine, which the manufacturer claims is very quiet, can be started or switched off while riding.

rrp $1290
For further information contact CM Schatz, (09)364 6544.

Solar water heaters

CopperSol is a solar hot water heating system which uses a copper hot water tank, copper pipes and copper collecters.

The suppliers claim that copper provides better corrosion resistance and less maintenance compared with other systems. The system comes with a 10 year warranty.

rrp $2220 for 300l tank including two panels
$2520 for 300l tank including heat exchanger linkup plus two panels
For further information contact Archer International Pty Ltd,
ph (03)763 2233 fax (03)763 4312

Unlike most other solar water heaters, which use a metal solar collecter and storage tank, the ***Solco*** unit uses a one-piece integrated unit moulded from polyethylene.

The polyethylene is UV stabilised and the unit is cheaper than conventional units. The manufacturers claim that maintenance costs are also lower than conventional water heaters as the unit does not rust and is unaffected by mineralised water.

Since the unit is integral there are no joints and gaskets, thus reducing leakage problems.

The MKl model requires a separate header tank if your mains water pressure is low. If solar radiation at your site is a problem, you will also need a booster heater. The MK2 does not need any additional equipment.

rrp MK2 $1049
MK1 $899
Header Tank $150 Booster Heater $150

Solar radiation sensors

Vaisala has a range of solar radiation sensors which can be incorporated into automated weather stations. The SR 12 pyranometer provides a voltage output signal proportional to the solar radiation falling on the instrument.

The DSU 12 sunshine detector provides a contact closure when the incident solar radiation exceeds 120 watts per square metre. The accumulated time of closed contacts gives the sunshine duration.

The FP 12 flux plate measures the heat flux into or from soil.

rrp DSU12 and SR12 $1290 each
FP12 $320
For-further information contact Vaisala Pty Ltd
ph:(03)696 5699 fax:(03)696 5766.

Earth revival kits

In ***Soft Technology*** #45, we provided information on worm composting kits produced by ***Aus-Worm Organics. The*** company has now come out with three different kits. The ***Ranger*** is 300 litre capacity and is designed for placing against a wall. The ***Homesteader*** is 270 litre capacity and, like the Ranger, is made of treated pine and comes in kit form for easy assembly. The ***Gardener*** has a 52 litre capacity and is made of polypropylene.

All of the kits are used for producing worm castings out of household and garden organic wastes for use as fertiliser.

rrp Ranger $149
Homesteader $139
Gardener $59 plus p&p
For more information contact Aus Worm Organics, ph (057)67 2319

Seedling shelters

Onguard seedling shelters and tree guards protect seedlings and trees from kangaroos, rabbits, sheep, etc, while providing an optimum environmental micro-climate for plant growth. The guards are made from double-skinned extruded poly-propylene sheeting which, according to the manufacturer, can be reused many times.

rrp $1 to $5 each, depending on size, plus delivery
For further information contact Corex Plastics,
ph:(03)794 0111 fax:(03)706 5402

Onguard seedling shelters provide protection from wind and grazing animals.

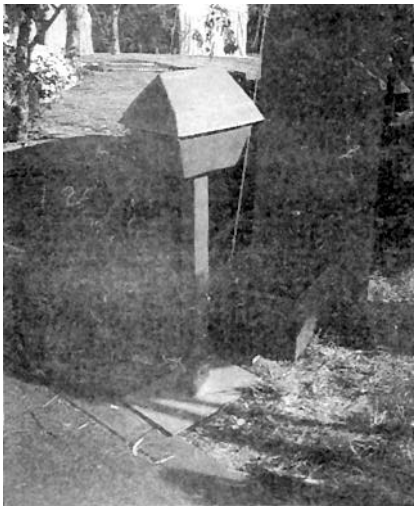
Recycled plastic products

Your old plastic supermarket bags could be turned into a feed trough for a horse! Your ice cream containers could end up as a letter box or even a picnic table! *Australian Recycling Technologies* makes a wide range of products from *Replas* - 100% recycled post-consumer waste plastic.

According to the manufacturer, the products are strong, rust proof, rot proof, insect proof and never need painting, although they may be painted to suit a particular colour scheme.

Managing Editor, Mick Harris has one of these letterboxes, and he thinks it is great!

rrp $35 for an unassembled letter-box
For a brochure giving the entire range of products, contact Australian Recycling Technologies
ph (053 1332 883 fax (053)334 303

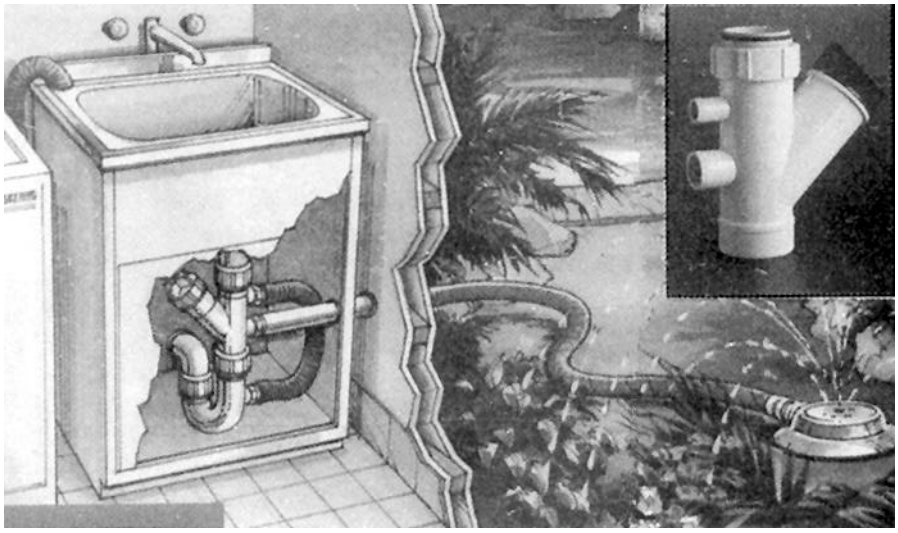


A letterbox made from Replas: recycled post-consumer plastic waste.

Repeat Plastics is another manufacturer making use of recycled plastics. Products include roadway lane markers, bases for road bollards, domestic water drainage grates and marker posts.

These products are made from recycled post-consumer or industrial scrap plastic, much of which would otherwise be sent to landfill. Recycled rubber from tyres is also used.

Repeat Plastics
ph (03)761 0484 fax (03)762 6257



Laundry greywater can be recycled with the *Suldi* greywater diversion valve.

Greywater recycling diversion valve

Green Harvest is a mail order outfit based at Crystal Waters Permaculture Village in Queensland and specialising in organic gardening and permaculture supplies. They handle a large range of products including natural fertilisers, pest management products, natural insecticides and pest repellents, plants and books.

The latest addition to their range of products is the *Suldi* water diversion valve for recycling grey water from the washing machine or laundry tub for use in the garden.

rrp $55, but a special price of $40 including postage is offered for Soft Tech readers.
Green Harvest, 52 Crystal Waters
MS16 Maleny QLD 4552
ph (074)944 676 fax (074)944 578.

Universal power & energy tester

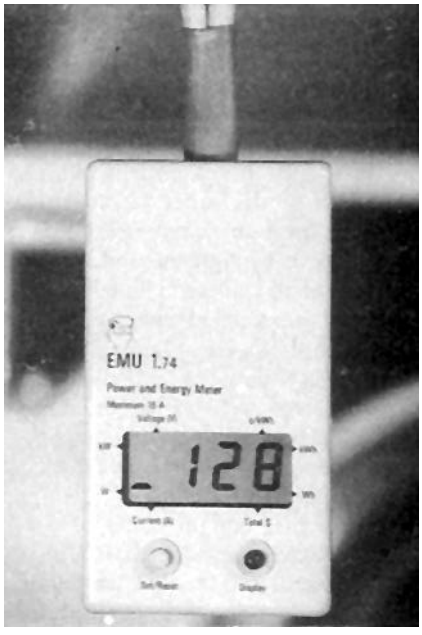
The EMU 1 universal instrument is a small and accurate electronic device which enables you to monitor the voltage, current, power, energy and electricity costs of a range of electrical equipment.

EMU 1 replaces several conventional electrical measurement instruments and their associated wiring.

Measurement data is stored and none is lost if the mains supply fails or if the device is moved to a new location. Readings can be reset to zero whenever required and a new energy cost per kilowatt-hour entered.

The device is handy for quick checking of power consumptions as well as 24 hour monitoring of appliances like refrigerators, heaters and VCRs.

Peter Bachmann ph (06)290 1639 is offering the unit to ATA members for an introductory price of $249 until the end of 1994.



The *EMU 1* universal power & energy tester.

Product Reviews

Product Reviews

Tri-Nature cleaning products

Review by Imelda Evans

Ever since I have had a bathroom to call my own, I have been looking for an EASY environmentally friendly way to clean it. Through trial and error, I have discovered that vinegar is fine for the toilet, vinegar solution works well on benches, bicarb soda paste does the basin, and just about anything cleans the mirror if it is wiped off with newspaper. But the shower, with its icky build up of body fats and soap residue has stumped me - particularly since our brilliant decision to install an oh-so-sexy but impossible-to-keep-clean clear-glass screen in our new bathroom.

I've tried bicarb and a scourer on the tiles - it works, but have you ever tried to keep a significant amount of bi-carb soda paste on a vertical surface? I tried vinegar and newspaper on the glass screen - that worked too, but it took forever, and wherever the newspaper touched the plastic screen surround I was left with black marks which proved very difficult to get off. Desperate for a quick remedy, I slunk surreptitiously by night into the 24 hour supermarket and emerged with a guilty cargo of commercial cleaners - only to find that in them, too, the magical ingredient was elbow grease. I shouldn't have been surprised - it never did make sense to me to use a soap- or detergent-based product to clean soap residues.

Ever hopeful, your intrepid reporter lashed out and bought some of ***Tri-Nature's Excel Bacteriacidal Cleaner &De-Stainer.*** I was fatally attracted by the claim that it removes soap residues, scale and mould growth, while being kind to the environment.

Excel bacteriacidal cleaner.

The literature said that it would stick to surfaces to cut through the dirt, so I was a little surprised to find a fairly runny, almost clear liquid coming out of the bottle. I suppose I have become used to highly coloured and full-of-fillers conventional cleaners. It certainly stuck to the surfaces though. I put a fairly liberal amount on the shower screen, towards the top, expecting it to run down, but found it ran only about 30cm, then stopped and hung there.

I spread it over the screen with a squeegee (it covered almost the whole screen - I was surprised at how far it spread) and left it for a few minutes to do its thing. Then I wiped and rinsed it off with a sponge and water and to my amazement, the screen was sparkling clean. No elbow grease! No bleach! No phosphates!

After a brief spring dance of joy around the bathroom, I tried the Excel on the tiles. The results were not as dramatic but it was certainly effective. The only problem I had was how to spread it around without wiping half of it off onto the sponge. The squeegee wipes off as much as it spreads, although I found it was gelatinous enough to scoop up and reapply. I also noted that the smell, though strong, is pleasant, and is not toxic to breathe, and my sensitive skin found that contact with the cleaner caused no problems.

At the same time as I bought the Excel, I also got a one litre bottle of the ***Tri-Nature Chamomile Liquid Organic Concentrate.*** This is primarily a dish-washing liquid, but has seemingly endless other uses. I was intrigued, not to mention a little skeptical.

I found the liquid fine for doing dishes. It doesn't make a lot of suds, but it performed as well as any other dish-washing liquid. Interestingly, it seemed to suspend the dirt in the water rather more than many detergents I have used. Usually, I get a ring of oily dirt around the edge of the sink, as the detergent breaks the surface tension of the water, but this stuff seems to have a greater attraction for the grease than the grease has for the stainless steel. Again, I found that I could use this product without gloves with no ill effects - my hands become very dry and itchy with normal detergents.

I also tried it heavily diluted in a sprayer as a general-purpose cleaner. I followed the instructions and used five drops in 500ml of water, which I found worked as well as anything else I have used, and better than a vinegar solution. I was a bit skeptical about it being a good glass cleaner, but I found it was quite effective. I have used it on mirrors with good results, and with the help of my all-purpose squeegee, I found it very handy in cleaning the filthy outsides of our windows. It smells better than Windex, too.

Tri-Nature say you can also use the Chamomile liquid to clean pesticide residues off fruit and vegies, wash your dog, your car and your polished wood floors, and as a kind-to-skin bubble bath. I think I will try the bubble bath next!

Excel costs $6.60 for a 500ml bottle and the Chamomile Liquid is $12.60 for a one litre bottle, or $54.60 for five litres. Going on usage to date, I think my 1 litre bottle is going to last me for several months, so although it is a significant outlay to begin with, over time it works out economical. And frankly, I would pay more for the Excel - but don't tell Tri-Nature .

A word of warning - don't use too much! Not only is it wasteful, it is very difficult to rinse off.

Tri-Nature is available through distributors. Call (049)28 2199 for more information. ☼

Turning rubbish to RICHES

Waste Not-a community group in Bunbury, WA - is making functional and beautiful things from 'junk'.

Anne Jennings

EVER wondered what could be done with 'waste' that is sent to landfill rubbish dumps but appears to be of value - if only you could find someone who wants it, or could make something from it? This was exactly the feeling of a small group of unemployed and under-employed people in Bunbury, Western Australia, who decided to do something about it themselves.

With the assistance of a local visionary, Kathy Summers, they decided to set up small businesses where they would re-manufacture waste products into goods to be resold in their local community. Most of those involved were members of Bunbury LETS (Local Energy Transfer Scheme), and they decided that using LETS local currency would be a part of the project.

Bunbury Community Group Inc., a local community group, was enlisted to assist the project, with the added bonus that Waste Not acquired legal status under Bunbury Community Group's incorporation.

With the assistance of Community Development Worker Anne Jennings, premises - in the form of a large warehouse with shop frontage on the edge of the central business district - were leased on a peppercorn rent from the South West Development Commission (a State Government regional body); a loan of $100 cash was obtained from Bunbury LETS, and the vision began to become a reality.

A grant of $2,200 was obtained from the State Department of Training to cover power, telephone, rates and office costs, and a further $1000 loan was secured from Bunbury Community Group to establish the project. Jobskills trainee, Brian Odine, is employed for six months under a Federal training program, and since its inception in October 1993, the project is gathering momentum.

To date, a number of projects have been accomplished. One person, work-

Above: Rob Berryman of *Waste Not* with some of his 'Wooden Toys of Yesteryear'.
The waistcoats (or should that be 'waste-coats'?) behind Rob are made by Debbie Jennings from recycled flour bags and recycled materials.

ing full time, has relocated and expanded a toy-making business (which was to have closed down) using mainly recycled timber. Training programs are also being provided by this enterprise, including skills development for a group catering for people with disabilities. Another person, working part time is establishing a rag trade business, providing quality rags to mechanics and heavy industry. A landscaping and gardening enterprise has been set up by a full-time worker, using recycled mulch and materials. Another person is investigating the possibility of establishing a mulching business, based at local landfill dumps. This person has been referred to the Leschenault Enterprise Centre for the New Enterprise Incentive Scheme assistance. Training programs are also being held on our premises.

Currently an airbrush painting course for fabric painting is being held and a partnership of two trainees is establishing a business in airbrush painting and silk screening. They will also be fabric painting on recycled clothes, particularly jeans and jackets. This course was organised by the newly formed Youth Market Scheme, which Waste Not hopes to work closely with in the future.

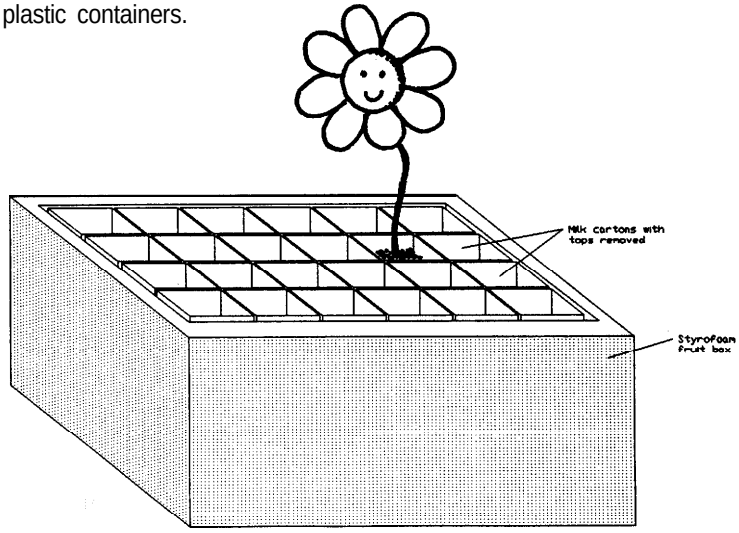
Beccy Parker with airbrushed T-shirts. Future plans include making the T-shirts at Waste Not.

Seedling planter

One of Waste Not's popular recycled products is this simple seedling planter you can make at home. It is made from a polystyrene fruit box and old milk cartons.

Cut the tops off the washed milk cartons and fill them with potting mix (or better still, compost from your garden). The cartons are just the right depth for good root growth. You will find that 24 cartons fit into the box like a glove.

According to Community Development Worker Anne Jennings, one of the Waste Not people has been selling seedlings in these containers to a local nursery, and the seedlings in the recycled cartons sell more quickly than those in plastic containers.



Several other projects are currently being developed, including sewing soft furnishings; producing herbal essences; and providing suitable premises for dusty and noisy businesses such as welding and carpentry. Waste Not also produces seedling trays from milk cartons and Styrofoam boxes, mulch from mattresses and carpet underlay, storage units from packing crates, clothing (hats and vests) from flour bags, plus other one-off goods as available.

Waste Not is also setting up 'Funrubbish', which will provide recycled materials such as egg cartons, paper offcuts, cardboard, etc, which can be used in school and kindergarten art and craft programs.

The group is currently preparing a submission to the South West Development Commission for land surrounding the premises. They would like to set up the area, which is part of the Better Cities Program, as a working example of appropriate technology, with a combination of equity and rental housing, sustainable businesses and permaculture gardens. The area is backed by the wharf and harbour and includes premises suitable for further development of Waste Not and similar enterprises.

The basic aims of the project are to produce a safer environment by reducing landfill rubbish dumps, to value each individual's creative talents, and to improve the local community economy.

All of this happened because someone started making shopping bags from recycled flour bags - now the sky's the limit. ☼

For more information, contact Anne Jennings, Bunbury Community Group Inc. PO Box 517, Bunbury WA 6230
ph:(097)913 214 fax:(097)913 333
Waste Not Enterprises 10 Carey St, Bunbury 6230
ph:(097)911 791

WIN! A houseful of compact fluoros . . . a solar oven … heaps of great prizes!

These are just a few of the fabulous prizes you can win in our Great Untapped Energy Sources competition (see the box on the facing page for more details)!

Have you ever come up with ideas on energy sources that are a bit whacky but just could be practical if only people were imaginative enough? Well this is your chance to tell the world. Whether it's windmills on the Sydney Harbour Bridge, an extra pipe to milk cows of methane as well as milk, or the bed that harnesses the motion of copulating couples, we want to know about it. The more imaginative the better. Use anything, buildings, machines, land, the weather, people, animals... You can write it as a news item, as an instruction manual (with diagrams), as a technical drawing with explanatory arrows and explanations, as a (bogus) photo with caption or as a straight description. The winners will be announced in our special 50th issue.

So get writing, drawing and photographing. You could win a great prize and have a lot of fun on the way!

HIG: The New Energy Source

by Dr Bob Rich and Anina Rich (Healesville, Vic)

HIG is a greenhouse gas, produced globally in huge quantities, thus adding to the deterioration of our life support system. Like emanations from garbage tips, it is offensive to most people. Villagers in some cultures go to extreme lengths to avoid the embarrassment of being associated with HIG production. In our own culture, HIG is no longer taboo, but is treated with low humour.

HIG has another similarity to garbage tip gases: it is inflammable. According to Brampton et al (1984), about 85% of it is methane. Unlike methane from the tip, however, it is produced in a decentralised way. Therefore it has the potential to involve millions of people in doing something for the environment, and earning some money at the same time.

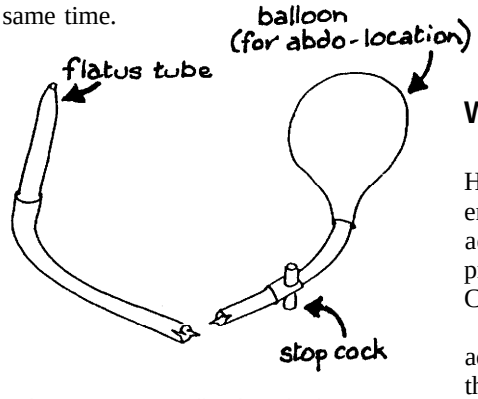


Figure 1. HIG collecting device.

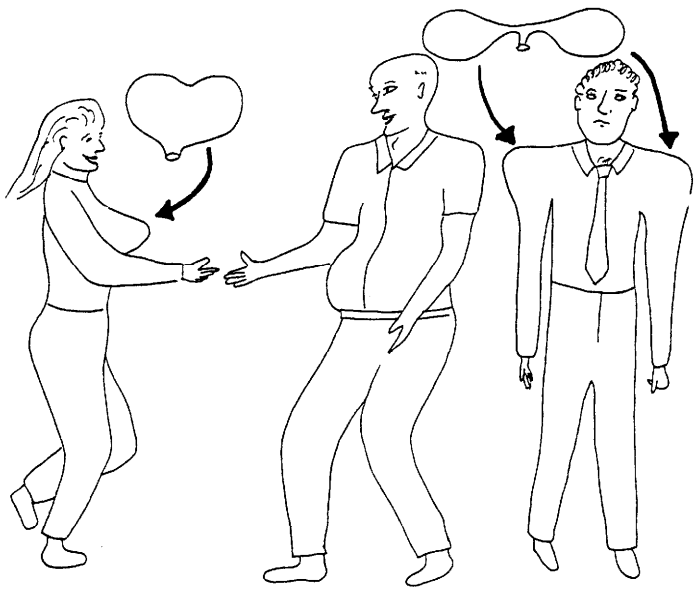


Figure 2. Sample hiding places for the balloon.

What is HIG?

What is HIG? The initials stand for Human Intestinal Gas. This offensive, embarrasing substance is useable as an additive to other fuel eases. Under proper conditions, it burns to produce CO_2, H_2O and energy.

An existing technology can be adapted for collection. This is based on the flatus tube. As doctors and nurses know, this is used to relieve the suffering of certain patients. ('Flatus' is Latin for HIG, which could also be termed FF: Flatus Fuel.) The flatus tube is inserted into the appropriate orifice, allowing free venting of the gas into the air.

The collecting device

The collecting device is simple. It is a flatus tube with a length of flexible hose attached. The hose can be occluded with a stop-cock, and has a bal-

loon glued to its other end. The balloon is worn on a convenient part of the body. When it is sufficiently full, the stop-cock is closed, the tube is withdrawn, washed, and inserted into a hole in a storage container. The balloon is squeezed, thereby transferring the HIG to the container.

HIG distribution network

A network of purchasing points is needed. Service stations would do admirably. Each would have a large tank into which customers can transfer their collected HIG. It is my suggestion that payment for the gas should be free of tax, and have no effect on Social Security benefits, in order to encourage this form of environmental action.

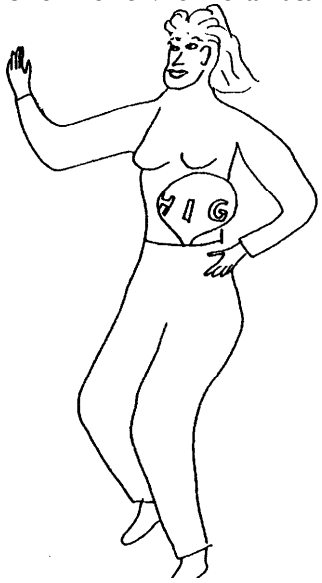


Figure 3. The collecting balloon could become a badge of honour!

Environmental and economic benefits

Poor people would have some additional income, especially since foods thought to induce HIG production are cheap yet healthy. Charities and the like would have a new source of fundraising, eg a school could have a collecting tank, and ask supporters to donate their HIG. Once the environmental and economic benefits of harnessing HIG were seen, the balloon of the collecting device could be proudly displayed: a badge of environmental consciousness. Poor countries could supplement their export earnings by sending their population's HIG to Japan or the USA, or could save precious foreign currency by reducing energy imports.

Without a doubt, HIG is the fuel of the future. Its use is an admirable example of 'turning bad into good'. It is free to produce, cheap to collect, process and use, and it empowers people.

Reference: Brampton, KC, Smythe, M, and Brzsyszky, XW The Biochemistry of the Digestive Tract, Churchill Livingstone, 1984.

This entry is our favourite of those received so far. Dr Bob Rich and daughter Anina of Healesville, VIC win an annual subscription to Soft Technology for their efforts, but they are still in the running to win the solar oven they listed as their first choice.

Send your entry to: **Great Untapped Energy Sources,** ATA, 247 Flinders Lane, Melbourne 3000.

Entries should reach us by final mail, October 28, 1994.

*** Please indicate your choice of prizes, in order of preference, on the back of your entry. ***

THE PRIZES

BP Solar
FBR 2/40 40 amp automatic solar regulator $461 rrp

12 'GE' Energy Choice compact fluorescent lights total value $300 to $360rrp

RAINBOW POWER CO. 12 volt ceiling fan $353rrp

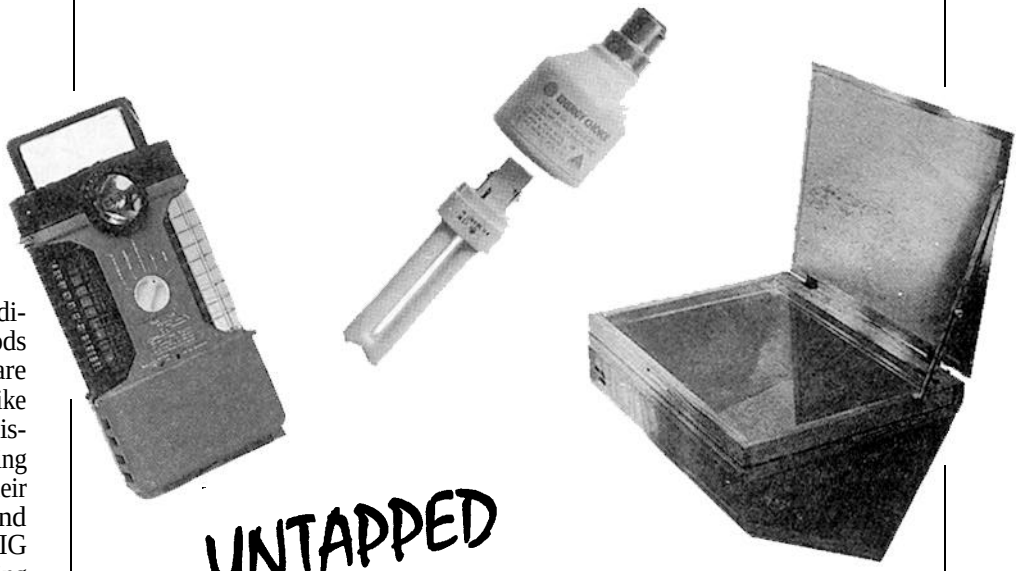
JURA SOL IND. oven and cookbook $280 rrp

SolarCorp
Bug Off solar or battery powered lantern $225rrp

AQUALIFE Showerfree shower filter $129rrp

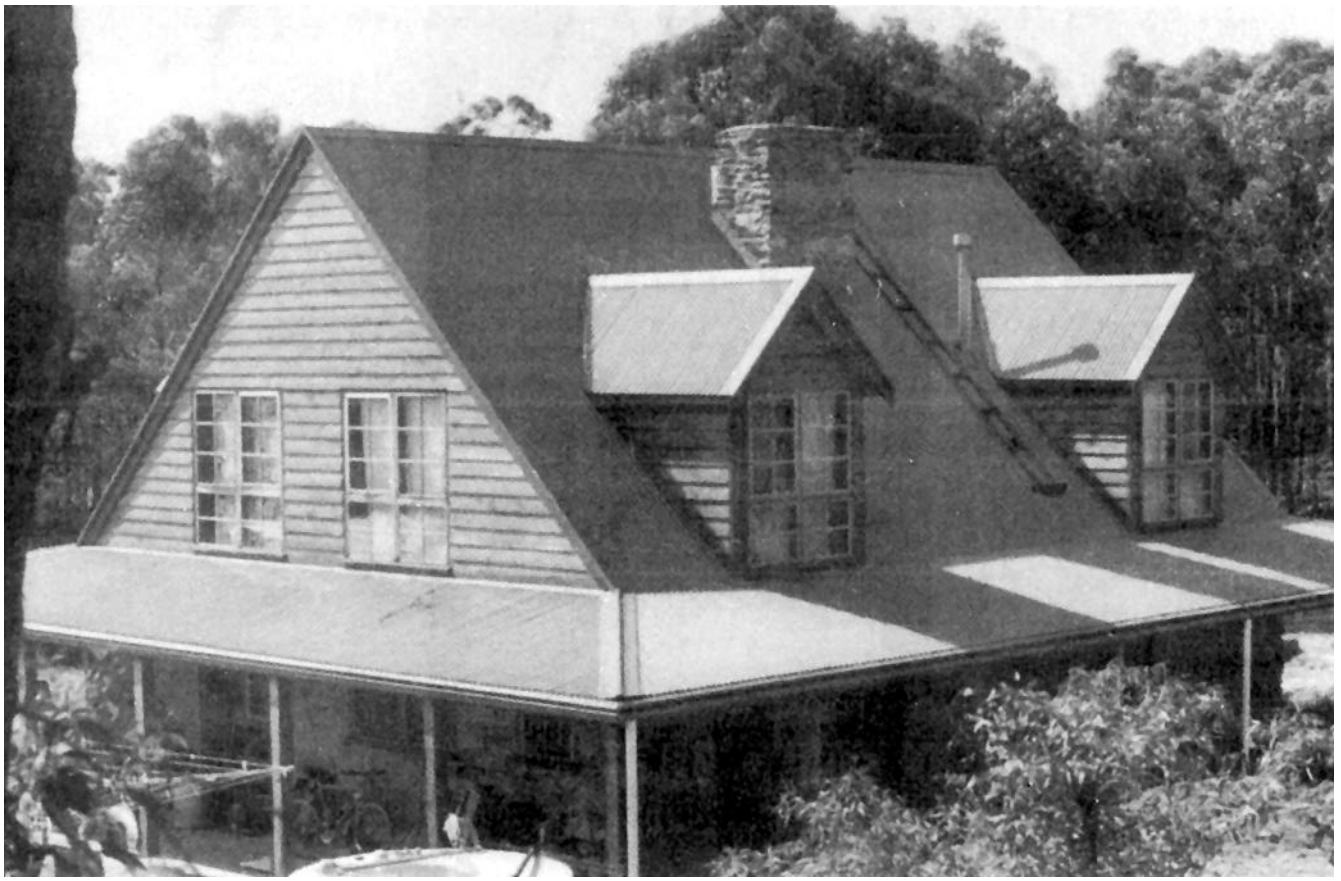
WINDPOWER AUSTRALIA UFO 12w or 22w low-voltage hybrid fluoro light $61 rrp

TRENDLINE PUBLISHING Book package $26rp



UNTAPPED GREAT ENERGY SOURCES

(A RENEWABLE FANTASIES COMPETITION)



LOFTY IDEAS

Like Doctor Who's Tardis, the loft house is bigger inside than it appears on the outside. It's cheaper to build than a conventional house, as it uses fewer resources. And you can build it yourself!

Ben O'Loughlin

WITH both a father and grandfather who were builders, it's little wonder that Peter Lees moved into both building and architecture as a career. As an architect with hands-on building experience, Peter is in an enviable position, as he can remain involved in the physical realisation of his plans.

Eighteen years ago Peter made the exodus to Daylesford in central Victoria, after working for an architecture firm in Melbourne.

It was never Peter's intention to set up shop in Daylesford, but soon after moving into the area, he was approached by a number of people wanting plans for their houses. Unintentionally, the Loft Concept crept into Peter's work. It was a design that people liked and began to ask for, and after a while, lofts became the norm. Peter describes the evolution of the loft house as 'self-design', it just happened without calculation.

An idea rediscovered

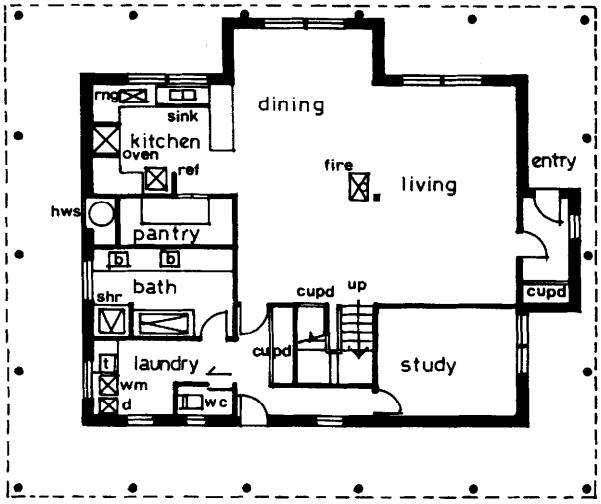
Peter doesn't claim to be the originator of the design - he merely rediscovered it. For hundreds of years, Northern Europeans and North Americans have been living in loft houses, but it is a relatively new idea in Australia. Peter believes this is mainly due to the way that Australia was colonised by small, slowly growing urban communities of Europeans in vast spaces.

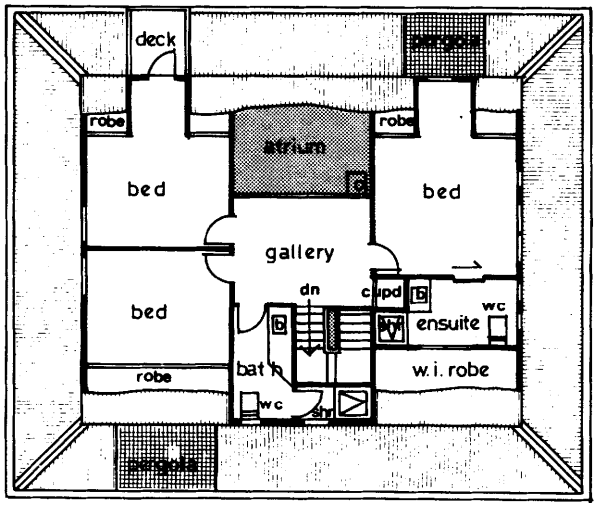
This space gave people the opportunity to express themselves in the more open 'ranch' style of architecture. We can still see this attitude in our large cities and fringes. In Melbourne, for

Above: This loft house, with sandstone exterior and timber lining, cost $60,000. It was trade built almost to completion.

