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Helpful tips for backyard biodiesel

Rainwater toilet flushing system

What are the wealthiest nations doing to tackle climate change?

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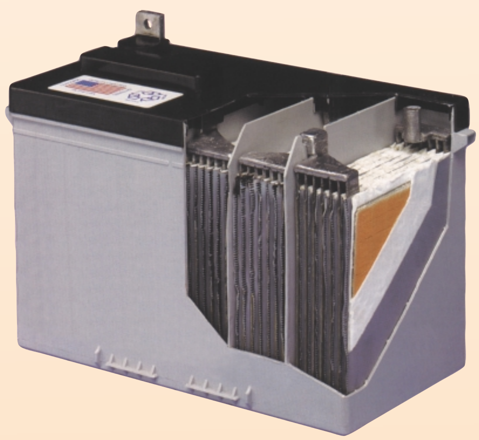

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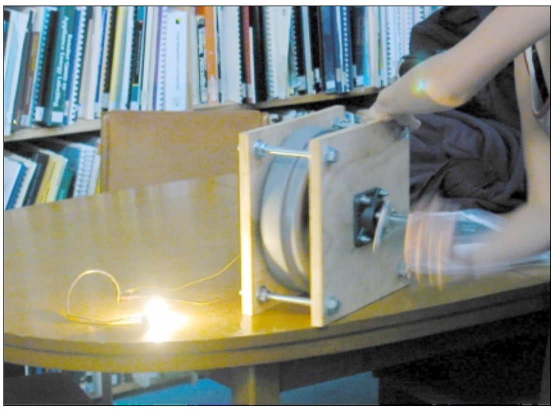
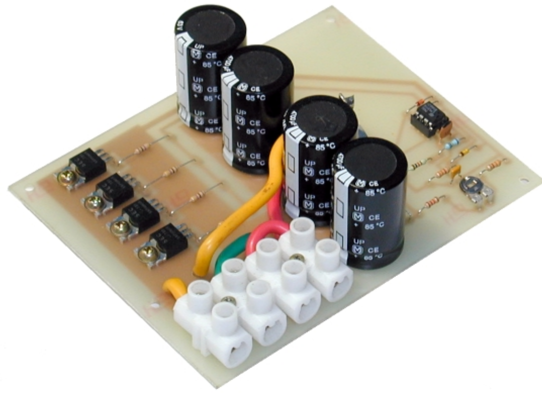


This low-speed generator could be ideal for your latest wind turbine project. Page 49.



Our new 20 amp maxi-maximiser may be just the ticket for that large solar pumping job.

This is Noel Jeffery, the man behind Noel's Treasures from Trash. Page 84.

regulars

This grid-interactive street light is just one of the interesting products we take a look at, starting on page 88.

About ReNew

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

ReNew also covers sustainable transportation and housing issues, the conservation of resources, recycling and broader environmental issues. *ReNew* is available from newsagencies, by subscription and as part of ATA membership. ATA membership costs $49 per year, and offers a range of other benefits.

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editorial

Sharing the load

Maybe it's just me, but it seems that renewable energy, energy efficiency and the complexities of climate change are popping up with ever more frequency in the public arena. Whether it be solar fountains on TV gardening shows, sustainable home tours advertised by local community organisations, or discussions about sustainable energy policy raging on national radio. Perhaps we are finally raising the level of debate about energy use from niche environment and technical groups to the formerly 'unconverted'.

The prospect is an exciting one, and certainly many aspects of the business community are gearing up for the new era, where renewable energy represents a larger and more competitive sector. For instance, at a recent wind energy conference held in Melbourne, representatives from some of Australia's major banks spoke about the growing and attractive investment opportunities in wind energy. Also at the conference, a speaker from the national electricity market manager, NEMMCO, spoke about the new challenges for electricity grid management posed by increasing amounts of wind energy coming online. After promoting the benefits of large-scale wind farming in the pages of *ReNew* for many years, it was heartening to hear some of the more conservative aspects of the business community recognising where clean energy makes economic sense, and hearing discussion about those issues that need to be overcome for renewable generators to be compatible with existing transmission systems.

Other schemes that have been announced in the past few months include the move by Origin Energy to enter the solar grid-connect market, by offering to install grid-connect solar systems for all electricity customers. And the Body Shop, in conjunction with Greenpeace, will soon to be promoting Green Power to its retail customers in Australia. The Bendigo Bank is offering green home loans and green personal loans to those wishing to invest in better home efficiency and environmentally friendly products, such as solar water heaters, water tanks or home insulation. While these initiatives are just the tip of the iceberg, it is this type of collective action that will see Australians redressing the fact that we are the world's worst polluters, per capita.

For us here at *ReNew,* it seems like the patchwork of product and policy responses that are needed to bring about systematic change are starting to emerge. For example, the Victorian Government now requires that electricity retailers include a greenhouse gas statement on electricity bills. However, the onerous challenge to avert dangerous climate change seems as far away as ever, especially as Australia is still to take the first baby step—that is, to ratify the Kyoto Protocol.

I hope you enjoy this expanded issue of *ReNew*. With an additional 16 pages, we have been able to jam-pack it with even more good ideas from our readers and supporters. Thanks so much to everyone that has written in to us, and apologies to those whose articles have not been included—no matter how much we try, we always seem to be short on space!

Kulja Coulston

WIN!

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Conditions and how to enter

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

(2) The prize is not redeemable for cash.

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

(4) The competition runs from 19 April 2002 to 25 October 2002. Subscriptions/memberships must be paid by 5pm on Friday 25 October 2002 to be eligible.

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

(6) To subscribe or join the ATA, use the subscription form on page 62 of this magazine (or a copy of it), or call the ATA on (03) 9388 9311 to pay by credit card.

(7) The competition is open only to Australian entries. The prize includes installation of the unit.

The *ReNew*/Edwards Solar subscriber competition is proudly sponsored by Solar Edwards Melbourne (Earth Two Solar P/L), 12b Macro Crt, Rowville VIC 3178, ph:(03)9763 6311, fax:(03)9763 6511, email: solar@earthtwosolar.com.au, www.earthtwosolar.com.au
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Mobile millions

There is an estimated $40 million of precious metals lying around in homes and offices in the UK in the form of redundant mobile phones. A British-based firm, XS Tronix, together with a UK electronics retailer, Comet, has launched a recycling plan where customers can send unwanted mobile handsets into Comet for recycling in pre-paid envelopes. Similar campaigns have been run in the past, with up to 1500 to 2000 phones collected per day at the height of the publicity. For every 3.5 tonnes of phones processed, 2.8kg of copper, 2.01 kg of silver, 0.4 kg of gold and 0.2 kg of paladium is recovered.

Body Shop joins push for renewables

A joint Greenpeace and The Body Shop campaign will be launched on World Environment Day, 5 June, to promote the use of renewable energy locally and globally. The campaign has three main objectives. Looking globally the campaign will promote renewable energy as the most cost-effective and appropriate way in which to provide energy to the vast majority of people living in developing countries. In Australia it aims to raise awareness of renewable energy as a viable way to produce an increasing amount of our grid and off-grid electricity—with the effect of reducing our reliance on coal. And locally, Body Shop outlets will be providing customers with information about Green Power products and presenting information about the effects of climate change and the role that can be played by renewable energy.

What ever happened to summer?

This year so far has been the warmest across the globe since records began. While in many parts of Australia people have been asking where the summer went, with lower than average temperatures across the country, the general trend in most other regions was toward higher temperatures, which is consistent with global warming. Temperatures across the globe in the first three months of the year were warmer than any other since records began in 1860, and are predicted to be the warmest since AD1000. CSIRO researchers say that while Australian temperatures were lower, the global warming models predict that Australian temperatures will soar by up to six degrees by 2070. These are the most recent figures released by researchers working in the British Government, the UK Meteorological Office and the University of East Anglia. A CSIRO spokesman told *The Age* that: 'If anything, it confirms the information that we have been saying for quite some time. If we keep increasing the levels of greenhouse gases in the atmosphere, it's going to warm the planet.'

Antarctic shattered over global warming

An Antarctic ice shelf known as Larsen B, which is almost 200 metres in thickness and has a surface area of around 3250 square kilometres, hit the news in March when it collapsed and broke into thousands of icebergs which are now adrift in the Weddell Sea. Global warming is being blamed for the spectacular disintegration of the ice shelf. Scientists had predicted that eventually the remaining part of Larsen B would collapse, having predicted four years ago that many of the glaciers on the Antarctic Peninsula were retreating. However, the break-up of the ice shelf took just 31 days, and glaciologists are reportedly shocked and dismayed at the scale and speed at which it shattered. No one knows why the Antarctic peninsula is warming at a rate five times that of warming anywhere else, with temperatures increasing by 2.5 degrees in just 50 years. Temperatures in that region are warmer than they have been for 1800 years.

IPCC chair ousted

Environmental groups are blaming the US government and ExxonMobil for the ousting of Robert Watson, the former chair of the United Nations Intergovernmental Panel on Climate Change. Watson was voted out of his position by member nations and replaced with Rajendra Pachauri in a vote of 76 to 49. Watson is considered one of the most outspoken and respected voices in the debate over global warming, which has led environmentalists to accuse the US government of engineering the replacement. Green groups have claimed the motivation behind such action was to please the energy industry, in particular ExxonMobil which reportedly asked the Bush administration to work to replace Watson, a request which was revealed in a leaked memo to the White House. Although the IPCC ballot is secret, it is understood that many developing countries also supported Pachauri. Many believe that this may have occurred because wealthier countries were supposed to provide support to developing countries to help ward off the impacts of climate change, but had failed to deliver.

Wind power good, survey

An Auspoll survey commissioned by renewable energy company Pacific Hydro has found that 95 per cent of Victorian households say they support building more wind farms in Victoria, and 86 per cent said they preferred wind energy to new gas or coal-fired power stations. The February 2002 poll also found that protecting the environment was now as important to Victorians as reducing crime levels, creating employment and providing quality health and education services. Pacific Hydro has plans to construct a wind farm on the Victorian coast near Portland. Pacific Hydro is awaiting a decision from the Victorian Planning Minister on the 120-turbine, up to 170MW Portland Wind Energy Project, which also seeks to stimulate a manufacturing industry, employing 2000 people in Victoria. NEG Micon has committed to constructing a manufacturing plant, most likely located in the Portland regon. The project has been subject to an Environment Effects Statement process and was 'called in' by the Minister. A decision should be made by the end of July 2002.

Alpine regions suffering from warmer conditions

A flora and fauna study of Australia's highest alpine region, that of Mount Kosciusko in southern New South

Coral bleaching events worsen

Coral bleaching is devastating more of Australia's Great Barrier Reef and other parts of the South Pacific. Bleaching occurs when sea temperatures rise and force out the microalgae that give the reefs their spectacular colour. Coral generally recovers when ocean temperatures cool in the colder months. Consistent high temperatures, however, cause the coral to die and the reefs to crumble. High ocean temperatures in the first few months of this year have lead to reports of dead coral across much of the South Pacific including Tahiti, the Cook Islands, New Caledonia and Fiji. Thomas Goreau, president of the Global Coral Reef Alliance based in New York, told *New Scientist* that: 'it will take a long time before we have full confirmation of the magnitude of the disaster. But when it is all in, I predict we will have confirmation that almost all corals across the entire South Pacific have died in the last few months.' Conservationist and tourism in northern Australia are using the threat to the Great Barrier Reef to increase pressure on the Federal government to ratify the Kyoto Protocol and for Queensland to reduce the high levels of land clearing still occurring in the state. Evidence shows that soil run-off from cleared land and other land-based pollution is also adversely affecting the Great Barrier Reef. Chief Executive of the Queensland Tourism Industry Council Daniel Geschwind said: 'We are not just talking about an irreplaceable part of the world's ecosystem, we are talking about an attraction that keeps thousands of Australian tourism employees in jobs.'

Wales, has increased concerns about the increasing impact global warming is having on the sensitive region. More than 70 scientists from around Australia surveyed more than 30 square kilometres of the park and found that many animals were moving to higher areas seeking habitat, and many plants were growing in higher areas than previously found. Alpine areas show early signs of the impacts of climate change. On *ABC Radio,* Ken Green, an ecologist who took part in the National Parks and Wildlife Service survey, said migratory birds were arriving up to two months earlier than normal after winter. 'So this suggests that with 30 per cent reduction in snow cover that we've had over the past four decades that there has been a shift in the fauna already and that shows that there may be greater changes in future.'

Metal detectives

More than 60 tonnes of computer waste has been saved from landfill through the efforts of a computer recycling company. Melbourne based company com.IT, also known as The Community Information Technology Program, has reclaimed discarded computers, rebuilt them and donated them to community organisations. Since its establishment in 1999, com.IT has donated more than 300 computers to community groups in East Timor, Fiji, Western Samoa and the Solomon Islands. More than 200 more computers are earmarked for Africa.

Rainforests shrinking

New research has found that the world's temperate rainforests are shrinking faster than even pessimists thought. Unsustainable development practices are responsible for the degradation of vast areas of rainforest from Chile to Russia. Researchers have found that 'greed and neglect' have had devastating effects on forests in Russia, Central Africa, North and South America and Southwest Asia. The World Resources Institute released the results of its two-year study into the health and management of rainforests in April 2002, confirming the worst. One researcher is reported as saying: 'As we examined what we thought were still vast, untouched stretches of intact forests in the word, we came to the conclusion that they are fast becoming a myth. Much of the green canopy that is left is, in reality, already crisscrossed by roads, mining and logging concessions.'

The researchers have developed new maps of the forested regions, identifying that many of the wilderness forests are now confined to 'islands of parks and reserves' with the surrounding areas managed commercially for timber and other resources. The study also found the destruction in many regions, such as Venezuela, Central Africa, Chile and Russia had been severely underestimated. The good news is that this type of research is aiding the conservation of forests and in some areas helping to slow the destruction.

Shell buy-out

Shell Renewables has bought out a joint venture with Siemens and E.ON to become the world's fourth largest photovoltaic company. Shell formerly owned a 33 per cent stake in the joint venture company 'Siemens and Shell

Solar'. Siemens held a 34 per cent stake in the business and E.ON Energie held 33 per cent. Now that Shell is the sole shareholder, the business has been renamed Shell Solar. Shell Solar now has manufacturing capabilities of 60MW per year and facilities in Europe and North America with retail outlets on every continent.