Sample floor plan 'C3' of a loft house. This is just one of many different layout options that can be used in the same space.
Ground floor - 15.1 squares
Total area - 26.9 squares

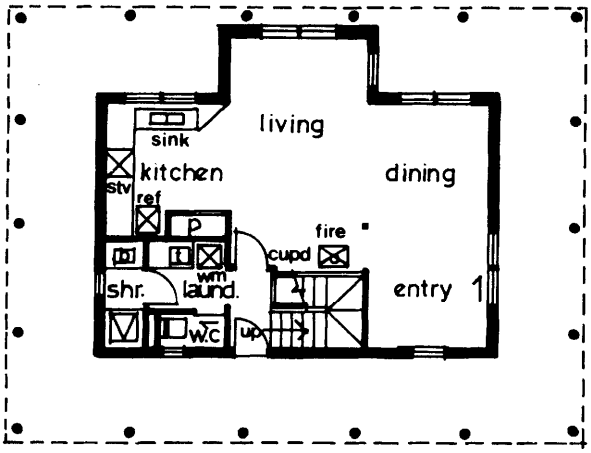
Upper floor - 11.8 squares

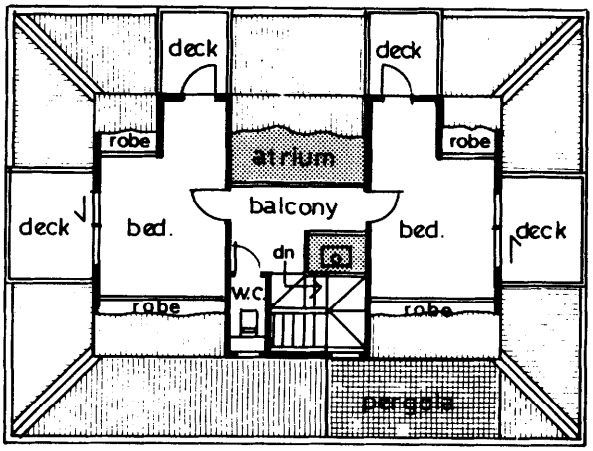




Sample floor plan 'S2'. This is just one of many different layout options that can be used in the same space.
Ground floor - 7 squares
Total area - 12.7 squares

Upper floor - 5.7 squares





example, the city has spread so much that many of the essential services are at crisis point. All for an ingrained desire to occupy as much space as possible. Some print advertisements sell houses purely on the space they occupy!

More space, less waste

The bigger the house, the more new materials used, and unfortunately this usually also means that wastage increases proportionally - wastage that need not occur.

While I spoke to Peter, he proudly showed me around his beautiful house. Most of the materials were recycled odds and ends from three miner's cottages. Some material was second- and even thirdhand. The beams supporting the upper storey came from an old *Nissan* packing crate.

Although Peter Lees' home takes up only seven squares of ground, it has the same living space as most two bedroom houses. He tells me that he can deliver the same space as a 22 square home on a twelve square slab! This means that there is a nearly 50 per cent reduction on slab cost, and because loft house walls are no higher than single-storey walls, a substantial cost reduction is achieved on the reduced wall area.

Loft homes have been built of a variety of different materials. This three bedroom home is made of pisé (rammed earth) and cost only $15,000 to build.

The primary principle of a loft house is that you are using the space you normally *waste* in a house. Most houses have a pitched roof, and the loft roof is usually only 150 cm taller than a normal roof, but pitched at a steeper angle. You can't use all of the space - like the wedgy bits where the roof meets the floor - in the loft as living space, but you can utilise this area for robes and other storage.

Energy efficiency

In summer, the internal chimney shaft represents a significant thermal mass, exchanging heat from inside the structure out via the slab, or out through the top of the chimney. Ventilation slats in the apex of the loft allow for cross-breezes to eradicate any hot air pockets.

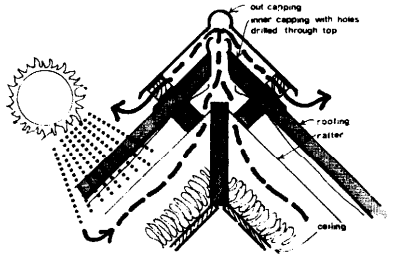
Between the ceiling and the roof lies a cavity which includes the insulation, rafters, and roof beams. The air in this cavity would otherwise heat, and eventually radiate through, the insulation and down through the ceiling if it wasn't for a gap running down between both sides at the apex of the roof. This gap is covered by an inner capping with holes drilled through it, and then covered at a little distance by an outer capping, ensuring the escape of a build up of hot air under the roof.

Other design techniques that can help reduce heat absorption include the use of double glazing, the landscaping of the terrain to include wind corridors and shade, and the removal of heat reflectors (such as concrete or gravel under windows) close to the structure. Positioning a mass of water - a pond or pool - downwind from the structure will also help to reduce the effect of unwanted heat.

During winter, or in cold climates, a different principle is at work. As the structure is so compact, you do not have to attempt heating horizontally through different thermal areas as in a conventional house. The loft house warms naturally as heat rises.

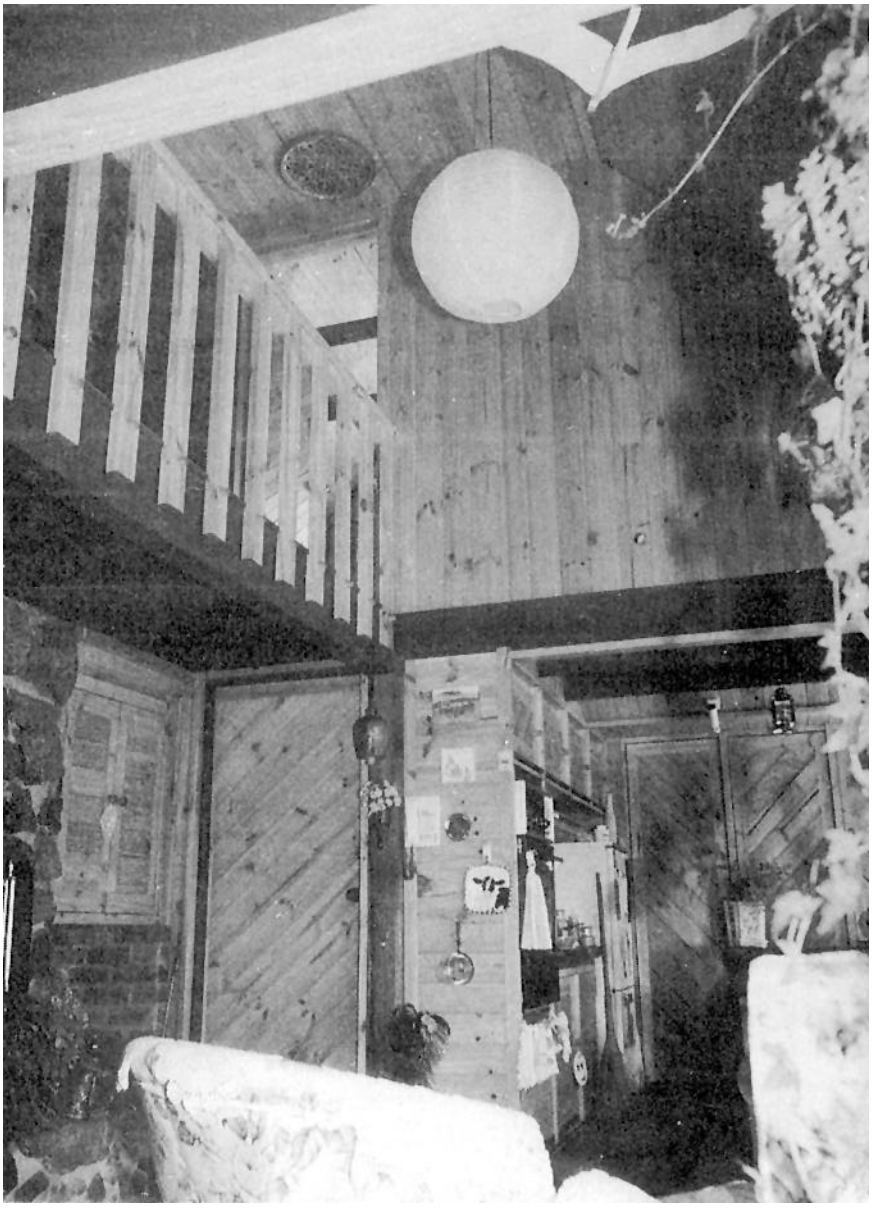
In most houses with chimneys, the bulk of the chimney shaft is added on to the outside of the structure, causing a 30 per cent loss of radiant heat to the outside. In loft houses, the chimney is an internal pillar which not only heats from the base through the fireplace, but up the column and out, as radiant energy moves up the chimney. Peter said that on cold winter days - his mother's house, his first loft design - becomes extremely comfortable with only a small log fire.

When we normally think of methods to increase a house's energy efficiency,



The double capping ventilation system.

Upstairs bedrooms have lots of cupboard space, plenty of room...and views.



Looking up from the living area, through an atrium, to bedrooms upstairs. The stone chimney (just seen) is a feature of both levels.

we seek to add on extras or fill the house inside with energy-efficient appliances. We are looking at remedial solutions for bad designs. Peter says, 'Even to insulate the roof and ceiling space of a single storey to compete with a loft, you have to buy twice the amount of insulation'.

Money matters

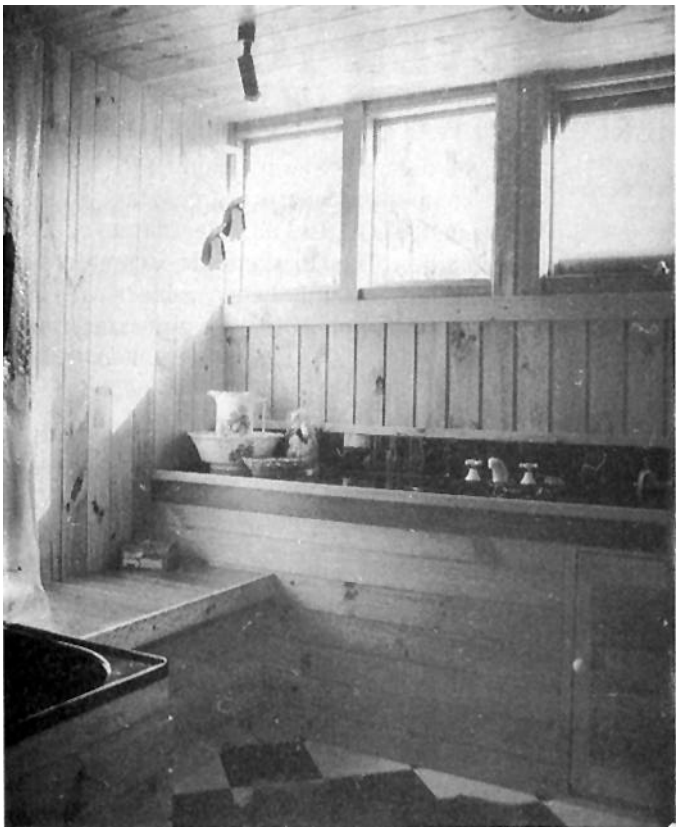
Normally we take for granted that if you want your own home, buying ready made, then you are up for a 25-year mortgage. However, Peter says that most of his loft designs can be built for around the $25000 mark. In one case, a client built a home for $15000. Of course, you have to do the building yourself, which in itself cuts your building costs considerably!

Building it yourself

Building yourself means sourcing your own materials. This means you have the power to choose not only the most appropriate materials for your needs, but also the cheapest. By going to auctions and house demolitions, you can pick up all sorts of materials for only a fraction of the retail value. The stairs or floor boards need not be the most expensive wood, if you intend to cover them with carpet.

In his own home Peter showed me the second hand toilet, which he has obscured by building a wooden box around it. The effect is quite dramatic, in the style of the old 'thunderboxes'.

But building your own means ***building*** your own: doing all the hard work yourself. If you become committed to



A bathroom set into a dormer window.

the plans or the instructions - they are made for people who have had no prior education or experience in the industry.

Problems

The main resistance Peter has received in selling his design concept has been over the stairs. Many older people perceive them to be a problem. Interestingly enough in some parts of the world, including New Zealand, stairs are included in accommodation for the aged, as they provide a valuable form of exercise. Even if the resistance to stairs remains, the rooms upstairs can be reassigned as guest rooms, with living room and main bedrooms downstairs, rather than expanding out. It still works out cheaper.

Another perceptual gap is that people think loft houses are only available in one design. Peter has been doing design work for lofts now for nearly twenty years, and although there are a few basic series, you can add on verandahs, dormers, balconies, and so on to suit your own needs and desires. Loft houses are also suitable for a variety of building materials, including stone, mudbrick, wood, and brick.

The first steps

Peter's designs can be seen all around Australia, and he is busily expanding his clientele internationally. If you are interested in obtaining more information, a plans book, *Lofts: the logical way to live and build*, is available by sending $15 to: RMB 4322, Daylesford VIC 3460 ☼

CUTTING YOUR ENERGY BILLS

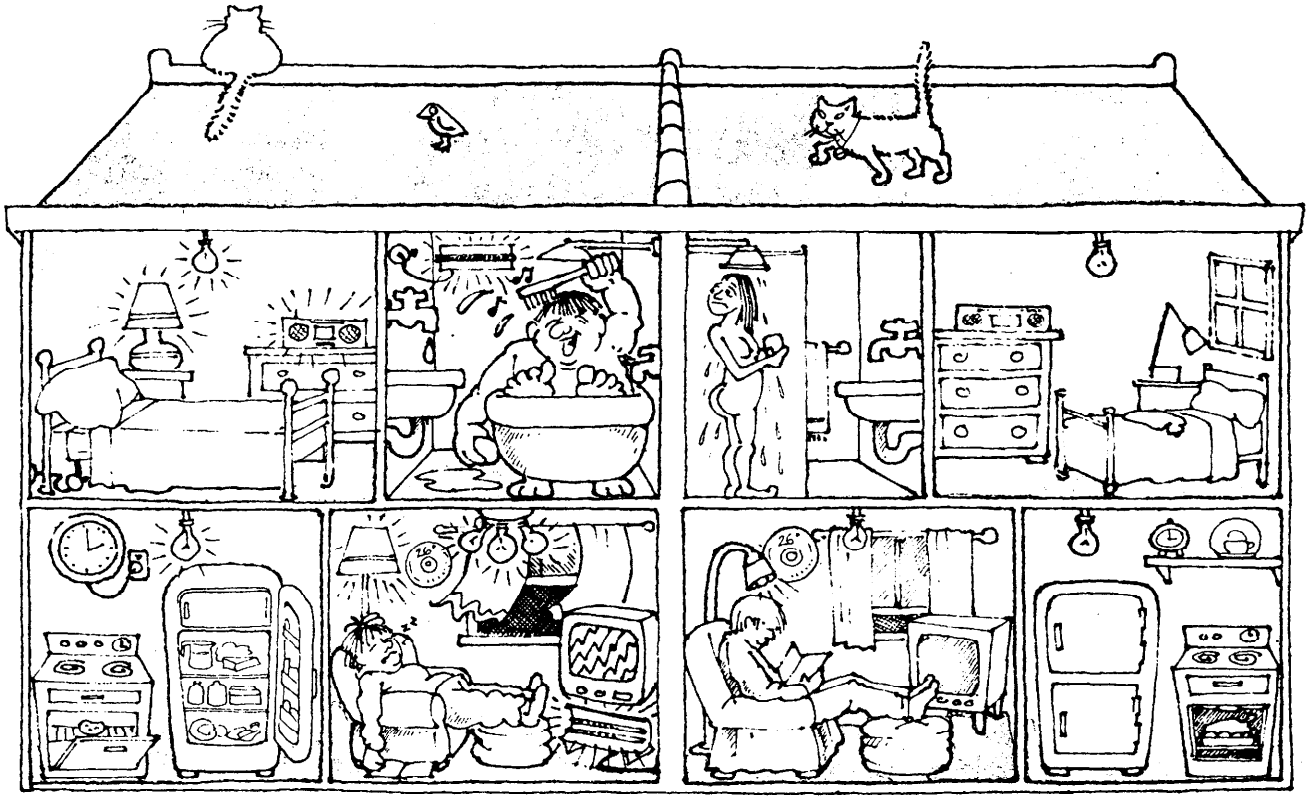


Illustration: Energy Saving for Schools (Energy Victoria)

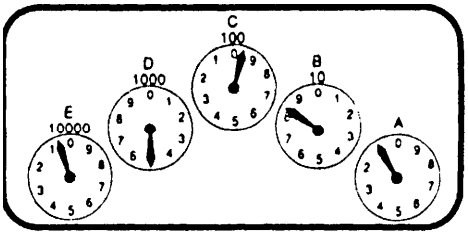
Ross Horman

WHERE did all the energy go?! How often have you received your gas or electricity account and asked this very question? Did you immediately harangue your teenage daughter for leaving the radio on? Many people immediately ring their energy supply authority with the hope that their meter has been read incorrectly. But alas the chances of this sort of mistake are less than one per cent. In fact, electricity meters are much more likely to be running slow rather than fast. What is really required is a detailed Energy Audit.

D-I-Y energy auditing

What does an energy audit entail? It is a careful evaluation of your energy use covering all types of energy and the appliances they service. It should also identify opportunities for energy savings and the rewards to be gained.

Most energy authorities now give very valuable information on the accounts they send out, even down to the average daily consumption and the average daily cost. However this only tells us how much energy has been used, *not* where it has gone. To find out where it has gone we need to perform our energy audit on the whole premises!



Older electricity meters have four or five 'clock-face' dials.

Firstly we need to get an idea of when the energy is being used. To do this we need to read the appropriate meters at the appropriate times. What are the appropriate meters, you may well ask. To answer this we need to look at the types of energy being considered.

In a 'normal' residential situation you could be expected to use some or all of the following energy types: electricity, gas, water, petrol, diesel and wood.

For domestic electricity we use a kilowatt-hour (kWh) meter and are charged by the kWh. The older meters have four or five circular dials which are connected in a ratio of 10 to 1 to give a decimal read-out across the meter.

More modern meters have a read-out like the odometer on a car. The most recent meters simply give a digital read-out on an LCD display.

Gas supplies are measured by the cubic metre and the result is then converted to megajoules (MJ). Usage is charged by the MI. Meters are general-

A typical table for reading electricity meters and noting daily energy use.

Day	Reading time	Meter reading	Energy used
Tuesday	6am	17583 kWh	
	8am	17586	3kWh
	6pm	17588	2
	8pm	17595	7
	11pm	17599	4

Listing ail appliances - including their energy ratings and daily use - on a table like this will give you a detailed picture of your household's energy use.

Room	Appliance	Qty	kW rating	hours used	kWh
Lounge	Light	3	0.060	3	0.54
	Television	1	0.075	4	0.30
	Stereo	1	0.050	5	0.25
	Heater	1	2.400	4	9.60
			Total kWh		10.69

ly of the odometer type and can be read directly.

Water is supplied by the kilolitre and the usage is read directly from the meter.

Petrol and diesel are sold by the litre and detailed records need to be kept to evaluate your own usage.

Wood is generally sold by the cubic metre, and depending on the type it can vary from $30 to $80. Different woods have different calorific values (energy content) and we pay accordingly.

As stated before, we need to look at usage at particular times of the day to get a clearer picture of the offending appliance or user. To do this requires a large amount of dedication, *memory*, and copious amounts of cooperation from the rest of the household.

Considering electricity, which is most likely to be the energy in question, the meters need to be read five times per day for at least a week. The reading times should be as follows, 6am, 8am, 6pm, 8pm & 11pm or as close to these as possible. This will help to identify the peak usage items and the 'base' load items.

Note that off-peak appliances such as hot water and storage space heating will be metered separately but must still be counted. They all contribute to the final bill.

Read the meter at these times every day for at least one week and upon analysis you should be able to see your peak usage times and relate these to particular appliances.

If you suspect that an appliance is using excessive energy, you may wish to borrow or hire a kWh meter which can be connected directly in line with the appliance to evaluate its particular usage. Energy utilities often have these meters available for loan through their energy advisory sections.

Some appliances, like electric stoves and hot water systems, are hard wired which means it is not possible to connect a meter directly to the appliance.

From this analysis it should be possible to identify which appliance (or user) is causing you grievous financial harm.

The culprits to look out for are *not* in fact the stereo or the television, which don't use any more than an incandescent light globe (around 75W). When the TV is left on for four hours this represents 4 x 75 = 300Wh or 0.3 kWh.

The real villains are firstly the hot water system (especially if it is on day rate metering) which may be undersized, have a faulty pressure/temperature relief valve or simply have a slow leak. Some folks switch their system on to day rate for a boost during periods of high usage and then forget to switch it back to night rate. A 300l hot water service generally has an element rating of 3.6kW or 4.8kW. Three hours of usage here represents 3 x 4.8 = 14.8 kWh.

Secondly, day-rate space heaters of the resistive type (those that contain an electric element) are particular offenders in winter time. These usually have a maximum rating of 2.4kW. If these are used for only two hours then the usage is 2 x 2.4 = 4.8kWhs.

Refrigerators and freezers are only rated at around 200W, but they operate from between eight and ten hours per day. This works out at a minimum of 8 x 200 = 1600Wh or 1.6 kWh.

Air conditioners operate on the same principle and can be evaluated similarly. In tropical areas they represent a major component of the electrical load. In cooler climes reverse cycle heat pumps are a far more economical way of heating houses.

Generally anything with an electric heating element is a ripe suspect for causing high bills. Typical appliances are kettles, hair dryers, clothes dryers, toasters and irons.

Be wary of electric towel rails that get left on. Water beds have a 350 watt heating element that is on all the time. The microwave oven you were sold as a 600W machine actually draws close to 1200W from the wall. (The 600 watts is the amount used in doing the cooking, but roughly 1200 watts are required to make the microwave oven operate.) Swimming pool filter pumps, pressure pumps and aquarium heaters all use surprisingly high amounts due to the time they are in operation.

And what about the personal computer? In itself it does not use much energy (100W) but the printer and most particularly the screen can use quite large amounts of electricity. (See Soft Tech #48 for some energy-saving tips for your home office.)

An all-electric house with two adults and two children may find its daily usage is around 15 to 20kWh per day. This will naturally vary greatly between summer and winter, but usage can be roughly divided up as in the pie chart.

To get a detailed picture of your usage you need to make an exhaustive list of all appliances, their rating and their

daily usage. For items used only several times per week, usage can be averaged out to get a figure per day. A table can be used for this task. The rating for each appliance can usually be found on the compliance plate, marked on the body of the appliance, or found from the technical information originally supplied with the appliance. Energy information centres can give average figures if no other way is fruitful.

A comprehensive table for the whole property should highlight the major energy users and help to identify areas where savings can be made.

Gas usage can be audited in a similar manner as can water, automotive fuel and wood to provide the appropriate figures.

Making savings

The pie chart shows that space heating is a major energy user so this area should be attacked with vigour. Look for ways to prevent heat escaping through gaps around doors and windows and so on. Uncovered windows and exhaust fans that do not have automatic shutters can allow heat to disappear. Insulate wherever possible, even under the floors. Passive solar design principles minimise heat loss while maximising the free heat gain from the Sun. Similar ideas are used in reverse in tropical areas to minimise heat gain.

Refrigeration is responsible for the next major usage sector. Energy usage can be reduced by keeping the rear coils of the refrigerator clear for air to circulate, ensuring the door seal is in good condition, using empty sealed cartons to fill under-utilised space, and removing frost before it gets too thick. Remember that ice is a good insulator and makes the fridge work harder. ... And do you *really* need that bar fridge in the shed?

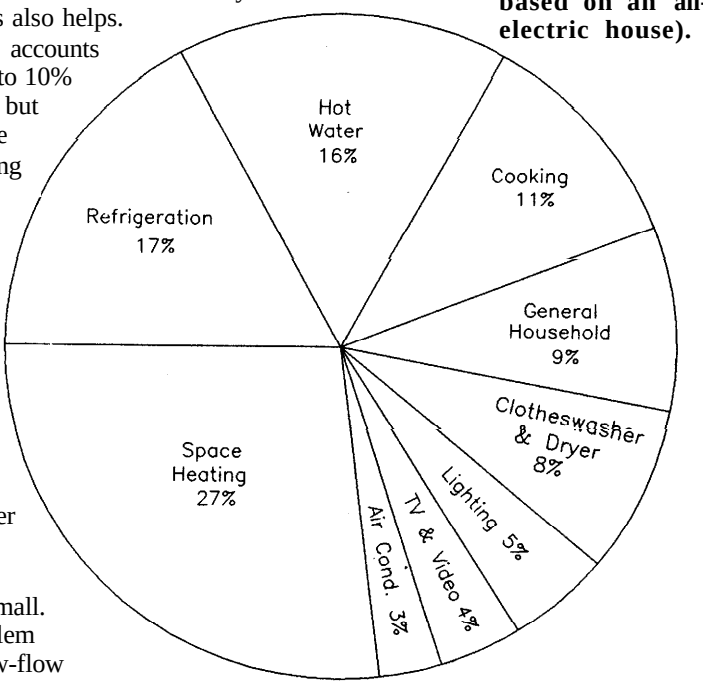
Hot water is another major contributor to the energy account. Why not consider a solar hot water system with savings from 50% to 95% on running costs depending on which part of the country you inhabit. Maybe you could simply turn down the thermostat and save money while reducing the chance of scalding the users. Small items such as low flow shower roses and repairs to leaking taps can make big savings. Keeping pipe runs short and effectively insulating pipes also helps.

Lighting only accounts for around 5% to 10% of energy bills, but even this can be reduced by using fluorescent fittings wherever appropriate. Beware of people who buy compact fluorescents to save energy, then leave them on for much longer than usual because their usage is very small. The same problem occurs with low-flow shower roses.

Finally, when purchasing replacement appliances always look out for the star rating and question the need for 'essential' items such as auto-defrost cycles on fridges. These auto-defrost devices are simply heaters and as such are energy munchers.

With prudent selection of appliances and careful usage patterns an all-electric house should be able to reduce energy usage to below 10kWh per day. If gas is available then this should be used for heating, cooking and hot water boosting and the electricity usage can be reduced to around 5kWh per day. ☼

Percentage breakdown of typical household energy use (figures based on an all-electric house).



ENERGY-WISE SCHOOLS

IN Victoria alone, schools spend around $30 million each year on energy bills. A typical Australian school will outlay $15,000 annually for heating, lighting and other energy needs.

Most schools could reduce their energy bills by up to 25% through adopting simple energy-saving practices.

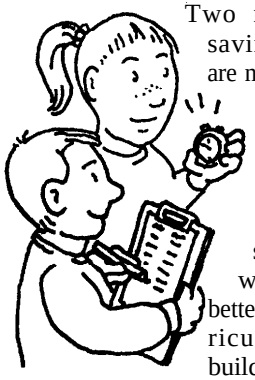


Illustration: Energy Saving for Schools

Two new energy-saving programs are now available to help schools cut down on energy wastage, thereby saving money which could be better spent on curriculum, school buildings or equipment.

Energy Victoria recently launched a publication called ***Energy Saving for Schools - Activities*** *for* ***Primary and Secondary Students,*** which is full of interesting energy activities tailored to both primary and post-primary levels.

SECWA has developed an innovative energy education program for secondary schools, called ***Saving Energy, Money and CO_2.***

The programs were developed not only to help reduce energy costs in schools, but to help develop long-term energy-saving practices in the wider community. It was felt that the principles of good energy management for schools could be extended to homes, businesses and industry. Students can apply the energy-saving methods they learn in their family homes and into adult life.

The activities in both programs are designed so that students will gain skills in areas such as mathematics, science and technology, research, analysis and report writing. They will also gain experience in dealing with a wide range of human attitudes and ideas.

The activities show in a concrete way that saving energy is not about decreasing our comfort levels or quality of life. It is about efficiency -being productive without waste. ☼

- Deborah Baker

Saving Energy, Money and CO2
Further information from: Trevor Still, Energy Education Officer ph:(09)326 6267 fax:(09)326 4984.

Energy Saving for Schools - Activities for Primary and Secondary Students is available from the Energy Information Centre, 136 Flinders St, Melbourne 3000 ph:(03)650 1195.
Cost: $49 plus postage.

NON-TOXIC ALTERNATIVES
Cleaners, cosmetics & garden products

Suelette Dreyfus

Researched by Claire Beaumont

Photo: Adrian Braun

SOMETIMES being 'green' can be a pain in the bum. Consider this recipe from the Australian Conservation Foundation for 'environmentally friendly' laundry detergent: 'grate a third of a cake of pure soap [into a pot on the stove], add a little water and bring to a boil until dissolved ... use a potato masher if necessary ... [Then] in a bucket, dissolve a third of a cup of washing soda in a little hot water... add the soap solution and top up with water. This mixture sets into a soft gel. Use 2 cups or more per wash.' Bored enough to consider sorting out your sock drawer yet? Wait, there's more! Don't forget to add a pint of water mixed with a tablespoon of vinegar in the rinse cycle - or the soap scum from the home-brew sits on clothes until the next wash.

Now, none of this is meant to put down the folks at ACF They do their work very well - and no doubt some people dutifully follow this complex procedure whenever they have a few socks to wash. But most non-superhumans just don't have the energy or inclination to spend more time brewing up laundry detergent than they spend cooking dinner.

The problem is that the convenient options - such as the big name household detergents, can also be a drag. Beyond all the guilt associated with using a detergent chock full of phosphorus which contributes to blue-green algae blooms, there are also some rather unpleasant potential personal side effects caused by other ingredients.

Some people have allergic reactions, such as eczema and dermatitis, to the whiz-bang contents - like perfume, bleach, preservatives and enzymes -of Multi-national Corporation Cleaner. And if the cleaners don't get you, the aluminium-filled, Alzheimer's-disease-causing anti-perspirants will.

So, it's the old guilt/time/energy/money trade off. The good news is that there are other options. With a little persistence, you can ***buy*** your way out of allergic reactions and green guilt.

There are a growing range of real green products for household cleaning, personal care and gardening. Some manufacturers have wised up to the fact that consumers don't think that cute dolphins on the bottle mean the product is necessarily 'green'. Consumers want the contents of the product - in English - no periodic table of elements needed.

Cleaning products

In general, the pre-packaged green cleaning products are expensive compared to the cleaners with nasty chemicals. However, the green products are usually more concentrated, so they not only give that warm, fuzzy feeling from buying green, they also offer better value for money.

Further, many of the green cleaning companies are Australian-owned and use Australian-produced ingredients. They provide local jobs. In contrast, many of the companies which manufacture less-environmentally friendly brand name cleaners are owned or controlled by foreign companies.

Tri Nature, an Australian-owned, Newcastle-based company, has an extensive range of green household and personal products. The company states that its products do not contain the usual fillers and extenders used in many household detergents.

This is no small statement, since up to 60% of some products are fillers, according to Tri Nature representative Jo Raydan. Salt is a common filler - but the price consumers pay for this household product is usually a lot more than the cost of salt. To illustrate exactly how much filler is used in many well-known brands, take a look at the size of the concentrated version of the same product. The difference may well be little more than over-priced salt.

Tri Nature Office Manager Elizabeth Joy said that egg shells, ground into a fine powder, are another common filler. 'There are regulations about *how much* filler and buffer you can use [but] it is not against the law [to use them]', she said. Without all the salt and eggshells, environmentally friendly products begin to look more cost competitive. Companies such as Tri Nature take the cost issue seriously enough to do a number of studies in the area. 'When used as directed, our products are not more expensive', said Mrs Joy.

Still, some consumers are understandably hesitant about paying more than $13 for a 1 litre container of disinfectant, even if it is made from sphagnum moss. Or almost $20 for 2 litres of laundry detergent. Or $12 for 500 mls of furniture polish. Tri Nature is not alone in this price range, though it does appear to be near the top.

Products such as *Bio* cleaning emulsion, for floors and furniture, cost about $13 per 1 litre through specialist shops like *Going Solar* in Melbourne. *Nature Solve Citrus Cleaner*, for cleaning fabrics, kitchen and bathrooms, takes the prize at a $7.50 for a mere 200 mls through the ACF catalogue.

Natural products and children

Some consumers are more than happy to pay higher upfront prices for true green products for one important reason: children. Mrs Joy said, 'Most dishwashing powders are very caustic

SUPPLIERS OF 'NON-TOXIC' PRODUCTS

HOUSEHOLD CLEANERS

Back to Basics ★
30 Mallop St, Geelong VIC
(052)29 4453
Health food stores, Going Solar, Back to Basics shops (Geelong and Williamstown VIC), mail order

Bio Products
25 Aldgate Terrace, Bridgewater SA 5155
ph:(08)339 1923
Going Solar, or phone the number above for nearest retail outlet.

Tri Nature ★
Box 304, Hunter Region Mail Centre NSW 2310
ph:(049)282199
Available through distributors

PERSONAL PRODUCTS

Aveda
Aroma Science, Easy St, Collingwood VIC
ph:(03)419 3355
Mail order, stores in Sydney and Melbourne

Back to Basics ★
[see listing in Household cleaners]

Blackmores ★
PO Box 258, Balgowlah NSW 2093
ph:(02)949 3177
Health food stores, most Safeways and Woolworths, some pharmacies

The Body Shop
1 Jacksons Rd, Mulgrave VIC 3170
ph:(03)565 0500
Body Shops throughout Australia

Freedom Body ★
Unit 8, 6-12 Mills St, Cheltenham VIC 3192
ph:(03)584 8011 or (03)584 8212
Health food stores

Jurlique International ★
PO Box 522, Mt Barker SA 5251
ph:(08)391 0577 or 1800 805 286 (toll free)
Health food stores, Jurlique stores.

Tri Nature ★
See listing in Household cleaners.

GARDENING

Green Harvest ★
52 Crystal Waters, MS 16 Maleny QLD 4552
ph:(074)944 676
Mail order

This is far from an exhaustive list, just a listing of manufacturers who impressed us with the quality of their products and the quality of information available to consumers.

★ = products made in Australia.

[and will] burn the eyes and mouth. Our products don't taste exceptionally nice, but if children end up eating them, they don't need to be hospitalised'. Tri Nature gets a regular stream of calls from parents who consider this one of the most important buying criteria for household cleaning products.

Do I need all of these products?