GHG statements on Victorian electricity bills

Victorian electricity bills will soon carry a 'greenhouse gas statement', where customers can see an indication of their contribution to global warming. Victorians are largely dependent on fossil fuel for electricity, with around 90 per cent of the state's power being generated through the burning of brown coal. In the third or fourth quarter this year, Victorian retailers will need to disclose the greenhouse gas emissions associated with a customers' bill. The aim is to raise community awareness of the link between energy use and greenhouse gas emissions, enabling households to monitor GHG emissions over time. The GHG statement will only be an indication, not an exact measure of how many tonnes of greenhouse gas emissions were produced. Customers who have chosen to purchase a Green Power product will have a 'zero' GHG emissions rating. To measure the amount of GHG emissions per household, a greenhouse gas coefficient of 1.39 tonnes of CO_2 is attributed to every 1MWh of electricity consumed. The coefficient is derived from the National Greenhouse Gas Inventory data and reflects Victorian sources of electricity supply based on the previous calendar year. That is, the GHG statement will be an indication only, not an exact rating on a per-retailer basis which would recognise differences in the energy mix. For example, some retailers use more gas fired or hydro electricity in their energy mix, others use more brown coal. Nevertheless it is a great initiative that has been pushed for by environment groups for a number of years. The Alternative Technology Association has been campaigning to government for this initiative since 1998 and welcomes the move. The Victorian Government is the first in Australia to take this very important step.

Paint-on solar panels

Chemists at the University of California, Berkeley, have developed inexpensive plastic solar cells. The cell is a hybrid comprising tiny nanorods dispersed in an organic polymer or plastic. A layer just 200 nanometers thick is located between electrodes and can produce, at present, about 0.7 volts. The nanorod/polymer layers can be painted onto any surface, such as clothing, and potentially is able to provide electricity for low-power devices. The first of the solar cells have had efficiencies of just 1.7 per cent, compared to the more than 10 per cent efficiency of standard commercial photovoltaic technology—but the potential is exciting.

Legal action touted for polluting nations

The island nation of Tuvalu has announced its intention to investigate legal action against countries which refuse to ratify the Kyoto Protocol. Tuvalu is a tiny nation of atoll islands and its very existence is threatened by rising sea levels caused by global warming. Its Prime Minister, Mr Koloa Talake made the announcement at the Commonwealth Heads of Government meeting in Queensland earlier this year and was supported by two other Pacific Island nations, Kiribati and the Maldives. Tuvalu has engaged two law firms to investigate the potential for legal action against those countries, such as Australia and the United States, which have not committed to signing the treaty. *The Paper* reports that any legal action is likely to be more a publicity stunt and a way of raising awareness of the precarious existence of these island nations, than a way of achieving true climate justice, due to high costs and lengthy procedures.

Oz emissions blow-out

A leaked report has revealed that Australia's greenhouse gas emissions are continuing to increase, which the federal opposition claims throws into serious doubt the effectiveness of federal government abatement policies. The draft report was released by the opposition environment spokesman Kelvin Thomson and indicated that emissions would be 33 per cent higher in 2010 than in 1990—while Australia's target under the Kyoto Protocol is set at eight per cent higher than in 1990. Environment Minister Dr David Kemp maintains that Australia will meet its Kyoto commitments, even if it chooses not to ratify. A *Canberra Times* report highlighted that if Australia is to meet its target, emissions reductions were likely to come from a cut in land clearing which, if halted completely in 2010, would cause emissions to drop by an estimated 100 million tonnes, compared with 1990 emissions. A 100 million tonne drop would bring Australia's GHG emissions to 28 million tonnes above 1990 levels, or just over a seven per cent increase. Most of Australia's land clearing occurs in Queensland.

Wind supplies power to 10 million homes worldwide

Wind power now provides the electricity for more than 10 million homes worldwide, and is the fastest growing energy source in the world. An increase of 45 per cent, or 6500MW of installed capacity, in 2001 has brought the total of the world's wind energy capacity to 24,000MW. Australia currently has an installed capacity of 73MW, which is set to increase by 22MW shortly with the erection of towers at Stanwell Corporation's 22MW Toora wind farm in South Gippsland, which will be fully commissioned in July 2002.

New breed of diesel

Most people think of diesel vehicles as being dirty and polluting—and quite rightly so. Even though they use less fuel than petrol engines, and produce less CO_2, they produce far greater levels of particulates and other damaging emissions.

However, the new breed of diesel engines currently being developed are set to change that belief. A number of advances have contributed to improvements in emissions, noise levels and the general performance of these new diesels. A device known as the Common Rail is one of those advances. By allowing fuel to be injected at much higher pressures, engine efficiency is improved, especially at lower engine speeds. Direct injection, where fuel is injected directly into the combustion chamber, rather than a smaller separate chamber, has also improved engine efficiency considerably. These two advances, along with better injector designs and exhaust scrubbers currently on the drawing board, are set to make diesel vehicles far cleaner than most diesels on the road today.

So, running one of these new breed of vehicles on a more greenhouse-friendly fuel like biodiesel should mean far less emissions and less reliance on fossil fuels in the future.

Buying more energy efficient appliances or cars

My letter in issue 77 of *ReNew* prompted an editorial comment by Lance Turner, and a letter in issue 78 by Trevor Berrill. Both queried my rule of thumb that the energy, in megawatt-hours, embodied in an object is one hundredth of the price in dollars. Trevor cites a rule of thumb of Manfred Lenzen that the embodied energy is 3 kilowatt-hours per dollar capital cost, which is one third of my estimate.

The mismatch is due to my looser use of the word 'embodied'. It is a very difficult task to track the energy physically embodied in an object as materials are mined, processed, and transported. Costing this energy is complicated when some of the energy may have been bought at a discount price.

The basis of my rule of thumb is very simple. I express the whole of the cost of an item as energy. I use a rate of 10 cents per kilowatt-hour.

My reasoning is that practically every cent received by the vendor will finish up as energy use. Electric power for an aluminium smelter is direct energy use. Less direct use happens like this: part of the price goes to advertising; an advertising executive spends part of his salary on childcare; the carer buys petrol to drive to work. Money has become energy use.

I welcome discussion on the idea of expressing prices in energy terms. It seems to me that most things are priced in a way that relates directly to energy use.

Ironically, we can save energy by producing goods in places with very low standards of living. Employees who cannot afford cars, air conditioners or airfares use very little energy. Australian staff demand salaries that permit profligate energy use.

The point of my letter was that buying new cars and appliances might waste more energy than using old ones that are inefficient. I believe this may be true even if the embodied energy is only 3 kilowatt-hours per dollar, rather than the10 kilowatt-hours per dollar that I suggest.

Garry Speight, Manilla NSW

Refrigeration correction

I'm always looking forward to *ReNew* magazine, and usually read it from cover to cover. I also use the product buyers guide to give me an overview of what is available on the market and their prices.

On the buyers guide for fridges, I would like to point out a small mistake in the introductory paragraph. When describing the compressor system, you state that 'a gas is compressed by a motor-driven pump to form a liquid, and pumped into the evaporator plate inside the fridge. Here it expands back into a gas and, in doing so, absorbs heat. The heated gas then moves to the condenser coils on the back of the fridge where it cools.'

This is not correct, as the sequence of the gas cycle is as follows:

The refrigeration medium (R134a) enters the compressor as a low pressure, low temperature gas and leaves it in a high pressure, high temperature state. It then flows to the condenser coils at the back of the fridge, where it cools down and liquefies (still at high pressure). Before the next stage, the evaporator, is an orifice through which the fluid must flow. After the orifice, the fluid is at a low pressure and will evaporate by absorbing energy (heat) through the evaporator. The fluid turns back into a gas and restarts the cycle at the compressor.

Thomas Pluess, Sun Power Mackay
sunpowermackay@bigpond.com

Earthing and safety

I find it disappointing that *ReNew* issue 79 contained not one, but two wiring recommendations that do not comply to AS 4509 Stand-alone Power Systems, and with no disclaimer.

AS 4509 Part 1, 'Safety requirements' and Part 3, 'Installation and maintenance', have been available in final form for some years. Part 2, 'System design guidelines', should be available in final form by the time *ReNew* issue 80 is published.

The first thing to note is that

AS 4509.1-1999 Section 2.1 says that all wiring 'shall be in accordance with AS 3000'.

The first non-compliant recommendation is in the letter and response entitled 'More earthing feedback' on page 10. Both Peter Laughton and Chris Stork should be made aware that AS/NZS 3000:2000 Section 2.8.2.3 is entitled 'Switches in earthing conductors prohibited', and says (in bold type) 'An earthing conductor shall not be isolated or switched. A combined neutral and earthing conductor shall not be isolated or switched.' The definition of neutral conductor, Section 1.4.63, includes '…the conductor of a two wire system which is earthed at its origin.'

In case that's not clear, we have in 2.8.3.1 'In DC systems, a switching device shall interrupt all poles, except in the case of a pole connected to earth or to a protective earthing conductor.'

The second non-compliant recommendation is in the article 'A timer for 24 volts' on page 52. The author helpfully suggests two ways to prevent the modified timer from being plugged into a 240 volt AC socket, but these require that the 24 volt DC socket that the timer plugs into should either be a standard 240 volt AC type socket with the earth hole drilled out, or an AC socket for another country.

The author also failed to suggest any way, other than a warning label, to prevent 240 volt AC appliances being plugged into the socket on the timer. Also, the fact that the timer's socket is unmodified means that the 24 volt DC appliance to be switched by it must have a plug which is capable of being plugged into a 240 volt AC socket!

AS/NZS 3000:2000 Section 7.7.11 is entitled 'Plugs and socket-outlets', and says 'Plugs and socket-outlets for SELV (separated extra-low voltage) and PELV (protected extra-low voltage) shall comply with the following:

(a) Plugs shall not be able to enter socket-outlets of other voltage systems.

(b) Socket-outlets shall not accept plugs of other voltage systems.

(c) Socket-outlets shall not have a contact for a preventive earthing conductor.'

Other country's LV plugs and sockets are not suitable for use as ELV sockets because they either have an earth contact; the plugs are no longer polarised if the earth pin is removed, or (as mentioned in the article) they have switches which are not rated for DC.

Standard ELV plugs and sockets have two pins in a T pattern. They do not correspond to any other country's LV plugs and sockets. They are readily available and are typically described in catalogs as 'unswitched, two pin, polarised, ELV (or 32V)'.

Of course, adapters between these two pin ELV sockets and standard three pin LV sockets are not available, and should not be made by anyone. So I suggest the original 240 volt AC plug and socket in the timer should be completely disconnected internally and a standard ELV plug and socket connected by short lengths of cable, properly retained and grommetted, through holes drilled in the case of the timer.

Dave Keenan, Brisbane QLD

Dave, your suggestion for the timer is the ideal solution for safety and compatibility with DC appliances, and is such an obvious solution I have no idea why I did not think of it!

Lance Turner

At no time did I mention that the negative side of the battery bank—which is usually earthed—be connected to a switchable device, and at no time did I mention that my isolation transformer is double switched, with a centre-tapped earth. It is purely for testing purposes.

What the reader sees in the printing is not always what is intended (double meaning sometimes), and space is always an issue to clarify everything. If someone wishes to purchase one of these from my website, they may do so and have exactly the same as I do.

Chris Stork

Biodiesel

Your article on biodiesel cars was a welcome antidote to the barrage of television commercials for new cars. It seems extraordinary that there are much more economical cars in world production, most of which are not available in Australia, yet car makers are having an uphill battle selling their cars here and people constantly complain about the cost of fuel. The solution seems obvious.

Out of all the late model cars that I could possible afford, only a few of the Daihatsu models are better on fuel than my minivan. These are only slightly better and they still use dirty old petrol.

Furthermore, with the relatively small number of cars that Daihatsu sells and the constant model changes Japanese manufacturers go in for, I would be a bit worried about the price and availability of replacement parts. I could, in theory, change the valve and valve seatings to stainless steel ones to allow the use of unleaded petrol but without a catalytic converter. I have heard it would actually be more polluting than LRP. Is this correct? Anyone? I have sometimes seen advertised in the Trading Post VW Golf diesels made in the 1970s for around $4000. Any information on model numbers and fuel consumption would be welcome.

Considering cars are capable of going well over the speed limit, it would seem to me that car races have outlived their purpose. Maybe they should be replaced with economy trials. The question would not be which car in its class gets there first, but which one uses the least amount of fuel.

On a completely different note, I use a drip filter coffee machine to make tea and coffee, as it is the most economical method, but occasionally the machine is left on. Is there a timer on the market that would automatically turn the machine off after a certain period of time like you get on a toaster oven?

Alexander Cranford,
alexcran@tpg.com.au

Refrigeration issues

We are now in the process of building a strawbale home for ourselves, with no mains power. We are installing a 5.5kW solar power system and solar hot water.

It is the fridge issue that intrigues me the most in the new system and it was your survey on fridges in *ReNew* issue 79 that made me sit and write to you.

We have spoken to many people and looked at gas, AC and DC versions, but even at around $2000 (which I don't want to spend) I still can't really get what I think makes the most sense in our case.

We have two children who can spend a long time staring into the open fridge to see if anything new has magically been addded to the shelves during the past 10 minutes. They don't notice their cold feet, as all the cold air escapes onto them (or maybe they do and this is the purpose of the exercise?).

While I am still on mains power it is annoying, but in a year's time, when we are fully on solar, it will become a constant battleground I wish to avoid. Hence, we decided that we'll have a top opening fridge—we don't need a freezer—powered by 24 volts DC.

Your issue included reference to an efficient (380Wh/day at 28° to 35°C) 160 litre Fisher and Paykel unit that is powered by a 12/24 volt Danfoss BD35F compressor, mere cost $1900—which, however, still has drawbacks, apart from the cost. Ventilation is an issue if it is installed under a bench in the kitchen. Also, the unit is relatively narrow but deep (611mm wide x 662mm deep x 860mm high) with two baskets. A 12 year old won't be able to reach past the baskets.

My idea is a two-door unit separating the kids' stuff from other items (so they open a smaller space every time) using a freezer cabinet (second hand?) for the extra insulation they add to them—possibly turned on its back if previously a stand-up unit.

We found at Waeco the Danfoss 35 and 50 compressor units, pre-gassed, which can be installed up to 2.5 metres from the evaporator—that is, under the house in the coolest, best ventilated spot. I am now looking for two-door freezers, chest or upright, and some info on how to do the conversion.

How can this be done? Has anyone done this? Where would be the best place to mount an evaporator?

Dunja Kuhr,
www.strawbalecottage.com

A contentious issue!

The article 'System earthing—getting it right' in issue 78 discusses only half of what is required for ESD protection. Good earthing will protect against ESD damage on the grounded leg of a circuit, but does nothing to protect the active (that is, ungrounded) leg. This is akin to protecting against intruders by locking only the front door whilst leaving the back door unlocked.

Planetary Power operates in a region of Australia where there is a lot of lightning activity. For example, our own premises have been struck at least 12 times in the past few months. In conjunction with Novaris Technologies Pty Ltd we developed a systematic approach to lightning protection, using surge diverters on the active legs of all AC and DC circuits. It may not be widely known that surge diverters specifically for 12, 24 and 48 volt DC circuits are manufactured by Novaris Technologies and are commercially available in Australia.

Inverters and some types of micro-hydro controllers are particularly vulnerable to lightning damage, and we used to see about three failures a year due to lightning. All of our new installations are now fitted with surge diverters and about 15 existing installations have also had diverters retrofitted. We have had no reports of lightning damage in the past two years, so it appears that this approach is effective.

Full details, including installation notes, photos and a wiring diagram, may be found at www.planetarypower.com.au/info/lightning.