One thing that might surprise you about these natural cleaning products is the huge range of products offered by each company, particularly when some products are seemingly suitable for a million and one uses.

Apparently these extensive product ranges are there to satisfy those consumers who 'need' to have a separate product for each household chore. If you choose products wisely, you should be able to drastically cut down on the number of jars and bottles lurking in the bottom of the laundry and kitchen cupboards.

Gardening

The most toxic items in the average suburban home probably dwell in the garden shed. Pesticides can be absorbed by the lungs, through the skin or ingested. According to Jeffrey Hodges, author of ***Natural Gardening and Farming in Australia,*** chemical pesticides can become concentrated in fatty tissue, building up over years. Worse still, the full effects of all pesticides have yet to be determined. Hodges estimates that of roughly 60,000 chemicals in common use, only 10,000 have complete toxicological data available.

Now here's the amusing part amid all this gloom and doom. After all this, the darn things may not even work much better than using nothing. Hodges quotes a study by entomologists comparing two garden plots, one sprayed regularly with pesticides and one left to the whims of nature. When both crops were harvested and weighed, the unsprayed plot produced a higher yield.

There are some good products available for setting up a non-toxic garden, but it is a little tougher to buy your way out of green guilt where the backyard is concerned. Good non-toxic gardening requires some research on topics such as companion planting, and some elbow grease to hand pluck those sneaky snails from your prized plants.

Useful reading

The Green Consumer Guide
John Elkington & Julia Hailes with CHOICE magazine and the ACF, Penguin Books, 1989

Natural Gardening and Farming in Australia
Jeffrey Hodges, Viking O'Neill, 1991

Sick Earth Syndrome and how to survive it
Jennifer Meek, Optima, 1992

The Maleny-based ***Green Harvest*** company has a superb catalogue and offers a money-back guarantee on all their products. There are some rather ingenious non-toxic cures for garden bugs, such as diatomaceous earth ($2 for 500 grams). Diatomaceous earth has 'microscopic...razor sharp edges which desiccate soft-bodied insects, snails or slugs on contact or when ingested'. Or ***Natrasoap*** ($12.50 for 1 litre) from potassium salts which, when mixed with water kills insects by blocking their breathing holes and disrupting their nervous systems. It is biodegradable.

Similarly, ***Clear White Oil,*** retailing at $7 per 200 ml, smothers scale insects. Finally, there are any number of plants which will help protect the garden. A winter crop of rapeseed, also available from the catalogue, apparently releases chemicals which destroy nematodes, commonly called eelworms.

The Queensland company also offers two natural fertilisers, ***Natrakelp,*** made from Tasmanian seaweed, and ***Bundaberg Fish Emulsion*** (sounds a bit like a personal care product for fish). A dual pack - one litre of each - costs about $15.50. There is an impressive selection of fly traps, ranging from about $8 to $26, which last between three and six months. For cockroaches, try their boric acid and pest pistol duster ($25 for both).

The company quotes research showing that boric acid dusted in cracks around the home is more effective than any chemical treatments on the market. It is certainly a lot less toxic.

Personal care products

The number of 'personal care products' on the market is truly breathtaking. 'Personal care' is the polite name for products which make your underarms smell nice, your dandruff go away and your face look well scrubbed. The '90s must indeed be the decade of leisure for the Western world, because only people with a lot of time on their

hands could 'purify, tone, exfoliate and moisturise' (for which there are, of course, four separate products) twice a day.

It is tough to pick the real 'green' products from the plethora of posers in personal care products. One good test is to ask the retailer for a list of ingredients. For example, the *Freedom Body* brochure includes a list of common ingredients used in their products. Stearic acid is defined as 'a fatty acid found in coconut oil and other vegetable fats...[a] Skin conditioner ... used in skin care products'.

This may not be a blow-by-blow break down of each chemical compound, but it is still more information than most manufacturers provide. *Jurlique* also lists all product ingredients.

Other companies, such *as Aveda*, provide a detailed list of contents to their sales staff in a product handbook. A few probing questions should land you with the chance to check out the handbook.

If you meet with initial resistance from representatives from a particular company, try the old, 'I'm allergic to *everything* so I need to check' line. Threatening to break out in instant hives from a tester usually does the trick.

Packaging

Packaging is perhaps the greatest crime of the personal care products industry. ***The*** Body ***Shop*** estimates that packaging makes up 70% (by volume) of domestic waste; 'Generally, the more you pay, the more you throw away'. The simple solution is to look for less - less packaging, padding and wrapping. And look for support services: The Body Shop allows customers to return bottles to be recycled or refilled.

Animal testing

Animal testing is another burning issue in the skincare products area. For once it is rather nice to see a growing number of companies jumping on the bandwagon. Indeed, it is a great point of pride with some employees of cosmetic manufacturers. Mrs Joy of Tri Nature, which also makes personal products, said, 'We do not test on animals - unless you consider our staff animals'.

Sometimes there has to be a trade off between 'natural' and 'ethical', as in the case of musk. The Body Shop uses a synthetic musk scent because 'natural' musk is extracted from the glands of the male musk deer.

Consumer power

Over the past decade, people have voted with their hip pockets on the cruelty-free issue and the result has been a boom in products which are free from animal testing and in some cases animal products. With luck, consumers demanding non-toxic products will find themselves with more product information - and more choice in the future . ☼

COMING SOON

***BUMPER 50th issue,* including:**

Highlights of Soft Tech 1 to 49

'Green' investments buying guide

Solar greenhouses

Build-your-own bread dough riser

Review: solar garden lights

THE ENERGY CHALLENGE . . .

Which has greater environmental impact...a Mack truck or a human-powered vehicle? If you think the answer is obvious, read on. An Energy Challenge competitor and the technical coordinator give their views.

The Competitor

ACCORDING to the rules of the Energy Challenge, 'The ultimate award in this Event should go to the entrant who provides: the greatest personal practical and economical mobility with the least environmental impact.'

Great rhetoric. Let us see if this is borne out in practice!

Just what does the GGI [see box below] measure? The GGI measures, or more correctly ***calculates,*** and ***only*** measures or calculates, what is perhaps the easiest pollutant to calculate - the **amount** of carbon dioxide produced by using the vehicles. The reasoning is that carbon dioxide (CO_2) is the major contributor to the Greenhouse Effect.

Poisons ignored

What is ignored in cars' exhaust gases is the poisonous pollutants that cause the smog in our cities, that continue to get worse, year by year, the carbon ***monoxide,*** the sulphur dioxide, oxides of nitrogen, lead, and various hydrocarbons. A mixture poisonous enough to be a popular form of suicide!

A 1993 German report said that in its lifetime of only ten years, the average car produces 1,016 ***million*** cubic metres of polluted air from its exhaust, causes 422 ***million*** from production of its materials, 452 ***million*** from production, and 102 ***million*** from disposal, as well as 26.5 *tons* of rubbish along the way! The German researchers also found that the acid rain produced by one car was responsible for three dead trees and 30 'sick' trees, thereby compounding the Greenhouse Effect by damaging CO_2-absorbing trees.

Each car is also responsible for 820 hours of lost life through road accident fatalities, and 2800 hours of damaged life. Cars have also been found to use 60% more land space than is used for housing!

Are the rules fair?

If, for a moment, we shut our eyes to these horrors - as most people seem to - then how fair is the CO_2 system? The CO_2 figure indicates how much CO_2 is released from producing, distributing and burning a particular fuel in an engine. For example, lkg of petrol produces 3.51 kg of CO_2, and lkg of methanol produces 2.27kg of CO_2.

Thus, to calculate the GGI all we have to do is see how much fuel the vehicle uses, convert it to CO_2, and divide by the kilometres travelled to get a result in kilograms of CO_2 produced per 100km travelled. For example in the 1992 Event, the little commuter built by Lake Tuggeranong College used 1.95 litres petrol over 153.5km, giving 1.27 litres per 100km or 0.93 kilograms = (0.93 x 3.51) = 3.28kg of CO_2 per 100km.

Payload

But what about cars carrying four or more people? Surely they are more efficient in moving people than those with one person? The next part of the equation takes on board the ***payload*** carried, and we come up with grams of CO_2 per 100km per kilogram of payload. Thus for Tuggeranong's commuter we divide 3,280 by 80, the weight of the driver, and we get 41 grams of CO_2 per 100km per kilogram or an Energy GGI of 41.

CO_2 in manufacture

But what about the CO_2 released by the manufacture of the vehicle? Here the Energy Challenge looks at the CO_2 value of the materials used to make the vehicle: steel is calculated to release 3.20kg of CO_2 in its production, aluminium 27.5kg of CO_2 per kilogram, and solar panels a whopping 450kg of CO_2 per square metre! Thus one arrives at a total CO_2 figure in kilograms of CO_2 for the materials of a vehicle, called 'X'.

Vehicle lifetime

The next trick is to convert it to grams of CO_2 per 100km per kg, so that it can be added to the Energy GGI to produce a Total GGI. This requires a vehicle 'lifetime' (2) measured in kilometres. The 1992 regulations simply said 'For a production vehicle, 2 = 160,000km.

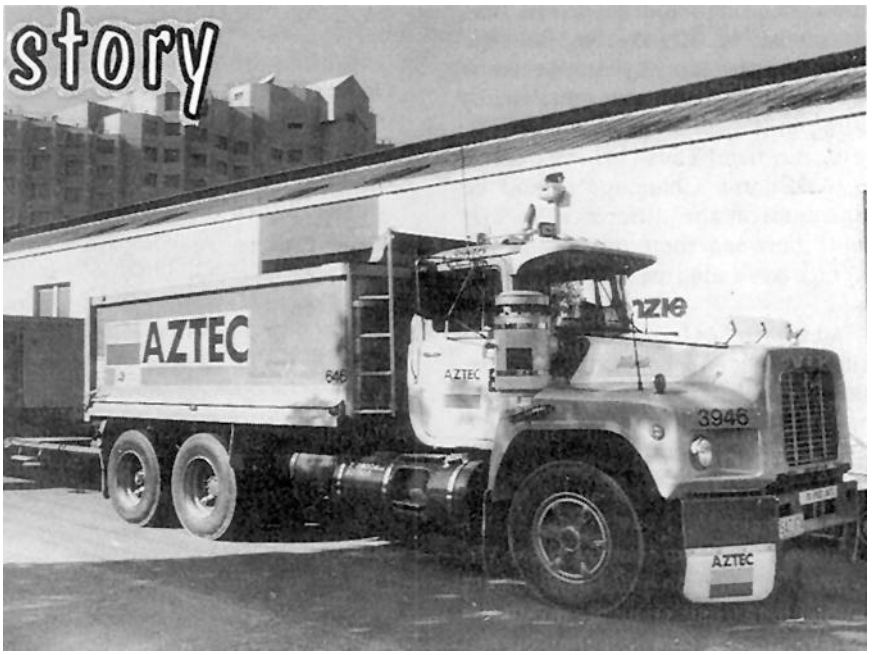
The Greenhouse Gas Index (GGI)

The Energy Challenge is judged on a rating system called the Greenhouse Gas Index (GGI). The GGI was developed by John Ward, Manager of Technical Services at NRMA, and is claimed to measure the impact of vehicles on the environment.

The energy efficiency of each vehicle is calculated by adding up: how much energy the vehicle takes to run; how much carbon dioxide is consumed during the vehicle's manufacture; and how much carbon dioxide is emitted when it is running. Each vehicle's life expectancy and the amount of energy that could be reclaimed when it is scrapped are also taken into account in the GGI ratings.

The GGI calculations are too complex to present here, but they require the vehicle to be broken down into its constituent components (metaphorically speaking), so as to be able to take into account the different materials – such as steel and other types of metals, plastics and electronics – that are used in its production and recycling.

the inside story



The winner of last year's Energy Challenge.

For an energy competition vehicle, Z = 5000km'.

Thus it seemed to me that any experimental vehicle built for the competition would have a handicap of 160,000 ÷ 5,000 = 32:l against it on the manufacturing side of the equation! Not a very strong encouragement for alternative vehicles! In actual fact, it turned out even worse!

After the 1992 event, I was rather shocked to see that the winning *Mack* truck, which was carrying less payload for its weight than my Human Powered Vehicle, was given a materials figure of 0.4 compared to my 75.7! My production trike with its special fairing (as described in *Soft Technology* #42) had been allocated a 'lifetime' of 5,000km, while the truck had been allocated a 'lifetime' of 1,000,000km! Six-and-a-quarter times the figure in the rules!

The Lake Tuggeranong College commuter was also given a 'lifetime' of 5,000km, which gave it a material GGI figure of 219.8, adding to the 40.9 Energy GGI for a total GGI of 260.7! The Annesley Girls' College solar vehicle was also allocated 5,000km and ended up in last place with a figure of 1958.2! By comparison, a *Holden Commodore* running on LPG was allocated 160,000km and had GGI E 42.5 + GGI M 12.2 = Total GGI 54.7.

When I complained to the organisers about what I considered to be a ridiculously short lifetime for my vehicles, I was told the truck entrants had provided proof of their lifetimes, and I would have to do the same if I wanted a better figure.

Unfortunately I had only been building my trikes for three years at the last Energy Challenge, and even the modern 'safety' bike is only one hundred years old, so very few people, if any, have any proof of how long they will last! I provided evidence that a steel bicycle frame appears to have an infinite life, with a number of bikes being handed down from generation to generation.

An HPV manufacture in Denmark had done over 150,000km in his HPVs, and thought a conservative figure would be 100,000km. Thus the 1993 regulations were changed:-

* production passenger vehicle Z = 160,000km
* heavy duty commercial vehicle Z = 1,000,000km
* production Human Powered Vehicle Z = 100,000km
* special energy competition vehicle Z = 5,000km

This lifted my results to eighth place in the 1993 Energy Challenge, with a total GGI figure of 17.2 on a less efficient unfaired trike, one place behind a bus, and still far away from that truck with a total GGI of 5.3.

It was interesting to note that petrol cars did better than electric cars, with the petrol Mira doing 37.2, electric Subaru on 92.3, while the Girls' College solar car came last again on 1373.3.

For 1994, pedal cycles, assisted cycles, and mopeds are given a life of 100,000km, with production cycles not accepted! Special Energy Competition Vehicles have 5,000 to 50,000km and 'Entrants must provide data to substantiate design life'. However this year the material GGI is likely to have little effect on the overall results, as up to 95% credits will be allowed for recyclable materials like steel.

Energy and fitness

This leaves us with the energy side of the GGI. The organisers claim that cyclists are doing 'vigorous exercise' and breathing out more CO_2 than would a car driver. Yet they also say, 'this energy can only be derived from food intake'.

In comparing a cyclist with a car driver, it seems to me that the cyclist is somewhat fitter than the average driver. As people become fitter they become more efficient. This is noticed in reduced heart rate. It may also be that they breathe less! Think how much more an unfit person pants with the same exercise as a fit person! It is also noticeable that a number of people who take up cycling do not eat any more than they did before! Thus it seems to me, that over a whole day, a cyclist would not breathe out any more CO_2 than a motorist.

Furthermore cyclists tend to be more careful of what they eat. In my case I have stopped eating meat. And when one takes into account the energy that is used to produce the fuel, or in this case food, that makes a *big* difference. It is estimated by *Earth Save Foundation* that 78 calories of fossil fuel are expended to produce one calorie of protein from beef, while only two calories are needed to produce one

calorie of protein from soybeans! Thus the amount of CO_2 released into the atmosphere from my cycling would be much fess than the average motorist just sitting in his car with the engine off, going nowhere! Thus I believe cyclists in the Energy Challenge should be measured on the difference in CO_2 value between their meals and the average Australian meals! What do you think?

And what other forms of pollution do you think should be included in the Energy Challenge calculations to meet the claim of the winner producing, 'the greatest personal practical and economical mobility with the least environmental impact'?

- Ian Sims, Greenspeed Bikes

The Technical Coordinator

THANK you for the opportunity to comment on Ian Sims' item on the Energy Challenge. It is encouraging to see active discussion on the objectives of the Energy Challenge. Another stated objective is to provide the opportunity for experimenters and researchers in alternative fuels and transport to demonstrate their work in a competitive and public way, so that they gain the recognition deserved.

With these ideals in mind the Energy 'Challenge' was created. It is a challenge to conventional thinking on transport, and a challenge to the alternatives to prove they are viable.

CO_2 major pollutant

The Greenhouse Gas Index (GGI) only considers CO_2 because it is 95 per cent by mass of the Greenhouse Gases emitted by transport. Oxides of Nitrogen (NOx) and carbon monoxide (CO) are the next highest, but are each less than two per cent. For the GGI calculation, it is assumed that any future alternative fuel would be subject to rigorous emission controls comparable to those applied to petrol-powered vehicles. On this basis the other well-known pollutants are not included in the GGI calculation. Human Powered Vehicles (HPVs) and bicycles have a very real advantage in this regard, but it is not an issue in the greenhouse debate.

Ian Sims quite correctly points out the evolution of the GGI as it applies to HPVs. As better data have become available, we have adjusted the factors, and Ian has contributed greatly to this process.

The key element in the GGI is the CO_2 produced throughout the life cycle of the transport vehicle. The index calculates the CO_2 produced: during the manufacture of the vehicle; during the processing and distribution of the fuel or energy; and produced by the vehicle during the event. It also accounts for any recycling of the materials at the end of the vehicle's useful life, by allocating CO_2 'credit'.

The GGI only includes the load carried, ie the passengers or goods. If a heavy vehicle such as a bus, train, or large car is carrying a small number of passengers, it is a very inefficient use of energy and produces more CO_2 than necessary to carry out the task.

ABOUT THE ENERGY CHALLENGE

Late this year the flag will drop on the fourth annual Energy Challenge. Organisers say the event is aimed at encouraging the development of energy-efficient fuels and vehicles.

Vehicles powered by human power, petrol, diesel, gas, electricity, alcohol and fuels derived from wheat, canola (the cooking oil) and coconut oil will all compete to see which one least affects the environment.

In this year's Challenge, city commuter vehicles will travel from Sydney to Campbelltown on Saturday November 26, and from Canberra to Queanbeyan on Sunday 27.

The large trucks will travel Sydney-Canberra-Sydney, using a route of freeways and highways. The cars and light commercial vehicles will travel a more difficult route encompassing country roads and diverting through Wollongong on Sunday.

Rather than a timed race, the Energy Challenge is a test to discover which vehicle provides the greatest efficiency at the end of a set course.

The Energy Challenge is the only event in the world in which different fuels and new technologies are compared in this way. Results are used for further research and in developing future clean vehicle policies. The Energy Challenge is really three parallel events: one for human-powered and city-only commuter vehicles, one for more conventional cars and light commercials, and the third for long-distance heavyweight trucks.

The Energy Challenge is co-sponsored by the Office of Energy and the NRMA, and organised by efficiency expert Hans Tholstrup.

Vehicle lifetime

The reason that the experimental vehicles in the Energy Challenge are allocated a shorter life is to encourage their designers to build them for a longer life. Ultra lightweight vehicles will certainly use less fuel and are to be encouraged, but if they do not last an economic lifetime, and need to be replaced too often, they will not find a place in the market for practical transport. The useful life of the vehicle is also important to ensure the energy used (and therefore the CO_2 produced) in its manufacture is not wasted. A vehicle with a longer life uses less energy overall.

Food energy

Ian Sims also raises the point regarding the food intake of cyclists compared with drivers, and this is indeed one of the most difficult areas in the calculation of the GGI. It is known that the CO_2 breathed out by a human is directly proportional to energy being used in any activity. In this sense, the human being is a very sophisticated internal combustion engine! If extra energy is used, additional CO2 is

1993 ENERGY CHALLENGE OVERALL PLACING RESULTS									
Place	Entrant/vehicle	Class	Fuel	Fuel consumption/100km	Unit	Load (kg)	Av speed km/h	Distance (km)	Total GGI
1	Apace Mack	LH	diesohol	57	L	28820	48.9	530.2	5.3
2	Heggies Volvo	LH	LNG	L83.2 + D18.4	L	28683	47	531.2	5.6
3	Apace Volvo	LH	diesohol	64.8	L	28270	50.1	531.2	6.1
4	Ford Louisville	LH	NGV	57.7	kg	27328	42.6	529.7	6.7
5	Cowra 2000 Mitsubishi	C	canola	8.95	L	829	56.1	528.8	11.7
6	Action Bus	C	diesohol	33.7	L	4335	51.3	530.2	15.3
7	Greenspeed 2	HPV	HPV	NA		77	27.8	109.9	15.7
8	Greenspeed 1	HPV	HPV	NA		66	27.8	109.9	18.3
9	Apace Landcruiser	C	ethanol/petrol	15.7	L	1800	53.9	528.8	22.0
10	Daihatsu Delta	C	diesel	8.71	L	1138	49.6	528.8	23.3
11	Honda Today	PN	NGV	2.3	kg	318	57.4	528.8	25.8
12	Apace Landrover	L	diesohol	7.13	L	672	56	528.8	30.5
13	Honda Civic	PE	ethanol/petrol	4.96	L	373	52.3	528.8	36.0
14	Daihatsu Mira	PP	petrol	4.2	L	317	50.2	528.8	37.2
15	Ford Falcon	PN	NGV	6.09	kg	570	59.4	528.8	37.5
16	Daihatsu Applause	PN	NGV	3.35	kg	319	52.1	528.8	37.6
17	Calmaster Commodore	PN	NGV	5.51	kg	509	58.2	528.8	37.8
18	Apace Camry	PE	ethanol/petrol	7.1	L	476	59.8	529.5	40.0
19	Toyota Camry	PP	petrol	6.97	L	476	60.2	528.8	41.9
20	Ford Falcon	PE	ethanol/petrol	8.68	L	493	56	18.2	43.1
21	Ford Falcon	PL	LPG	11.62	L	475	53.6	528.8	47.5
22	Daihatsu Charade	PP	petrol	4.14	L	242	49.7	109.9	49.5
23	Energy Focus Commodore	PN	NGV	5.96	kg	300	58.2	528.8	62.4
24	Approp. Tech. Motor Cycle	PP	petrol	5.12	L	205	58.1	528.8	66.0
25	Walkabout Electric	PEL	electric	3.26	kWh	62	3.5	109.9	66.2
26	Daihatsu Charade	PL	LPG	9.12	L	238	49.5	528.8	72.4
27	Penfold Electric Team 1	PEL	electric	15.47	L	197	30.8	109.9	92.3
28	Daihatsu Feroza	OP	NGV	4.74	kg	178	58.1	528.8	94.3
29	Daihatsu Mira	PP	petrol	3.73	L	102	49.1	528.8	104.0
30	Blessing Electric Team 2	PEL	electric	28.89	kWh	276	28.7	528.8	113.2
31	MTA Commodore	PP	petrol	12.13	L	283	60.9	546.8	117.3
32	Daihatsu Charade	PP	petrol	3.81	L	88	50.9	528.8	124.7
33	Stewart Strik	EX	ethanol/petrol	4.2	L	90	17.4	109.9	144.7
34	HDC Commodore	PP	petrol	9.4	L	176	59.5	546.8	148.9
35	James Sheahan School	S	solar	0		64.5	32.8	56.6	248.6
36	J Diduszko	HPV	solar/HPV	NA		63	24.5	109.9	253.5
37	Singleton High School	S	solar	0		63	17.6	56.6	304.1
38	Strath Steam	EX	coal	18.76	kg	97	10.3	53.3	628.7
39	Annesley College	S	solar	0		80	20.5	109.9	1373.3

emitted. One cannot do any work such as moving from A to B, or carrying goods from Y to Z without expending additional energy. In the case of humans this energy is obviously derived from food.

In calculating the GGI for HPVs, the food used is bread. The CO_2 generated in producing the equivalent food energy is then calculated from food processing data. It is assumed that the conversion efficiency of food energy to physical energy within the body is 30 per cent, and that it requires an average of 100 watts of power to propel the HPV. The time taken by each competitor to complete the course is known, and this is used to calculate the total energy used. From this, the GGI is calculated. The rider's mass is the payload. It is worth noting that if meat and milk was included in the 'diet', the CO2 would be considerably higher, as the production of these is more energy intensive.

This methodology is far from ideal. Data is needed, or testing to directly measure under controlled conditions the CO_2 output during the activity of riding a HPV. This is done for athletes and cyclists, but at this time I do not have data that might be applied to the HPV. I would be happy to discuss this issue further with experts in the field.

Learning from experience

With a pioneering event such as the Energy Challenge, the only practical approach is to work with the information available, and learn from the experience. The three events run to date have provided opportunities for experimenters and researchers to demonstrate their work in fields as diverse as hydrogen power, solar power, electric vehicles, compressed natural gas (CNG), liquid natural gas (LNG), and renewable fuels such as ethanol and canola oil. Each has an element of controversy. Ian Sims and hundreds of others are contributing to the learning experience, and in the process, exposing the issues for public awareness and debate.

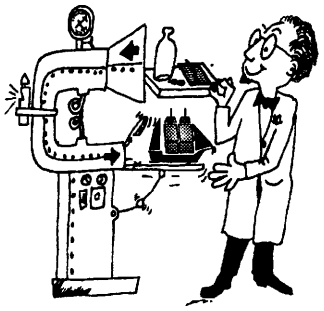
A primary consideration for our society is to retain the advantages of *practical, personal mobility* and *minimise*, or *eliminate* where possible, the *environmental impact*. The Energy Challenge and the GGI are but two interesting and educational ways of promoting the cause of Alternative Technologies, including HPVs and any other prospective technology.

- John Ward, NRMA

KEY:

C	= commercial
EX	= experimental
HPV	= human powered vehicle
LH	= line haul
PE	= passenger ethanol/petrol
PEL	= electric
PL	= passenger LP gas
PN	= passenger compressed natural gas
PP	= passenger petrol
S	= solar
LX	= luxury passenger

MAKE YOUR OWN



Solar Model Boat

Mick Harris

OVER the last few years, school kids around Australia have been competing building model solar cars. Well, why not a model solar boat?

A model solar boat is actually much simpler than a car. There are no wheels to worry about. You don't have to gear the motor, and it can connect directly to the propeller.

How to do it

First you need a boat. You could visit the toy shop and pick one that tickles your fancy, or you could make your own from balsa wood, polystyrene, or even recycled drink bottles. Use your imagination. But make sure it won't sink. Good quality solar cells are expensive, and it would be a pity to lose them at the bottom of a lake!

The solar cells

Next you need some solar cells. It is best to keep your voltage low but have a high current. This means that a small number of large cells could be a good way to go. Unfortunately most small panels tend to be low voltage and low current. Most high-current panels are rated at 12 volts. Ask around at electronics and solar shops and see what you can come up with.

The ATA has 3 amp 0.5 volt cells in the catalogue. Three or four of these, giving 1.5 to 2.0 volts at 3 amps, would work well.

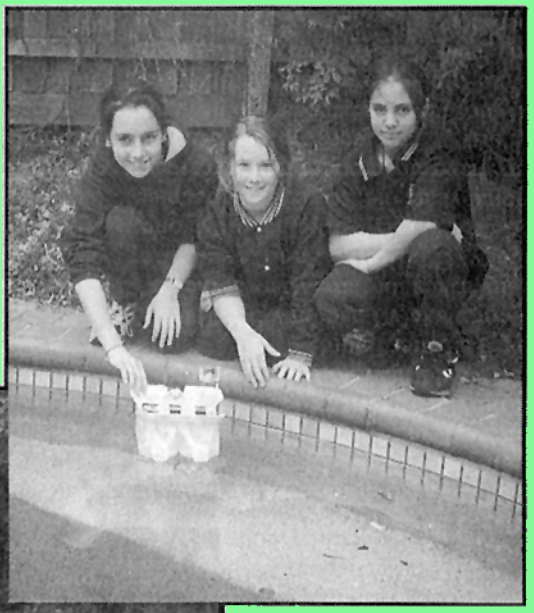
If you want a larger panel you could try one of those used for the model solar car races. They come from APPSYS Pty Ltd [ph:(03)563 7253]. These panels supply 3, 6, 9 or 12 volts at up

Energy Victoria Model Solar Boat Challenge

Since 1990, Energy Victoria has sponsored the annual Victorian Model Solar Car challenge, a competition which has now captured the imagination of students and teachers all over Australia.

This year a model solar boat challenge for primary schools will be held for the first time. All primary schools are eligible to participate. It will cost approximately $50 for regulation small solar panels, curriculum ideas and race regulations. The challenge will be held on Saturday, November 26 at *Science Works*, on the same day as the Victorian Solar Car Challenge.

If you would like further information on the solar boat challenge, please write or fax to the Victorian Model Solar Boat Challenge, c/o Dept. of Mechanical Engineering Monash University, PO Box 197, Caulfield East VIC 3145 fax:(03)903 2766, or phone John Molenaar at the ATA on (03)650 7883.



to 3 amps, have a nominal 8 watt rating, and cost $160.

The motor and propeller

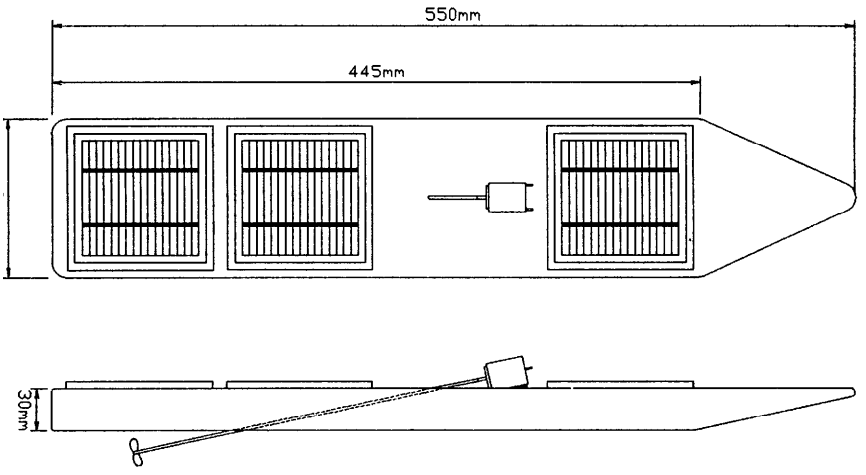
Next comes the motor. You will need one designed for a low voltage, so pick one rated at between 1.5 and 3 volts. These small motors are available in toy shops.

If you want to go for a super-dooper high-efficiency motor, you might want to obtain a quality motor of the type used in electronic equipment such as audio or low voltage control gear. These might take some tracking down, but could help turn your motor boat into a speed boat.

The final component is the propeller. Hobby shops supply a range of designs and you may have to try a few to find out which is best for you.

Once you have all the bits, wire the solar cell(s) to the motor and check that it works while placed in the sun.

Next, mount your motor onto the boat and run the shaft and propeller into the water. The motor can be set at an angle by propping up one end with a scrap piece of Styrofoam glued into place.



The prototype solar model boat

My first boat

My prototype was made of polystyrene sheet which was good as it allowed me to make holes in it without any danger of it sinking. It also gave me a flat platform on which to mount my solar cells.

The boat was a bit slow to start with, but by using a bigger propeller, I managed to get more speed out of it. Another problem was that it tended to go around in circles because of the turning force of the propeller. This could be fixed by fitting a rudder of some sort to the boat, although I did not do this. ☼

HOME WORKSHOP BOOKS AND PLANS

We have designed these projects especially for the home workshop enthusiast. They are easy to build using ordinary tools found in the average home workshop. (Welding and lathe work are not needed on any of these projects.)

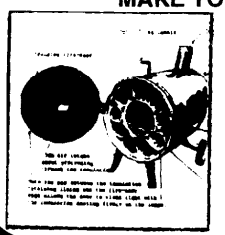
AUSTRALIAN DESIGNS — Our projects are designed in Australia for Australian conditions using easy to get bits and pieces from your local area.

RECYCLED PARTS — We place a heavy emphasis on using recycled parts. It can cut the cost to nearly zero on some projects. We show what parts to use, and where to get them.

WE BUILD AND TEST THEM — We build and test these projects before we print the books. By doing so we know you will be a satisfied customer, as your recommendations became an important source of business to us.

FREE TECHNICAL ADVICE — The projects are detailed and easy to make, but if a difficulty arises either in making or using them, we are only a letter or phone call away for free technical advice.

MAKE YOUR OWN CHARCOAL



This unit produces 10 litres of high grade charcoal per hour from waste wood. The wood is baked in "coaling tubes" which expels gas and tar etc from the wood leaving pure charcoal. The process is started with a handful of sticks, then the unit is **totally self fueling using the expelled gas and tar.** (This principle was used during the 17th and 18th century in the production of charcoal for the glass furnaces and iron foundries). This process produces a very pure high grade charcoal with the maximum possible carbon content. It is ideal for barbecues, water filters, melting aluminium, forge work, (particularly impact welding where a clean hot fire is required), and many other uses around the home and workshop. **CC56-$8.00**

DIESEL BLOW TORCH

This is a powerful, fast heating torch. Compressed air vaporises the diesel giving an intense fierce heat. The flame is fully adjustable from a gentle heat for soldering up to a searing blasting flame a metre long.

DT54-$8.00

BUILD A MELTING FURNACE

The melting furnace is possibly the most spectacular project of all. It is easy to build using refractory cement. (Used the same as ordinary cement.) Exact grades are specified together with the suppliers address and phone numbers, for delivery anywhere in Australia. This furnace melts all normal casting metals, eg aluminium, brass, cast iron stainless steel etc, and reaches a brilliant, dazzling shimmering whiie heat in the melting pot. Despite these high temperatures i.e. 1,550°C in the melting pot, the furnace is cool on the outside and quiet, smokeless and safe for backyard use. The main outer casing is a 12 gallon drum, and the air blast is supplied by an old vacuum cleaner. Included is an easy method of casting aluminium using plaster of paris moulds. **MF55-$9.00**

HOW TO PATENT YOUR INVENTION

You do not need to actually build your invention This manual shows you how to draft.out and lodge a "Provisional specification" for $60.00 This gives you 12 months of patent protection in which time you can sell your idea to a manufacturer or promotional agency for outright cash or royalties. The only work you need do is fill in the forms - about 1 hours work, on average and pay the patents office a $60.00 lodgement fee. We explain all about patents, how to fill out the forms, and show completed examples to make it easy for you.

P40—$7.00

Portable Stove

This is an unusual design, very easy to build and capable of all types of cooking, roasting and barbecuing. Lightweight and works in pouring rain. Uses all types of fuel, eg. wood, newspaper, coal, etc.

PS51 $6.00

Blacksmith Forge

This is a brilliant design, being easy to make, low in cost and exceptionally efficient. It will heat heavy pieces of steel to a soft plastic state in a few minutes. Plans included for making old style bellows, and procedures to harden, temper and anneal steel.