Max Enfield, Planetary Power

Oil press design needed

I found an article by an NGO on a hand oil press for edible and lamp oils. The NGO was Approtech and the area was around Nairobi. I cannot obtain any information on the construction details. I am writing from WAU in Papua New Guinea and we have a need of a design for a simple oil press suitable for low-tech construction.

We are at present producing dried rainforest mushrooms with a cabinet-type hot air drier directly fired by charcoal. The charcoal is a byproduct of plantation logging. Solar heaters (suspended collector type) have been tried but there is too much cloud cover, especially in the mushroom season.

There are many villagers here who are remote from the main roads. These people need high-value-added crops and simple technology to assist them to replace manufactured products with locally produced ones.

You may be able to assist in directing me to the right channels.

Tony Flynn, aflynn@datec.net.pg

Fridge feedback

Judging from a comment made in the RAPS Fridge Buyers Guide featured in *ReNew* 79, it looks as though Peter Wood has been taken in by corporate greenwash.

In this article he refers to the HFC (hydrofluorocarbon) R134a as being far more environmentally-sound than CFCs, but unfortunately it is far from being a good replacement. Although it is ozone safe, it has 1300 times the global warming potential of carbon dioxide. A report produced by Burnbank Consulting anticipates a 480 per cent increase in Australian HFC emissions between 2000 and 2020.

When CFCs were being phased out, the chemical industry invested heavily in HFCs as replacement refrigerants, and their use is promoted by an influential lobby which goes under names such as the Alliance for Responsible Atmospheric Policy, based in the US.

Of the brands of fridges covered in the article, Vestfrost uses environmentally preferable hydrocarbons both as a refrigerant and for blowing the insulation. It is possible that some others are too, and from an environmental viewpoint there is great value in checking that they are using hydrocarbons before buying.

On another subject, it is unlikely that the insulation in an imported fridge would be blown using CFCs, as the Montreal Protocol prohibits the import of products made using these chemicals into 'developed' countries. However, HCFCs (hydrochlorofluorocarbons) may be used for such imported products, and are worth avoiding as they are ozone-depleting.

Martin Oliver, Lismore NSW

Happy on biodiesel

I was impressed to see the article on biodiesel in your last magazine. My husband has been operating his vehicle on biodiesel for the past year with good results. He has a Nissan 2.2 D 4x4. Recently we purchased a Mazda 626 which is also running on biodiesel. I am so impressed with the cleanliness of the product. We make it in the shed on our farm and, although it is time consuming, we are saving a lot of money with fuel costs. I am so happy when I drive along on the highway at the same speed as every other vehicle knowing that we are not polluting the planet.

I spoke with the local post master this morning who was driving up the hill following my husband home last week. He said that the smell coming from our ute made him very hungry and he considered giving up his healthy diet for a fish and chip meal!

Yes, the biodiesel certainly smells like the fish and chip shop, but I'm pleased to say that we haven't put on any weight since using biodiesel!

Dominique Finney,
Flaxton Queensland

Biodiesel cars

Hi Phillip, what a great article in *ReNew*. I too have been trying to work out which car to use. As a possible new convert to the alternative fuel idea, I found that your article came at a very opportune time—it has saved me from a lot of research. But I was wondering, with the Mercs referred to as imported in late 60s to mid 70s having an ID of C200 CDi or C220 CDi, what does CDi stand for?

I was unable to find info on older Mercs. I am looking at a 1976 240 diesel, it had a full rebuild (new motor) 35,000 kilometres ago. My question is, does it have the 220CDi referred to in the article? As it is an old mechanical injection model, is it a waste of time trying to run it on biodiesel?

Melville Leslie, Cobargo NSW

Generally speaking, many car manufacturers specify the vehicle model and type by the designation, and there is a kind of semi-standard (but this does vary a huge amount). In many cases, the first name, letter or letters indicates the model type, then a combination of numbers and more letters that usually indicates the engine size and model sub-types. With Mercedes Benz, for example, the first letter, such as 'C' or 'E', designates the model type. This is followed by a number such as '220' or '450', which is the engine size in centilitres (hundredths of a litre). Other commonly used engine size measurements include millilitres (or cubic centimeters), litres and cubic inches (now usually only used for North American vehicles). So a Merc 220, for example, has a 220 cL or 2.2 litre motor.

Some models have additional letters which tell the model sub-type—such as 'CDi', which indicates that it is a Diesel engined fuel injected model. Other letters commonly used by manufacturers include 'S' which can be 'Standard' as with the standard (or normally) aspirated engine, such as the Golf SDi, and 'T' for turbocharged, such as the Landrover TDi. However, there are always numerous exceptions, and 'S', for example, can also denote 'sports' models or 'supercharged' or almost anything else.

Regarding what vehicles are okay to use with biodiesel, there are a lot of conflicting statements around. Many manufacturers may say that all models after such and such a date are okay with biodiesel or that they 'should be' or that they don't know. In some cases, such as VW, they say that all their cars from 1998 onwards are fine with biodiesel but then Bosch (who make their fuel injection systems) dispute this.

Generally, older type cars may (or may not) experience problems, as the biodiesel may affect o-rings in the fuel pump and other components, as well as fuel lines, while newer cars are okay, but it is very hard to know for sure.

With my nine year old car, I've done 30,000km on biodiesel and no problems (yet). The worst that could really happen is that the fuel pump fails, and that will cost about $1200 for my car. But if one looks at it from a cost point of view, so far I've saved about $1,300 in fuel costs, so if the pump blows up today I'm still ahead. The other thing is that I would rather run my car on a fuel that is environmentally, socially and economically (to Australia) less damaging than petroleum diesel, so even if it costs more, I'm still willing to do it.

Phillip Calais

Beautiful results with straw

Backing onto a national park, and with no connection to outside services except for a telephone line, Phil Cutler has found his bit of paradise. He tells us about his strawbale home situated in a rural area north west of Brisbane.

Like many, my dream of building a sustainable house started many years ago with magazines such as *Soft Technology, Owner Builder* and *Grass Roots* providing inspiration and ideas. Now I find myself in the fortunate position of being able to turn this dream into reality.

Having considered various alternative building methods, for me the one that was leagues ahead of all the others in terms of speed, ease of building and 'feel' was strawbale.

So, drawings of what I wanted in hand, off I went to a local engineer who had designed and built several other strawbale houses over the years. Over the following weeks he turned my rough sketches and ideas into workable plans that would be acceptable to the local council. It wasn't long before the plans were certified and council approved. Now all I had to do was find a builder.

I contacted just about all the licensed builders in the local area, only to be met by strange looks and such comments as 'You've got to be joking!' and 'You want to build what?'. I was starting to get somewhat disillusioned, and wondered if I would ever get my dream house built. Then, out of the blue, a friend rang to tell me that they had met somebody local who had built his own strawbale house and he was also a registered builder. My faith in humanity was restored, and construction started a couple of months later.

The house

I wanted something open and airy that incorporated passive-solar features and made the most of my fantastic views. I also wanted to stay right away from conventional 90 degree corners and low ceilings, and give the place an 'organic' feel. It also had to be functional and easy to live in. In addition to the main open living area and kitchen, there is an entrance hall, indoor and outdoor bathroom, separate toilet and three bedrooms; two downstairs and the main bedroom upstairs.

The construction of the house is a standard slab-on-ground with timber frames and a tin roof. With the strawbales, I opted for the infill method of construction. This essentially means that the house has a timber frame for structural integrity and the bales are stacked in a running bond within these frames. This method, as well as being easier to build, is far more common than the bales being used as a load-

Picture: Grahame Day

The north face of Phil's home is both dramatic and excellent for solar gain!

bearing element, and is much more acceptable to local councils. The house itself is fairly moderate in size, at about 140m² (or around 15 squares). Approximately 400 standard straw bales were required and were sourced from a local farm. The render mix is a standard three parts sand to one part cement with a waterproofing agent added. A yellow oxide was added to the top coat to provide the permanent colour.

A series of freestanding courtyard walls that extend from the front are of a different construction method. The bales in these walls have been compressed, tied down with fencing wire secured into the footings and tightened with gripples. The thick coat of cement render then makes them a very solid structure.

Being on a large, five acre rural block, situated north-west of Brisbane, meant that I wasn't restricted in where and how I sited the house. This allowed me to orient the house to true north for maximum passive solar gain. The design placed most of the windows on the north side and still allowed me to have a south-facing roof in order to minimise solar gain in summer for maximum efficiency. A minimum of R3.5 insulation has been used in the roof and in the north facing, non-strawbale walls primarily to keep the summer heat out. Thermal mass is provided by an extra thick, coloured concrete slab. With the strawbale walls providing superb thermal insulation the house should stay warm in winter and, more importantly up here in the sub-tropics, cool in summer.

Since moving into my home in late March 2002, the internal temperature has not dropped below 20°C, despite overnight temperatures dropping to around the 14 degree mark.

Renewable energy systems

Despite the fact that electricity is readily available at the corner of my land, being an ardent believer in solar power, I decided from the outset that I would have a stand-alone power system. This was a moral decision, rather than a financial one. I calculated my average power consumption at around 3.6kWh per day, which included a 'normal', off-the-shelf energy-efficient refrigerator, compact fluorescent lights and an energy-efficient front-loading washing machine.

The refrigerator is rated on the government website: www.energyefficient.gov.au at 481kWh per year or approximately 1.3kWh per day, one third of my average daily power consumption. I did investigate gas refrigerators as a way of reducing my daily power consumption. However, the high cost of gas fridges, coupled with the generous state and federal government rebates on the solar power system influenced my decision to use a normal fridge and put in a bigger power system to cope with it. The house is completely wired for 240 volt, with no extra-low-voltage circuits at all.

The power system consists of eight 150 watt, 24 volt, BP monocrystalline panels and an Air 403X wind generator. These feed, via a Plasmatronics PL40 regulator with shunt adaptor, to an 1100Ah, 24 volt battery bank. A Selectronic SA32 sinewave inverter completes the system (see Figure 1). For aesthetic reasons and to overcome roof shading problems, the panels are mounted on a free-standing frame, some 20m from the house, near the wind generator. Although this is not ideal, extra heavy duty cable has been used to reduce cable losses where necessary. The PV system will produce a maximum of 5.6kWh per day in summer and a minimum of 4.3kWh in winter. Taking into account cable losses, battery and inverter inefficiencies, this will provide around 95 per cent of my annual energy requirements with the remaining five per cent coming from the wind generator.

As I am in a valley, I am not in an ideal wind generator position. However, in winter, the terrain channels the wind with a fair degree of ferocity down the valley. I am relying on this factor for my wind energy. Students from the local TAFE, studying the wind module of the Certificate IV in Renewable Energy Technologies, have recently erected an anemometer and data logger adjacent to my wind generator as part of their studies. This will give me some accurate wind data figures for future comparisons.

Picture: Grahame Day

Phil Cutler in his strawbale kitchen.

The rebates from the state and federal governments and the savings I was able to gain by signing over my Renewable Energy Certificates (RECs), essentially covered two thirds of the cost of both

Picture: Grahame Day

Left: The main living area looking north.
Above: Phil's electricity supply.

the PV system and the solar hot water. (For more information about RECs, see the website: www.orer.gov.au or ph: (02) 6274 2192 – *Ed*).

Hot water is supplied from a Solar Edwards 300 litre system, with no boosting. I realise this is a little bit of a gamble, but electric boosting is not an option and a gas booster would have cost almost as much as the solar hot water system itself. Although the system seems to be working well, I would have preferred a higher level of after-sales service from the local agent.

Water and waste treatment systems

On-site waste treatment comprises evaporation trenches for the greywater and an Enviroloo dry composting toilet (this being the only unit I found which is totally sealed and could be installed under a slab). Greywater is disposed of on site through two evaporation/absorption trenches.

The greywater is not treated in any way. It passes through a grease trap to remove any solids then flows to the trenches some 60 metres from the house. These are 400mm wide and deep and are filled with gravel. The water is dispersed through a perforated pipe that runs the full length of both trenches. This gravel is then covered with a geo-textile mat and the top soil is replaced on top of this. The greywater evaporation trenches are currently surrounded by banana and paw paw trees, which both love the moisture and nutrients. The system was designed and specified by an engineer and installed by the plumber. So far, it has performed flawlessly. There were no problems with the council from either system. I did get one phone call from the health department regarding the toilet, but when I explained it was a commercial unit they said that it was fine, and that was the last I heard.

There is no town water available, all water is collected from the roof and stored in two 5,000 gallon (22,500 litre) above-ground tanks.

(Almost) no bills!

With the combination of all of these systems, it means that my only connection to the outside world is the phone line, which, I must say, is pretty hard to do without.

Results

Despite the building taking twice as long to complete as first planned, due mainly to the unusual design, I am very happy with the results. All the various energy-saving and energy-efficient features of the house seem to be working as expected. Now that I am in and settled, I will monitor factors such as internal temperature, energy use and system efficiency over the coming year. My intent is to write a follow up article to let you know how well it all works in practice.

Open house

I had two open houses during the construction of my house, mainly to promote the strawbale construction aspect. Both of these were well attended, with around 30 to 40 people on each occasion. I also held a tour in March for members of the Alternative Technology Association (ATA) and ANZSES (Australian New Zealand Solar Energy Society). This was specifically for members, although quite a few non-members heard about it and came along. This was a full demonstration and explanation of all of the house's features. This was also very well attended, with around 60 to 70 people coming along. I may have another tour later in the year, probably in five or six months time.

In the meantime, anyone wanting

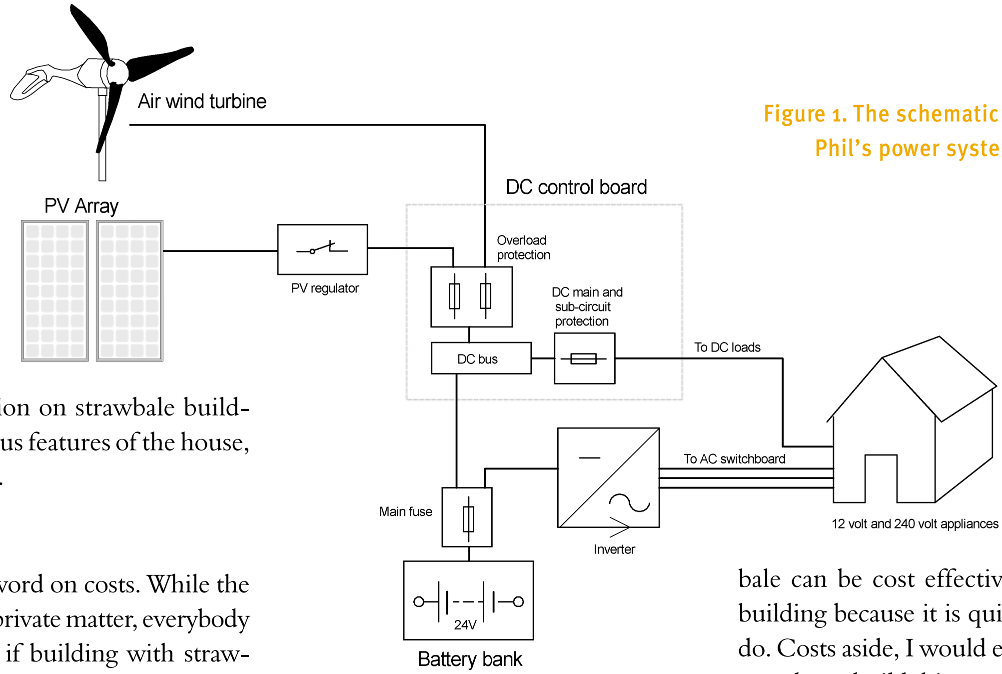


Figure 1. The schematic of Phil's power system.

more information on strawbale building, or the various features of the house, can contact me.

Cost

Finally, a brief word on costs. While the overall cost is a private matter, everybody wants to know if building with strawbales is cheaper than building with conventional materials. In my experience, there is very little difference between them. With my particular house, the costs were associated with the unusual design more than the construction method. In an average house, the cost of the walls is only about 15 per cent of the overall cost of the house, so a saving of, say, 20 per cent on this is a pretty small saving on the total cost. Where strawbale can be cost effective is in owner building because it is quick and easy to do. Costs aside, I would encourage anyone else to build this way as the finished effect and feel is just so wonderful. ✲

Phil Cutler is the convenor of the Alternative Technology Association Brisbane Branch. Contact Phil by email: pcutler@tpg.com.au

Climate action—and inaction

Alan Hoban compares the effectiveness of international responses to climate change and identifies some interesting correlations

This year, Mele Village in Vanuatu is commencing relocation to higher ground. Exacerbated coastal flooding and storm surges, coupled with the gradual creeping of the oceans, mean they cannot continue to support their population without moving. What have the people of Mele Village contributed to the concentration of carbon dioxide in the atmosphere? Perhaps no more than several tonnes of carbon dioxide, when Australia's annual emissions are 27 tonnes per person.

The Australian government's current climate policy is that any approach to reducing greenhouse gas emissions must include limits on the emissions of poorer countries too. Nonetheless, the government often restates its committed to meeting its Kyoto Protocol target, but without commiting to ratifying it.

Similarly, the government has put $1 billion into programs to reduce its greenhouse gas emissions, yet recent projections from the Australian Greenhouse Office (AGO) estimate net greenhouse gas emissions in 2010 will be between 122 per cent and 144 per cent of 1990 emissions, compared to our Kyoto target of 108 per cent.

How should we interpret these contradictions in Australia's climate policy, and, more importantly, what sort of policy should Australia adopt?

Environmentalists are often accused of not being pragmatic or realistic in their requests of government. So, for the purposes of this article, let's examine some of the emission reduction policies that have already been implemented internationally with demonstrated success.

Current context

This year is the 10th anniversary of the United Nations Rio Earth Summit, when world governments acknowledged the threat of climate change and agreed to take action to 'prevent dangerous anthropogenic intervention with the climate system'.

Last year, the Intergovernmental Panel on Climate Change (IPCC) acknowledged that, to stabilise carbon dioxide concentrations in the atmosphere, 'emissions would need to decline to a very small fraction of current emissions'. Yet, despite all the warnings and negotiations, since 1990 world emissions have risen 6.7 per cent. Most concerning though, is that the wealthiest country's emissions are growing faster than the world average, having increased by 10 per cent in that time.

Photo: Pilar de la Torre

It is not as though the governments of those countries have failed to implement policies or strategies to reduce their emissions. The problem is that most of the policies they have implemented are inadequate to reduce emissions.

Taking all emission sources into account, since 1990, Australia's emissions have risen 14 per cent above 1990 levels, Canada's emissions have risen 15 per cent despite a target of -6.0 per cent and New Zealand is 6.0 per cent above its stabilisation target.

Conversely, the United Kingdom has successfully reduced its emissions to 14.5 per cent below 1990 levels. Its Kyoto target is -8.0 per cent and was further reduced to a legally binding -12.5 per cent under the EU burden sharing agreement. The UK is now pursuing a more rigorous target of 20 per cent reductions.

Germany also reduced its emissions by 14.5 per cent and is well on the way to achieving its EU target of -21 per cent.

What leads to such a divergence in the effectiveness of the climate policies of countries like Australia and the United Kingdom? Many claim Australia has higher emissions due to its heavy resource base, including a reliance on coal. This may go some way to explaining why Australia's emissions are higher per capita than the UK, but it does not explain why the two countries have significantly different trends.

The performance of countries towards meeting their Kyoto targets can be grouped into three categories: those with positive targets and positive emissions growth, those with negative targets and positive emissions growth, and those countries who have actually reduced their emissions. Only four industrialised countries fit into the last category: Germany, Luxemburg, the UK and Russia (Russia's emissions fell due to its economic recession).

Voluntary measures: the carrot versus the stick

The factor that most typifies the climate policies of those countries that have not reduced their emissions is a reliance on voluntary agreements. Voluntary agreements, generally with industry, have become a popular tool with governments eager to avoid putting the real heat on polluters.

Schemes like the US Climate Challenge, the Canadian Voluntary Challenge and the Australian Greenhouse Challenge all serve to engage industry in the greenhouse debate, yet these three programs exist in the very countries with some of the highest emissions growth.

The philosophy of providing encouragement and recognition for emissions abatement, rather than regulation and economic measures, dominates the approaches of Australia, Canada, New Zealand and the US. All four countries have experienced emissions blowouts.

To their credit, voluntary agreements can influence the environmental culture of corporations and other decision-makers by raising the profile of greenhouse gas performance or energy efficiency objectives.

However, according to an OECD study, voluntary measures are only likely to bring about GHG emission reductions where significant 'no-regrets' opportunities exist. In other words, voluntary programs can help industry identify ways to increase profits through doing more with less, although these opportunities are limited by the skewed effect of fossil fuel subsidies, discussed later.

Indeed, in its first commitment period, 90 per cent of participants in Australia's Greenhouse Challenge Program failed to meet their own emission reduction goals, despite most of them lessening their expected emissions savings by about 10 per cent. Indeed, around half of the participants felt that the Challenge did not play an important role in stimulating abatement action.

Furthermore, most voluntary programs measure emission reductions below business-as-usual baselines (BAU). In other words, they only seek reductions in the pace of emissions growth.

To achieve stabilisation of emissions, and then real emissions reductions, an OECD report states the need for some type of 'stick' to accompany the no-regrets 'carrot'.

This could take the form of legally binding, target-based agreements with penalties for non-compliance, or economic instruments such as carbon or energy taxes. Germany and the UK, two countries to have actually reduced their emissions, have adopted the latter option.

Heading in the opposite direction, the US has postponed binding targets for industry until 2018 and, by tying its emissions to economic growth, is on course to increase its emissions to 29 per cent above 1990 levels. The Australia–US Climate Action Partnership was announced on 27 February 2002, and, while specifics of the agreement are yet to be made public, emissions reductions are unlikely to result. Instead, it appears as an Australian endorsement of the US rejection of the Kyoto Protocol.

Economic instruments

It is obviously counter-intuitive to continue to attempt to reduce emissions while subsidising fossil fuels.

Globally, the IPCC estimates that removing the $235 to $350 billion worth of fossil fuel subsidies would reduce emissions by four to 18 per cent. The UK has reduced its coal subsidies from $11 billion to zero.

Most voluntary agreements exist in countries with significant fossil fuel subsidies. A recent Australian Conservation Foundation study found ongoing financial incentives and subsidies to fossil fuel production and consumption in Australia amount to $8.52 billion annually. In the US, this figure is $29 to $46 billion.

In 2001, the UK, one of the few OECD countries to have reduced its greenhouse gas emissions over the past decade, implemented a climate change levy applicable to energy used in the business and public sectors. The levy is revenue neutral, with funds contributing in part to energy efficiency measures. There is also an 80 per cent concession available to energy-intensive industries that enter into emission reduction agreements. Renewable energy and co-generation (known in the UK as combined heat and power) are exempt from this levy, increasing their competitiveness.

The British government now believes that by reducing emissions it can increase business competitiveness by increasing efficiency and opening up new markets in low carbon technologies, and established a Carbon Trust that provides funds for approved energy saving investments.

Denmark has also successfully implemented energy taxes to change the price difference between high and low CO_2 energy sources. In the Netherlands, renewables are exempt from the regulatory energy tax, and cogeneration receives a concession (leading to relatively lower prices).

In 2000, Germany introduced an Eco Tax targeting road fuel, oil, gas and electricity. Similar to the UK carbon levy, there are exemptions for energy-intensive industries including:

- Manufacturing, forestry and agricultural firms pay only 20 per cent of all energy taxes.
- The industrial sector pays only 20 per cent of the standard electricity tax.
- Cogeneration plants operating at least at 70 per cent of their capacity, are exempt from tax on petroleum products.
- Cogeneration with an electricity ef-

Existing carbon taxes

Finland: The first country to implement a carbon tax, but this was reduced when they joined the EU, due to competitiveness. Now at $34 per tonne CO_2, there is a 39 per cent concession for industry and major polluters.

Germany: Tax on oil, gas and electricity. Revenue used to lower old age pension premiums. Has increased the consumer price of petrol by four per cent and of electricity by seven per cent.

France: Is considering a carbon tax of $150 to $200 per tonne of CO_2, which could rise as high as $500 by 2010.

Britain: Climate change levy. Revenue recycled as reduced employment taxes, with 80 per cent rebate for industries that undertake energy saving activities.

Norway: Tax on offshore oil and gas production that reduced emissions by three to four per cent. Considering a carbon tax of $88 tonne of CO_2 and a landfill disposal tax.

Switzerland: Has a mileage tax on heavy vehicles—revenue directed to public transport. If voluntary emission reduction programs don't work, they plan to introduce a carbon tax in 2004 at $250 per-tonne with exemptions for industrial sectors that achieve voluntary reductions.

Netherlands: Green taxes account for 14 per cent of national taxes. A fuel tax has reportedly saved 1.7 million tonnes of CO_2 since 1994.

Denmark: Has had an energy tax in place since 1966—resulting in a drop in residential fuel consumption by 15 per cent. Wind energy producers also receive Eco Tax relief worth 16 cents per kWh.

Sweden: The Green Tax Commission estimates that their CO_2 tax caused an 11 per cent reduction in CO_2 emissions from 1987 to 1994. As with most EU countries, it is allowing major industries to be exempt when they face cross border competition with companies without such taxes.

ficiency factor of at least 57.5 per cent are granted a 10 year exemption from tax on petroleum products.

The Eco Tax was praised by the OECD as 'an important climate protection measure by the German government' and plans exist for an EU wide energy tax. This would go some way to reducing the current exemptions given to industries that are in direct competition with industries from non-energy taxed countries.

However, it is not all rosy when it comes to energy taxes in Europe. Plans for an EU-wide energy tax have been delayed as Spain and Britain want EU-wide energy market liberalisation to precede the tax. In Denmark and Sweden, energy-intensive sectors have either been excluded from energy taxes or are subject to a reduced tax rate. This has weakened their motivation to save energy. It has also led to the energy tax burden falling disproportionately on households. Similarly, in Germany, social movements have commented that the Eco Tax was a trade-off for reduced taxation on big business. Clearly, carbon or energy taxes cannot be implemented in isolation of encompassing issues of social justice.

Renewables

Rapid uptake of renewable energy is at the heart of any successful climate policy.

Australia's target of generating an additional 9500 giga-watt hours of renewable generation by 2010, representing an increase of 0.5 per cent of electricity from renewable sources, falls well short of international standards.

The UK wants to have 10 per cent of electricity generated from renewable sources by 2010 (an increase of five per cent), while Scotland has set an 18 per cent target nationally, Canada has a 20 per cent target for government, and New Zealand is aiming for at least a 19 per cent increase in renewable capacity by that date. The commitment to non-fossil fuel power in the UK has reportedly halved the price of renewable electricity since 1990. The German initiative to cover 50,000 roofs with solar panels has been expanded to 100,000 roofs, and subsidises owners of energy-efficient houses.

Residential demand management

In the UK, electricity and gas retailers are obligated under the Energy Efficiency Commitment to encourage or assist customers to take up energy saving opportunities, particularly in low-income households. The EEC gives the government the regulatory framework it needs to require stronger commitments to energy efficiency from electricity retailers.

To reduce energy used in heating and to offset the carbon levy, Scotland and

Northern Ireland both offer £500 worth of insulation for low income households.

New Zealand has a target of 20 per cent improved energy efficiency by 2012, doubling the current rate of improvement.

Government structures

For effective policies to be implemented, there needs to be an adequate government structure in place to draft and implement legislation.

In Australia, the Ministers for Environment and Heritage, Agriculture and Rural Affairs, Industry and Primary Resources, Transport, and for Foreign Affairs and Trade can all veto policies proposed by the Australian Greenhouse Office. Unsurprisingly, it is only the lowest common denominator policies that get approved.

Effective government structures exist in the UK and Denmark. In Denmark for example, the Greenhouse Office is one of the most senior government departments and gets a right of veto over policies proposed by many other government departments, depending on their impact on emissions.

The higher the greenhouse office is within the government hierarchy, the more effective and holistic its policies are likely to be.

Reserve packages

It is evident that existing policies in most countries are inadequate to achieve the emission reductions required by the Kyoto Protocol (about five per cent), let alone reducing emissions by the scale necessary to actually prevent dangerous climate change (60 to 90 per cent).

Having recognised this, many countries have developed a set of reserve policies which could be implemented closer to the end of the first commitment period. Since Kyoto performance is measured as the average of 2008 and 2012 emissions, countries could commence late with concerted emission reduction programs. The motivation being that non-compliance with the Kyoto Protocol could incur a penalty of 1.3 tonnes for every tonne short of their target, to be made up during the second commitment period.

New Zealand is considering moving from its voluntary agreements with industry toward more challenging binding agreements coupled with penalties and tax incentives. In the Netherlands, where electricity use has increased 33 per cent since 1990, existing policy measures are expected to result in a five per cent increase in GHGs (compared to its target of six per cent reductions). A reserve package of policies at the government's disposal includes an energy tax and/or excise duties on motor fuels, reducing NO_2 emissions from industry and underground storage of CO_2 produced from large industries. About half of the policy shortfall, or 25 million tonnes, is likely to be sourced abroad through the Kyoto flexibility mechanisms, such as carbon sinks and clean development credits.

All the 'Economies in transition'—mainly eastern European states—have reduced their emissions well beyond their Kyoto targets due to the economic recession in the region. Under the rules of the Kyoto Protocol, these countries could sell their emissions savings to other countries or companies, often referred to as the trade of 'hot air'.

Conclusion

While nearly all countries now have emission reduction programs, it is evident that some of these are more effective than others. Ineffective climate policies are characterised by voluntary measures, poor positioning of government departments and a continuation of fossil fuel subsidies. The UK and Germany are among the few OECD countries to have reduced their greenhouse gas emissions. Their effective policies comprise carbon taxes and strong commitments to renewable energy and energy efficiency, coupled with a regulatory framework that ensures emission reductions.