F52—$9.00

Case Harden Steel

Make tools, chisels, etc, from ordinary steel, then case-harden to a hard tool steel finish.

Harden shafts, tractor pans etc. Methods formulas and techniques tor use in the home workshop The mixture is absorbed up to 1/8" into steel by a heating technique. No special skills needed. Chemicals are cheap and easily obtained. **CH53—$7.00**

Water Divining

Details the proper methods ot making and using divining rods to find underground streams and reservoirs. You will be able to accurately assess the depth, rate of flow, amount and purity of the underground water.

D38—$6.00

MANUAL OF 210 FORMULAS

FOR HOME, WORKSHOP AND FARM

With the information contained in this manual you will be able to make your own products to use in the home, workshop or on the farm. All chemicals are readily available, with the names and addresses of Australian suppliers included. You will learn how to make paint of all types, i.e. rustproofing paint, fireproof paint, luminous paint, marine paint, latex paint, putty, household cleaners, ant repellents, fly killers, soap, cockroach spray disinfectants etc. Formulas are also included for making imitation marble plastic, imitation gold, gunpowder, rocket fuel, etc. All formulas are relatively simple, do not require any special equipment and can all be made at home.

F16 – $6.00

How To Build A Portable High Voltage Power Plant And Welding Unit Using A Second-hand Car Or Truck Alternator

Research and Design by Jim Allowyn

This special research manual shows how to convert old car alternators into a high voltage power plant and welding unit. This unit will run 24v lights, power tools, heating tools, universal brush type electric motors (will not operate induction motors).

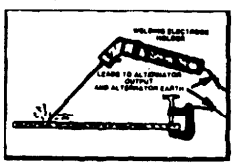
You will be able to fast charge batteries, arc weld, fusion weld with carbon arc rods, solder, braze, cut steel and heat steel to near melting point for shaping and bending.

Old 35 amp Bosch and Lucas alternators work very well The modifications are easily done by anyone with ordinary tools. All the required parts are available from auto electricians or auto accessory shops and the total cost of parts is "$12.00 to $15.00".

As a guideline to performance one 35 amp alternator will run 240v lights, drills, spot weld, heat

steel with twin carbon arc rods and do light welding. Two 35 amp alternators wired in parallel give an output of 70 amps which is adequate for most applications.

NOTE: You do not need a welder – this unique design enables welding leads to be connected directly to the output terminal of the alternator. The amps/voltage ratio is easily varied and controlled, enabling a low voltage, high amperage weld



ing current output from a direct connection on to the alternator.

In addition to using your existing car alternator and pulley you will learn about various drive line options including a high speed ground level wind chute power turbine which you can build yourself and a water wheel with enough power and torque to twist and break a 25mm solid steel drive shalt. Included is a simple method to convert old car generators into 2-speed 12v electric motors and a special section on formulas and chemicals which you can use and make yourself to rejuvenate old batteries. **P37 – $9.00**

How to Make Alcohol Motor Fuel

This manual shows an easy method of making alcohol fuel (methanol) by fermenting plant and vegetable waste. Methanol can be added to petrol as a fuel extender, or used straight with a motor carburettor adjustment. Methanol is water soluble which means it can be mixed with water, and in fact will absorb water from petrol tanks Methanol, water and petrol will all mix and dissolve into smooth motor fuel which is efficient and economical. Production is slow and not suitable for commercial ventures. However, it is a fascinating and rewarding project. **P23–$6.00**

AIR COMPRESSOR PLANS

Build your own compressor using the piston assembly of an old lawn mower and used car parts

This detailed manual shows exactly how to set up the compressor pump, air tanks and regulator for high pressure, high quality, automotive spray painting, spray painting around the home, high-pressure engine cleaning, sand blasting, operating air tools, nailing guns, air hammers, etc and with these unique design plans it can be built by anyone using ordinary tools, an electric drill and a few hours to spare. **C33 - $7.00**

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ST

SOLAR HOT WATER

Many people find the initial outlay for a domestic solar water heater too expensive to contemplate. This low-cost solar system, which uses the existing electric or gas water heater as a backup, is a realistic alternative. Trevor Berrill found that it cut his hot water bill by 75%!

Trevor Berrill

FOR most of us, the single most important reduction in the use of fossil fuels for our domestic energy demand can be made through the use of a solar water heater. Water heating generally accounts for between 40 and 60 percent of our domestic energy demand. In Queensland, where I live, this amounts to about seven to ten kilowatt-hours of electricity each day to heat water by electricity.

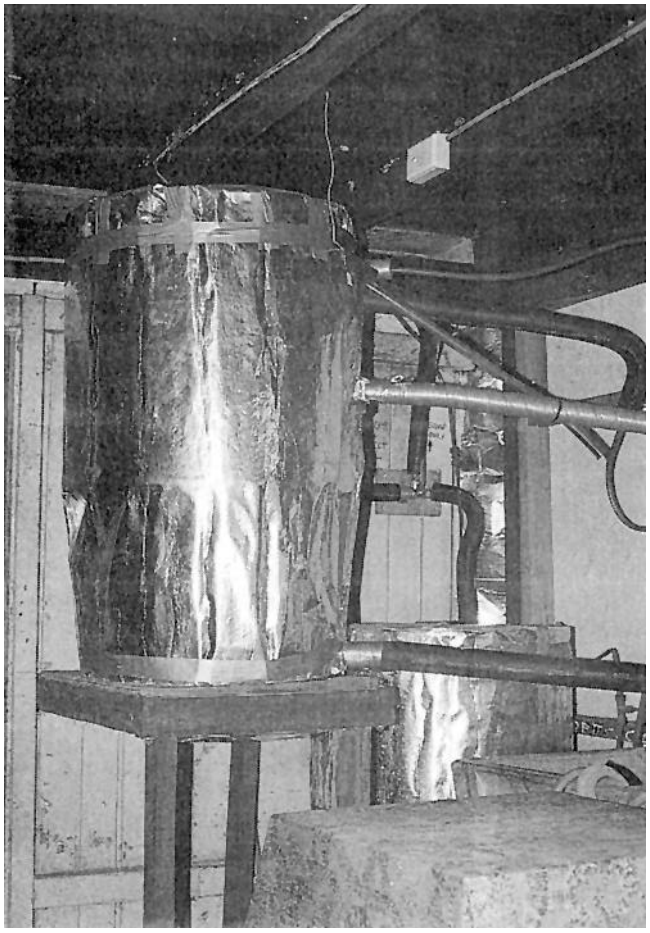
Due to the inefficiency of converting coal to electricity, 32 kilowatt-hours of energy from coal is needed to provide 10 kilowatt-hours of heat energy in the hot water system. In terms of coal usage, this would require burning up to 5 kilograms of black coal per day, or 11 kilograms of brown coal.

Thermodynamically, environmentally, politically and socially, this doesn't make sense. Thermodynamically because it wastes a lot of energy, environmentally because it produces copious amounts of pollutants, politically because of the centralised control of energy production, and socially because more jobs are created through the use of solar water heating than through electric water heating.

As if this is not bad enough, nearly all water heater storage tanks are poorly

Trevor with the solar collector mounted on the western side of his house.

A cheaper way to D-I-Y!



Solar tank (higher) and electric tank located under the house.

insulated. The Australian Standard for domestic hot water storage tanks allows on average about 15% to 20% heat loss from the tank and pipes. This is appallingly high.

Some years ago the South East Queensland Electricity Board advertised off-peak electric water heaters as clean and efficient. The same advertisement claimed that you could hang your clothes around them to use the heater as a clothes drier. Rather a contradiction, say what!

So what is the alternative to electric or gas hot water? Solar of course, but for some it's too expensive, and off-peak electric tariffs, minimum charges on tariffs, cut-throat deals of electric and gas systems and high interest rates on money borrowed to purchase solar all make solar less attractive.

A real alternative is a low-cost solar system using the existing electric or gas water heater as a backup. This is how I did it in a rented house for two energy-conserving people.

The system

The solar system consists of a cosmetically damaged 1.9 square metre, aluminium fin and copper tube solar collector (standard size from suppliers like *Solahart* or *Edwards)* coupled to a modified 150 litre low pressure, copper storage tank with a heat exchanger coil. This tank is in fact an old electric system with additional fittings to accept the 19mm diameter supply and return pipes from the collector. I then re-insulated the tank with a combination of 50mm thick fibreglass roofing blanket and 25mm thick polystyrene sheeting wrapped around this and secured in place with sisalation. The fibreglass insulation is against the tank to withstand the high temperature. Note that polystyrene should not be used directly against the tank or fittings as tank surface temperatures are likely to exceed 70°C and could cause polystyrene to ignite.

Our house is a high-set Queenslander and the existing electric water heater is located under the house on the western side. I decided to mount the solar tank beside and slightly above the electric tank. This allowed the collector to be ground mounted outside and the water to thermosiphon through the collector. As well, the solar and electric systems tanks could be easily coupled together with a minimum of copper pipe.

It should be noted that the collector is by no means in an ideal location, receiving full sun from only 11 am to 3pm each day, particularly in winter. However, since it is rented accommodation, I did not feel at liberty to mount the collector on the roof. Hence, I compromised to make installation and removal easy.

The tanks are plumbed together such that the solar system either acts as a pre-heater to the electric system during poor weather or else the electric system is turned off and by-passed through the use of a three-port two-way valve.

All pipes are insulated with 19mm thick foam rubber. The electric tank has also had an additional 25mm of polystyrene insulation wrapped around it. This is held in place with sisalation. A pressure/temperature relief valve should be added to the outlet of the solar system as a safety precaution.

A digital indoor/outdoor thermometer is used to monitor the temperature of the solar tank at about two thirds the tank height. The digital display is mounted in the house upstairs above the system so that we can quickly tell if there is sufficient heat for our use.

Occasionally we heat water on our gas stove to wash-up dishes if the solar temperature is less than about 50°C.

Digital indoor/outdoor thermometer. The upper temperature is the tank water temperature. The lower temperature is the indoor air temperature.

Solar water heating systems software package

The software Trevor used for his solar water heating system consists of a manual and an F-chart worksheet file that operates on LOTUS 123 or compatible spreadsheets.

It will predict the performance of flat-plate solar water heating systems. Input data includes load data (litres of hot water), radiation data on horizontal plane, ambient air and water temperature, collector efficiency, curve constants, and system capital and running costs.

The worksheet calculates insolation on the collector plane (north and south facing planes only.) To allow an economic comparison of solar water heating with electric, gas, or wood-fuelled systems, the life cycle costs for these systems are calculated using capital and running costs, inflation and discount rates. Cost: $100.

(A second software package for designing remote area power supply systems is also available. Cost: $150.)

To order, or for further information, contact Trevor Berrill, 19 Lily Ave, Yeronga QLD 4104 ph:(07)369 9011

System performance

On average, we use about 60 litres of hot water per day. This is required for showers, washing dishes and clothes. A low flow shower nozzle is used together with a front loading washing machine. Cold water in Brisbane must typically be heated from about 20° to 60°C. Therefore, 60 litres of this water would contain about 2.8 kilowatt-hours of heat energy. A water heater must provide this amount of energy plus heat losses through the tank insulation and pipes.

During January 1993, our hot water electricity consumption averaged 4.2 kilowatt-hours per day and this was the end of summer. The heat losses from the tank and pipes were measured at almost 50 per cent, although this included one very slow leak from the tap. I immediately added extra insulation to the tank and fixed the leak. The consumption for the autumn quarter averaged 3.1 kilowatt-hours per day, a very worthwhile 26 per cent reduction. Heat losses were reduced to about 1 kilowatt-hour per day.

On June 6, 1993, I installed the solar system and used it as a pre-heater to the electric system during the winter quarter. On a clear winter's day, the solar system would heat the water to about 50°C. However, much of the winter was overcast and wet and so the electricity consumption only fell a little to average 2.9 kilowatt-hours per day over this quarter. Our hot water energy demand had of course increased to about 4.6 kilowatt-hours per day due to the cooler weather so the solar system was still contributing significantly.

I had modelled the performance of the solar system with an F-chart spreadsheet (see box). This had shown an expected annual average solar contribution of just over 50 per cent of our hot water requirements. In summer we could anticipate up to 80 per cent solar contribution while in winter as low as 27 per cent. The graph shows the estimated back-up electricity (F-chart model) plotted against the actual measured electricity. The match between the curves of the estimated and measured back-up energy is very good. The graph also shows the reduction in the quarterly electricity bill for all quarters of 1993 and two quarters of 1994.

For the first quarter of 1993 we used the electric system unmodified. Autumn 1993 shows the reduction in demand due to adding extra insulation to the electric system and fixing a leak. The preceding quarters show the reduction from solar system together with the re-insulated electric system. During these quarters, most of our hot water was supplied from the solar system. Note that the quarterly bill falls to the minimum charge of about $8.30 per quarter.

I estimate that if we had used the electric system as it was when we moved in, our yearly hot water bill would have been about $120. With the solar system installed, our bill has dropped to about $40 per annum, that's a yearly saving of $80. The installed cost of the system was about $300, with half of this cost being for a second-hand collector. So the simple payback time for this system is about four years.

I had to laugh when we received our last electricity bill. It had a little note stamped on the outside encouraging people to report the theft of electricity. I thought that maybe the electricity authority suspected I was one such thief since our bill had been getting lower and lower. They should know by now that the last thing I would steal is electricity from their dirty coal fired power station.

It's always satisfying to install a system that performs as predicted, saving both money and the environment. The project has been very worthwhile and has encouraged a few others to try the same. It's simple, cheap and fun. ☼

Trevor Berill is principal teacher & coordinator of the Renewable Energy Centre, Ithaca TAFE College, Brisbane.

Making a SOLAR PANEL

A WIDE range of materials is currently used in the manufacture of solar modules. The materials used depend on the type of solar cell and the use of the solar module.

Glass is generally used as the clear front material because it allows light to pass through and also because it is a cheap, rugged material. The front glass must satisfy two very important conditions when used in the manufacture of silicon solar modules. These are: high transmissivity and resistance to the elements.

High transmissivity

As much as possible of the energy from the Sun must reach the solar cells. Any material that absorbs any of this energy will reduce the power output of the solar module. Generally, a low iron content glass is used as this material allows almost all of the light to pass through it.

Resistance to the elements

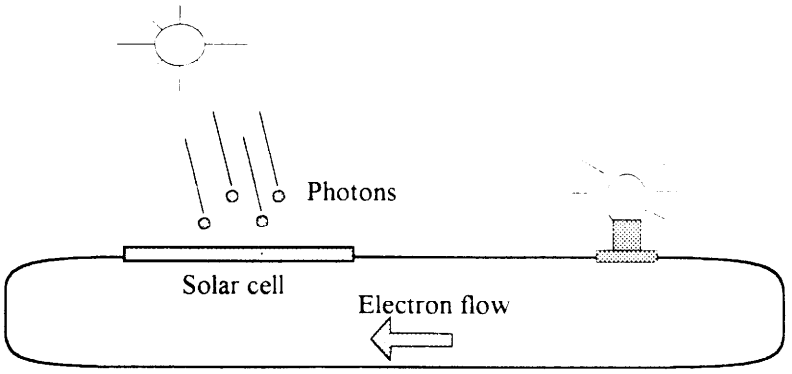
The other important criteria for selecting a material for the front of the solar module are its ruggedness and ability to withstand the elements. It must protect the fragile solar cells against rain, hail, wind and heat.

EVA stands for Ethyl Vinyl Acetate. It is a plastic material that has a good transmissivity and reasonably high melting point. EVA is the material used to bind the solar cells to the glass and also to the material used on the back of the solar module.

Tedlar is the material often used as the backing material of the solar module. It is a rugged plastic material that can withstand the elements. The electrical connections of the solar module are fixed to this backing material, Sometimes aluminium is used instead of Tedlar as a backing material.

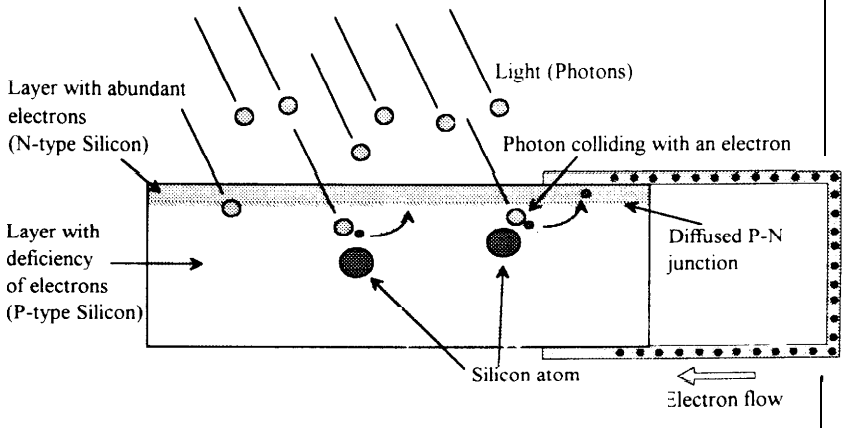
How does a solar cell work?

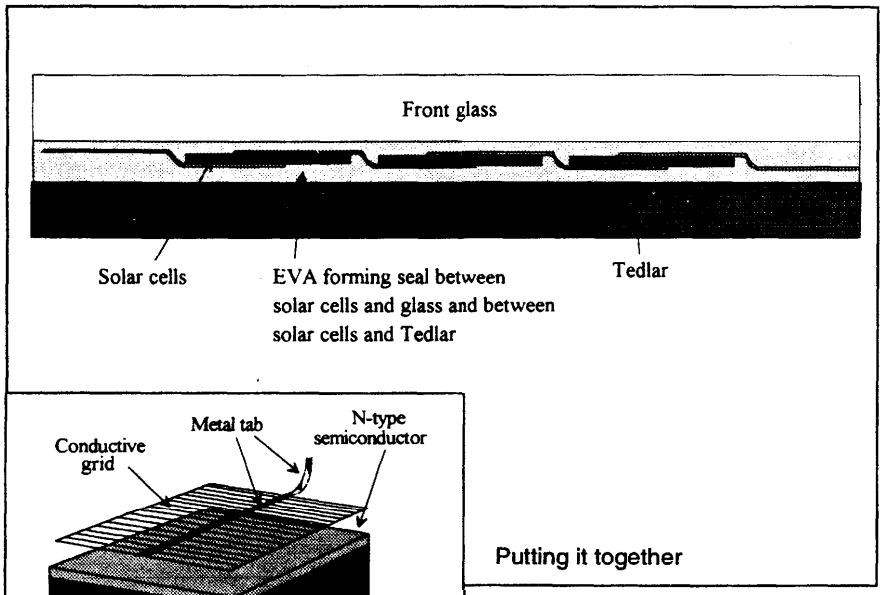
Billions of photons (energy packages) stream down from the Sun to the Earth. When the photons strike a solar cell, some of their energy is transferred to the cell.



A silicon solar cell is a wafer of silicon crystal to which impurities are added to form two diffused layers, a thin layer which has an abundance of electrons (N-type) and a thicker layer which has a deficiency of electrons (P-type).
When light shines on a solar cell, photons experience billiard-ball-like collisions with electrons in the silicon atoms to generate a flow of electrons or an electric current. This process is called the 'photo-electric effect' and the current generated is a 'photo-electric current'.

When a conductive material (wire) is connected between the N-type material and the P-type material, electrons flow (electric current) from the N-type material to the P-type material.





Putting it together

Complete solar cell

Connecting the solar cells

Metal tabs are soldered to the conductive grid. These tabs are the basic connecting blocks of the solar cells. The tab on top of one solar cell is soldered to the underside of the next solar cell. The solar cells are soldered together in this way until the required voltage has been achieved.

The joined solar cells are placed between two layers of EVA material. This is sandwiched between the front glass and the Tedlar backing material.

The sandwich of materials is placed in a heated vacuum chamber where all the air bubbles trapped in the sandwich are removed and the EVA melts to form the seal between the solar cells and the glass, and between the solar cells and the Tedlar. If the air bubbles are not removed before the sandwich is sealed, they are likely to expand in the heat and 'explode' causing irreparable damage to the solar module.

An aluminium alloy frame is then placed around the sealed solar module to give it stability and to provide a means of mounting to a structure. The aluminium alloy is usually anodised to prevent corrosion by the weather.

The two end tabs from the solar cells are brought out to the rear of the solar module and connected to a junction box. The junction box is naturally weatherproofed to prevent corrosion or rusting of leads and connectors. ☼

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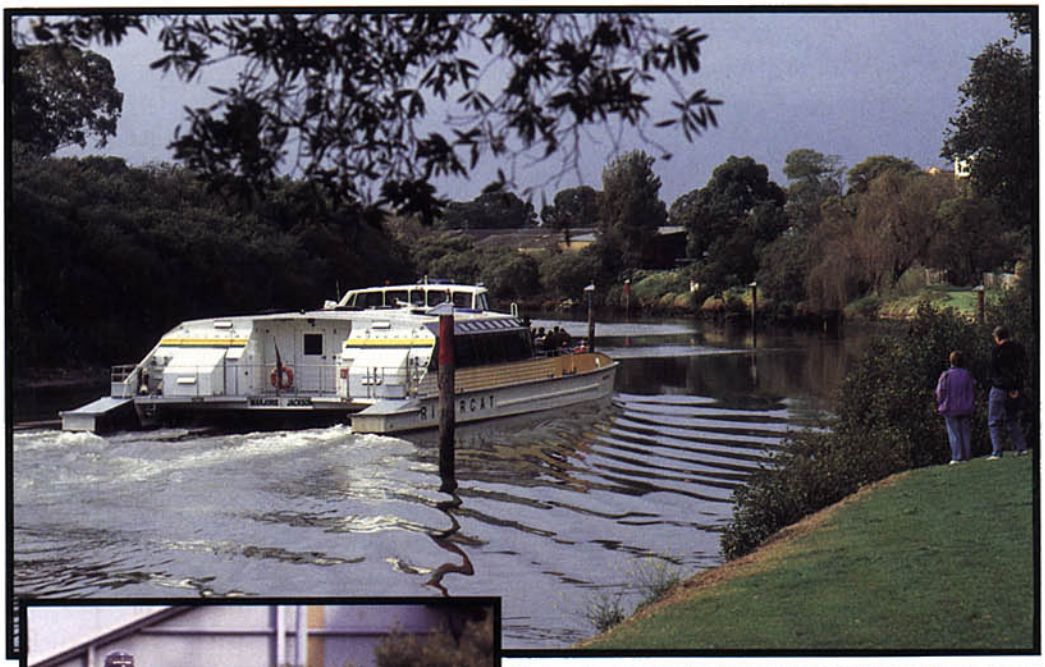
SOLAREX

AUGUST
ISSUE
No: 6

SHOWING THE WAY

In December 1993 the NSW Minister for transport Mr Bruce Baird opened the new Fast Ferry service from Circular Quay Sydney to Parramatta thereby completing a project to re-establish an historic transport artery from the City to the West. This ferry service was a key item in the Sydney 2000 Olympic bid and is planned to be extended to cater for passengers travelling to the games.

Solarex in association with Solar Technology Australia has played a vital role in making it possible for the new Rivercats to commence operation by providing a total of 90 solar powered navigation lights to mark the newly dredged channel in the river. In all 81 Solarex MSX10 and 9 MSX18 solar panels were used in the Solar Technology manufactured Series 4000 navigation lights.

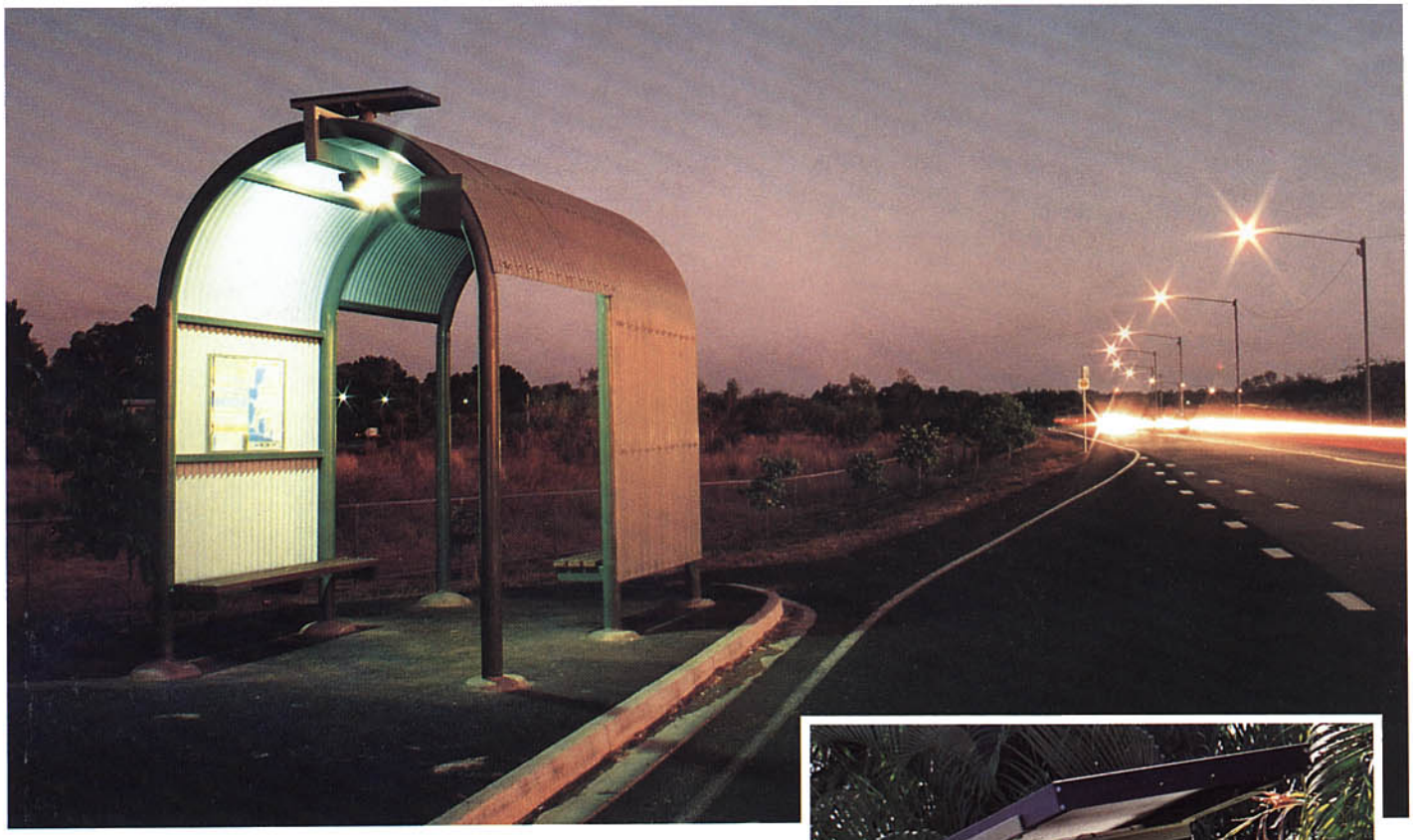


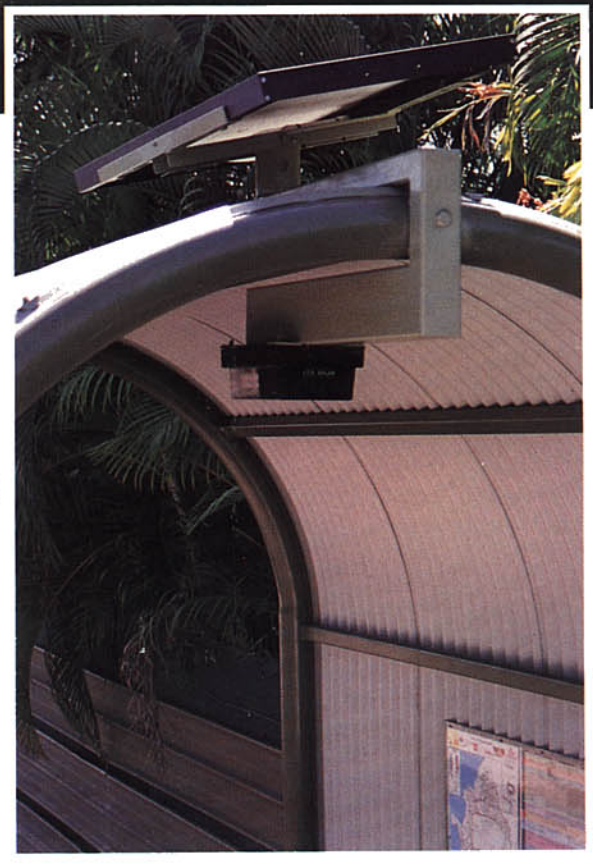
Photographs reproduced by kind permission of Maritime Services Board

The dredged channel in the river permitted minimum clearance for the Rivercat class ferry and the navigation lights accurately marked the extremities of the channel and the centre lines under the four bridges encountered on the route. Solar Technology utilising Solarex solar panels designed a navigation light specifically for this project. The Solarex panels provided the reliable efficient power source required for this vital assignment. The price of the panels was a significant factor in enabling the amount of lights required for safe navigation to be produced within budgetary restrictions.

Solarex and Solar Technology continue to provide an essential role in assisting mariners throughout NSW to navigate safely at night. Together we plan to expand our market for solar powered navigation aids throughout Australian and international areas.

Darwin Bus Shelters LIGHT UP with Solarex





The experience, innovation and design capabilities of Integrated Technical Services NT (ITS) have again proven successful with the recent installation of photovoltaic lighting systems at eight bus shelters in and around Darwin.

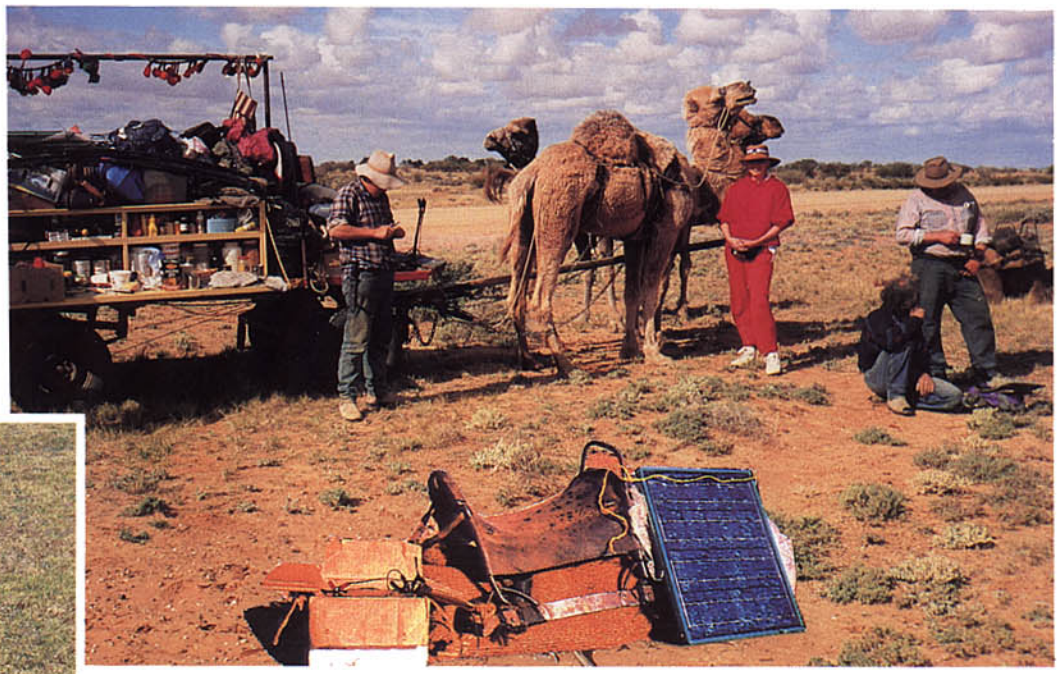
Commissioned by the Northern Territories Department of Transport and Works the ITS designed system features small, high quality A500 series Sonnenschein batteries, maximum power point trackers and Solarex MSX-40 solar modules.

Located across suburbs of Ludmilla, Coconut Grove, Karama, Rapid Creek, Fanny Bay and Berrimah the systems provide light from sunset for a 6 hour period and require no service and only minimum maintenance. ITS incorporated the same design technology for the bus shelters that has proven so successful in their main street lighting systems of which over 40 units are now in operation.

MSX-5, MSX-10, ~~MSX-18~~ MSX-20, MSX-30

BIG PERFORMANCE from SMALL MODULES

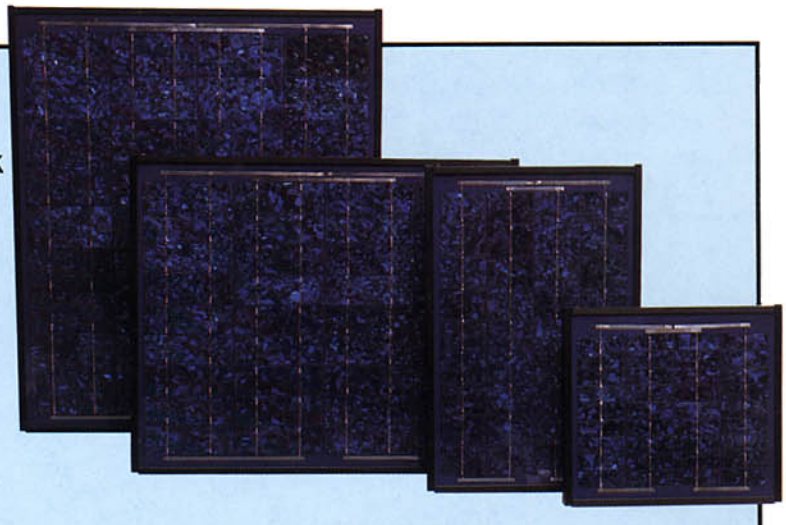
Through continued manufacturing process enhancements the MSX-18 will soon be replaced by the MSX-20 and still with some of the tightest power tolerances in the industry.



The MSX-5, MSX-10, MSX-20 and MSX-30 modules are designed primarily for use in single module systems, but may be interconnected to provide increased current or voltage as required. Typical commercial applications include remote telemetry, instrumentation systems, security sensors, signals and navigation aids. They are also well suited to small electrical jobs around the home or farm, such as powering radio, portable communications equipment and electric fences.