The Australian climate policy will be under the international spotlight at the Johannesburg Earth Summit, which convenes on 25 August 2002. A carbon-constrained future is inevitable, and bringing the Kyoto Protocol into force is the necessary first step, because without binding targets it will be business as usual in Australia. ✲

Alan Hoban works with Friends of the Earth on the Climate Justice Campaign which is advocating for sustainable and equitable emissions targets and appropriate support for those most vulnerable to the impacts climate change. For more information on FoE campaigns visit www.foe.org.au

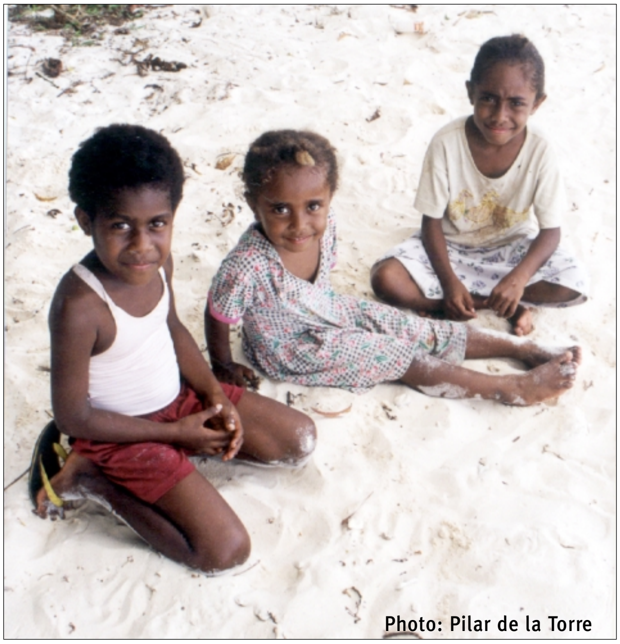


Photo: Pilar de la Torre

Striving for sustainability

Efficient building for urban environments. Trish Langford explains the rationale behind her choice of building materials and home design

Somewhere in Melbourne, just beyond the traffic thunder of the Westgate Bridge and the oil refinery's long shadows, is a construction zone unlike any other. In a quiet street the sound of hammers and power tools is interrupted by the plucker of chickens; and behind a pile of rubble near the back fence, an area the size of two queen-size beds overflows with tomatoes, cucumbers, grape vines and cantaloupes.

It is a year since my partner Liam and I collected the plans for our new sustainable house from architects Sunpower Design. Like all owner building experiences, the learning curve has been steep and progress slow, but when you're harvesting vegetables already and improving the soil as you build walls, perhaps the definition of progress needs to be altered rather than stepping up the pace.

Trish tying in a door frame on her home to be.

Location, location

I'm the first to admit Spotswood wasn't where I imagined building my permaculture dream, but these days I've become used to the idea. After creating my first food garden in Footscray, I realised that space isn't really the issue; it's use of space that matters, and six hundred square metres is more than enough to provide food, shelter and surplus for two adults. Living in the bush is all very well—until you have to go to work on Monday morning. The energy you save making your own bricks out of mud can easily be consumed commuting into town each day, which was the main factor influencing our decision to experiment with urban sustainability. That, and the knowledge that when our circumstances change we can sell up and head for the hills!

The central tenet of permaculture is 'each in their own way, to the limit of their means'. It's fundamentally about the efficient use of that energy, be it solar power, human or animal labour, money, whatever. As you begin a project such as this, you realise there are myriad ways to spend energy, and that your responses to design needs will necessarily be individual, influenced by skills you have or are prepared to learn. What I am about to outline was simply our response to the brief 'to build a sustainable urban dwelling', and not a prescription for living.

Energy efficient design

Our first major decision, once we'd found a block of land, was to spend some money-energy on getting our house designed by people who make a living designing energy efficient structures. Sunpower Design agreed to just draw up the plans and leave the rest to us, though they've been generous with advice along the way. Efficient design basically involves three areas: the embodied energy of the structure, the energy performance of the structure and eventually, the recyclability of the structure.

Embodied energy is a measurement of the amount of energy required to manufacture and transport the materials required for building. Metals, for example, have high embodied energy, (aluminium has been called solid electricity!) and wood has perhaps the lowest embodied energy, though it requires plenty of time for production.

It is in fact a more complex issue than it first appears: a product with low energy requirements for manufacture, which has to be imported from Europe, for example, may not be such a good bet. Likewise, in a rural setting where materials such as stone or clay are readily available on site, choices for construction will differ from an urban environment where manufactured materials can be easily accessed.

Efficient performance of a structure rests on the foundation of passive solar design—the correct orientation of the building to the sun's rays in order to maximise warmth in winter and shade in summer. Solar houses will generally run east-west, approximately 1.5 times as long as they are wide, though this is obviously flexible. The structure must also have sufficient thermal mass and insulation to keep internal temperatures stable.

Usually, a passive solar house will use a slab floor to provide thermal mass. A slab was essential in Spotswood due to the high degree of movement in the basalt clay soil. Concrete has an average embodied energy rating but use of 'slag blend' (concrete manufactured with a bi-product of iron smelting as an aggregate) reduces the embodied energy, as does the use of recycled steel reinforcing material.

We used stones recovered while laying the plumbing for landscaping—on a level, urban site such as ours the opportunity to use local materials was obviously limited. There seemed little point in buying mud bricks, and strawbale construction wall thicknesses take up a lot of room, which is an issue on a small site.

Building materials

Sunpower Design recommended aerated autoclaved concrete (AAC) blocks for the walls, which have a fairly low embodied energy rating and excellent insulation properties, due to the tiny pockets of air created in the concrete

The chooks in their tractor on the construction site for weed control.

during manufacture. They are widely used in Europe but not so common in Australia. As no internal lining material such as plasterboard is required, they are comparable in cost to brick veneer, for example, with a far superior insulation rating. They are also easy to shape and can be cut with a hand saw.

As an additional means of keeping the embodied energy low, the north wall of the house is insulated weatherboard construction, with large areas of double glazed windows for winter solar gain. The south, east and west walls are all 200mm thick AAC blocks which will have a thin render finish.

AAC has the reputation of being easy to lay, another reason why it is favoured by Sunpower. We're not bricklayers, but 'easy' isn't the word I'd choose. Recycled bricks, cheap and readily available, with an extremely low embodied energy (technically zero), have to be another option if a good method of insulating them can be devised. Bricks have the added advantage that it is relatively easy to engage a bricklayer to lay them. New bricks, however, are not a good option as, like roof tiles, the firing process makes their embodied energy high.

Insulated weatherboard construction is a good option, with a low embodied energy; double glazing with curtains and pelmets is also okay. Obviously timber from native forests here or overseas is highly unsustainable, despite having a low embodied energy rating, and sourcing recycled or recovered timber (the distinction is an important one) has been a challenge.

For the shiplap weatherboard cladding we are using *macrocarpa,* a hardwearing cypress that has been used for windbreaks all over Australia and is frequently burned when the tree has reached a point where it drops limbs, endangering stock. As new uses are found for this material, it is becoming more readily available. Due to over-ordering on my part we'll probably have enough to have it remachined for architraves, skirting boards and the kitchen cupboard doors (and shelves and furniture...).

Unfortunately, when the time came to order the windows, which are also timber (rather than aluminium), I was unable to source a grade of *macrocarpa* high enough for joinery. Hopefully, this will change in the next couple of years as demand increases.

A quick word about 'recycled' and 'recovered' timber. The difference as I define it is that recycled timber is previously used timber. 'Recovered' timber is the salvage of unprocessed logs from non-forest sources such as back gardens, windbreaks, power poles, et cetera, which are then sawn.

In general, I have been heartily disappointed with recycled timber merchants who have found a market and demand exorbitant prices. I was on the verge of buying a metal detector and setting up shop myself when I found Rob Horner at Yarra Timber Salvage, at the foot of the Westgate bridge. Rob is a sawmiller who machines salvaged logs at prices that make recovered timber affordable for building house frames and other low grade work. The huge advantage of recovered timber is the absence of nails, which means it can be machined without fear of injury and tool damage.

The roof will be zincalume, the high embodied energy of the material being balanced by its easy recyclability and light weight, which allows savings in the supporting structure. The roof and walls will be lined with reflective foil and recycled polyester insulation for the ceiling weatherboard walls.

As my skills have improved I have taken on more of the work, and intend to do much of the carpentry, based on the theory that no-one will work as cheaply as me! Among other things, I am building the internal doors out of recycled oregon, and intend to lay jarrah tiles rescued from Victoria Dock over the concrete slab floor. All the sawdust from my woodworking is thrown in with the chickens for the soil improvement program. These are the sorts of things that you'd really only do for your own house, labour intensive and highly satisfying—but hardly cost effective if you put a dollar value on your time.

Water systems

Obviously, constructing a dwelling is only one aspect of sustainability, and we have attempted to take other matters into consideration. We have installed a 13,000 litre rainwater tank which will be fitted to a pump—initially for irrigation but with the option of using it for showers if it proves clean enough.

'The most important thing I've relinquished this last year has been the idea of perfection, the desire to create the 'perfect' sustainable house.'

- Trish Langford

Learning about grey and black water was a long process. The local council insisted we be connected to the sewer, but not before I'd explored other options. The problem with septic tanks and the like is the area needed for the water to be absorbed, especially with clay soil. The practical alternative, a composting toilet, needs to be thought of early, as they function far better on the north side of the house—which is not the ideal situation from a passive solar design point of view! In the end we were forced to settle for low volume, dual flush toilets connected to the sewer.

Greywater, on the other hand, is pretty much unlegislated at this point, although things are changing. After much consideration, we decided against storing either treated or untreated greywater. Untreated greywater cannot be stored for more than 24 hours as it can turn septic. Development of greywater treatment systems such as Environment Equipment's electrofloculation unit is under way, but has yet to be approved by the EPA. Electrofloculation uses electricity to remove solids from grey water, cleaning it to the extent it can be stored, used for toilet flushing and even washing clothes. This sounds like an excellent option, but with the unit predicted to cost between $5000 and $10,000, not one that will be immediately available to most people. Another option, the Wattworks system, stores grey water for toilet flushing but releases it into the sewer every 24 hours.

At present, we're in favour of letting greywater run directly onto the garden where and when it's needed, and down the drain at other times. We have designed our plumbing so that water from the shower and laundry can be diverted into underground irrigation in the summer months, but only to fruit trees and non-food producing plants, as there is a small risk of contamination by pathogens. Greywater is not suitable for any airborne irrigation such as sprinklers, and would probably clog a drip irrigation system.

Renewable technology

Our hot water system will be solar with gas boosting, and we intend to install grid-connected solar panels, hopefully before the government rebate runs out!

Grid-connected solar is a good metaphor for what I feel we're trying to achieve; rather than self sufficiency, we aspire to self reliance within a community. No person is an island, and many environmental technologies would function far more efficiently in small communities than for individual households. While we hope to produce most of our food, with surplus to give away or trade, we recognise the interdependence of all beings, and the inefficiency of complete self sufficiency.

Building is a challenging process, and we've been well tutored in its fundamental rule, 'everything has to be done before everything else'. But the most important thing I've relinquished this last year has been the idea of perfection, the desire to create the 'perfect' sustainable house. Each in their own way, to the limit of their means ... searching for a better way of living in a very messy world. ✢

Rainwater dunny flushing

Ralf Pfleiderer, the manager of this project, takes you on a tour of the ATA's new rainwater toilet flushing system. Anyone can install this type of system and save huge amounts of water each year

The ATA has long thought that all the rainwater falling on the roof of its office could be put to better use, rather than just running off onto the land. With the recent installation of a rainwater collection system for flushing the toilets adjacent to the ATA office, that better use has been found.

The 'Rainflush' system, as it has been dubbed, stores rainwater run-off from the roof of the office in a water tank, and pumps it to the two toilet cisterns when needed.

Anyone who has the room for a rainwater tank can install a similar system. While our tank is right up against the toilet block, the use of a mains pressure pump means that the toilets could be a considerable distance from the tank—even on the top floor of a double-storey home.

We anticipate the ATA office roof area of around 60 square metres should collect 36,000 litres per year, on average. Assuming all of this gets used for flushing the toilets, and also assuming an average of 4.5 litres per flush (an average of the three litre half flush and the six litre full flush), then we can expect around 22 flushes per day purely from the rainwater collected.

These toilets serve the CERES environmental park site, and come under heavy use. While the rainwater system may not provide many flushes relative to the use of these toilets, in the average home it is possible for a similar system to provide all the water needed for toilet flushing, though this depends on your location and rainfall, of course.

Our rainwater tank demonstration model, Rachel Ollivier, thinks the system is great!

The installation

The project began by assessing what needed to be replaced. The overhang with the main gutter on the south side of the office had been built too low from the beginning and was a safety hazard, so needed to be shortened. The gutters and downpipes needed replacing and the fascia boards needed a coat of paint.

The current toilet pans and cisterns were big water wasters, so needed to be replaced with 6/3 litre low-flush units. The plumbing to the toilets needed altering and tidying up if possible. The ATA already had a 2500 litre rainwater tank that wasn't being utilised.

The first job was to alter the roofline. Herman Out, a regular ATA volunteer, knocked the job over in a day. With a coat of paint the new roofline looks fantastic.

We decided to replace the guttering with the Enviroflo guttering system. The manufacturer generously donated this to us. We decided on tuscan red (which also matched our tank) for the colourscheme, which set the tone for the colour of the fascia boards and the downpipes.

The guttering comes in pieces that slide together. Joints are held together with pop rivets and sealed with silicone sealant. End pieces are attached in the same way. The filter nipples are plastic and clip into the pre-made holes in the top of the tube gutter. The drop-outs (the down-pipes connect to these) also need to be fitted at the appropriate positions. Again, pop-rivets and silicon hold the drop-outs in place. We elected to use 90mm downpipes as this is the standard size for plastic pipes. However, the standard manufacturing sizes for metal downpipes are 60 and 75mm. 90mm pipes can be made but they take longer (especially over Christmas) and are a little more expensive.

Sourcing plumbing supplies

After shopping around we decided to purchase most of our supplies from the helpful mob at Tradelink in North Fitzroy. We elected to go with full china toilet suites. They are said to be quieter in flushing and look better for longer. As most people will only interact with them when they actually sit-down to do their business, we thought it was important to give a good impression and impart a positive feeling about the whole thing. More seriously, when selecting a bowl you need to know whether the waste pipe goes through the wall or the floor. The new toilets should also be similar in size to the existing ones to make your life easier.

A gravity feed system was not possible as the roofline was too low and the tank could not be elevated. Therefore, the water exiting the tank had to be pumped into the cisterns. A 24 volt Shurflo 2088 was selected, as we could run it off the 24 volt battery bank of the main solar power system. The pump was purchased from Solar Charge in Brighton. To avoid running the pump every time the toilets are flushed, an accumulator tank was placed in-line between the pump and the cistern. Accumulators store a given quantity of water under pressure. These tanks come in sizes from one litre to 100 litres and beyond. We selected a 15 litre tank as it fitted within our budget (cost was $100) and it allowed two half, or one normal, flush to occur without the pump coming on. Ideally the pump should come on less regularly, so the larger accumulater tank you can fit, the better. A 15 litre accumulator actually only holds about six litres at a high enough pressure.

The pump, pump filter and accumulator were housed in a specially made wooden box that can be locked up and still allows access to the filter. The pump needs to be kept out of the weather but as close as possible to the cistern and the tank.

As the toilets in the ATA building are open to the public and used frequently everyday, water supply to the cisterns had to be guaranteed. The system also needs to be fool proof and should not require any valves or taps to be turned unless there is an emergency. This is why we placed a double float valve in the tank. The floats are attached to an electric switch that opens and closes a 24 volt solenoid. The solenoid is opened when the water level drops to just above the tank outlet. At this point both of the floats will be suspended in the air and their weight will activate the switch and let in water. As the amount of water in the tank increases, the rising water will buoy the floats. At that point they release pressure on the switch and allow it to click back into the off position and close the solenoid. This system ensures that there is always enough water in the tank and no one needs to do a thing for the system to operate, with or without rain.

As a backup (should the pump fail), water can be supplied to the cistern directly from the mains without going through the tank and pump. Placing a link between the tank supply line and the cistern supply line and breaking it with a ball valve achieved this. Another ball valve and a check valve were placed between the input point of this line and the pump and accumulator set-up to isolate the pump and prevent back-flow into the pump and tank (see Figure 1).

This type of system is considered a 'low risk' alteration by the plumbing industry and the water boards. As such, a double check valve must be placed at the mains line just after the connection to the feed line. This prevents any water flowing back into the mains system and possibly contaminating it. John Jamison from Frog Solar did all the plumbing work and it looks very neat.

The new toilets

The toilets needed to be removed and the new ones put in place. The plastic cisterns were easy to take off the wall, but the old toilet bowls needed a sledge hammer to move them. Eye protection and thick rubber gloves are highly recommended. As with most retrofits, the new things won't fit exactly to the old. Flexible joiners are a godsend!

We used 100mm x 100mm rubber sleeves with ring clamps to join the new toilet bowl waste pipes to the existing pipes in the wall. This allowed for variations in the distance that the old and new bowls were away from the wall and for alignment frustrations when seating the toilet bowls. The seating consists of a firm cement pile that fills the hollow area under the S-bend and ensures that the bowl is level. Screws into the floor are then used to hold it all secure. The cisterns are then connected as per the instructions—but wait for the cement to set first.

Ceramic cisterns are heavier and more fragile than plastic ones, so ensure that a strong back is at hand and that the wall and attachment screws are up to the task. The bowl takes some of the

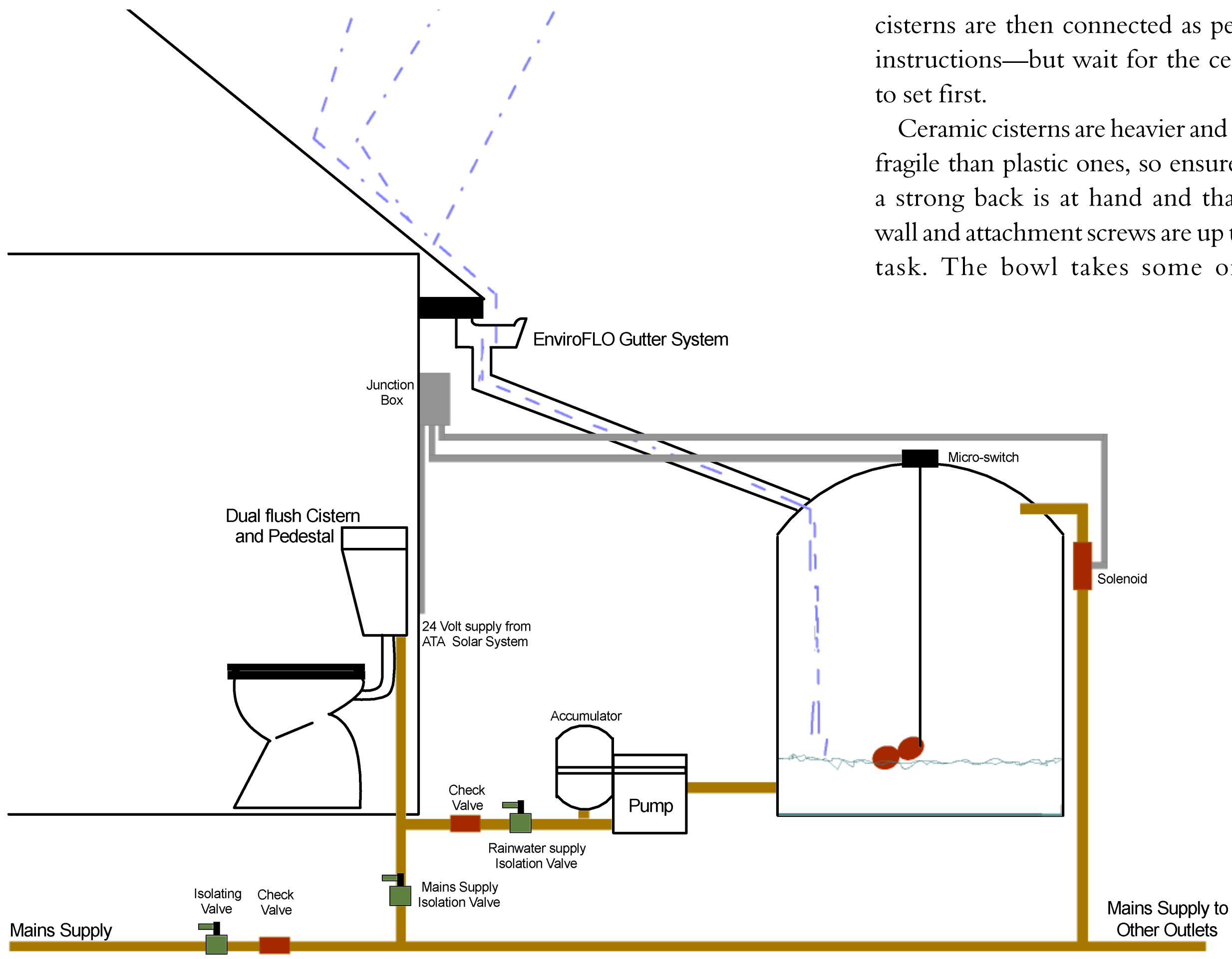
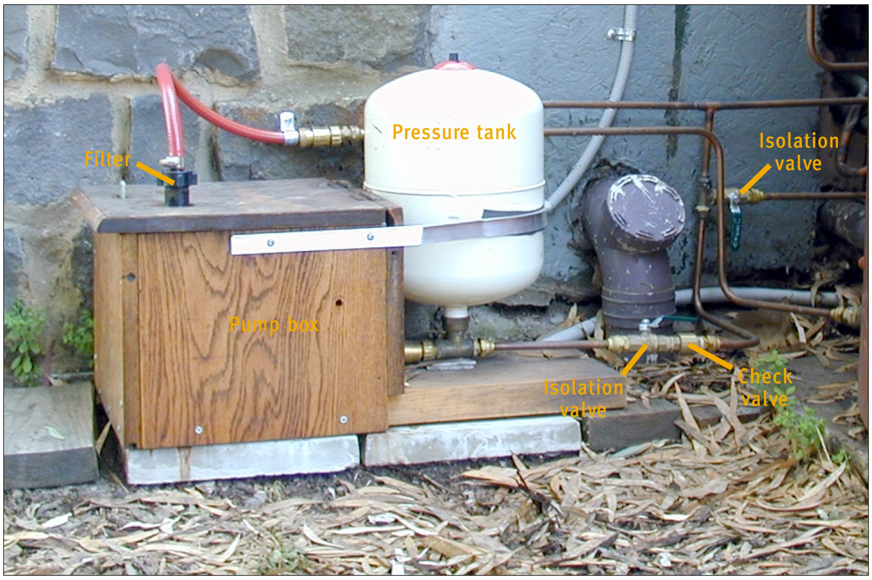


Figure 1. The schematic of the Rainflush system. Note the backup water supply should there ever be a pump failure.



The pump is housed in a purpose-made wooden box, with the pressure tank attached to the outside.

weight of the cistern so the wall does not need to be too significant (but plasterboard alone will not do). Lastly, a flexible cistern hose is used to connect the water supply to the cisterns.

Performance

The system has worked well so far, and has been pretty much a 'set and forget' affair. The rain has been infrequent over the past few months but with the backup water supply the system has been performing flawlessly.

We were surprised at how little water the new toilets use compared to the old ones, and it's a good feeling to know that a proportion of the water used to flush them would have otherwise been wasted.

Costs

The toilet suites cost just under $200 each, while the tank cost around $400. The plumbing came to around $350, though this was a reduced price—it normally would have cost around $500 or so.

The pump was just over $200, while the pressure tank was around $100.

There were also a lot of pipe fittings and other small bits and pieces, as well as the float switch and wiring. Total cost was just over $1500, and most people should be able to install a similar system for less than $2000.

The Rainflush project was funded by a donation from a division of ICI, made to the ATA after they won an internal environmental award.

A lot of the information needed to install this type of system can be found in the technical information bulletin from the Plumbing Industry Association (No. 91). A contact at Whitehorse Council, Libby Anthony, came across information on a similar system that the council had installed, and sent the information to the ATA office. ✲

Solar-powered heating system

Colin Gillam

Over many years of reading *ReNew* and *Soft Technology* I have been intrigued and inspired by the ingenuity of Australians to solve problems.

Besides RAPS systems, wind power, water pumps and other articles encouraging us to save our planet by reducing our reliance on carbon-based fuels, the other recurring theme has been heating and cooling homes.

Ideally, we would all live in passive solar designed homes that virtually heated and cooled themselves. But what of the 6.5 million homes in Australia that aren't? How do you heat without using coal-derived electricity or natural gas heating, which both contribute to the 20 million tonnes of greenhouse gases created by our homes each year just for that purpose?

Again, the innovative readers of *ReNew* have forwarded many of their own solutions to the problem. For the home handyman these have offered some novel and workable solutions. But what if you can't cut a piece of timber or hammer a nail and use a welder.

For those of you who are less technically inclined, a Melbourne company, Alternative Fuels and Energy, may have the solution. They have started building prototypes of a fully solar-powered heater that also helps to cool in summer. While there is nothing new in the concept, they have used current technology to make an affordable heater and cooler that can be fitted to virtually any house or office that has good solar access.

Solar box heaters are simple and effective, and can save you a lot in heating costs.

The photo shows a unit on a home in Mt Evelyn, where it can get very cold in winter. The house is 23 squares, with 13 squares of offices downstairs. You can see the vent openings further along the wall for units to be attached to heat other areas of the house and offices.

The unit consists of a solar collector, much the same as a solar hot water heater, but heating air that is pumped by the control unit, which is powered by a photovoltaic panel. The glass in the solar collector is in fact the same low-iron glass used in water heaters as it lets more sun hit the solar collector.

The unit is self regulating. The higher the solar gain (sunny day) the higher the heater temperature and greater the electrical energy available to the fans. This means hotter air being pumped faster through to the house. If it gets cloudy, there is less solar energy, less heat and the air is pumped slower so you don't get blasts of cold air, which is a problem with similar units powered from mains or other power sources. At night it stops, of course.

Even in the middle of a Melbourne winter, we average 4.5 hours of clear sunny skies every day (this is not the same as equivalent sun hours—Ed). It is fairly uncommon to have more than two or three days in a row where there is no sun breaking through the clouds. In other parts of Australia this number varies. As anyone who lives in a passive solar house will tell you, they rarely need to supplement the house's natural heating with other sources, but occasionally nature strives to make us evolve by having longer periods of cold.

This heater is not a perfect solution, but you don't have to worry about the cost of heating for those 4.5 hours every day and can come home to a house that is already warm most days. With it you can drastically cut the amount of gas and electric heating you use. It is also safe to use, as there are no heating elements or electrical wires that could cause fires. This means you can go out during the day confident that the heater is on, working and safe.

This first prototype pumps hot air at around 50ºC when the outside temperature is around 18ºC. The heater in the photo pumps air down ducted heating vents installed in the house when it was built. The initial tests show that the room temperature is raised 3 to 4ºC during the day. This makes the difference between a house that is 17 to 18ºC (put on a jumper) and one that is 20 to 22ºC (still in a t-shirt).

The next prototypes will be better insulated and have bigger fans so higher temperatures and airflows are expected. The fans will pump around seven cubic metres per minute of air, which will circulate the entire air volume of a standard 4 metre by 4 metre room in around six minutes. So the only real problem here might be a house that is too hot in winter!

In summer, a simple switch changes the air from being circulated through the heater, to being exhausted from the house. Removing hot air from near the ceiling of a building forces cooler air in from under doors or other vents to replace the hot air. The combination of moving air and removing the hot stratified air near the ceiling reduces the internal room temperature and makes it much more comfortable to live in. This switch from summer to winter and back again is about the only maintenance you will need to do.

All of this is done without the need to burn a single piece of coal (if you ignore the embodied energy of the unit).

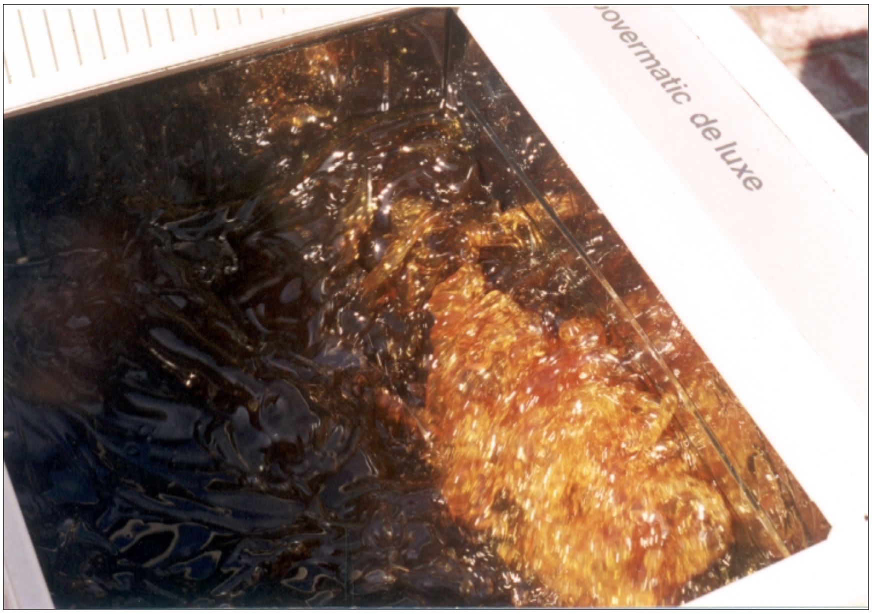
Given the projected lifespan of the unit being 15 to 20 years, with the main components lasting much longer, it has the potential to make a huge dent in our greenhouse gas emissions.