Solarex tests each and every module it produces and labels it with its actual output peak power and voltage and current at peak power at STC. (Standard Test Conditions). Each module is also covered by our 5 year limited warranty, which guarantees :

- ***That no module will generate less than its guaranteed minimum power when purchased.***
- ***Continued power (at least 90% of guaranteed minimum) for 5 years.***

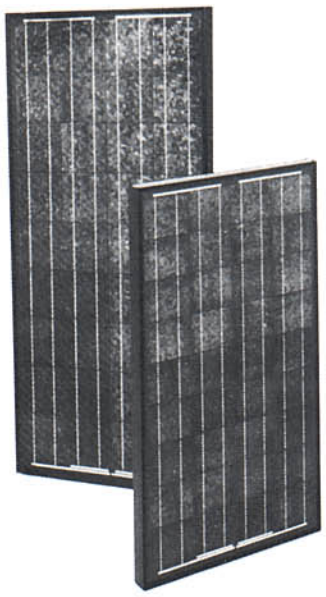


SOLAREX

Holder of
Australian Standard
AS 3901, ISO9001

SYDNEY HEAD OFFICE 78 Biloela Street, Villawood, NSW 2163 Tel: (02) 727 4455 Fax: (02) 727 7447 Toll Free: 008 802 762

MSX-MEGA SERIES



PHOTOVOLTAIC MODULES

❑ Glass Front

High Power	Nominal Volts	Amps @ Peak Power	Watts (Nom)	Dimensions (mm) L	W	D
MSX-83	12 *	4.85	83.0	1109	660	50
MSX-77	12 *	4.56	77.0	1109	660	50
MSX-64	12 *	3.66	64.0	1109	502	50
MSX-60	12 *	3.50	60.0	1109	502	50
Mid-Range						
MSX-50	12 *	2.92	50.0	942	502	50
MSX-40	12 *	2.34	40.0	769	502	50
Slim Line						
‡MSX-30S	12 †	1.75	30.0	590	498	23
‡MSX-18S	12 †	1.10	18.5	418	498	23
Low-Power						
‡MSX-10	12 †	0.58	10.0	420	269	23
‡MSX-5	12 †	0.27	4.5	249	269	23

*Can be rewired for either 6 or 12 volts †Can be purchased in either 6 or 12 volts.
‡A blocking diode is prewired to the output cable.

MSX-MEGA SERIES

REGULATORS & CONTROLLERS

	Volts (Nom)	Amps (Max)
SR4 12	12	4
SR4 24	24	4
SR8 12	12	8
SR8 24	24	8
SR8 36	36	8
SR8 48	48	8
SC18 12	12	18
SC18 24	24	18
SC18 36	36	18
SC18 48	48	18

30 Amps wall or rack mount, 60, 90 and 120 Amps in rack mount only

AMORPHOUS SILICON MODULES

❑ Glass Front

Low Power	Nominal Volts	Amps @ Peak Power	Watts (Nom)	Dimensions (mm) L	W	D
SA-5	12	0.29	5.1	305	346	21
SA-2	6	0.29	2.2	171	349	13
SA-2/12	12	0.145	2.2	171	349	13
SA-1	12	0.08	1.4	124	330	11

CHOICE ELECTRIC CO
QUEENSLAND
3 Prospect Street, Bowen Hills, Qld 4006
Tel: (07) 252 4909 Fax: (07) 854 1038

POWER PLUS
TASMANIA
37 Barrack Street, Hobart, Tas 7000
Tel: (002) 31 5377 Fax: (002) 31 5438

SOLAR SALES PTY LTD
WESTERN AUSTRALIA
97 Kew Street, Welshpool, WA 6106
Tel: (09) 362 2111 Fax: (09) 362 3231

INTEGRATED TECHNICAL SERVICES
NORTHERN TERRITORY
36 Gardens Hill Crescent, Stuart Park, NT 0820
Tel: (089) 81 5411 Fax: (089) 81 5870

R.F. INDUSTRIES PTY LTD
QUEENSLAND
Brisbane: 16 Kyabra Street, Newstead, Qld 4006
Tel: (07) 252 7600 Fax: (07) 252 5505
Townsville: 48A Punari Street, Currajong, Qld 4812
Tel: (077) 75 6433 Fax: (077) 75 6409

PECAN ENGINEERING PTY LTD
SOUTH AUSTRALIA
13 Acorn Avenue, Dry Creek, SA 5094
Tel: (08) 349 8332 Fax: (08) 260 6643

SOLAR CHARGE PTY LTD
VICTORIA
115 Martin Street, Gardenvale, Vic 3185
Tel: (03) 596 1974 Fax: (03) 596 1389

SOLAREX

Green tech on the INTERNET

Suelette Dreyfus

YOU sit down in the comfort of your study, turn on your PC, plug your phoneline into your modem and start dialling a local Bulletin Board System (BBS). This BBS, a local Internet site, happens to be a non-profit operation - most likely the hobby of some street-smart 20-year-old computer prodigy who has delicately soldered together a jumble of used computer parts and set up shop in his garage. Fortunately, you cannot see the tangle of wires surrounding this Frankenstein-like creation. Instead, all you see is the smooth menus of the system as you log in and begin your search for information on energy conservation.

A few minutes later you are 'inside' the *LBL Center for Building Science* in California reading about its latest research in energy-saving technologies such as electronic ballasts, compact fluorescents and low-emissivity glazings. Did you know that these three technologies are expected to save US$17 billion per year? That is the equivalent of 38 electric power plants, 140 offshore oil platforms, or 50 million 25 mile-per-gallon cars on the road. All this information for little more than the cost of a local phone call. Welcome to the Internet - have modem, will travel.

Being hooked into the Internet is like having the Library of Congress in your study. It is a simple and relatively cheap way of getting information, articles and cutting-edge ideas on thousands of topics, including renewable energy. However, a word of warning - the 'structure' of the Net is fairly organic. This means that you need a bit of persistence to learn where to look. Computer system administrator Stuart Marburg, who runs the Melbourne-based *Insane* BBS, described the Internet as 'a library with no index'. This does however, have its advantages. Said Marbug, 'There is basically no one saying, "Do this" and "Don't do that". Behaviour is controlled by peer pressure'.

The Internet – Green technology of the '90s

The Net itself is the perfect green technology. When you step into the Net and 'slurp' information into your PC (yes, slurping is yet another word in Net-lingo), you are not only saving your time but also the environment. Administrator Julian Assange of the Victorian BBS *Suburbia* says, 'Using the Net saves paper, trees and transport energy. It also reduces waste, such as ink cartridges and thermal fax paper, and perhaps most importantly, greenhouse gas emissions. Sending data over the Net is a very environmentally-friendly way to transfer information'.

He estimates that if the accessed information on just one part of the Net – the APANA subgroup – was printed on paper instead of transferred electronically, it would produce more than 44 tonnes of paper per week. Producing that amount of paper would in turn generate more than 100 tonnes of CO_2. There are no accurate figures available for the amount of 'paper-avoided' for the entire Net in Australia. However, it is not unusual for the APANA section of the Net to receive some quarter of a million articles or more per week – all of it passed on to Net users without using a single piece of bleached paper.

The World Wide Web

One way to start a search for information is to tap into *the World Wide Web*, affectionately known by Net-regulars as 'www'. There is a www 'virtual library', which has information on everything from Agriculture to Fortune Telling. The prize for most bizarre heading goes to 'Human Factors', described as 'The McDonnell Douglas Human Modelling System -a 3D interactive modelling system providing the capability to analyse human body fit and function within a geometric structure'. An ideal conversation-starter at a dinner party.

A number of research organisations, such as the US Department of Energy's *National Renewable Energy Laboratory* (NREL), have information available through the Web. For example, you can browse through a bibliography of staff papers and books on renewable energy, energy efficient technologies and biofuels. Perhaps you have a particular interest in cutting-edge recycling technology? The institute has a long list of press releases on its recent research and development projects, such as its new carpet recycling technology. NREL has developed a way of recycling carpets made of nylon 6 fibre (used in 30% of carpeting), into caprolactam, the chemical used to make the fibre. The cost of this recycling process is less than half the cost of producing new caprolactam and uses only a third as much energy. Or, maybe you are interested in Sunrayce '95, a biennial, intercollegiate solar car race across the US. NREL publishes a calendar of events on the Net relating to the race.

In fact, if you *really* like what you see on your screen, you might like to apply for a job at NREL - over the Internet. The government laboratory posts the positions it has available, ranging from patent attorney to chemical engineer to associate analyst (but you would have to move to Washington DC for that last one). Electronic job applications are a lot faster than 'snail mail', as Net-surfers refer to the good old postal service.

Electronic news

You may want to use all that information you have been absorbing from the

Web to flex your intellectual muscles. Newsgroups and mailing lists are the places to do it. They ate, as their names suggest, places where people post ideas on topics ranging from energy to architecture. You can post a general request for information or comment on one of the several hot debates generally raging on any one board at a time. For example, there is a steady stream of arguments posted by regulars on the 'sci.energy' group about the pros and cons of nuclear power. The quality of the comments varies from informative and thought-provoking to ridiculous.

Some good message boards for green technology information are: Sci.Energy; Sci.Energy.Hydrogen; Sci.Environment; Talk.Environment; Alt.Architecture; AltSave.The.Earth, and Aus.Conservation.

There are also free subscription mailing lists, covering topics from alternative energy (ae@sjsuvml.sjsu.edu) to electric cars (ev@sjsuvml.sjsu.edu). Just send an email to hstserv@sjsuvml.sjsu.edu with a message saying 'subscribe ae' followed by your first name and your last name on the same line. The whole thing is done automatically.

When you join a mailing list, you can post your own articles, information or opinions on the subject - which will be read by hundreds of people around the globe. Finally, if all this information isn't enough for your ever-inquiring mind, you might like to subscribe to a free electronic journal, such as the *American Wind Association's* newsletter *Wind Energy Weekly*. Just send off a request to Tom Gray via email: tgray@igc.apc.org.

How to join the Net

There are three ways you can get onto the Net: get an account through your employer, your university or a local BBS. University computer accounts can be tough to get, but they are free - so be persistent. There are some good commercial services, some of which are reasonably priced at $15 to $25 a month.

If you want to get on the Net for your personal use only, a good option is to join a BBS affiliated with APANA, the non-profit Australian Public Access Network Association. With annual fees at some APANA BBS around $50, APANA sites are a good deal. ☼

These are just a few of the many BBS you can join to access the Net:

MELBOURNE

Suburbia
6 modems (03)596 8366
Cost: $50 pa, $35 pa (students)
Contact: Mark Dorset: zerohour@suburbia.apana.org.au
Tech details: IP, Linux Unix, 20Mb mem, 1.2 GB disk, CD rom, mail, news, ftp, telnet, PPP

Insane
11 modems (03)886 1230
Cost: $50 pa
Contact: Stuart Marburg or Richard Preen: admin@insane.apana.org.au
Tech details: IP, NetBSD UNIX, 16MB RAM, 1GB disk, mail, news, ftp, telnet, PPP

SYDNEY

Geko
8 modems (02)968 4335
Cost: Shell $25 (once off)+ $15/month. Fast Links Dialup IP – $65 (once off) + $50 per month
Contact: accounts@geko.com.au, voice:(02)968 4333, fax:(02)968 4334.
Tech details: IP, SLIP, mail, news, telnet, ftp, irc, www

BRISBANE

Ozspace
3 modems (07)372-8321
Cost: from $50 (Email/News), $75 (Email/News/telnet/ftp/www/etc)
Contact: BrisNet (non-profit), john@ozspace.brisnet.org.au (07-372-5296)
Tech details: IP, Linux Unix, UUCP and IP feeds (SLIP/PPP) available

CANBERRA

Posgate
1 modem (06)2851701
Cost: APANA membership (mail info@apana.org.au for details)
Contact: Paul McConnell voice: (06)282 4328, (paul.mcconnell@posgate.apana.org.au), fax:(06) 2822783
Tech details: IP, Linux 1.2, mail, news

Capcon
4 modems (06)292 7655
Cost: $10/month (+ $30 joining fee)
Contact: Craig Gibson - craig@capcon.apana.org.au, ph/fax:(06)292 5366
Tech details: IP, Linux Unix, news, mail, gopher/www

PERTH

iiNet Technologies
21 modems, number by application
Cost: $15 setup + $25/month
Contact: Michael Malone: iinet@iinet.com.au or (09) 307-1183
Tech details: IP, Linux Unix, ClariNet News, all hours support, news, mail

Multiline
46 modems(09) 370-3333
Cost: $45 pa for BBS + $50 pa for Mail/News/Ftpmail + $200 pa for full internet access
Contact: Voice support (015)190-465 gmplatt@cougar.multiline.com.au
Tech details: IP, Main BBS has 45 CD-Roms, ftp, telnet, gopher, irc

HOBART

Calvados
1 modem (002) 34-8530, (login as 'new')
Cost: $30pa
Contact: John Lamp: system@calvados.apana.org.au
Tech details: UUCP - time to internet: 18 hours, MS-DOS, Waffle Clarion mailing list, mail.

ADELAIDE

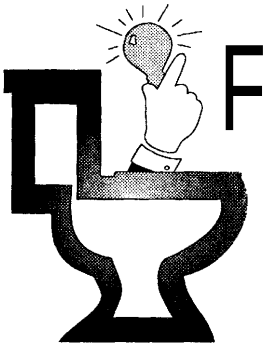
Apanix Public Access Internet
9 modems (08) 373 5485
Cost: 2 hrs/day at $65/year
Contact:Adrian Corston adrian@apanix.apana.org.au
Tech Details: IP, ftp, www, irc, telnet, news, mail, SL/IP also available.

Cleese
4 modems (08) 373-6006
Cost: $65/year, or $10/month
Contact: Mark Newton: newton@cleese.apana.org.au
Tech details: IP, FreeBSD UNIX, 16Mb RAM, 1.6GB disk, UUCP, SLIP, news, mail, SA APANA hub site

WOLLONGONG

Dwarf
1 modem (042) 973837
Cost: Free
Contact: Russell Noble: russ@dwarf.apana.org.au
Tech details: UUCP-18 hrs to net, Linux, 1.2Gb disk, mail, news

For APANA information: info@apana.org.au



Further 'round the S-bend

Andrew Blair

WHAT a waste of water and nutrients is a normal toilet connected to a sewage authority system! It does not have to be this way. In *Soft **Technology #46,*** 'Beyond the S-Bend', we looked at alternatives to the sewage authority systems. The septic tank, which for years was seen as the only flush toilet option to sewage authority systems, has been improved with recent technology.

In many systems the sewage is treated with chlorine tablets so that any pathogenic microbes are killed before the treated water is used for garden watering. Another treatment is with the use of ultraviolet light which, according to *Ultra Violet Light Services,* kills not only bacteria but also viruses, as they pass out from the final treatment.

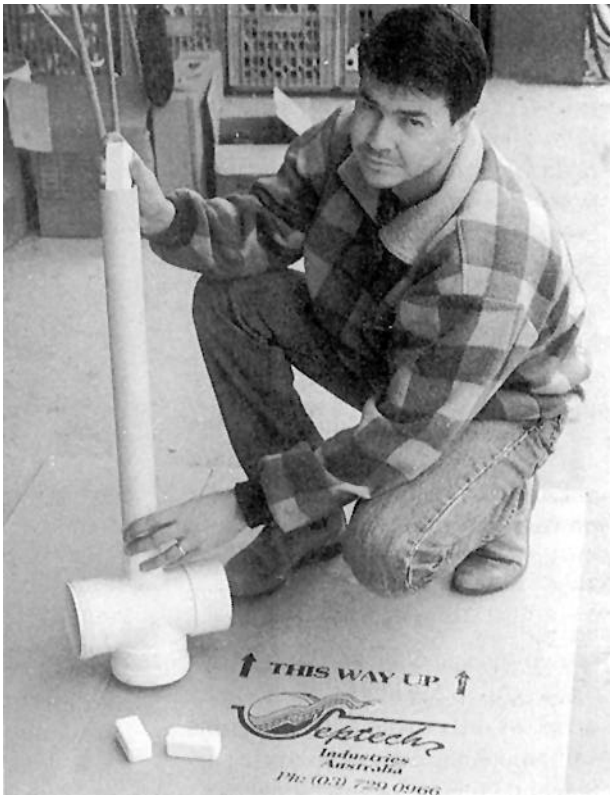
Septech Industries in Melbourne showed Soft Technology the way they treat sewage using chlorine tablets; the sort of tablets used in swimming pools. The sewage flows through a plastic pipe fitting in which a chlorine tablet sits and kills the bacteria coming through.

After experimenting with various types of chlorine tablets, Septech found that the large block tablets shown in the photo were the most successful. The liquid soaked up through other tablets like a wick and they became jammed in the storage tube. This does not happen with these large rectangular tablets. New tablets slip down the tube as the old tablets are dissolved away. The system is reasonably cheap and effective.

Ultraviolet light can also be used for treating sewage effluent. Unlike chlorine treatment it adds no chemicals to the effluent, but kills both bacteria and viruses.

Septech Industries use the ultra violet treatment where they can, as they feel it is the best system, but the chlorination treatment is considerably cheaper to install and to operate.

Australian Ultra Violet Services operate several plants in the ***Melbourne*** *Water* treatment areas. They have also been carrying out work using ozone in conjunction with ultraviolet light in a treatment that enhances the kill rate of the bacteria and creates a slight residue in the effluent. They believe that this plant is the first of its type in Australia.



Chlorine tablets are stacked in this tube. The tablets slide down the tube and into the sewage as it passes out of the septic tank. As the tablets dissolve, they are replaced with more tablets from the tube.

The ultraviolet light treatment units are sized according to the flow rate of sewage being treated. As ultraviolet light adversely affects plastics, the section of the treatment where the ultraviolet lights are shining must be made of either stainless steel or concrete. Treatment with ultraviolet light is more expensive to install than chlorine treatment, but it has the benefit of killing viruses whilst adding nothing to the sewage leaving the system. ☼

For further information:

Septech Industries
14 Burgess Road, North Bayswater VIC 3153
ph:(03)729 8655 fax:(03)720 5534
The Septech Chlorinator costs $56. The chlorine tablets cost $60 for a 4kg bucket of tablets. The number of tablets required over a year will be determined by the amount of sewage being treated, but may be about 4kg per year.

Australian Ultra Violet Services
49 Valley Road, Wattle Glen VIC 3096
ph:(03)438 1279 fax:(03)438 3113
The simplest ultraviolet light treatment system costs $1240. The annual running costs are likely to be $210, for the cost of power and replacement lamp. As systems are designed individually, it is usual to price each job separately.

Your Local Government office will advise on their requirements in your area.

An easier life with the 'Green Grid'

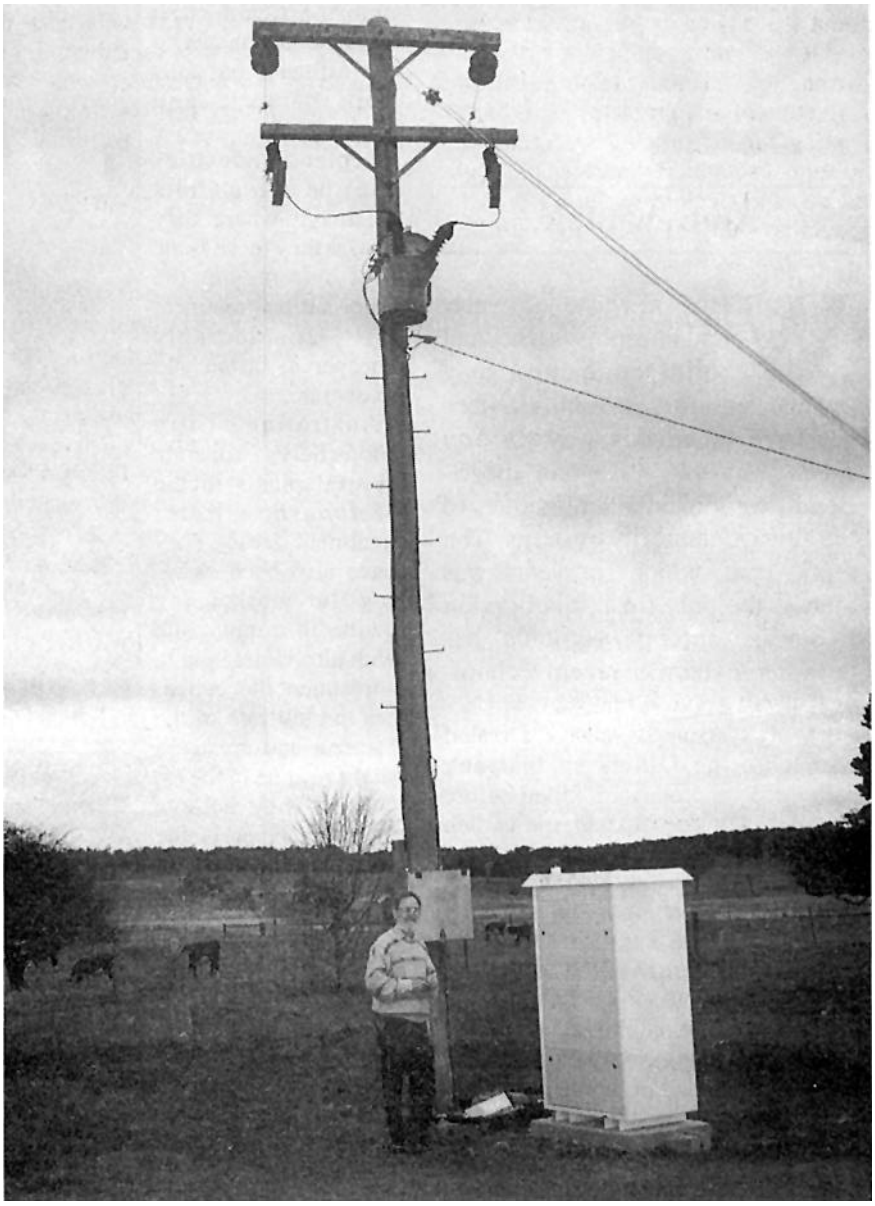
*While most **of** us are at least partially familiar with RAPS systems, inverters and the like, grid interactivity is one technology that has not been all that well known up until now. But all that may be set to change with systems such as the one described here.*

Lance Turner

LIVING at the end of a power utility's grid can be a most frustrating business. When the power is actually available, the supply can suffer from all sorts of fluctuations and glitches, from voltage dips, surges and spikes, to extended brown-outs and black-outs. All of these will play havoc with many types of electrical and electronic equipment, and can even cause permanent damage to some devices.

Dale Butler of Butler Solar Systems Pty. Ltd., in collaboration with Siemens Ltd., has come up with a system to virtually eliminate such problems forever. Known as the Green Grid*, it can supply the demands of a normal household without disruptive variations in voltage and line frequency in the power supplied to the home.

Basically, the Green Grid consists of a Siemens Sunsine grid interactive inverter coupled to a bank of gel cell storage batteries. For those of you not familiar with grid interactivity, this is a system where the inverter is not only connected to the batteries to provide clean sinewave power to the house, but also draws power from the mains grid when the power is available and is of useful voltage. It can even be used to feed excess power that may be generated by the consumer's auxiliary generators (windgenerator, etc) back into the mains grid. Also, mains grid power is used to recharge the batteries when the demand from the house is low, and ample grid power is available.



A Green Grid unit at the end of a mains grid spur

A smart inverter?

The whole system is controlled by a programmable microprocessor which can be programmed to set the maximum limits on power drawn from the grid to a level suitable for that part of the grid. It can also be programmed to raise the maximum power drawn from the grid supply at certain times, such as off-peak hours when the hot water heater is operating. The majority of power supplied to the house comes from the grid directly. Any power demand above that level is supplied from the batteries.

Another feature of the system is the protection it affords to expensive equipment connected to the mains. When the mains grid voltage or frequency varies past certain limits, the inverter's microprocessor will disconnect the mains supply, and power the house purely from batteries, reconnecting when things stabilise.

The built-in microprocessor controller can also make de-bugging a system much simpler. By connectingthe Green Grid unit to a computer, either directly or via a phone line and modem, data about the power consumption, mains grid levels, and so on can be retrieved and analysed in order to find and allow correction of any problems. This 'data logging' function also allows records of power consumption at various times of the day and week to be recorded, thus providing valuable information for future reference, should it be required.

Adding renewables

As the system basically consists of a box full of batteries and a large inverter, it makes sense to be able to charge the batteries from renewable sources of energy if so desired, allowing consumers to go it alone and generate some or all of their own power. This is possibly the most important feature of this system from an environmental standpoint. The system can accept alternative power sources up to the continuous power rating of the inverter, and this power will then be fed back into the grid when in excess.

Users' comment

So what do users of this system have to say about it? Sandra Keith and husband Max, of Richlands NSW, (who have been using the Green Grid since April 1993) say, 'To know that you have power for practically everything is great, that you can carry on regardless of what happens'. Sandra also suggested that the system would have great advantages for dairy farms, as cows get stroppy if their milking routine is upset.

One comment from another user of the system was that it needs a mains fail indicator inside the house. The only indicator is on top of the unit in the form of a flashing light. If the unit is not in a readily visible position, it is perfectly possible, as this user did, to flatten the batteries very quickly with excessive loads during an extended blackout.

Another problem that springs to mind is that during an extended blackout (several days or so) the batteries will be exhausted, and the user will be without power anyway. This is because the battery storage capacity is relatively low when compared to normal RAPS systems, which are usually designed for at least three days reserve. This problem could of course be overcome simply by fitting a source of renewable energy, such as a solar array or something similar, although it is interesting to note that the users I spoke to had not considered doing this.

Good for the power company too

While the advantages listed above may be great for the consumer on the end of a very unstable grid line, there are also many advantages for the supply authority themselves. Knowing that the maximum power drawn from the line will have a set limit, and that each home fitted with a Green Grid will draw no more than this limit, means more homes may be connected to the same section of the grid than before without the need to upgrade the supply lines and associated equip ment Also, by limiting the grid power drawn, the supply lines to the residence need only be able to carry the maximum level of power set by the microprocessor.

So for people on or near the end of the mains grid, the Green Grid system may well be a dream come true. With its ability to provide ample quantities of clean, glitch-free power 24 hours a day, it has the potential to become an industry standard for grid interactive systems in the future.

For specifications on the Sunsine range of inverters, including the unit used in the Green Grid system, see the inverter buying guide in this issue. ☼

Cruising...on an electric boat

Tourists enjoy a cruise on the electric boat, MS Rubeena, at Lake Tyers VIC.

Mick Harris

WHEN Bob and Julie Whadcoat go to work they don't sit in an office. They spend their time cruising beautiful Lake Tyres, in south-east Victoria, in an 82-year-old wooden boat. And when they take visitors on a tour, instead of the familiar drumming of the engine and diesel fumes, they enjoy peace and quiet and the fresh air. It's because they operate an electric-powered touring boat.

A colourful history

Bob and Julie's boat, the *M B Rubeena,* has a long and interesting propulsion history. Rubeena was built in Sydney in 1912. She was licensed on April 4, (six days before the maiden voyage of the *Titanic).* She was brought down to Lakes Entrance, Victoria on the deck of a steamer and dumped into the sea off Lakes Entrance.

Originally steam powered, the Rubeena then toured the lakes until 1940, when the steam engine was replaced by a six cylinder Chevrotet petrol engine from an army *Blitz* truck. In 1958 the Rubeena moved from the main lake system to the more isolated Lake Tyres.

Bob's family bought the boat in 1970, and in 1975 fitted a four cylinder BMC diesel engine, (the same as the ones in the London Taxis).

Julie and Bob took over running the boat in 1983. Ten years later the diesel engine was getting very tired. One night they were watching *Beyond 2000* on TV and saw an item about electric-powered boats in England. This got them thinking and after three years of research and determination they had Australia's largest electric boat.

Cruising in comfort

Powering the boat electrically had a number of advantages. The existing engine was noisy, smelly and left an oily scum in the water that couldn't be good for the environment. Bob was also concerned about the effect of the engine vibration on the 80-year-old wooden boat. Initially the licensing authorities had trouble working out how to handle the application for the boat with an electric motor. It took two-and-a-half years to ease their doubts at something this 'different'. However, eventually they were satisfied and the Rubeena had its official electric cruise on November 12, 1993.

A cruise around Lake Tyers in Rubeena is a wonderful experience. The first thing you notice is how quiet it is. Most tour boats come complete with a microphone, amplifier and speakers so the people can hear the commentary over the noise of the engine. The electric boat is so quiet that Bob can speak to everyone on the boat without an amplifier. Because the boat is so quiet, wildlife is not disturbed, and the boat can creep up on an amazing range of birds and animals without disturbing them.

Running costs

The electric system is also more manoeuvrable, making it possible for the boat to get in and out of tight spots without a bit of bother. The Rubeena cruises at a comfortable five knots, a similar speed to when the diesel engine was fitted. But the running costs are much lower. Diesel fuel costs amounted to $380 per month. Now Bob plugs into the power supply at the jetty and he pays around $115 a month, close to a quarter of the previous cost. He also expects lower maintenance costs and better life from the boat due to the less motor vibration.

Bob has considered adding solar electricity to the boat at some time in the future. 'It's too expensive at the moment to run the whole boat on solar, but maybe one day.' With the increasing use of boats in our waterways and the noise, air and water pollution that comes with them, Bob and Julie's electric Rubeena points the way to a clean and practical future. If you are down at Lakes Entrance, join them for a cruise.

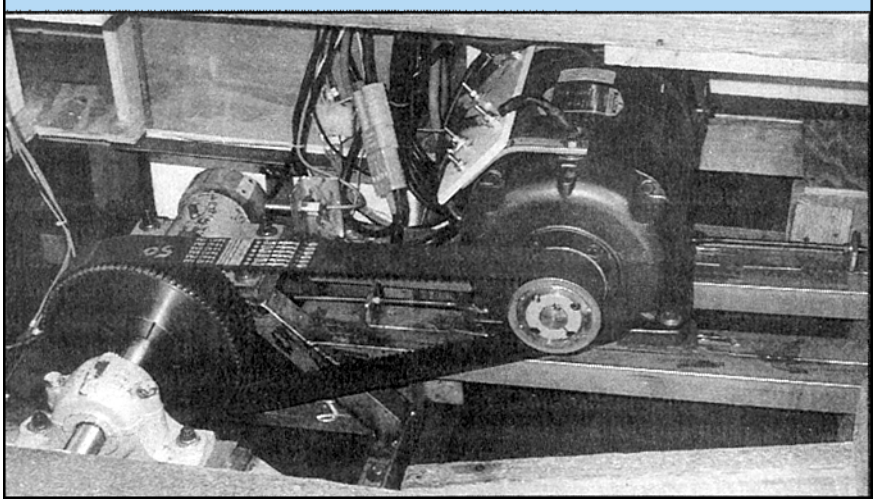
How It Works

The boat uses 24 Century Yuasa, two volt, deep cycle, lead acid batteries. They are wired together to give 48 volts at 435 amp hours.

The battery bank is charged by a pair of 48 volt, 25 amp battery chargers. These single phase chargers are ex-Telecom and wired so that after the battery bank charges to 57 volts, one of the chargers drops out, halving the charging current.

The drive motor is a 'Baldor' 72 volt, 8 horsepower motor. Because it is being driven at 48 volts its maximum power is about five horsepower. The motor draws about 75 amps while operating at maximum power. The motor is operated by a standard commercial electric vehicle controller.

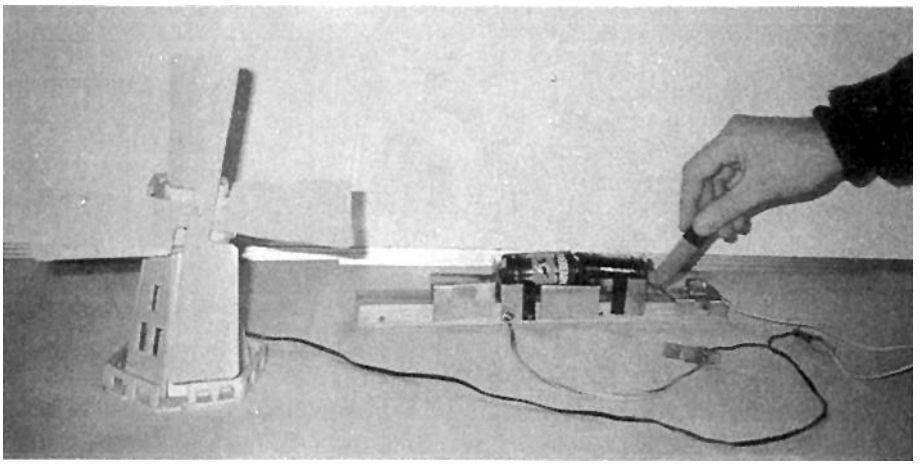
The 'Curtis' controller was supplied by a Sydney company. They supply a range of controllers for any voltage between 24 and 120 volts.



NOEL'S TREASURES FROM TRASH
Low Cost Home Science Project #9

This project lets you build a simpIe power supply to give you from 1.5 to 6 volts to power anything from toys to torch bulbs and radios.

Sometimes we want to drive some piece of electrical equipment that needs between 1.5 and 6 volts. Dry cell batteries are ideally suited for this type of task, but it is often difficult to hold the cells together, as well as holding wires to the cells. This battery holder and switch can provide any voltage from 1.5 to 6 volts.



The power supply at work.

Getting started

Using a can opener, take the tops and bottoms out of the jam tins. Cut along the seam in the tins and then cut off the ridges around the top and bottom. You should now be able to flatten out the cans into pieces of tinplate.

Now, mark out the four patterns on the tinplate, cut out and then fold as shown in the diagrams.

You will need one each of parts A and B, and two each of parts C and D.

Be careful when working with metal like this as it is very sharp and can give you a nasty cut. You may want to remove the sharp edges with a fine file or emery paper.

Making the spring

Take the paper clip and straighten it out. Wind it into a circle about 20mm in diameter and spiral it in until you have a circle about 10mm in diameter. Pull this out about 10mm so that it makes a spring like those found in the battery compartments of radios. Solder the spring into the middle of the 17mm circle on part D1 as in the diagram.

Strip about six millimetres of insulation from one end of each of the two wires, and while your soldering iron is hot, solder one of the wires onto part D1 and the other onto part A.

Putting it all together

Wrap some insulating tape around the ends of both parts D and the thick end of part B, as in the diagrams.

Nail part A to one end of the wood using 12mm nails.

Drill a small hole in part D2 and use a small nail to hold parts D2 and B together, bending over the end of the nail to secure it. To make sure there is good contact between parts D2 and B, you can solder a piece of connecting wire with a couple of small loops in it between them. The loops allow the wire to flex in the middle rather than break off at the ends.

Push part B in between the slots of part A to allow correct positioning of part D2, position part D2 on the wood and nail it on using 12mm nails.

Now put a D cell up against part D2 and then place part D1 with its spring against the battery.