When the heater goes on sale they are expected to retail for around $1200. Add the cost of some plumbing and ducting and you have a heater and cooler that will run on the sun for free and pay for itself in around 10 years if you use gas heating, or four years if you use electric heating. After that it's all money in your pocket and greenhouse gases cut dramatically.

What the company developing these heaters needs now though are some real life testers. The prototype has been set up in a well-designed home and so orientation and installation issues haven't been a problem. If you would like to try the heater, email them at afe@alternativefuels.com.au or ph:(03) 9737 1566. They will supply you with a test unit at cost price (approximately $750). *

Backyard biodiesel

Hot titration, warm fractionation and cold filtration. By Michael Gunter



Bubble, bubble, toil and trouble—or at least a reasonable amount of mess! A batch of biodiesel being mixed in the twin tub.

During the winter of 2001, I made a bold decision and bought a diesel car. It is a 'grey import' Japanese sedan: a 1991 Mazda Capella 2.0D—basically a Mazda 626 which uses the same RF diesel engine as in the E2200 van. The plan, now successfully implemented, was to use it as the main family car for daily commuting, and for country trips both long and short.

Early drama and loss of nerve

I bought a tank full of biodiesel from an experienced guy who makes it in large quantities for his organic fruit and veggie delivery truck. The fuel was not clear, but milky mustard yellow in appearance: advocates of washed biodiesel make the strong case that a fine water emulsion in washed fuel (say 0.5 per cent or less) is far preferable to feeding acids, salts or alkalis into your fuel system. My car initially ran well, with the characteristic 'deep fryer' aroma coming from the exhaust.

But, after a few days, the car began losing power dramatically, then 'died' completely while taking the kids to school. The family was not impressed with biodiesel's performance. I thought I had blown the engine (which would cost thousands to repair). After completely draining the fuel tank and lines, replacing the fuel filter and re-filling the fuel system with fossil diesel the car again ran normally. I gradually came to the realisation that the only real problem with the bought biodiesel was that its excellent solvent properties had cleaned 10 years worth of accumulated gunk out of the fuel tank, clogging the fuel filter to a state of complete blockage. This tale shows just how dramatic and alarming your first tank of biodiesel can be, unless it is going into a brand new vehicle.

Rule of thumb for newbies

'In the first month, for all the hours spent making a good brew of biodiesel, you will go more kilometres at a much lesser financial, health and environmental cost if you ride a bicycle for the same number of hours.'

Definitions

What is biodiesel?
Biodiesel is a direct replacement for fossil diesel made by reacting vegetable oil with an alcohol and a catalyst. The catalyst used is often caustic soda (sodium hydroxide, NaOH).

Titration
Titration is the term used to describe the process of adding a solution to a second solution until the chemical reaction between them is complete. In the case of biodiesel, titration is necessary when using old oil containing fatty acids (a type of rancidity). The proportion of alcohol used is fixed, but the caustic soda has to be adjusted depending on how rancid the oil has become.

Confidence returns

As the warmer spring weather returned, I finally plucked up enough courage to try making my own biodiesel, and have now made several batches in a dedicated Hoovermatic Deluxe Twin Tub washing machine with a stainless steel wash bowl.

The Hoovermatic is a good size to do medium-sized trial batches of around 35 litres. It was modified by removing the back cover and fixing a 13mm ball valve under the drain hole of the washing bowl. It holds 40 to 45 litres when full. It must be filled to the top for making each batch of biodiesel, otherwise the agitator will stir too much air into the reactants.

Joshua Tickell's book, *From the Fryer to the Fuel Tank,* was my main source of information, though I decided not to bother with his recommended small, food blender, trial batches, figuring that it would be impossible to match the crucial temperature and mixing characteristics of a food blender to the 'real world' performance of a larger biodiesel mixer. The book is a bit annoying as it omits some important details in the recipe, such as 'heat the oil to 47 to 53°C' (this sort of stuff is fairly important for achieving a good result). My recipe requires only 6.7 litres of methanol, so I decided to use a 10 litre glass demijon with a silicone bung as the mixing device for making the sodium methoxide reagent/catalyst.

The basic recipe for my biodiesel is: 33 litres new, dry canola oil; 115 grams of sodium hydroxide; and 6.67 litres of methanol.

Starting with the easiest recipe, use 33 litres fresh canola oil at 50°C. All containers must be completely clean and dry. Methanol is difficult to pour from a full 20 litre drum into the 10 litre demijon without splashing and spilling it. However, with care, including the wearing of goggles and gloves, it can be poured into a two litre jug and then via a funnel into the demijon. This is definitely an outdoor operation, to be performed without children, pets or naked flames in the vicinity.

Pour 115 grams of finely granulated and *dry* sodium hydroxide into the methanol, via the funnel. Coarse, flaked caustic soda takes too long to dissolve. Seal with the silicone bung, and commence agitating the demijon as soon as possible, to prevent the NaOH granules forming a large clump in the bottom of the vessel. The demijon, being clear glass, allows you to see the reaction proceeding. The methanol becomes almost hot during the reaction as sodium methoxide is formed, and the bung must be carefully released several times to prevent excessive build-up of pressure inside (gloves and goggles are essential here!). New demijons are sold wrapped in a plastic mesh basket, simulating the wicker basket of an earlier era of wine making. This basket provides only limited protection for the demijon, and extreme care must be taken not to knock it against anything hard during the three to five minutes of agitation required to dissolve all of the NaOH. A 10 litre HDPE container would be a safer mixing vessel.

We now have some warm sodium

methoxide in a big bottle and some even warmer oil (50°C) in the washing machine. Turn on the wash agitator in the machine and *slowly* pour the methoxide solution into the oil. Almost immediately a reaction will become evident, as the clear oil becomes opaque and its viscosity increases significantly. Close the lid, cover with an old rug if there is a cold wind, and allow it to mix for 60 minutes. Then turn off the wash agitator and allow the glycerine to settle for eight to 12 hours. Insulate to keep it warm as long as possible—reduced viscosity will allow improved separation of the layers (fractionation). External heat will not help, as it will create convection currents that tend to break up the layers.

NB: All electrical switching should be done remotely from the far end of an extension cord, not at the washing machine itself; the induction motor has no brushes, commutator or sparks, so by taking extra precautions with switching, we minimise the risk of fire or explosion.

Waste veggie oil

When you are making clear batches of unwashed biodiesel from new canola oil consistently, you are ready to try the much cheaper *used vegetable oil* from your friendly local fast food joint. If you are really lucky it is a Chinese restaurant that does lots of deep frying using only the best cottonseed oil. In my case the local fish and chip shop uses a blend of 50 per cent palm oil and 50 per cent tallow/dripping/beef fat in their fryers—quite a challenge to make a good fuel from this heavy-duty frying medium.

Titration: some like it hot

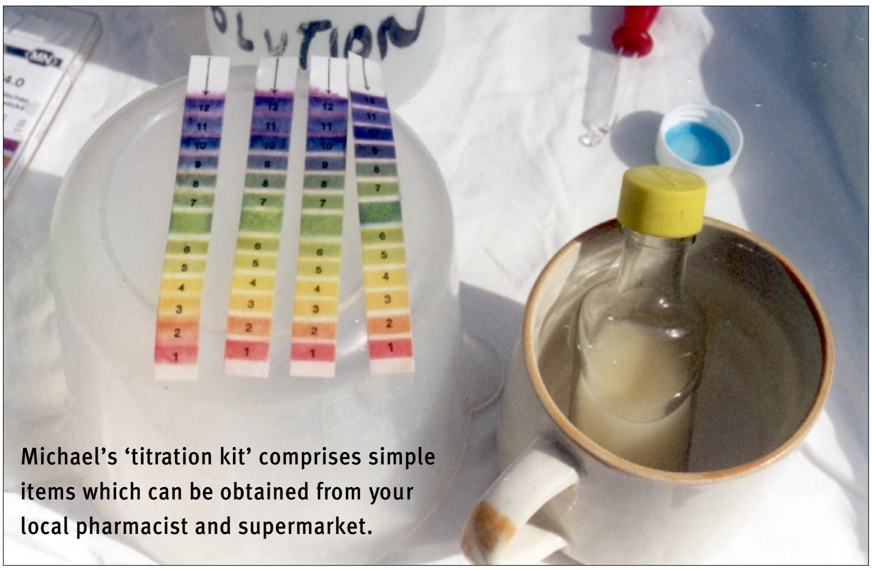
From the Fryer to the Fuel Tank says to dissolve 1ml of your grease into 10ml isopropyl alcohol, then add specially diluted caustic solution, one millilitre at a time, until a neutral acid/base balance is achieved. At the risk of oversimplifying, it's a bit like calculating the right amount of yeast to add to make a good bread—too little and you get hard damper, too much and you get a bubbly loaf overflowing the tin. In this analogy, the 'damper' would be fat (triglyceride) that could damage the engine, and the 'bubbly loaf' would be soapy fuel.

Unfortunately, the book seems to have forgotten some important details about titration of heavy chip grease, or fats that are solid at room temperature. If you squirt 1ml of hot fat (for example, from a hypodermic syringe) into 10ml of cold isopropyl alcohol, it almost seems to go solid again! My best titrations, resulting in the best quality biodiesel I have yet made, were done when the isopropyl alcohol and its container were warmed to between 35 and 45°C. It is also a good idea to warm up the dilute NaOH solution that is used for the titration (I do this by placing it in a cup of hot water). Doing the titration at about 40°C seems to result in a more complete titration reaction, and a more accurate result on which to base the NaOH calculations for the main processing batch.

Biodiesel rescue remedy: washing those suds away

Mostly because of doing inaccurate cold titrations, I ended up with soapy fuel on at least two occasions. *From the Fryer to the Fuel Tank* tells you to make soap out of this, but with an equal amount of time and care, you can actually rescue usable fuel from the gluggy mess. The trick is to wash it *very carefully*. The risk is that if you mix soap, water and oil too vigorously, then the soap will emulsify most of the oil into the water. The result is an oil-in-water emulsion that may never settle out into a layer of oil on top and soapy water beneath. This is a waste of time and money, and the useless emulsion is a serious waste disposal problem. I would strongly recommend never trying to use a bubble wash technique on soapy batches, as this is almost certain to permanently emulsify whatever fuel you have actually made.

The time-consuming rescue involves ladling the diesel/soap into a second vat, leaving the solid glycerin layer in the first mixer. Say you have about 30 litres of this gooey stuff. Warm it to about 45°C, until the soapy lumps dissolve, taking care to avoid breathing the methanol fumes given off. (I heat it on my outdoor gas BBQ hotplate, before putting it in the mixing vessel. The heat requirement is much less than would be required to heat the same volume of water.) Put 300ml of vinegar and 15 li-



Michael's 'titration kit' comprises simple items which can be obtained from your local pharmacist and supermarket.

tres of warm water into a watering can, and sprinkle the mixture like a shower of rain through the biodiesel/soap. You will see whitish soap precipitates forming almost immediately. Drain or syphon the water from the bottom, and, if it is not milky, return it to the watering can for another rain shower. Repeat the rain shower several times, using *fresh* warm water each time. By this stage, the fuel itself will probably be getting increasingly opaque due to the soaps having absorbed some water or created a fine emulsion (water-in-oil this time!).

We need to test how much agitation can now safely be used to remove the remaining soap from the fuel: get a one litre sample of the biodiesel in a two litre plastic milk jug, add 500ml water, and shake it vigorously until it is completely mixed. Allow to stand for one hour and see if a clearly demarcated biodiesel layer has formed on top. If you are lucky there will be a uniform milky (soapy) water layer below the biodiesel, but more likely there will be a bottom milky water layer, and a middle layer that looks like very greasy soap. In fact it probably *is* a type of soap, mixed with unreacted fats, and/or methyl esters. The presence of a significant middle greasy layer means you must continue to work on the main batch, washing it with repeated single-passes of fresh warm water 'showers' until the water droplets no longer form whitish blobs as they hit the surface of the biodiesel. Another factor which may aid clarification of the fuel at this stage is to re-test the pH and add a little more vinegar if the pH is still above 7.5.

When a test batch vigorously mixed with warm water will separate into two layers, the main batch may be vigorously agitated with warm water too—perhaps even a bubble wash—to remove the last of the soap from the biodiesel. Some experienced biodiesel makers advise simply stirring some or all of your bad (soapy) batch into the next good batch immediately after the main methyl ester reaction.

Skim off the good stuff

Finally, after settling for 12 hours or more, decant the biodiesel from on top of whatever layer or layers remain beneath. Put it in clear plastic containers and leave the containers outdoors on a cool or cold night to see if it starts to set (that is, if it reaches the cloud point of the fuel). Chances are that in cooler weather it will not remain completely liquid, in which case store it for use in hot weather, or blend it with 50 to 80 per cent fossil diesel until a clear batch is achieved on a cold night. I have tried adding five to 10 per cent ethanol to lower the cloud point but although the fuel appears to clear remarkably and stay liquid in the fridge, closer examination reveals that the ethanol/methyl ester mixture is unstable at low temperatures, and tends to separate out, with big blobs of ethanol also separating from the oily components. This is despite an internet site in Nebraska reporting various mixtures of beef tallow methyl ester, ethanol and fossil diesel being 'the same viscosity as fossil diesel, and runs the engine very well'.

Glycerine disposal

One advantage of using heavy chip fat is that the glycerine layer is solid and can be cut into blocks with a knife, wrapped in paper, and given/sold to your local gift shop as 'raw glycerine soap base'. Or try giving it to the local service station as 'heavy duty degreaser'. You can even compost it.

'Cold filtered'—good for biodiesel?

Gradual overnight cooling of small biodiesel batches seems to cause the 'heavier' unreacted triglycerides in tallow or palm oil to precipitate near the bottom. Low-pressure gravity filtration using conical filters can then selectively remove these impurities and in theory lower the cloud point of your fuel, but it is quite a time consuming procedure. Filter it in the early morning while the fuel is still cold. Disposable vacuum cleaner filter bags can be cut, folded and stapled to make conical filters quite cheaply. They work best in conjunction with a piece of conical wire mesh acting as a spacer to prevent them sticking to the inner wall of the funnel. But they will clog if what you pour into them contains too much 'free' water.

Contrast that with a quality automotive diesel filter, which uses a silicone-impregnated filter medium: like a Goretex raincoat it can repel water droplets (and glycerine droplets!) trying to get through. The droplets coalesce and fall into the sediment bowl below. Leaving washed fuel in an open gerry can in the hot sun for a few days allows much of the moisture to evaporate. This sun-dried and subsequently chilled biodiesel will then pass through cheap paper filters much more readily than 'wet' fuel does.

A few good tips

One hundred per cent isopropyl alcohol is hard to get in small quantities. When my supply ran out, I switched to rubbing alcohol (65 per cent isopropyl alcohol, 35 per cent water) and it seems to work okay. Biodiesel dissolves polystyrene foam. Biodiesel softens plastic paints, and is probably a good organic paint stripper. Biodiesel does not burn in a kerosene heater—it is too viscous to flow fast enough up the wick to sustain the flame. Biodiesel can be used in pressurised blowlamps that are designed for kerosene, but its flame is unstable and prone to flare-out.