Drill a hole through D1 and the piece of wood so that the 60mm nail will hold D1 in position when placed through the hole. This position will give 1.5 volts.

More batteries

Remove the nail and slide D2 back so that two cells can be placed end to end. This gives us the 3 volt position. Place one of the parts C between the two parts D to keep the batteries in place (the C parts are simply clipped over the wood).

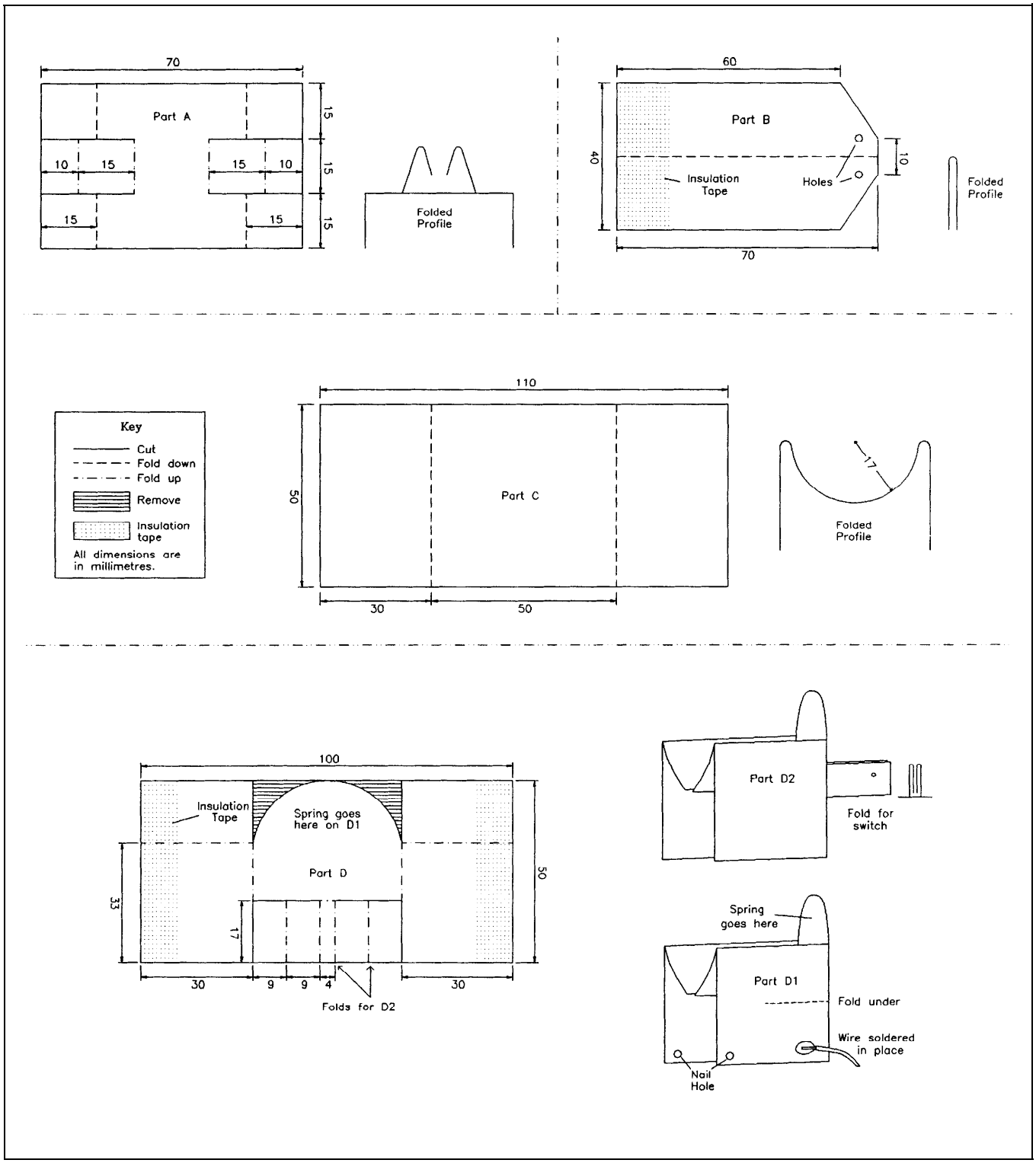
Now drill another hole through the wood so that the nail can be used to keep Dl in this position. Repeat, using three and four cells for the 4.5 and 6 volt positions, positioning the other part C in place when there is sufficient room.

You will need:

- *a piece of wood 315 x 39 x 19mm*
- *two jam tins*
- *one 6Omm nail*
- *two pieces of flexible wire approx 400mm long*
- *two crocodile clips or two plastic spring type clothes pegs*
- *four D type cells (or AA cells made into D cells -see ST#48)*
- *insulating tape*
- *some 12 mm nails*
- *a paper clip*

Tools needed:

- *a drill and bits (just larger than nails)*
- *tin snips*
- *soldering iron, flux & solder*
- *a pair of pliers*



Cutting and folding patterns for the portable power pack.

Making a crocodile clip

If you have no crocodile clips, you can strip off 40mm or so of insulation from each wire and wrap the bare wire around one half of the closing end of a spring clothes-peg to make substitute crocodile clips.

You now have a 1.5 to 6 volt power supply suitable for powering all of those low voltage gadgets.

Good luck.

BOOST YOUR SOLAR POWER!

Build a maximum power point tracker

G. William Slade

THOSE of you who are familiar with solar cells know that their daily energy output is dependent on the amount of light falling on them. There is a second factor involved in squeezing energy out of photovoltaics. The load that is connected to the array also helps determine the total daily energy supplied. To get the maximum daily energy output from your solar cell arrays, you could use a sun tracker (like the one in ST #47) to maximise the incidental light in conjunction with a device that optimises the load. Such a device is a maximum power point tracker (MPPT).

Essentially a MPPT matches the load to the solar cell array by boosting the current through the load so that the cells are operating at their maximum conversion efficiency.

This MPPT will charge a 12 volt battery or run a motor if you wish. The prototype of the basic design uses two Solarex 10 watt panels, a 12 volt 7.0Ah gel-cell battery and a shunt regulator circuit. All the parts used in the prototype came to less than $75 (excluding the solar panels and battery). If more junk-box parts are used, the cost can be reduced further.

The MPPT is based on switched mode power supply (SMPS) technology and operates at fairly high frequencies (100kHz). Since the circuit operates at high frequency, care must be taken to keep all lead lengths short and all inputs and outputs must be properly bypassed to prevent radio-frequency interference. A metal (or metal-lined) box should be used as an enclosure. The battery is protected from overcharging by using a shunt regulator. We shall discuss these circuits in simple detail, so if the terms are unfamiliar, do not despair.

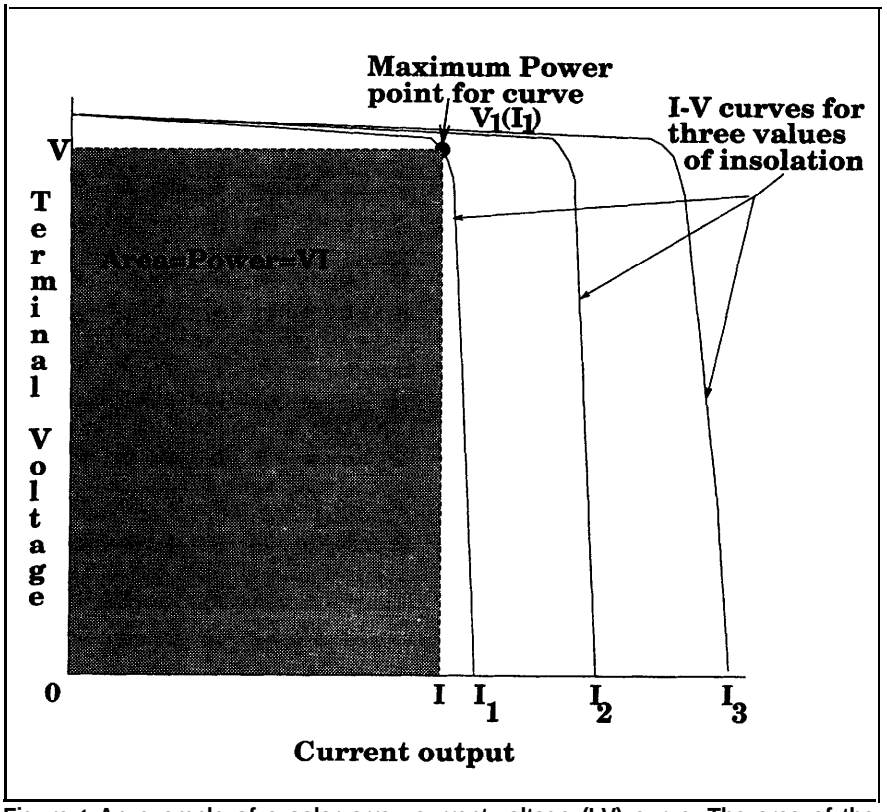


Figure 1. An example of a solar array current-voltage (I-V) curve. The area of the shaded box represents the electrical power transferred out of the array. The maximum power point typically rests on the knee of the I-V curve.

Solar cell characteristics

Unlike a mains-connected power supply, a solar cell array does not represent a constant power source. The current varies almost in proportion to the effective insolation (amount of light). The output voltage follows a non-linear relationship to the current, so the effective source resistance changes as well. Figure 1 shows a hypothetical solar cell characteristic current-voltage (I-V) curve. The shaded box under the curve has an area equal to the maximum power. As the insolation changes, we want that box under the curve to change so that it fills up as much area as possible under the I-V curve (the area = V **x** I = Power is maximum). In other words, we wish to build a circuit that will maximise the instantaneous power from the array that is delivered to the load.

For most solar cell arrays using 36 silicon cells, the maximum power point is attained when the array output volt-

age is around 16.8 volts (0.47 volts per cell) at 40°C (summer operating temp). (This could be somewhat different from array to array, depending on the materials used to make the cells. Check the specifications on your array.)

How it works

Our simple MPPT works by keeping the array output voltage at a constant value near the maximum power point voltage (Vmp), by using the 78S40 switching regulator chip (available from ***Dick Smith*** for around $6.95). Of course, as the solar insolation and array temperature change (especially the array temperature), the curve shapes in Figure 1 will change, thereby changing the location of the maximum power point with respect to the array voltage, However, by choosing an appropriate voltage point, the error shouldn't be more than a few per cent.

We will start off with a simplified discussion of the MPPT to give an idea of how the circuit works. The circuit is based on a simple switching power supply topology. Figure 2 illustrates the main workings of the MPPT. Light shines on the PV array, thereby energising the circuit. The switched-mode power supply controller senses that the array voltage is above 16.8 volts. The controller turns the transistor Q1 on and current begins to flow through the load and L1. During the time that Q1 is turned on, current is drawn out of the PV array as well as the filter capacitor Cl, thereby allowing more current to pass through the load than through the PV array.

When the SMPS controller senses that the array voltage is below 16.8 volts, Q1 is turned off. Capacitor Cl draws current from the PV array as it recharges, Additionally, since no current is flowing through Q1 anymore and inductor L1 is resisting any change in its current, diode D1 turns on and closes the loop containing the inductor and load (and filter capacitor C2). This effectively allows the energy that was stored in the inductor's magnetic field (during Q1's 'on' time) to be fed to the load during Q1's 'off' time. As the PV's voltage goes above 16.8 volts, the entire cycle repeats itself (tens of thousands of times a second).

Figure 2 shows the general circuit for the so-called 'step-down' DC to DC converter suitable for charging a six cell, 12 volt lead-acid battery from a 16.8 volt power source. If you want to charge a 24 volt or higher voltage battery, there are 'step-up' DC to DC converter topologies that can be used to boost the output voltage above the input voltage, but we shall not discuss them here. Interested readers can look in the ***1993 ARRL Radio Amateur's Handbook*** for a basic discussion of step-up (and step-down) SMPSs.

To protect the battery from overcharging, we use a so-called 'shunt regulator' to limit the battery voltage to 13.8 volts. The shunt regulator is a simple circuit that is put in parallel with the battery and that 'shunts' current away from the battery when the voltage gets too high. Figure 3 shows the basic circuit.

It is very important that Q1A (2N3055) is mounted on a heat sink large enough to dissipate the full wattage of your solar panels (in my case, 20 watts). The 2N3055 can safely dissipate up to 100 watts if the proper heat sink is used. For larger power applications, more transistors in parallel can be used. If you use a couple of 2N3055s in parallel, be sure to put a 0.05Ω five watt resistor in series with each transistor's emitter to balance the currents through each transistor.

Referring to Figure 3, the transistor Q1A does not turn on until the diodes Z1A, Z2A and D1A begin to conduct. The two zener diodes drop 6.2 volts and the plain diode nominally has 0.7 volts across it when conducting. The base-emitter junction of the 2N3055 typically has a 0.7 volt drop across it when the transistor is operating in its active region (i.e. turned on). This gives a total drop of 13.8 volts across our shunt regulator. This voltage should keep your gel-cell battery happy.

Circuit details, construction and adjustment

The complete circuit is not much more complex than the circuits in Figures 1 and 2. The LM78S40 IC is practically a power supply on a chip, so the parts count is kept down. Figure 4 shows the full schematic diagram and

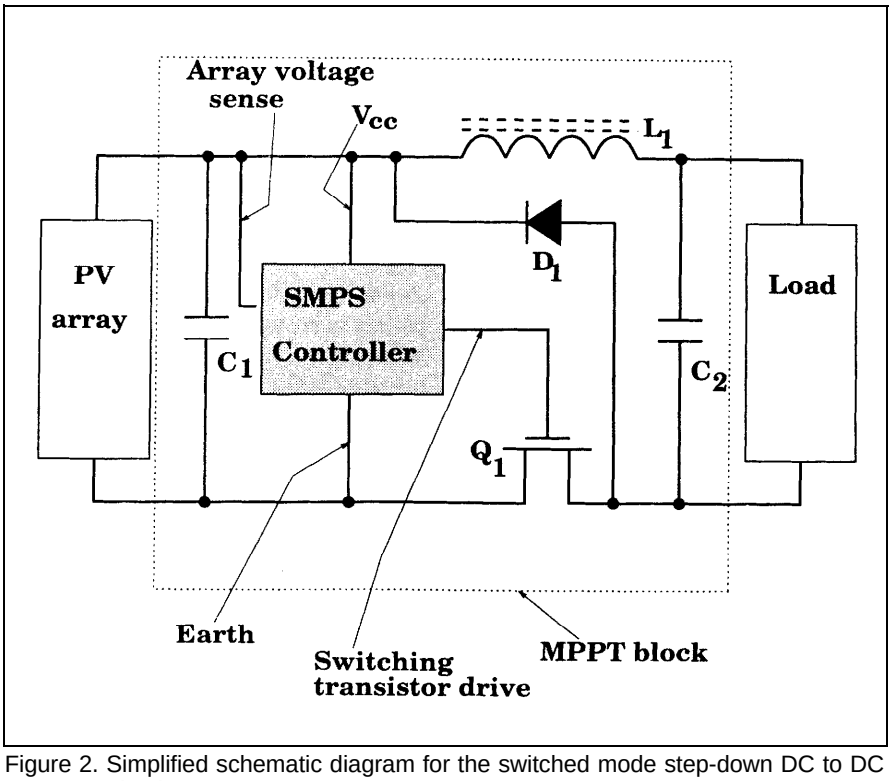


Figure 2. Simplified schematic diagram for the switched mode step-down DC to DC converter circuit.

components are listed in the box on page 63.

The prototype circuit was built on veroboard using point-to-point wiring techniques. Low current connections were made using light-duty hook-up wire. High current connections were made using 1mm^2 stranded copper wire to minimise losses and maximise safety. The inductor L1 was wound on an Amidon FT-150-A powdered iron mix J toroidal core using twelve turns of 1mm diameter enamelled magnet wire. (This gives an inductance of around 800uH.) The clamping diode D1 and the blocking diode D2 are high current Schottky barrier rectifiers to minimise losses. The switching transistor can be any N-channel enhancement mode power MOSFET that can handle the current and voltage present in the circuit.

Start the construction off by soldering in a 16 pin IC socket for the LM78S40 chip. Then arrange the resistors, capacitors, diodes and transistors such that lengths of all connections are as short as possible. Make sure that the Schottky diodes are installed properly. (See Figure 4 inset for orientation of the diode.) Use an ohmmeter or a small battery and a light globe to check the diode direction. If the clamping diode D1 is installed incorrectly, your switching transistor and D1 could be instantly destroyed on the initial power-up.

The electrolytic capacitors must be installed in the proper way too. The negative lead is indicated by a row of minus signs running down the side of the capacitor. The connections to the source and drain of the MOSFET should be made with heavy wire (be sure that you have connected the transistor properly: see the inset of Figure 4). Clip a small TO-220 heat sink to the MOSFET Q1 (if it is in a TO-220 case. If not, use the appropriate small heat sink). Since the MOSFET is either fully on or fully off, it should not dissipate much power, but it will get hot if there is no heat sink and you are running it with a 60 watt solar panel. All connections to the inductor L1 and the Schottky diodes should be made with heavy wire too. In the schematic (Figure 4), the thick lines show the connections using the thick wire. The thin lines on the schematic indicate where the thin wire is appropriate. Again, all wiring should be as neat and compact as possible, especially the high current wiring.

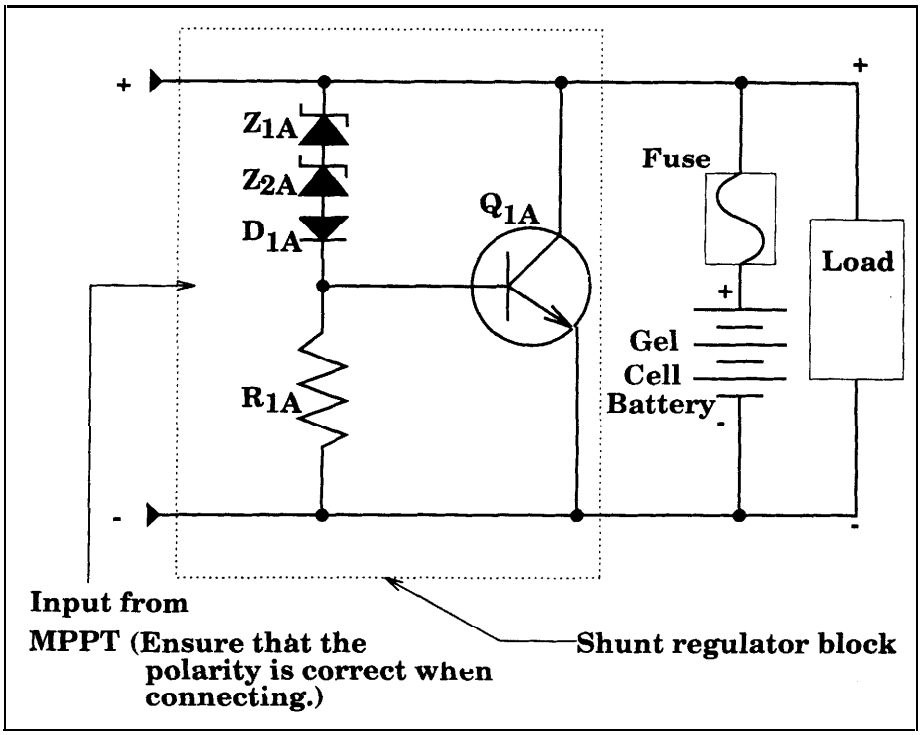


Figure 3. Complete schematic diagram of the shunt regulator. Q1A must be mounted on a heat sink. The fuse is a 5 amp 3AG size; a must for preventing fires. The components list for the shunt regulator is given in the next section.

Once all wiring is done, connect a 10Ω 10 watt resistor across the MPPT output terminals. Then, connect a current limited power supply (or a solar panel) to apply 18 to 21 volts to the input without the 78S40 IC installed. The circuit should not draw any appreciable current. Use your multimeter to measure the voltages across the MOSFET, and all the pins of the IC socket with respect to earth. Pins 13 through to 16 should have the full 18 to 21 volts between them and earth (Earth = Pin 11), while pin 9 should vary as the potentiometer R_{adj} is turned through its range. All other pins should be at earth potential. If they are not, there is something wrong. Go back and check that there are no short circuits. The MOSFET should have zero volts on the gate (G) pin, 18 to 21 volts on the drain (D) and zero volts on the source (S). If there is no voltage anywhere and a large current flowing at the input terminals, check for those pesky short circuits.

If all the voltages are correct, remove the power from the input and discharge all the electrolytic capacitors carefully. Insert U1 into its socket. Be sure to get it the right way around, otherwise it could go up in smoke when the power is applied. Once you are satisfied that everything is right, adjust R_{adj} to its midpoint and apply the power. Connect the shunt regulator (in the proper direction, of course) you should hear a soft whining noise emanating from the inductor if everything is working correctly. The transistor on the shunt regulator should begin to get warm. The voltage across the shunt regulator should be between 13.8 and 14.0 volts (depending on the current).

The next task is to look at your solar panel specifications for the voltage Vmp, which is the voltage at which the panel delivers its maximum power. This is usually listed for a certain temperature and insolation rate. As mentioned before, for a 36 cell array, this lies around 16.5 to 17.0 volts for 1000 watts per square metre solar flux at somewhere between 25° to 45°C am-

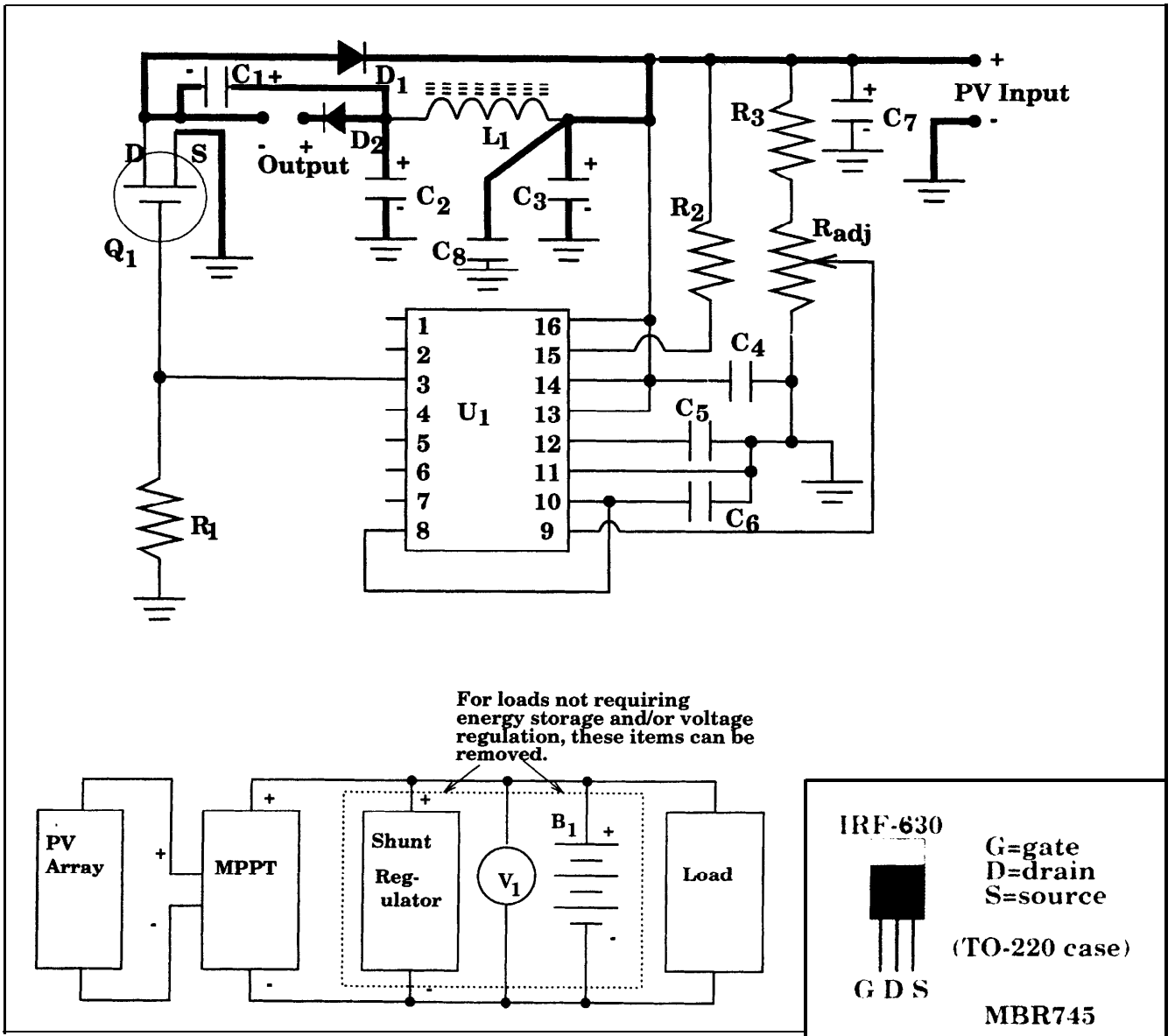


Figure 4. The full schematic diagram of MPPT. In addition, the pinouts for the IRF-630 power MOSFET and MBR-745 Schottky diode are presented in the inset area. The transistor and diode are viewed from the front. The block diagram at the bottom shows the entire system layout. The shunt regulator block represents the boxed-in portion of the circuit in figure 3.

bient temperature. As the insolation and temperature (especially the temperature) change, Vmp will change. However, the maximum power point voltage will not vary more than several per cent, so you can experiment with the adjustment to see what gives the best result. If the array is to operate over a wide temperature range, estimate Vmp a little low. This will allow the power rectangle (figure 1) to fill most of the area under the VI curve over the widest possible range of operation. Generally, with a little tweaking, you can find a happy medium.

If everything seems to be working properly, install the device in a shielded box. A stamped or die cast aluminium box is ideal, but a plastic box with metal foil or screen glued on the interior will work well too. Be sure that the shield is connected to the common earth (the '-' pin on the power input). Better radio interference protection can be had by using a prepackaged RFI filter from your friendly electronics shop on the input and output pins.

Operation

Using the completed circuit is easy. Just connect the solar panels to the input, the shunt regulator, battery and load to the output (taking care to observe the proper polarities), put the solar panels in the sun, and away you go! The prototype has operated for weeks, continuously connected to the battery, with no stuff-ups. Incidentally,

the output of the MPPT does not have to be connected to a battery. The circuit is ideal for matching motorised loads to your solar panels. If you are operating a small water pump that runs at 12 volts, connecting it to your solar panels will only give you about 70% of the maximum power. The MPPT will supply 87% of the maximum available power to the pump motor (13% of the power is lost due to inefficiency of the components - mostly in the inductor, capacitors and MOSFET).

The efficiency of the MPPT varies with the output voltage. The circuit will operate at low output voltages, but the efficiency drops off rapidly as the MPPT output voltage dips below five volts or so. Despite this, at six volts, the prototype MPPT is still operating at about 65% efficiency.

Some benefit is still gained in spite of the increased loss. Of course, this depends heavily on the quality of the components used as well as the construction practices. The components used in this project were standard cheap off-the-shelf parts. High efficiency for a wide voltage range could be gained if an expensive, high-quality switching power MOSFET were used. High quality, high current electrolytic capacitors (like the kind you find in inverters) would have also increased efficiency somewhat.

Experiment with various components and see which give the best performance. Even with a handful of 'junk-box' parts, you can build an efficient, practical device! ☼

List of components needed to build the MPPT and shunt regulator

The part designators (Q1, R1, etc) refer to the designators in Figures 3 and 4. The IRF 630 and MBR 745 are available from *Vorlac Electronics* in Huntingdale, VIC. The 78S40 can be bought from *Dick Smith Electronics*. The *Amidon* powdered iron toroid core for L1 can be had from *Stewart Electronics* in Huntingdale, VIC. All other parts are readily available at your favourite electronics store.

Q1 ..... IRF-630 N-Ch Power MOSFET
Q1A ..... 2N3055 NPN Power transistor

D1 & D2 ..... MBR-745 Schottky rectifier
D1A ..... 1N4004 silicon rectifier

Z1A & Z2A ..... 6.2 volt 1 watt Zener diode

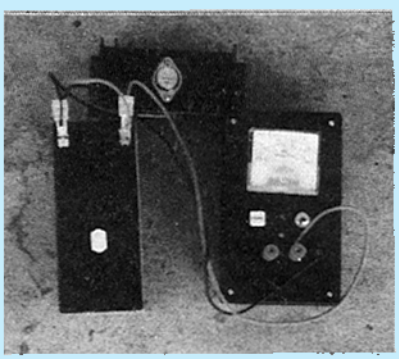
R1 ..... 1000 ohm ¼ watt resistor
R2 ..... 180 ohm ¼ watt resistor
R3 ..... 27K ohm ¼ watt resistor
R adj ..... 2000 ohm ¼ watt variable resistor
R1A ..... 1500 ohm ¼ watt resistor

C1 ..... 1000 µF electrolytic capacitor (35WVDC)
C2 & C3 ..... 1 µF tantalum electrolytic capacitor (35WVDC)
C4 ..... 0.1 µF polyester capacitor (50WVDC)
C5 ..... 0.001 µF polystyrene capacitor (50WVDC)
C6 & C8 ..... 0.1µF polyester capacitor (50WVDC)
C7 ..... 4700 µF electrolytic capacitor (35WVDC)

U1 ..... 78S40 switching regulator IC

Extra parts

12 volt 7.0Ah gel cell battery
heat sink for Q1
another heat sink for Q1A
panel voltmeter
PV array
box enclosure
assorted terminals and binding posts
knob for R_{adj}
wire
fuse holder
small prototype board
10 ohm 10 watt wirewound resistor



INVERTER BUYING GUIDE

This is an update of the Inverter Buying Guide which was published in Soft Technology #37.

Alan Hutchinson

IN Australia, electrical energy is supplied by the power utilities in an alternating current (AC) form at 240 volts. The voltage polarity (and hence the current flow) reverses 50 times per second (50Hz). This standardisation has allowed mass production of electrical appliances, and there are few appliances available that operate on different voltages.

This is unfortunate for users of alternative energy sources such as solar or wind. The energy from these sources is usually available only in a low-voltage direct current (DC) form (typically at 12, 24 or 48 volt). It is normally stored in batteries to provide a continuously available power source.

Thanks to the automotive industry, a limited range of 12 and 24 volt appliances is available. However, many devices are not available - have you ever seen a 12 volt microwave oven? - or you may have a household full of conventional appliances that you don't want to replace. These difficulties can be overcome by using an inverter.

What is an inverter?

An inverter is a device that converts energy from a DC source into an AC form, similar to that supplied by the electricity utilities. This allows you to run conventional 240 volt AC appliances from a low-voltage source, such as a windgenerator, photovoltaic panels or batteries. It works by using fast electronic switches to effectively reverse the connections to the battery 50 times a second and then feeds this through a transformer to change the voltage to 240 volts.

When do you need an inverter?

The most common form of energy storage is a battery. This is a low-voltage DC source. Bearing this in mind, there are two main reasons for choosing to use an inverter:

1. You want to use conventional 240 volt appliances.
2. It is a better way to move large amounts of energy around. To deliver the same power as a 240 volt source, a low-voltage source needs to supply a much higher current. Because of the high current, the wiring for low voltage needs to be much thicker, and hence rather more expensive. Reliable high-current switches are also expensive and more difficult to operate. For large systems, it is preferable to use conventional 240 volt wiring and run the whole system from a large inverter.

Choosing an inverter

There are many considerations involved in choosing an inverter, but the main two things you need to determine are the power output required and the input voltage.

Power output

The power level that may be drawn from conventional mains power supply is only limited by the wiring capacity and the fuses. However, an inverter can only supply up to a fixed level of power. If you attempt to draw more than this, the inverter is designed to turn off to protect itself.

The maximum power rating of the inverter must be higher than the total power requirements of all the appliances you wish to use at any one time. So the first thing you need to do is to determine the appliance (or appliance combination) which will draw the most power. The inverter you choose must be capable of supplying at least this amount of power.

Inverter power ratings range from small 20 watt inverters intended for single fluorescent tubes up to 15000 watt dreadnoughts.

Input voltage

An inverter is designed to operate only at a specified input voltage and cannot be used at a different voltage. The commonly available voltages are 12, 24, 32, 48 and 110 volt.

Twelve volt inverters are the most common choice for low power requirements. As power requirements increase, it is better to choose a higher input voltage to keep the input current down to practical levels.

The largest available 12 volt inverter is 2800 watts, and even this is considered undesirable by many in the field as it requires average currents of 280 amps, which not many battery banks will support for a sustained period. The largest 12 volt sizes from other manufacturers are all around 1200 watts continuous.

As a rule of thumb, for low power an input voltage of 12 volts is a good choice because it reduces the number of cells required in the battery bank. If your power needs exceed 1000 watts, consider setting up at 24 volts. Above 3000 watts, think about 48 volts.

CORRECTION ST#48
Regulator Buying Guide

Prices given for *Plasmatronics* regulators were wholesale, not retail as implied by our table.

Inverter details

Power output

Inverter power output capability can be defined in a variety of ways. The *continuous* power rating is the usual basis of comparison. This rating depends on the ambient temperature and can be reduced by up to half for operation at 45°C. You should therefore keep the inverter cool and well ventilated.

Some manufacturers make provision for additional inverters to be coupled with the original inverter to increase the total available power output at a later stage.

Most inverters can supply considerably more power than their continuous rating for a short period. This *surge* capacity is useful for appliances which need a much higher starting current than their usual operating current. A refrigerator consuming an average power of 200 watts may well require 1000 watts for a few seconds to start it.

If large starting loads are a problem, inverters that can sustain surges of four or five times larger than their continuous rating are available.

The surge ratings in the table should be treated with a little caution. There is no standard period over which the surge rating is to be valid, although five seconds is typical. If surge capacity is critical in your application, you should check the actual specifications or talk to the manufacturer.

Overload handling

There are differences in the way various inverters handle overloads. All inverters have thermal overload protection which will protect against sustained moderate overload.

When confronted with a large overload, such as a stalled motor, some inverters will simply turn off. Others limit the current output, which is preferable, because the inverter will still deliver some power into the load. This may be enough to get it going.

Reactive power handling

Inverters vary in terms of their ability to handle loads that are not purely resistive. These 'reactive' loads do not use all the energy supplied to them each cycle. They store some (all in the case of pure inductors or capacitors) of this energy and return it to the source later in the cycle. This returned power has to flow back through the inverter. The inverter can either let it flow back to the battery or dissipate it within itself.

Some inverters, such as the Power Conversion Devices range, dissipate the power internally. This limits the power factor range and makes them less suitable for running motors.

One consequence of this returned power is distortion of the voltage waveform around the zero crossing. To control this, many inverters use 'dead space clamping' to hold the voltage to zero during this part of the cycle.

Most of the larger inverter designs use various forms of 'reactive current control', which allow them to handle loads of any power factor. If you are running motors or complex loads, such as a large bank of fluorescent lights, you would do well to consider an inverter that can handle any power factor.

Efficiency

Inverters waste some energy in the process of conversion. There are two components to this loss. The idle or no-load loss is the energy wasted when the inverter is not supplying any power to a load. The other part of the loss is roughly proportional to the power being drawn. Efficiencies range from 95% (that is, five per cent lost) at best, down to about 50% to 60% at worst. There are significant differences between inverters in this area, and you need to consider what power you will be using the inverter at most, and to make comparisons of efficiency in this range.

Basic electrical terms

Voltage
Voltage is the strength of the electromotive force which drives an electric current to flow around a circuit. It is measured in volts (V). An analogy is the pressure of water in a pipe, or the fall of water on a river.

Current
The rate at which electrical charges are being moved along a wire or other conductor is called the current. It is measured in amperes (or amps for short). An analogy is the rate of water flow in a pipe or river.

Power
Power is the rate at which energy is transferred or used up. It is measured in watts (W). In AC systems, the term volt-amps (VA) is often used to describe the power output instead of watts. This is because, technically, 'watts' is reserved for the 'real power' component of the total power. The power used in an AC circuit depends on the power factor. For resistive loads (eg. an incandescent light globe), the power factor is one and the power drawn in watt is equal to the VA rating. For loads which have some inductive or capacitive component, the power factor is less than one and the real power drawn in watts is less than the VA rating.

Power factor
The power factor is the ratio between the real power in watts, dissipated in an electric circuit, to the volt-amps applied to the circuit.
A power factor of one means that the voltage and current are completely in phase and all power delivered by the source is used by the load.
A power factor of zero means that the voltage and current are completely out of phase and no real power is actually used by the load. (A pure inductor or capacitor doesn't use any power)

Load
Any device or appliance that is connected to the inverter and draws power is known as the load.

Reactive load
Any load that has a capacitor or inductor in it is a reactive load.

Autostart

To avoid wasting a lot of energy while no appliances are turned on, most inverters now automatically switch to a standby mode which doesn't consume much energy at all. As soon as the autostart circuit detects that an appliance has been switched on, it switches the inverter back to normal mode and starts supplying power.

There are a number of autostart techniques, some better than others. Older inverters used a low DC voltage to test for current flow, which worked well on resistive loads, but was a problem with some other loads, such as fluorescents. Most manufacturers have switched to using systems which work better.

For autostart to work, a minimum load - usually about 10 watts - is required.

Waveshape

The voltage supplied by the electricity utilities varies smoothly with time in the form of a sine wave. The cheapest way to make an inverter is to switch the DC voltage back and forward. This produces a square wave output voltage. This is fine for incandescent lights or heaters, but will cause motors and ballasts to run hotter than normal. By leaving a gap between the positive and negative segments, a modified square wave -which is a better approximation to a sine wave - can be created.

Some appliances will not operate correctly on square wave inverters.

One thing to be careful of regarding modified square wave inverters is that they vary the on/off ratio as a means of regulating the output voltage. This means that when the battery voltage is high, the output dead space can be large enough to cause problems for some switching power supplies, such as those in personal computers. In this case a sine wave inverter would be better. Also the peak voltage of a modified square wave inverter is lower than that of a sine wave inverter. This may cause problems with devices, such as some fluorescent lamps, which rely on the peak voltage for starting.

Many manufacturers now produce true sine wave inverters. These produce quite an accurate sine wave either by using resonant circuits, or filtered pulse width modulation (PWM) schemes. The *Rainbowsine,* for example, uses resonant circuits and the *Siemens Sunsine* uses filtered PWM. These inverters produce the best approximation to the mains supply, but at roughly double the price of a similar size modified square wave type.

The points in favor of sine wave inverters are:

- correct peak voltage
- higher efficiency
- fewer equipment compatibility problems
- lower distortion, noise & RFI.

The only point against them is their cost!

DC isolation

In most inverters, the output is electrically isolated from the input. This can be a - literally - lifesaving feature!

Noise

Some inverters, such as the *Sunsine* for example, make significant amounts of audible noise.

Square wave inverters can couple audio and radio frequency electrical noise into appliances - such as bars on a television screen or hum in a stereo system - which can be annoying.

Fluoro inverters

Most large inverters are not very efficient when only delivering 20 to 30 watts of power. If you are only running low power fluorescent lights for substantial periods of time, it may be better to use a separate small inverter for each light. One-tube fluorescent light inverters are available from *Choice Electric* from about $20 for the cheap imports, up to $60 for more substantial units.

Protection

Inverters are usually protected from a variety of errors that users can make.

Reverse polarity

Most inverters use a contactor relay both as an on/off switch and as protection against connecting the battery the wrong way around. This is preferable to using a diode, which wastes a lot of power.

Battery undervoltage

Inverters usually turn off if the battery voltage falls too low. This is to protect the battery from damage due to over discharge.

Battery overvoltage

To protect the inverter (and the load) there is usually an overvoltage cutout. The voltage at which this occurs is something you should note with care. There is an increasingly common problem occurring because battery manufacturers are wanting higher boost voltages when charging their batteries, and some inverter cutoff voltages are below these. This means that these inverters will turn off at some time during the daily charge, which is very annoying if you are using a computer at the time!

Output overload/short circuit

If the inverter is overloaded, it will get too hot and the over temperature protection will turn it off.

Low output voltage

Some inverters will switch off if they are unable to keep the output voltage high enough. This will protect some appliances that can be damaged by under voltage or 'brown out'.

When a fault occurs, the inverter can reset itself automatically if the fault condition ceases, or it can be reset manually. The automatic reset is useful if it saves you frequent walks to the inverter shed, but the manual reset is safer and makes fault finding easier because you can see which fault caused it to turn off. Some inverters have remote fault indicators.

Physical design

Physical design is important to prevent dust, condensation and bugs penetrating the case. The finish of the case material should be considered because a battery shed is a corrosive environment.

An inverter that uses a 50Hz transformer will of necessity be rather heavy. Inverters that use higher frequency transformers can be a lot lighter for the same power rating.

Cooling may be done by natural convection or enhanced by fan forcing (at the expense of having moving parts).

The battery connection is either a pair of bolts on the back of the case or a pair of short heavy-duty flying leads (some with alligator clips on them).

Dale Butler (who designed the Sun***sine*** inverter) used to claim that by liberal use of zener diodes across FET gates, etc, that he could give his inverters a sporting chance of surviving a lightning strike on the solar panels. I'm more inclined to think that some judiciously placed lightning rods and lightning arresters may be a surer option. If you are in a bad lightning area you will need to give some thought to this.

Battery charge option

Some inverters will work backwards as battery chargers. This adds another level of complexity which may not be worthwhile, as many generators have battery chargers built into them.

Warranty

Warranties are usually in the one-to-two-year range.

Installation

The connection between the battery and the inverter should be as short as possible and use heavy wire or copper braid. The connections should be done up tightly (or else they will get hot) and covered with a grease layer as corrosion protection.

Due to the proximity of the inverter to the battery bank, spark precautions are needed. The initial connection should be done with the inverter turned off, or the fuse taken out, so that there is no spark when the lead is first connected to the battery. If the inverter case is open, there is a further possibility of sparks from the relay contacts.

To reduce losses in the front panel power outlet sockets, some of the larger inverters provide a junction box for a hard-wired connection.

If a 240 volt generator is to be used as an alternative energy source, a double pole change over switch should be used to switch between the inverter and the generator.

Safety

Be careful - 240 volts AC is enough to kill you. Wiring for 240 volts should be done by a suitably competent person. According to one school of thought, it is generally safer to have the inverter output floating with respect to ground than it is to earth the neutral. This is because shorts or accidental contact between one side of the circuit and ground are far more likely than shorts between the two sides of the circuit. If the inverter output is floating, then shorts to ground will not be dangerous.

The other school of thought, now being enshrined in the accreditation standards, wants to earth everything in sight so that if there is a fault it blows the fuse. This approach adds roughly $400 to the price of an installation and is considered to be of dubious benefit by some. Ask your 'accredited installer' why it's a good idea.

Inverter problems

Fluorescent lights

Some inverters will not autostart fluorescent lights on their own. Sometimes it is necessary to turn on an incandescent lamp to get the inverter going. Once the inverter is running, the lamp can then be turned off. Most, but not all, of the inverters mentioned in our table claim to start with fluorescent lamps.

Flicker and buzzing can be a problem when square wave inverters are used. Fluorescent lamps are noticeably more noisy on square wave than sine wave. Compact fluoros with electronic ballasts may not work properly.

Motors

The start-up power requirement for larger induction motors will often trip out the inverter overload. If you want to start motors, choose an inverter with a high surge power rating and with the ability to handle any power factor.

Problem loads

Half-cycle loads

Some hair dryers or heating elements use a diode for their half-power setting, which results in a large imbalance between half cycles and consequently, transformer saturation. Use them only on high.

Waveshape intolerance

Some electronic controllers for fans, some electronic timers without trans-

Inverter manufacturers and suppliers

Advanced Energy Systems Pty Ltd (Sinemax)
PO Box 375, Como WA 6152
ph:(09)470 4633

Altronics Distributors Pty Ltd
174 Roe St, Perth WA
ph:(09)328 2199

Australian Solar Distributors
5/83 Hector St, Osborne Park WA 6017
ph:(09)244 2686

BP Solar (Trace)
PO Box 519, Brookvale NSW 2100
ph:(02)938 5111

Butler Solar
PO Box 329, Castlemaine VIC 3450
(054)74 2301

Choice Electric Company
3 Prospect St, Bowen Hills QLD
ph:(07)252 4909

CSA Energy Technique
PO Box 2207, Shepparton VIC 3630
ph:(058)31 1518

Jaycar Electronics
6 Leeds St, Rhodes NSW 2138
ph:(02)743 5222

Latronic Sunpower Pty Ltd
PO Box 73, Moffat Beach QLD 4551
ph:(074)91 6988

Power Conversion Devices
2/6 London Dve, Bayswater VIC 3153
ph:(03)761 1252

Rainbow Power Company
PO Box 240, Nimbin NSW2480
ph:(066)89 1430

Selectronics
25 Holloway Dve,
Bayswater VIC 3153
ph:(03)762 4822

Sharpe & Jeffcott
5 McLaughlin Ave,
Sandringham VIC 3191
ph:(03)598 5775

Siemens
544 Church St, Richmond VIC 3121
ph:(03)420 7595

Wind Energy Australia (WEA)
20 Homestead Dve, Bangholme VIC 3175
ph:(03)773 2935

formers, and some VCRs cannot cope with a modified square wave power source.

Mains-powered halogen lamps may flicker because they can cool significantly during the waveform dead space.

Computers

Most computer switching power supplies do not have a lot of energy storage capacitance. If an appliance with a large starting surge is turned on while the computer is running, the computer power supply may drop out, causing the computer to crash. You might consider a separate small inverter of about 300 watts just for the computer. The printer can be connected to the main inverter. ☼

ABOUT THE TABLE

The table compares the characteristics of most of the inverters available in Australia today. Listings are arranged in order of increasing continuous output power, to allow you to compare the inverter options at the power capacity you require.

KEY

Waveshape
M = modified square wave
S = sine wave
SQ = square wave

Indicators
L = low battery voltage
H = high battery voltage
O = overload
S = standby
T = over temperature

Protection
R = reverse connection
O = overload
T = over temperature
V = over or under voltage
U = under voltage only
H = over voltage only

THD = total harmonic distortion

rrp*
Recommended retail price (does not include 21% sales tax). Inverters are sales tax exempt if used for solar electric systems.

These prices include sales tax.

Soft Technology

Inverter buying guide

entries are in order of increasing output

Manufacturer/ Supplier	Model	Input Voltage Nom V	Input Voltage Range V	Power output Cont W	Power output Int W	Power output Surge W	Efficiency at % of full load 10	Efficiency at % of full load 100	Power factor range	Idle power used W	Standby power W	Wave shape	Auto start	Min. auto start load W	Start with fluoro only	Output isolation	Indicators	Output current limit	Protection	Size W x H x D cm	Weight kg	Comments	rrp* $
Jaycar	MI5035	12	—	100	—	—	82	86	—	—	—	M	no	—	—	—	Power	no	RO	14/8/16	2.7	Reliable and robust	90 #
Wind Energy Australia	1201	12	10.8-16	100	—	150	—	80	—	7	—	M	no	—	—	—	LHO	no	ROTV	166/17/11	4		299
Rainbow Power Co	PROwatt125i	12	10-15	125	200	400	75	90	—	2	—	M	no	—	—	—	—	—	ROTU	15/4/12	0.42		185
Australian Solar Distributors	Eclipse 500	12	10-15	200	—	500	85	90	all	10	0.048	M	yes	10	yes	yes	LHOS T	yes	OTV	14/10/17	4.2	Impulse start, reactive card	349
	Eclipse 600	24	20-30	200	—	600																	369
Jaycar	MI5038	12	10-16	200	—	400	—	90	—	1.8	—	M	no	—	—	—	Power	no	UO	10/4/14	0.75	compact size	160 #
Selectronic Invert-a-power	SPI200-12SS	12	10-16	200	260	800	80	80	0.3-1	4.8	0.24	M	yes	2	yes	yes	LHOS T	yes	ROVT	19/14/23	4.2	12 month warranty Australian made	415
	SPI200-24SS	24	20-32	200	280	800	75	85		9.6	0.48												
Altronics	K6755	12	—	300	—	—	—	—	—	—	0.012	—	yes	40	no	—	LT	—	RO	25/8/22	4.4		
Jaycar	MI5040	12	—	300	—	—	—	75	—	14.4	—	M	no	—	—	—	Power Volt	no	O	20/13/23	5.3		200
	MI5030	12	10-14.5	300	—	450	70	82	+/-0.75	0.8	—	S	yes	10	—	—	LOT	yes	ROTV	26/11/23	3		699
Power Conversion Devices	250i	12	10-16	300	—	500	70	83	+/-0.6	10	—	S	no	—	yes	yes	LHO	yes	ROTV	26/10/23	2.5		565
		24	20-32																				
Rainbow Power Company	Rainbow Sine	12	10-18	300	400	400	67	75	all	10	0.78	S	yes	4	yes	yes	LHTS	—	ROTV	30/15/23	12.2	24v available, very robust	749

Soft Technology

Inverter buying guide

entries are in order of increasing output

Manufacturer/ Supplier	Model	Input Voltage Nom V	Input Voltage Range V	Power output Cont W	Power output Int W	Power output Surge W	Efficiency at % of full load 10	Efficiency at % of full load 100	Power factor range	Idle power used W	Standby power W	Wave shape	Auto start	Min. auto start load W	Start with fluoro only	Output isolation	Indicators	Output current limit	Protection	Size W x H x D cm	Weight kg	Comments	rrp* $
Wind Energy Australia	1203	12	10.8-16	300	—	450	—	80	—	12	—	M	no	—	—	—	LHO	no	ROTV	22/18/13	6	Remote start	449
	3203	32	28.5-43					90															500
Australian Solar Distributors	Power Point	12	10-15	350	—	1000	85	90	all	10	0.048	M	yes	15	no	yes	HLO T	yes	OTV	21/12/26	7.5	Reactive card	499
Latronics	350VA	12	10.8-15.6	350	600	1050	85	92	all	—	0.3	M	yes	adj.	yes	yes	LHOS	yes	ROTV	25/12/21	6	100% Australian made	599
		24	20.5-32								0.5												
		48	41.5-64								0.7												
Wind Energy Australia	1204	12	10.8-16	400	—	600	—	80	—	18	—	M	yes	25	—	—	LHOS	no	ROTV	24/27/15	8		759
	2404	24	21.5-32	450		650		87		17										24/25/15			
Australian Solar Distributors	Eclipse 1200	24	20-30	450	—	1200	85	90	all	10	0.048	M	yes	15	no	yes	HLOT	yes	OTV	21/12/26	7.5	Reactive card	549
Advanced Energy Systems	12/500/IC	12	10-18	500	—	1000	85	89	all	9	0.56	S	yes	9	yes	yes	LHOT	yes	ROTV	25/22/33	22	Battery charger also	2450
Jaycar	MI5050	12	—	500	—	—	—	85	—	9	—	M	no	—	—	—	amps /volts	no	O	29/16/24	10		420 #
Wind Energy Australia	3205	32	28.5-43	500	—	750	—	90	—	16	—	M	yes	25	—	—	LHOS	no	ROTV	24/25/15	7		795
Latronics	550VA	12	10.5-16	550	800	1650	85	92	all	—	0.3	M	yes	adj.	yes	yes	LHOS	yes	ROTV	30/13/26	8	100% Australian made	899
		24	20.5-32								0.5												
		48	41.5-64								0.7												
Altronics	K6774	12	—	600	—	1200	—	90	—	8.4	0.012	SQ	yes	—	—	—	—	—	ROTV	—	—		699
	K6775	24								16.8	0.024												
Australian Solar Distributors	QBC 6-12 Bravo	12	10-15	600	—	960	—	—	—	5	—	M	no	—	—	yes	LOTS C	yes	OTV	26/15/26	9	Inverter/charger (20A), UPS	1099
	QBC 6-24 Bravo	24	20-30																			Inverter/charger (10A), UPS	1299
Latronics	s/Sun 600	12	10-17	600	750	3000	90	92	all	—	0.3	M	yes	adj	yes	yes	LHOT S	yes	ROTV	30/26/13	9		880
		24	20-34		950						0.5												
Selectronics Invert-a-power	SPI 600i-12SS	12	10-16	600	750	2300	87	80	0.3-1	10	0.36	M	yes	2	yes	yes	LHOT S	yes	ROTV	24/18/29	8.5	Low RFI, Australian made, 12 mth warr.	890
	SPI 600i-24SS	24	20-32		900	3000	91	85			0.72												
Australian Solar Distributors	Eclipse 2000	12	10-15	650	—	2000	85	90	all	10	0.048	M	yes	15	no	yes	HLO T	yes	OTV	31/15/32	14	2 yr warranty, reactive card	895
		24	20-30																				965
Latronics	700VA	12	10.5-16	700	—	2100	85	92	all	—	0.3	M	yes	adj.	yes	yes	LHOS	yes	ROTV	30/13/26	12	100% Australian made	1099
		24	20.5-32								0.5												
		48	41.5-64								0.7												
Advanced Energy Systems	24/850/IC	24	21-36	850	—	1700	85	89	all	19	1.18	S	yes	9	yes	yes	LHOT	yes	ROTV	25/23/33	25	Battery charger also	2950
	24/1000/IC			1000	—	2000				21	1.31									55/57/28	35	Battery charger also	3475
Australian Solar Distributors	Brutus TB12-12	12	10-15	1000	—	5400	87	92	all	—	1	S	yes	—	yes	yes	LOTS	yes	OTV	38/20/38	19	<3%THD, massive surge	3499

Manufacturer/ Supplier	Model	Input Voltage		Power output			Efficiency at % of full load		Power factor range	Idle power used	Standby power	Wave shape	Auto start	Min. auto start load	Start with fluoro only	Output isolation	Indicators	Output current limit	Protection	Size W x H x D	Weight	Comments	rrp*
		Nom	Range	Cont	Int	Surge	10	100															
		V		W	W	W				W	W			W						cm	kg		$
Australian Solar Distributors	QBC 10-12 Bravo	12	10-15	1000	—	1440	—	—	—	5	—	M	no	—	—	yes	LOTSC	yes	OTV	26/15/26	11	Inverter/charger (30A), UPS	1099
	QBC 10-24 Bravo	24	20-30							6												Inverter/charger (15A), UPS	1299
Jaycar	MI5060	24	—	1000	—	—	—	85	—	18	—	M	no	—	—	—	amps /volt	no	O	29/16/24	12.2		649 #
Wind Energy Australia	1210	12	10.8-16	1000	—	1500	—	80	—	24	—	M	yes	25	—	—	LHOS	no	ROTV	35/30/19	15		1425
	2410	24	21.5-32					87		22											14		1440
Latronics	1050VA	12	10.5-16	1050	—	3100	85	92	all	—	0.3	M	yes	adj.	yes	yes	LHOS	yes	ROTV	30/13/26	14	100% Australian made	1499
		24	20.5-32								0.5												
		48	41.5-64								0.7												
CSA	TC1000	12	10-16	1100	—	2800	89	89	all	8	0.8	S	yes	adj.	yes	yes	LHOS	yes	ROTV	21/17/36	13	<1.2% THD, RAPAS	2070
	TC1000c										—			—			LHO			21/17/38	14	<1.2% THD charger, RAPAS	2380
Altronics	K6792	12	—	1200	—	2400	—	88	—	4.8	<1	SQ	yes	—	—	—	—	—	ROV	34/12/29	12.3		999
	K6793	24								9.6													
CSA	TC1000	24	20-32	1200	—	3200	90	89	all	8	0.8	S	yes	adj.	yes	yes	LHOS	yes	ROTV	21/17/36	13	<1.2% THD	1980
	TC1000c										—			—			LHO				14	Charger also	2280
BP Solar	2024A	24	21.6-30.7	1200	—	2000	65	90	all	—	0.21	M	yes	2	no	yes	—	no	RTV	16/25/32	17		2497
Selectronics Invert-a-power	SPI 1200i-12SS	12	10-15.5	1200	1450	4600	86	88	0.3-1	17	.72	M	yes	4	yes	yes	LHOS	yes	ROTV	32/21/31	19	RAPAS $1755 2yr. warranty, Aust. made	1495
Australian Solar Distributors	Eclipse 3000	12	10-15	1250	—	3000	85	90	all	19	0.048	M	yes	15	no	yes	HLOT	yes	OTV	31/15/32	18	2 yr warranty, reactive card	1199
	Eclipse 3000 R	12	10-15	1250	—	3000	85	90	all	19	0.048	M	yes	15	no	yes	HLOT	yes	OTV	31/15/32	18	2 yr warranty, reactive card, remote available	1322
	Eclipse 3000 S	12	10-15	1250	—	3000	85	90	all	19	0.048	M	yes	15	no	yes	HLOT	yes	OTV	31/15/32	18	2 yr warranty, higher reactive load capacity	1349
	Eclipse 3000 SR	12	10-15	1250	—	3000	85	90	all	19	0.048	M	yes	15	no	yes	HLOT	yes	OTV	31/15/32	18	2 yr wty, higher reactive load capty, remote available	1382
	Eclipse 4000	24	20-30	1250	—	4000	85	90	all	25	0.048	M	yes	15	no	yes	HLOT	yes	OTV	31/15/32	18	2 yr warranty, Reactive card	1299
	Eclipse 4000 R	24	20-30	1250	—	4000	85	90	all	25	0.048	M	yes	15	no	yes	HLOT	yes	OTV	31/15/32	18	2 yr warranty, remote available	1331
Latronics	1250VA	12	10.5-16	1250	—	3800	85	90	all	—	0.3	M	yes	adj.	yes	yes	LHOS	yes	ROTV	30/13/32	17	100% Australian made	1899
		24	20.5-32					92			0.5												
BP Solar	2012	12	—	1300	—	—	65	—	all	—	0.13	M	yes	1	no	yes	—	no	RTV	16/25/32	17		2004

Soft Technology

Inverter buying guide

entries are in order of increasing output

Manufacturer/ Supplier	Model	Input Voltage Nom	Input Voltage Range	Power output Cont	Power output Int	Power output Surge	Efficiency at % of full load 10	Efficiency at % of full load 100	Power factor range	Idle power used	Standby power	Wave shape	Auto start	Min. auto start load	Start with fluoro only	Output isolation	Indicators	Output current limit	Protection	Size W x H x D	Weight	Comments	rrp
		V		W	W	W				W	W			W						cm	kg		$
Advanced Energy Systems	24/1500/IC	24	21-36	1500	—	3000	85	89	all	28	1.75	S	yes	9	yes	yes	LHOT	yes	ROTV	55/57/28	40	Battery charger also, RAPAS	3575
	48/1500/IC	48	42-72							21	1.31											Battery charger also	
Selectronics Invert-a-power	1500i-24SS	24	20-31	1500	2000	5600	83	88	0.3-1	26	0.7	M	yes	4	yes	yes	LHOS	yes	ROTV	32/21/31	21	RAPAS $1910	1650
	1500-48SS	48	40-62							—	2.9											RAPAS $2040	1780
Siemens	1.5INV/24	24	20-32	1500	1750	3000	79	86	all	2.5	0.6	S	yes	15	yes	yes	LHOST	yes	ROTV	44/37/24	25		2900
	1.5INV/24IC							88		37	6			10							28	1500W Charger booster, LCD, RAPAS	4200
Latronics	1500VA	24	21-31	1800	—	6000	88	93	all	—	0.5	M	yes	5	yes	yes	LHOS	yes	ROTV	35/18/40	19	RAPAS, 100% Australian made	2299
		48	42-62																				
Wind Energy Australia	1218	12	10.8-16	1800	—	2700	—	80	—	30	—	M	yes	25	—	—	LHOS	no	ROTV	42/35/26	20		1999
	2418	24	21.5-32	1800	—	2700	—	87	—	29	—	M	yes	25	—	—	LHOS	no	ROTV	36/35/20	20		2125
	3218	32	28.5-43	1800	—	2700	—	90	—	32	—	M	yes	25	—	—	LHOS	no	ROTV	36/35/20	20	Also a 1000W unit	2235
	4818	48	43-64	1800	—	2700	—	92	—	29	—	M	yes	25	—	—	LHOS	no	ROTV	36/35/20	20		2235
Advanced Energy Systems	24/2000/IC	24	21-36	2000	—	4000	85	89	all	30	1.87	S	yes	9	yes	yes	LHOT	yes	ROTV	58/68/30	45	Battery charger also	4550
	48/2000/IC	48	42-72							28	1.75												
Australian Solar Distributors	Eclipse 6000	12	10-15	2000	—	6000	85	90	all	38	0.048	M	yes	15	no	yes	HLOT	yes	OTV	39/20/55	35	2 yr warranty, Reactive card	2650
	Brutus TB12-24	12	10-15	2000	—	10800	87	92	all	—	1	S	yes	—	yes	yes	LOTS	yes	OTV	38/20/38	30	<3%THD, Massive surge	4399
Latronics	2000VA	24	21-31	2000	—	7000	88	93	all	—	0.5	M	yes	5	yes	yes	LHOS	yes	ROTV	35/18/40	19	100% Australian made	2699
		48	42-62																				
Selectronics	SA30	24	20-34	2000	3000	6000	92	83	all	14	1.4	S	yes	3-20 adj.	yes	yes	LHOST	yes	ROTV	53/17/37	25	LCD display, <4% THD, RAPAS	2990
Siemens	2/INV/24	24	20-32	2000	2600	4000	87	83	all	35	1.3	S	yes	15	yes	yes	LHOTS	yes	ROTV	45/32/37	35	RAPAS $4672	4300
	2/INV/48	48	40-63	2000	3500	5000	87	89	all	35	1.4	S	yes	15	yes	yes	LHOTS	yes	ROTV	45/32/37	35	RAPAS $4672	4300
	2/INV/48IC	48	40-63	2000	2400	4500	87	89	all	37	6	S	yes	10	yes	yes	LHOTS	yes	ROTV	44/24/37	28	2000W charger booster, LCD, RAPAS	4500
CSA	TC1800	24	20-32	2100	—	6000	90	89	all	14	0.8	S	yes	Adj.	yes	yes	LHOS	yes	ROTV	25/22/41	18	<1.2%THD	2970
	TC1800c	24	20-32	2100	—	6000	90	90	all	14	0.8	S	yes	Adj.	yes	yes	LHOS	yes	ROTV	25/22/41	19	<1.2%THD charger also	POA
	TC1800	36	31-46	2200	—	6000	90	89	all	14	—	S	yes	—	yes	yes	LHO	yes	ROTV	25/22/41	18	<1.2%THD	2970
	TC1800	48	40-65	2200	—	6000	89	90	all	14	—	S	yes	—	yes	yes	LHO	yes	ROTV	25/22/41	18	<1.2%THD	2970
Advanced Energy Systems	24/2500/IC	24	21-36	2500	—	5000	85	89	all	34	2.12	S	yes	9	yes	yes	LHOT	yes	ROTV	58/68/30	45	Battery charger also, RAPAS	4650
	48/2500/IC	48	42-72																				
Australian Solar Distributors	Eclipse 8000	24	20-30	2500	—	8000	85	90	all	38	0.048	M	yes	15	no	yes	HLOT	yes	OTV	39/20/55	35	2 yr warranty, Reactive card	2650

Manufacturer/ Supplier	Model	Input Voltage		Power output			Efficiency at % of full load		Power factor range	Idle power used	Standby power	Wave shape	Auto start	Min. auto start load	Start with fluoro only	Output isolation	Indicators	Output current limit	Protection	Size W x H x D	Weight	Comments	rrp*
		Nom	Range	Cont	Int	Surge	10	100															
		V		W	W	W				W	W			W						cm	kg		$
Wind Energy Australia	2425	24	21.5-32	2500	—	3700	—	87	—	36	—	M	yes	25	—	—	LHOS	no	ROTV	42/35/26	30		3079
Australian Solar Distributors	Brutus TB12-30	12	10-15	2800	—	11400	87	92	all	—	1	S	yes	—	yes	yes	LOTS	yes	OTV	38/20/38	35	<3%THD, Massive surge	4499
	Brutus TB24-32	24	20-30																		30		4599
	Eclipse 10000	48	40-60	3000	—	10000	85	90	all	38	0.048	M	yes	15	no	yes	HLOT	yes	OTV	39/20/55	35	2 yr warranty, Reactive card	2650
CSA	TC3000	48	40-65	3300	—	8200	90	91	all	24	—	S	yes	—	yes	yes	LHO	yes	ROTV	25/22/41	27	<1.2% THD	4120
Latronics	3000KVA	48	42-62	3000	—	—	88	93	—	—	0.5	M	yes	5	yes	yes	LHOS	yes	ROTV	35/18/40	25	100% Australian made	3699
Butler Solar	Green grid	96	84-128	3000	3600	9000	80	91	all	80	—	S	no	N/A	N/A	yes	LHOT	yes	ROTV	115/65/85	550	Inc. battery bi-directional	POA
	Generator interactive												yes	—	—					65/24/65	45	Bi-directional	
Wind Energy Australia	3230	32	28.5-43	3000	—	4000	—	90	—	38	—	M	yes	25	—	—	LHOS	no	ROTV	42/35/26	35		3719
	4830	48	43-64	3000	—	4500	—	92	—	38	—	M	yes	25	—	—	LHOS	no	ROTV	42/35/26	35		3719
CSA	TCG2500		72-145	2200	—	—	91	93	all	15	—	S	yes	20	—	yes	—	yes	—	25/22/43	22	Grid COS phi 1	POA
	TCG4000		72-145	3300			90							25							28		
Latronics	4000VA	48	42-62	4000	—	—	88	93	all	—	0.5	M	yes	5	yes	yes	LHOS	yes	ROTV	35/18/40	29	100% Australian made	4699
Siemens	4INV/48	48	40-63	4000	5000	8000	92	96	all	50	1.8	S	yes	15	y	yes	LHOTS	yes	ROTV	45/37/32	45	RAPAS $5843	5250
Wind Energy Australia	11040	110	98-145	4000	—	6000	—	95	—	39	—	M	yes	25	—	—	LHOS	no	ROTV	42/35/26	40		5055
Advanced Energy Systems	48/4500/IC	48	42-72	4500	—	9000	85	89	all	62	3.4	S	yes	15	yes	yes	LHOT	yes	ROTV	70/85/42	125	Battery charger also	5975
Australian Solar Distributors	Brutus TB24-50	24	20-30	4800	—	17000	87	92	all	—	1	S	yes	—	yes	yes	LOTS	yes	OTV	38/20/38	—	<3%THD, Massive surge	6200
Advanced Energy Systems	110/5000/IC	110	96-165	5000	—	10000	85	89	all	75	—	S	no	—	yes	yes	LHOT	yes	ROTV	70/85/42	135	Battery charger also	6935
Wind Energy Australia	2450	24	21.5-32	5000	—	7500	—	87	—	72	—	M	yes	25	—	—	LHOS	no	ROTV	84/35/26	60		4265
Advanced Energy Systems	48/5500/IC	48	42-72	5500	—	11000	85	89	all	72	4.5	S	yes	15	yes	yes	LHOT	yes	ROTV	70/85/42	135	Battery charger also, RAPAS	7250
Wind Energy Australia	3260	32	28.5-43	6000	—	9000	—	90	—	80	—	M	yes	25	—	—	LHOS	no	ROTV	84/35/26	70		7279
	4860	48	43-64					92		86													5460
Sharpe & Jeffcott	7.6kVA	250	225-335	7600	—	32500	90	96	all	15	—	M	no	—	—	—	LHOS	yes	OUH	80/60/25	50	Includes charger	3500
Advanced Energy Systems	110/10000/IC	110	96-165	10000	—	20000	85	89	all	110	—	S	no	—	yes	yes	LHOT	yes	ROTV	65/120/40	200	Battery charger also	10100
Siemens	10INV/120	120	103-163	10000	13000	15000	90	92	all	120	5	S	yes	10-25	yes	yes	LHOTS	yes	ROTV	76/39/65	160	Ammeter & voltmeter	9690
Advanced Energy Systems	110/15000/IC	110	96-165	15000	—	30000	85	89	all	220	—	S	no	—	yes	yes	LHOT	yes	ROTV	85/140/55	250	Battery charger also	13500

QUESTIONS & ANSWERS

Self-regulating panels

Some time ago I bought a 'self-regulating' solar panel, and it does not seem to put out much power a lot of the time. I am also aware of a system that uses some ten of these panels, and it seems that very little power is produced by them. What is the difference between these and normal panels, and why does their performance seem so poor?

Ron Palmer, Ringwood VIC

Solar module voltage decreases with increasing temperature. Normally solar modules have 36 cells to ensure that there is still a high current from the solar module at high battery voltages, when the solar cells are hot.

Self-regulating modules are designed with fewer solar cells in them, so that as the battery voltage rises, you get a 'knee' of the solar module characteristic and the current decreases, thus creating a 'self-regulating' effect. It is convenient that the battery charging voltage varies in a way similar to module voltage, ie at lower temperatures the voltage is higher, and conversely when the battery temperature increases, the voltage decreases.

With self-regulating modules, you need to take care of the mounting method so that they do not heat up any more than normal. Make sure that the back surface is clear so cooling can take place. I would also check the cables and connectors for corrosion and adequate cross sectional area so that voltage drops are not excessive.

Richard Collins, *BP* Solar

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

Andrew Blair is here to answer your general technical questions.

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

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.

Send your questions to:

Soft Technology

247 Flinders Lane, Melbourne VIC 3000

Central heating

Any tips on home hot water central heating would be appreciated, such as optimum positioning for hot water service, circulation pump to heat source and pipe diameters for system (60 gallon unit, four medium single-panel radiators, small pump) placed around cold spots in a 15 square timber home. Most clear nights in the Huon Valley in Tasmania will record minus temperatures between July and September.

Peter Broadhurst, Crabtree TAS

There is always lots of information to be collected before we can start giving recommendations for a central heating system. The starting point is to decide how much of your 15 squares you want to heat and then work out the size of the boiler you require. Details of these calculations are included in ST#45. With a wood-fired boiler it is usual to have the boiler lower than the hot water cylinder so that the pump is not required to push the hot water up to the cylinder.

A 60 gallon (270 litre) hot water system full of hot water may heat a house for about an hour only. The circulating pump is usually located near the boiler. Putting the circulating pump in the ceiling space may not result in enough water pressure on it from the expansion tank. With insufficient pressure the circulator may cavitate (produce vacuum bubbles within the pump), which may damage the pump, prevent the water from circulating properly, and make a noise.

Pipe sizes are determined by the amount of heat you want out of the panel radiators the pipeline is serving, the distance that the water has to travel, the pressure and capacity of the circulating pump and how quiet you want the system to be. In general terms, a 12mm copper pipe may serve a 4kW heater and a 19mm pipe up to about 12kW.

As you can see, there is a lot to designing a system. If you want to play around with the few components that you have, do so by all means, but please work with an experienced installer or designer and do your sums first.

Andrew Blair

Making a windgenerator

I still have a long way to go on building my own windgenerator as I have only just arrived at an efficient design for a turbine. I still need to select a suitable generator and arrive at a design to govern the speed of the windgenerator to avoid overcharging and destruction in high winds. Can you supply me with any information on manufacturers or distributors of small permanent magnet generators suitable to be driven by a wind turbine.

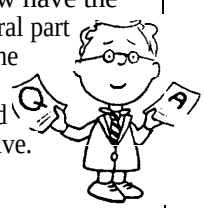
Chris Harris, Coolbellup WA

The ATA booklet *Planning a windgenerator system* has good information on siting, towers, etc for commercial-grade windgenerators. Some computer printers have low-voltage motors that have been used in homemade windgenerators, but like automotive alternators they have to be geared up to get them going fast enough for any sort of efficiency. If you want to try it regardless, use a four pole not a two pole motor.

Many modem windgenerators use large diameter rotors with permanent magnets round the perimeter. These magnets turn beside a set of fixed coils. The large diameter allows many coils to be used and means that the rotor can be driven at slow revs, without gearing. The fixed coils avoid the need for a split ring commutator, brushes and gearing. The Platypus Power micro hydro generator works on the same principle and if you were to buy the generator alone, the cost would be about $2000.

Most windgenerators now have the generator section as an integral part of the whole construction. The generators are purpose built and not a mass-manufactured article, making them expensive.

Andrew Blair



BEHIND THE SCENES

Energymobile tour

The Energymobile tour is going well so far, with a lot of enthusiasm shown by the public at every stop.

Much information on renewable energy systems and energy conservation has been given out and we have also learnt about many people's experiences and projects. Classes and demonstrations have been given at TAFE colleges, primary and secondary schools and on the school of the air. Agricultural shows, shopping centres, Aboriginal communities and a permaculture village are just some of the places that the Energymobile has travelled to. We also had a lot of interest along the road by people who were keen to use solar panels on their campervans and mobile homes.

The trip has also been a major endurance test for the Energymobile. On one of the really big bumps the heavy, lead plate contents of the see-through battery display leapt up, turned and came down sideways back into the container. Fortunately there was no acid in this battery! The working batteries of the Energymobile's electrical system appear to have survived. The acrobatic battery was sent to battery heaven when the Energymobile reached Darwin.

And the dust! After each day of travel on the rough dirt roads, there was a big clean-up to remove the thick coating of red dust from the sleeping and cooking areas as well as the walls, displays and models.

Other tour 'adventures' include a shredded tyre and tube on the trailer, crossing the crocodile inhabited Daintree River on a transport barge, a 'big bang' blowout of another trailer tyre and fording a creek on the way to Arnhem Land.

Thanks to the centre for Appropriate Technology in Alice Springs for helping with repairs to the Energymobile, and showing us around their centre. The Energymobile is now on its way back from Darwin, travelling through outback Queensland and NSW, South Australia and arriving back in Melbourne in late September. We'll have a full report of the tour in the next edition of Soft Technology.

Brisbane ATA meetings

The Queensland branch has held its first few meetings, with much enthusiasm shown all round. Meetings are held on the fourth Tuesday of each month at the Queensland Conservation Council building, level two, 166 Ann St. Brisbane, so come along and meet the other members.

At the June meeting discussions were held in small groups, and items of common interest were debated.

Twenty-three people attended the next meeting on July 26, which was held at the same venue. Discussions were held on how the group is to operate, and there was general agreement that this branch will have minimal administration and formal procedure.

For more information contact Paul Edwards, (07)849 4565

The Brisbane ATA group - quite a bit of interest here!

Canberra national ATA meeting

The National ATA meeting was held at Canberra on the weekend of June 4 and 5.

This meeting was a chance for the various groups to get together and discuss the future direction and goals of the association. Some 17 people attended the meeting from the Melbourne, Sydney and Canberra ATA groups.

Many things were discussed over the two days, including the Energymobile tour, the definition of the role of the ATA, and possible name changes for the ATA and Soft Technology. For the time being it has been decided to leave the names as they are, although further discussions will be held at a later date.

Canberra branch meeting

The Canberra group continues to grow, with four new faces at the July meeting. The group decided to decline attending the Canberra Show this year, feeling that the Environment Day and the Murrumbateman field day were more worthwhile.

The theme of the September 28 meeting will be a *Forum on retrofitting for energy savings and solar design*, while the November 30 meeting will be *Rons Energy Tour of the US and UK.*

Also planned are workshops on *Basic Electricity* and *Appliances and Inverters*, and a tour of the the 50kW ANU solar collector.

For** more information, **contact Ron Tito on (06)235 9172

Information on tap

The sharing of information and other resources between the groups is set to become far more viable thanks to the upgrading of the computer system at the National Office in Melbourne. Once the database has been established, the regional branches will be kept up to

date with memberships and the resources that the Melbourne office has available. It is expected that this sharing of information will be a two-way street, with an increase of material provided by the other groups for the newsletter and magazine.

Sydney update

The Sydney branch is one year old. About one hundred people attended *their Building&y,* with their *Water day* attracting about fifty interested people. They have also managed to secure a LEEP grant, which will allow them to run three seminars. The first, held in conjunction with the Energymobile tour, was in August. The next seminar will be on Sunday September 18 at the Randwick community centre, and will cover the topic of domestic energy conservation. The cost will be $10.

For more information contact Peter Moore (02)683 5605, Jenny Dibley (045)796 7 136 or Wolfgang Spranz (02)560 8643.

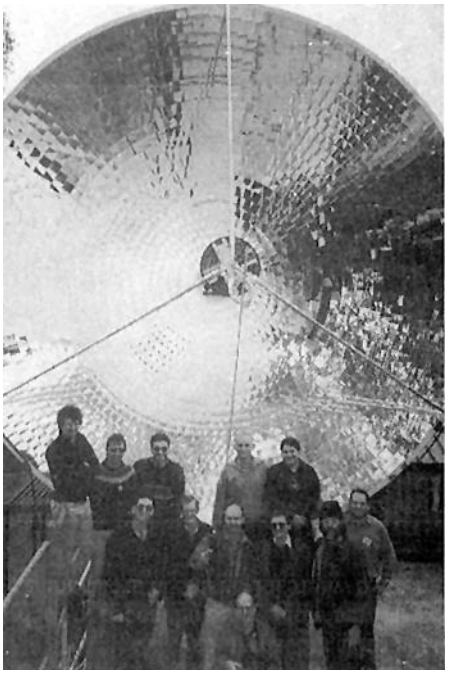
School holiday programs - July 1994

The ATA organised a successful School Holiday Program during the last school holidays at the Caulfield Primary School campus in Glen Iris. Each day saw twelve children aged between 5 and 12 years of age, tinkering with renewable energy ideas.

The Monday was *Solar Day* where children learnt about solar energy through making simple circuits, experimenting with solar panels and making models powered by solar energy. Wednesday concentrated on wind energy. Children looked at how things move through the air and developed simple working models that were able to move considerable distance using wind energy. The Friday saw the consolidation of the information collected earlier in the week and these were applied to the 'inventions' that the children worked with.

The response to the program from children and parents was very enthusiastic and encouraging. The programs will be conducted again during the September school holidays at Caulfield Grammar in Glen Iris, at the Deepdene Primary School in Deepdene and also at the Energy Education Centre in Burnley.

For further information contact John Molenaar at the ATA office - (03)650 7883.



The Canberra AGM group

AGM

The next Annual General Meeting will be held in Melbourne on the weekend of Saturday October 1 to Monday October 3. This is a long weekend for NSW. The AGM will include two days of discussions and an optional day of visits and tours.

Call ATA on (03)650 7883 for details.

Information nights

The Melbourne ATA, in co-operation with *Going Solar*, are now holding monthly information nights on a range of topics. They are held at 6.30pm on the last Thursday of every month. So far, there have been both 'Non-toxic' and 'Mud Brick Building' nights, which were held in July and August.

The September night will be on the topic *of Renewable energies in northern Australia,* Mick Harris and Ross Horman will talk about their experiences on the Energymobile tour, with details on the renewable energy installations that they visited.

The October night will be on the topic of Biogas, and will be presented by Callum Morrison at the CERES workshop.

November's topic will be 'Recumbent Bikes' and the December night will be the end of year bash.

Everyone is welcome to attend, so come and meet the other members, learn something new, and have a great time while you're at it.

For more information, see the latest newsletter, or contact the ATA on (03)650 7883

We now have credit card facilities!

The ATA has upgraded services for its members and supporters again! We are now offering credit card facilities. This means that if you want to buy any of our publications or products, just ring us up and order over the phone. No more fussing with cheques or money orders! You can also use your credit card to become a member or subscribe, or to renew your subscription or membership. We hope that this new service will be particularly useful for people in remote areas.

New faces

As mentioned in the last issue, Assistant Editor Nikki Brand has left the team and headed off to Scotland to live. The hole left in the production team has been given to me, Lance Turner, to fill. I am learning quickly although I would be lost without the guidance of the rest of the team. Being a techno-nut, I have been helping with the various technical enquiries and problems that crop up here on an everyday basis, which has made the work varied and interesting.

BOOK REVIEWS

Energy Efficient Housing Manual: design guidelines & case studies

Energy Victoria, $45.00 plus postage
Available from Energy Victoria
ph:(03)650 1195

This is a substantial text with page after page after page of mostly useful information on:

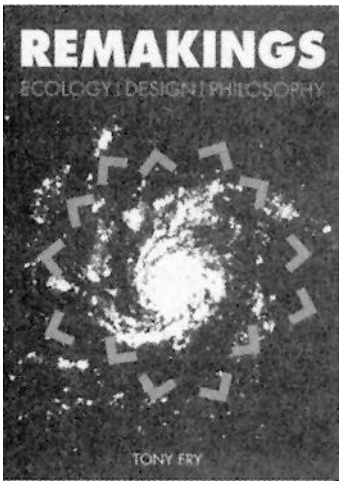
- choosing a building lot that will give a sunny aspect
- siting your house to take best advantage of sunshine
- thermally separating or 'zoning' spaces for controlling heat flow
- sizing, shading and positioning windows
- incorporating 'thermal mass'
- installing insulation
- providing air flow in summer
- choosing energy-efficient lighting and electrical appliances
- landscape design to enhance your house's energy-efficient qualities.

For this revised edition, the subtitle, *'A manual for architects and designers'* has been dropped. Presumably, it was thought that a government department should have as its target readership the tax-paying dream-home-seeking public rather than a select educated few. This is a commendable approach.

However, this type of publication (a manual) from this type of organisation (a government department) invariably ends up involving many (anonymous) authors over a long period as well as addressing suggestions from users of previous editions. This process has led to a publication far too extensive, even though each section seems at first glance to be succinct enough.

If you are considering designing your own energy-efficient home and feel inclined to read this thing from start to finish (which is the only real option for those new to the topic) you may well emerge with enough information to become a design consultant. Unless of course you only read the summary design guidelines conveniently placed at the beginning of the manual!

-James Banfield



Remakings: Ecology, Design, Philosophy

Dr Tony Fry
Envirobook (Sydney), 1994 -- $24.95

This book comprises a group of essays by a university lecturer in design, and is well named. Design is the centre of the book's concerns, with ecological issues as its inspiration, philosophy as its framework, and the need for change as its reason for being.

The academic style is telegraphed by the blurb on the back of the book which says it is 'post-disciplinary'. I'm not sure I know what that means, but it is certainly cross-disciplinary. The author quotes from Hegel, Marx, Heidegger and Aristotle, to name but a few, and each essay is accompanied by at least 13 footnotes for readers to follow up, should they be so inclined.

Which brings me to the problem with this book for the casual reader - it is bloody hard work! The author's erudition makes for strong arguments, but his style assumes an audience with a certain amount of prior knowledge, and experience in reading academic arguments. The following example is from the essay titled 'Neuma, Anima and Animation: a question of education and ecodesign.'

'Writing on ecodesign and education is a writing against the error of education. That is both the error of an induction into, and an extension of, the productivist trajectory, and a complicit coupling with the anthropocentric thought.'

Boiled down, (and I'm sure he would hate me for summing it up in so few words!) the essence of Dr Fry's point seems to be that environmentalists who are obsessed with 'nature' are barking up the wrong tree - we live in an artificial world, and so it is design, a radically rethought design, which must be the way for us to progress to an ecologically sound and philosophically correct future.

Personally, while I found some of the arguments interesting, I didn't find the book terribly inspirational. Nonetheless, it should make thought provoking reading for students and design professionals, which is a good enough reason for existence in a world depending in no small way on designers to get us out of the mess we have got ourselves into.

- Imelda Evans

The Reverse Garbage Garden

Sandra Clayton
Hyland House Publishing, 1993

The foreword to this book could have been called 'Allen Gilbert (well-known organic gardening expert) RAVES' - and frankly, I'm with Allen Gilbert. I loved this book!

To quote the foreword, it offers 'guidance in recycling, organic garden-

ing, saving water, growing food for the home, saving energy, and most importantly enjoying backyard gardening'.

The author's main theme is that Other People's Garbage (OPG), in the form of free mulching materials, is a great resource for the inventive gardener. The Reverse Garbage Garden (RGG) combines elements of permaculture, organic gardening, no-dig gardens and composting to produce an easy to use system that is cheap, successful and environmentally friendly. In Ms Clayton's garden, even the garden-bed edges are recycled!

This system will be welcomed by those (like me) who would like to get into organic gardening, but find the carbon/nitrogen ratio of the perfect compost heap, or the thought of converting their whole backyard into a permaculture forest a bit daunting. It is also a good system for those (also like me) who are starting a garden from scratch with poor-quality soil, since improving soil quality is one of the lain aims of the system.

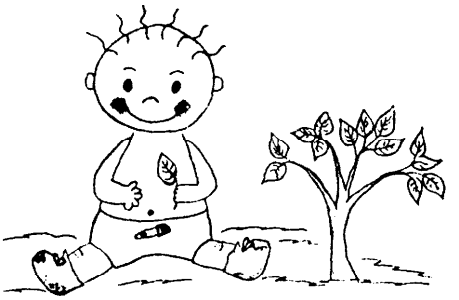
Ms Clayton provides a good amount of detail while still keeping it simple and to the point. There are chapters on soil structure, how plants grow, and garden planning, as well as heaps of specific information about types of mulches and their benefits, plants to grow and how to maintain and propagate them, pests and even compost. In short, it contains all the information you need to have your own organic food farm.

There is also a refreshing lack of the word 'should' in this book. The emphasis in this book is on providing the reader with easily digested chapters of pertinent information for each gardener to use as he or she sees fit. The flexibility of the system and the author's gently encouraging style makes it sound easy and fun - and therefore much more likely to be implemented than some other systems, at least in my garden!

For anyone starting a garden, improving their garden or looking at going into commercial gardening, this book is eminently practical, refreshingly inspirational and engagingly written. Buy it.

- Imelda Evans.

Illustration: Melissa McGroarty



Growing into Gardening with your children

Melissa McGroarty & Noelle Weatherley - Hyland House, $19.95

This book would make an interesting alternative gift to booties or a rattle, particularly since the extensive range of suggested activities could begin from the time the child is born. It is full of ideas that will help to develop not only gardening skills and knowledge, but hopefully an interest in and appreciation of the natural world.

The contents range from how to survive gardening with a baby or toddler through to creating balanced ecosystems and how to grow and care for your bonsai. The book is divided into two main sections; the first part being for younger children and the second for older children. Set out in A5 format with sketches and diagrams throughout its 150 pages, it makes for very easy reading. The detailed index and subtitled bibliography make it a useful reference book.

It would make a terrific resource for primary teachers. Many of the experiments and activities included in the book would be appropriate or easily adapted to the primary science curriculum, including: growing plants in limited space; art and craft ideas; growing foods; chemistry of soils and fertilisers; environmental issues, including cornposting and pesticides; food chains.

Perhaps the greatest indicator of how worthwhile I found this book is that it inspired me to gather my children and venture into our long-neglected backyard.

-Miranda Milaszewicz

Solar: Power of the Future

Dodwell Keyt
APPSYS, 1994 rrp$30
Available from APPSYS, ph:(03)563 7253

This book looks at the various forms of usable energy provided by the sun, and in particular, that of electricity generation via photovoltaics. While intended to be part of a school-oriented resource kit it also stands well on its own, providing considerable information on solar energy.

The layout allows for quick and easy access to the information. There are many diagrams, graphs and tables to allow understanding at a glance.

Unfortunately, several topics are not really covered, including types of storage batteries, regulators and wiring. As this is a text book, and not a full-on design-your-own-power-system publication, that can probably be forgiven, but these subjects could have been better covered.

The first half of the book deals with the fundamentals of solar energy, such as how the sun produces it and what light actually is, how photovoltaic cells and panels are made, their differing types and efficiencies, and factors that affect power production.

The second half deals with the computer interface and program that come with the kit. This specially designed hardware and software allows the user to experiment with the supplied solar panel in various configurations to find maximum voltage, current and power of a solar cell, etc. Also in the latter half is a section dealing with designing solar-powered devices such as a model car and boat. There is also a section on designing a model solar power system for a house.

All in all, a useful, if not complete, reference book to have on hand if you want to understand how solar panels do their thing. And I must say that for the kids who get to use the whole kit, well I wish they had had this type of thing when I was at school.

- Lance A. Turner

[Educational Solar Resource kit -- 425mm x 280mm, 8 watt solar module $160, load box $85, computer solar interface and software $180.]

LETTERS

The installation debate continues

I am firmly opposed to more limitations and regulations imposed as detailed in your magazine, and proposed by SEIAA. I feel that we as individuals are yet again being manipulated into conforming with industry directives and marketing schemes for their benefit alone.

I use solar power because I believe in doing my bit for the future of this fragile earth. My system is self designed and installed, and is certainly safe and effective.

When solar power first came in vogue, it was promoted as clean, effective, simple to install and use with a little common-sense. Now that solar energy is a multi-million-dollar industry, we see that the word has changed. No longer is it simple; sure it's clean and efficient, but 'safety' is an inflated issue. Guarded caution has replaced unbridled optimism, and we now must be 'taught' to install these once basic building blocks. We must pay for 'qualified' (industry) personnel to ensure our own safety, and incentive schemes must be 'approved' by the vested interests of the industry.

The SEIAA plan to ensure systems installed by accredited personnel only will be eligible for RAPS incentive schemes is shrewd, but very disturbing. Whilst I agree an accreditation scheme is a worthwhile project to pursue, and a three-day course a worthy introduction to current equipment and practices, these schemes should be entirely voluntary and in no way limit any person's access to incentive schemes.

In all walks of life, 'amateur' constructions and installations can be far superior to so called 'professional' equivalents, and often are. To limit creativity and innovation through regulation is not a panacea to end perceived problems, but a thinly disguised marketing ploy.

I'm sure many individuals and businesses believe in this technology, and like myself are committed to global improvements through renewable resources, however regulations and restrictions will not only stifle innovation, as you say, but also restrict our future from one of flexible expansion to one of dictated commercialism.

The challenge is *not* to stamp out the worst and encourage the best, but to rectify the worst and inspire the best. We must advance with freedom, not constraints.

A. John Robinson, Denmark WA

It was interesting to read your article/letters concerning the SEIAA. and its proposed accreditation scheme, and to note the opinions of other readers.

The effects of climate change and ozone depletion have been discussed widely, through all forms of media, for many years now. However, like many millions of television viewers, I thought that most of the theories and ideas shown in science/environmental documentaries were mostly theoretical, and hearsay. If there were such problems with our environment, why didn't I notice them when I walked out the door? In the past few months, however, I feel it has come to that point now. The sky seems different. I can see the pollution on the skyline. I can notice the temperature and climate changes. I see dual crops appearing on our fruit trees, increasing in size each year, which didn't exist five years ago.

OK, now for the good news. Having become aware, I wanted to know what I could do to help solve the problems I had become aware of. The *Enviro-Fest* at Templestowe in March of this year proved to be a springboard to a number of changes in my lifestyle, the most important of which has been alternative energy.

Unfortunately, I don't have a thorough knowledge of electronics, but should be able to get by with advice given to me by some experts in the field of RAPS, as I have no confidence in being able to choose a reliable company or individual to install my system. This is the crux of the problem facing the solar industry today.

The technology has advanced to such a stage where it *is* viable in urban areas. This is the key to solving our pollution problems. In urban areas, (where the majority of the global population and pollution come from) RAPS has the potential to cut our greenhouse emissions by half. This is a point which seems to have been lost in the argument.

In remote areas, where people have more control over their lives, and more time to learn the intricacies of RAPS, they should be permitted to install their own systems, because in an isolated system where you generate your own power, there is that inbuilt responsibility towards oneself: 'I built this system, therefore I am responsible for maintaining it.' The SEIAA accreditation proposals have got to acknowledge this.

Unfortunately, urban areas are geared towards a lifestyle of no responsibility. This is, I believe, where the accreditation system is aimed. Co-charging is a very real possibility, as our environmental situation worsens. To do this, RAPS systems of the highest order and installation values are needed. Perhaps the SEIAA (and some of your readers) need to make this distinction between co-chargers and non co-chargers in relation to policies and attitude. I believe the solar power industry is on the brink of widespread acceptance, and it could stand or fall purely upon laws relating to accreditation. I look forward to Australia (and the world) switching to solar!

Shane Fincke, Altona VIC

I have read with interest your recent articles concerning accreditation of RAPS installers. I agree that there is a need for an Australian Standard for RAPS installations. I think that it would be best to enforce the standard by requiring RAPS systems to be inspected

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.

after installation. I believe the SECV already requires inspection for eligibility for their rebates. This would overcome the problem of a 'closed-shop' of accredited installers (as anybody would be able to install a system) and the problem of unsafe systems.

Until the issues of the Australian Standard and accreditation are resolved, there is a need for more information about how to safely set up and maintain a RAPS system.

I recently purchased some RAPS equipment manufactured in Australia. The instruction manuals that came with the equipment said to join the equipment directly to the battery and PV modules. I understand the reason for directly joining the equipment is to reduce the transmission losses. However, this approach excludes the use of safety equipment (fuses, circuit breakers, etc.) and so could lead to fires, explosions and physical injuries.

I also feel that Soft Technology needs to play a larger role in educating people regarding safe RAPS practices (both installation and maintenance), perhaps by publishing a series of articles. There is a potential for conflict here with the impending standard, however I believe that there is still considerable scope in what can be covered.

Martin Strandgard,
Box Hill Nth, VIC

There will be an article in the next edition of Soft Technology on this very subject. Ed

Solar panel quality

We noted with interest an article in ST#47 regarding problems someone had with an amorphous solar module.

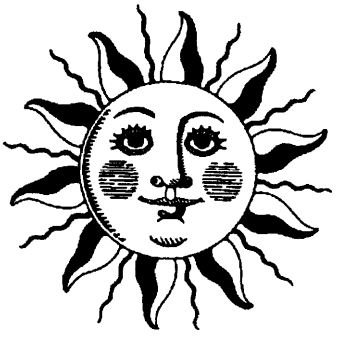
Environmental protection of amorphous silicon cells is critical, and in the final module structure determines the ultimate service life. Techniques used in crystalline module construction are not sufficient for protection of amorphous silicon cells.

Besides providing mechanical strength to the final solar module, the materials and processes used to convert the coated glass to a finished product are extremely important in providing the required sealing for corrosion protection.

The sealing requirements are more stringent for any thin film solar module than for a crystalline one. The polymer backsheet used in most crystalline solar module constructions allows some water vapour penetration, and in most amorphous silicon solar module constructions is replaced by a second piece of glass laminated to the back of the coated top glass. Sealing around the edges of this laminate is vitally important.

Beware of amorphous solar modules that are not constructed as described above.

Peter McPherson,
Regional Manager,
W.D. Moore & Co. / NAPS



A new subscriber - with email

By chance I picked up your journal while I was in Australia recently, and I'm glad to see that there is now a magazine available that provides information on all kinds of new products and practical tips and advice for D-I-Y appropriate technology. As they say - 'Keep up the good work!'

sfoley@worldbank.org

As communications with Indonesia are often slow and unreliable, I seem to be using email more and more - so I have provided my email address above, and would be glad to have your email address if you have one. I would be glad to use email to correspond with other people interested in appropriate technology.

Dr. Sean Foley, Jakarta Indonesia

Three phase motor - on single phase

In the winter 1994 issue of Soft Technology, a reader, Joseph Havlena, asked about running three phase motors from single phase power. *Plough Book Sales,* PO Box 14 Belmont Vic 3216, have a book titled 'How to run three phase motors on single phase' at $5.75. I cannot vouch for the book, but at least it is worth a try.

John Allott, Wolvi QLD

Another happy solar user

I installed a PV cell, fixed to the roof of my motor home, in 1988 instead of buying a petrol generator, and had been extolling the virtues of so doing to fellow travellers, when one loaned me your Autumn '94 mag.

The article on halogen lights was most interesting (as were all articles), as I made up two and fitted them two years ago, mainly because the fluoros we had interfered with the radio badly. A bonus of course was vastly better light. I used cheap white plastic reflectors and cut up standard 240 volt bayonet fittings and switches and epoxied them together.

My panel sits out of the way on the roof and gives us three amps in full sun, down to one amp with overcast sky, which keeps up with our modest requirements.

I also installed a 240 volt inverter for $600, but wouldn't recommend it, as power output from a 90Ahr battery is too small to run a ¼" electric drill. We only use an electric shower, TV or radio.

Roy Fishley, Cooroy QLD

Information wanted

Could you please advise me on a book or back issue article on the construction of a control panel for a solar system?

I would like to know the wiring details for the panel, amps and volts etc, to and from the battery bank.

Maybe some of your readers may have an idea.

David Holzgrefe, Newport Vic

WHAT'S ON

The 1994 Peninsula Mud Brick House Tour - VIC

- Sunday November 6, 10.00 am

Somers Primary School

The Peninsular Mud Brick House Tour is in its fifth year. Due to demand to visit some old favourites, this year's tour will be a 'mud brick retrospective'. Join the tour to pick up your tour booklet. Six mud brick houses will be on display until 4pm. David Baetge, Managing Director of Post & Beam Pty Ltd, will conduct mudbrick making, laying and rendering demonstrations on the day.

For further information contact Sandy or David Baetge on (059)83 1488.

Current developments in electric vehicle technology - VIC

- Thursday October 6, 5.30pm for 6.00pm

Monash University, Caulfield Campus

Speaker: R. Lisner

Australian Electric Vehicle Association ph:(03)691 4094 fax:(03)691 1362

Solar '94 - NSW

- Thursday October 6

Secrets of the Sun: developing integrated end-use solutions

International guests will include Professor Paul Ehrlich, Dr David Suzuki, Dr Bill Beckman and Dr Keith Kozlof

Local guests will include Professor Martin Green, Professor Maria Skyllas-Kazacos, Robyn Williams (The Science Show), Rodger Meads (Solahart Sydney) and David Jordan (BP Solar Australia).

Education and training workshops for renewable energy will also be held. All educators and trainers in renewable energy are invited to attend.

Enquiries to Solar '94 Conference, attn Dr K Prasad, SOLARCH, University of NSW PO Box 1, Kensington NSW 2033 fax:(02)662 1378

1994 National Greening Australia Conference - WA

- October 4, 5 & 6,

Esplanade Hotel, Fremantle

'A vision for a greener city -the role of vegetation in urban environments' ...an opportunity to examine how protecting, securing and adding to vegetation cover can bring enormous benefits to people in large cities and small towns.

More than 400 representatives of local government, community and environmental groups, academia, state and federal government agencies, the corporate sector and industry associations are expected to attend.

For further information, contact Brian Peck, Public Affairs Manager, Greening Australia Ltd ph: (06)281 8585

Australia's Festival of the Environment

Ecolife conference - ACT

- December 9 to 11

December 1994 will see the Exhibition Park in Canberra host two major environmental events. These are *Ecotex '94* and the *Ecolife Festival.*

Ecolife will be a festival for all the family, offering seminars on such things as food growing, preserving and storing, building your own home and generating your own power. There will be demonstrations of solar and wind power generation, tepees and earth houses, cornposting, and much more.

For more information, contact Diane Rae, Ph. (07)367 0717

COURSES

GREEN HARVEST resources for a sustainable future

Permaculture Design Certificate - QLD

- September 18 to October 1
- October 30 to November 12
- January 8 to 21

Crystal Waters Permaculture Village

These courses will give you the skills, practical knowledge and techniques to implement your permaculture ideas.

Enquiries to Jeff Michaels, 52 Crystal Waters, MS 16, Maleney QLD 4552 ph:(074)94 4676 fax:(074)94 4578

SYNERGY

Wind power courses - NSW

Synergy Power Corporation are conducting two-day free wind turbine installation courses for interested people in the RAPS industry. The courses are a hands-on practical approach to learning the skills required for correct wind turbine installation.

For more information, call Ian Wymer on (02) 687 0199 or write to PO Box 734, Penrith 2751

Activities for the family - VIC

- October 8 - Electricity
- October 22 - Magnets
- November 19 - Wind
- December 3 - Water

The ATA has organised four interactive workshops for the whole family. The aim is for parents to work with their children to explore technology and science concepts in a fun and hands-on way. Children who attend must be accompanied by an adult.

Enquiries to John Molenaar, ATA Ph. (03)650 7883

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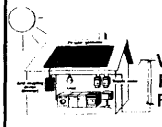

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SOLAR PRICE BREAKTHROUGH?

A Parting Shot

OVER recent months, the media have run a series of sensational reports on a breakthrough in the development of low-cost solar cells (photovoltaics).

The reports, based on a press release from Martin Green's unit at the University of New South Wales, suggest that we could see a dramatic drop in the price of photovoltaics. The press release states that by using thinner laser-grooved cells with cheaper lower grade silicon, full solar systems for suburban houses could be a viable option within ten years. It also states that the price of photovoltaics could drop to close to three per cent of the current price.

While technical progress in the development of solar power is something we all support, and the work of Martin Green in the University of New South Wales has been very encouraging, these reports are actually very counter-productive.

Immediately after these reports started to get widespread publicity, members of the community started ringing their local retailers and asking about where they could get these new high-efficiency cells. When they were told the cells were not available and would not be in the foreseeable future they quickly lost interest.

Some people who were seriously considering investing in solar equipment have decided to delay their purchase 'until the price comes down'.

The problem is that media reports such as this strengthen the perception that solar cells are 'too expensive' and should not be purchased until the price drops.

Reports of revolutionary, high-efficiency, low-cost solar cells come out regularly. There have been dozens over the last ten years, and none have resulted in dramatic price drops. In practice they probably never will.

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The extra profit would help pay for the expensive research you had been doing. It would also allow you to invest in a bigger factory to supply demand, and make even more profit. The technical improvements only reduce price gradually.

Martin Green's developments to date have resulted in more efficient cells but they are much more expensive than conventional solar cells, and this cost has slowed their move onto the mass market.

When researchers do their number crunching on price, they seldom take into account the realities of the market. In the process they create unrealistic expectations in the community and do damage to short-term demand and long-term expectations.

Mick Harris

Contributions to *A Parting Shot* are welcome. If you have something you'd like to get off your chest, why not drop us a line? Send your piece to: The Editor, Soft Technology, 247 Flinders Lane, Melbourne VIC 3000

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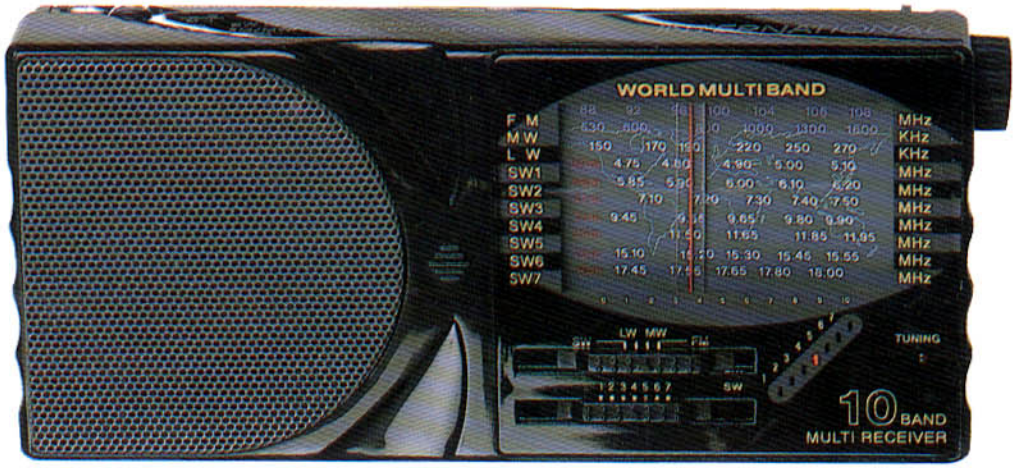

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