Someone should design a modified blowlamp that works well with heavy fuel oil, diesel fuel and biodiesel, we can then run Stirling engines on biodiesel to generate green power at home! A practical low-emission biodiesel burner could also power a home hydronic central heating and hot water system. If I decide to persevere with palm oil and tallow, because that's what my local fast food shop uses, I will probably add heating to my car's fuel system, so that biodiesel can provide cheap all-weather transportation.

Fuel economy

My car is getting around 6.2 litres/100km on both types of fuel. This is for warm/hot summer driving, with the biodiesel being a blend of 40 per cent palm oil/tallow and 60 per cent canola oil. If the car was run on 100 per cent palm oil/tallow, even in warm weather it would be too viscous to spray fine droplets from the injectors. Cold winter weather would probably make it damage the fuel pump and injectors, not to mention contaminating the engine lubricating oil with heavy oil deposits inside the cylinder head.

Summary and conclusion

Beginners should get experience and build competence using new canola oil initially, and if the results look clear, just filter it and use it unwashed. Used oil requires careful and accurate titration. Joshua Tickell's titration method appears to be temperature sensitive when heavy fats and greases are involved. The time and effort in rescuing usable fuel from a soapy batch can be a salutary lesson in just how important an accurate titration really is. Because used oil generally needs more caustic soda, it may be more important to wash it, even if it does not look lumpy or soapy. The automotive fuel industry could save us all a heap of time by following the German example and marketing 100 per cent biodiesel at regular fuel outlets around the nation: come on guys, before my wife divorces me! ✲

Michael Gunter
www.voltscommissar.net

The All New *AIR-X*

A breakthrough in small wind turbine

patent pending

patent pending

AIR-X:

ROTOR DIAMETER: 46 inches (1.15m)
WEIGHT: 13 lbs (5,85kgs)
MOUNT: 1.5" schedule 40 pipe (1.9" OD, 48 mm)
START-UP WIND SPEED: 7 mph (3.13 m/s)
VOLTAGE: 12 and 24 VDC (36 and 48 VDC available soon)
RATED POWER: 400 watts at 28 mph (12.5m/s)
TURBINE CONTROLLER: Microprocessor-based smart Internal regulator with peak power tracking
BLADES (THREE): Carbon fiber composite
BODY: Cast aluminum (AIR-X Marine is powder coated for corrosion protection)
KILOWATT-HOURS PER MONTH: 38 kWh/mo@12 mph (5.4m/s)
WARRANTY: 3 Year limited warranty
SURVIVAL WIND SPEED: 110 mph (49.2 m/s)
OVER-SPEED PROTECTION: Electronic torque control

Southwest Windpower is pleased to introduce the latest evolution in small wind turbines, the **NEW *AIR-X***. The ***AIR-X*** combines what has made AIR the world's number one selling small wind turbine with new technology previously found only in today's state-of-the-art mega-watt-class wind turbines.

All of these features are primarily found within the body of the turbine. The new microprocessor based speed control results in increased performance, improved battery charging capability and the **elimination** of "flutter" noise from the machine. The controller allows for peak-power tracking of the wind by optimizing the alternators output on all points of the cubic curve and then efficiently delivers the energy to the battery. The turbine's smart controller allows it to actually control blade rotation speed thus **eliminating** the buzzing noise commonly found with the AIR 403 and 303 in high winds. Furthermore, a new series of carbon-reinforced blades with a modified pitch angle further increases power production.

The new electronics are a considerable improvement over the previous AIR-403 controller that consisted of diode-rectification and a simple on/off voltage switch.

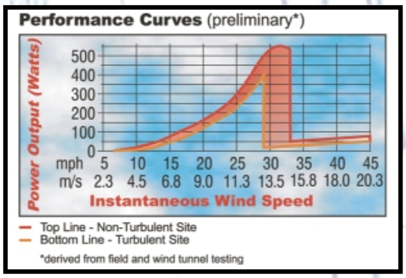
To the customer this means:

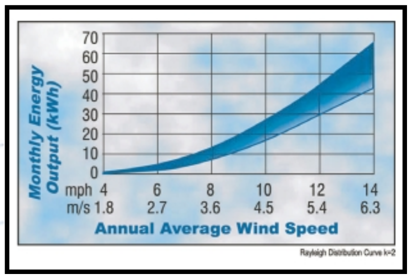
1) Much Lower Noise: Previous AIR wind modules relied on their aero-elastic blade design for protection in high winds, causing loud flutter noise in winds above 35 mph (16 m/s). AIR X's circuit monitors the wind speed and slows the blades as it reaches its rated output **preventing** it from ever going into flutter. The result is a much quieter wind turbine. In high winds, the ***AIR-X*** will continue to produce power at a reduced level until the wind decreases, at which point maximum output will resume. Additionally, when the battery has reached its charged state, the ***AIR-X*** will slow to an almost complete stop. Only when the battery has dropped below its voltage set point will it startup and resume charging.

2) Improved battery charging: Previous AIR designs required 300-400 amp hour battery banks so the trickle charge of the wind turbine could be adequately absorbed. The AIR X's charge controller periodically stops charging, reads the battery voltage, compares it to the voltage setting and if the battery is charged, it completely shuts off all current going to the battery. This function is performed within a few milliseconds. The closer the battery is reaching its full state of charge, the more often the AIR X's circuit repeats this action. This means any size battery from 25 to 25,000 a/h or higher can be charged safely.

3) Lower stress design: *AIR-X* limits power on the input side of the electronics by controlling the torque from the blades. The power no longer has to be dissipated by the electronics resulting in lower stress on the circuit, bearings and other materials. Furthermore, stress on wind turbines occurs primarily in high winds. Under these conditions, the electronic stall design reduces the speed to 600 rpm, thereby significantly reducing turbine and tower loading.

The ***AIR-X*** is our most expensive venture to date. Thousands of hours of research and testing have gone into the design. We are confident you will love the improvements the ***AIR-X*** has to offer.





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DIY combination solar water and home heating system

By transforming the north-facing roof of his house into one large solar collector, John Hermans now has a solar space heater and a solar water heater. He explains how it works

For many years now I have intended to carry out my plans to build a combined solar domestic hot water system and a solar space heating system. This rather large project has now come to fruition; last winter being its test period. My aim in this article is to explain how such a system might work, at reasonably high efficiency, and discuss some of the variables. As this project involved a long period of design and construction, I found that I had to develop particular skills and methods as I went along.

Although the system I have constructed was for a new building, this style of collector could easily be used to replace all or part of an existing north-facing roof. The primary objective of this solar heating system was to reduce to an absolute minimum the need for any other heat inputs into the house—the goal was 100 per cent solar heating!

John Hermans sitting atop his solar collector.

In order to achieve this, you need to appreciate the simple rule 'you only need to generate as much heat within a building as that which is being lost'. Therefore, before going ahead with any home heating project, it is imperative that you do as much as possible to maximise the insulation of the house envelope.

This includes wall and ceiling insulation (R3 and R5 in our case), draught proofing, double glazing (all non-opening windows), curtains (an option we have not taken up, as the double glazing is so effective), minimum south facing windows and keeping the surface area of the house's outer walls to a minimum in relation to its volume.

I might also point out that our house is earth covered to the south and earth bermed around the east, west and part of the north walls—a non-essential part of good design. The use of large quantities of internal thermal mass is also a key factor in designing comfortable solar houses. We have tonnes of thermal mass in the form of a concrete slab, internal mudbrick walls and one concrete wall. Although the 36m^2 'active' solar heater on the roof is quite large for a house with a floor area of 200m^2, this energy input represents only around half of the total input from the sun. Our house also has 30m^2 of glazing on the north side, which is referred to as 'passive' solar heating (as it uses the direct sun to heat the internal thermal mass).

In a nutshell, the three key principles of functional solar houses are: maximum insulation, maximum internal thermal mass and maximum summer-sheltered north facing glass.

Solar heating system

The hot water generated by the 36m^2 of solar collectors on the north roof is stored in a 3000 litre steel tank located

Left: Manoeuvring the 3000 litre storage cylinder into its final position, before boxing it in and insulating it. Right: One end of the 3000 litre storage cylinder, showing the access hole with the swimming pool water heat exchangers prior to final positioning.

on top of the garage roof to the south of the house, above the collector area. The heated water from the collectors naturally flows upwards (thermosyphons) into the storage tank above. When this collected heat is required inside the house, an electric pump transfers the hot water to any or all of the seven hydronic plastic pipe loops in the house floor slab. This mode of heating is called 'active solar', as an external energy source is required to transfer the heat to where it is needed.

A similar, and simpler, system could be made by doing away with the storage tank and circulating water directly from the collector to the floor coils, or even to wall-mounted radiators. In our situation the house already gains so much energy via the passive system that it may overheat in the autumn and spring seasons. Being able to store the heat in a large, well-insulated cylinder enables us to direct this heat where and when we want it. The stored heat is also used to heat a courtyard greenhouse and can be used in my workshop office (when I build it). Most importantly for the kids, the system is also used in the warmer months to heat the above-ground 20,000 litre swimming pool.

System sizing

The sizing of the solar water collectors and heat storage cylinder determines just how much stored reserve heat can be carried. In our case, we decided to make the entire north roof of the house into the collector. For every square meter of collector, the recommended volume of water to have in storage is approximately 75 litres, so our tank is 3000 litres. In the coldest season, I have set the thermostat to operate the hydronic heat transfer pump, so that it comes on when the temperature at the top of the storage tank reaches 35°C and turns the pump off at 30°C. On a sunny winter's day, the tank temperature actually continues to rise while the pump takes water from it. By 5pm the entire house slab is noticeably warm, with the air temperature around 21°C. So far, each morning the house temperature has not fallen below 17°C.

As the house has so much built-in heat storage, or thermal mass, the heat is carried through to the next day with minimal temperature drop through the night. There is no provision in the house for any other heating input, despite living on a 40 hectare bush block with abundant firewood. I consider the work we have done in fabricating this home heating system to be less than the effort of gathering, cutting, splitting, stacking, carting, feeding and cleaning an indoor fire place for the rest of our lives. We do burn some wood in a well-insulated AGA stove for cooking and for domestic water heating. There is also provision for heating the water in the 3000 litre storage tank with a large, cast iron water jacket heater for successive days of no sunshine. This stand-by heater resides in the court-yard/glass-house and is used around once a fortnight in winter.

The north facing roof which makes up the solar collector has a physical dimension of 15m x 3.3m. This entire

Robyn carefully applying heat and home-made solder in order to join the copper riser tubing to the galvanised corrugated iron.

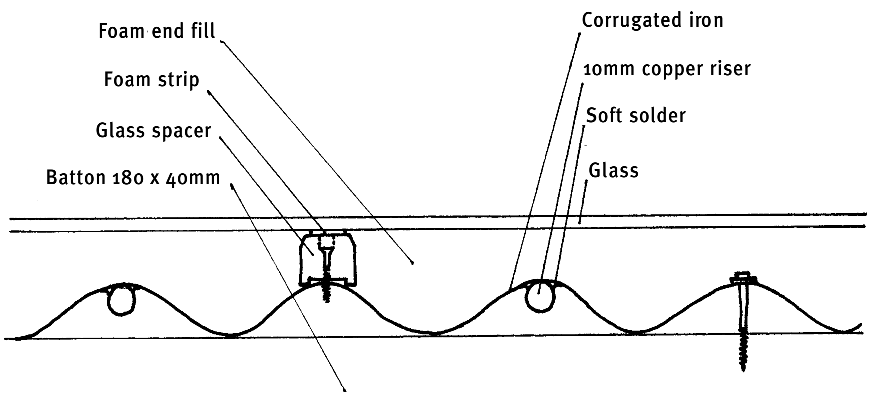


Diagram 1. End of view collector

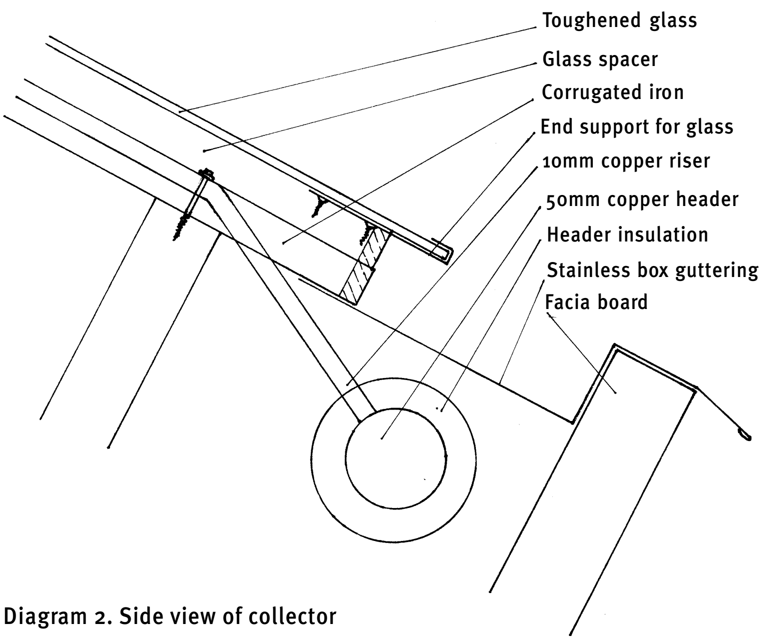


Diagram 2. Side view of collector

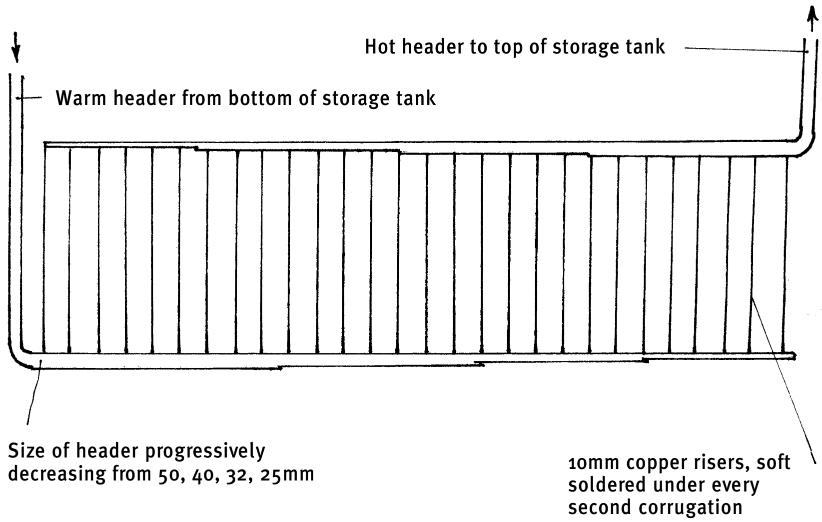


Diagram 3. Pipe layout of solar collector

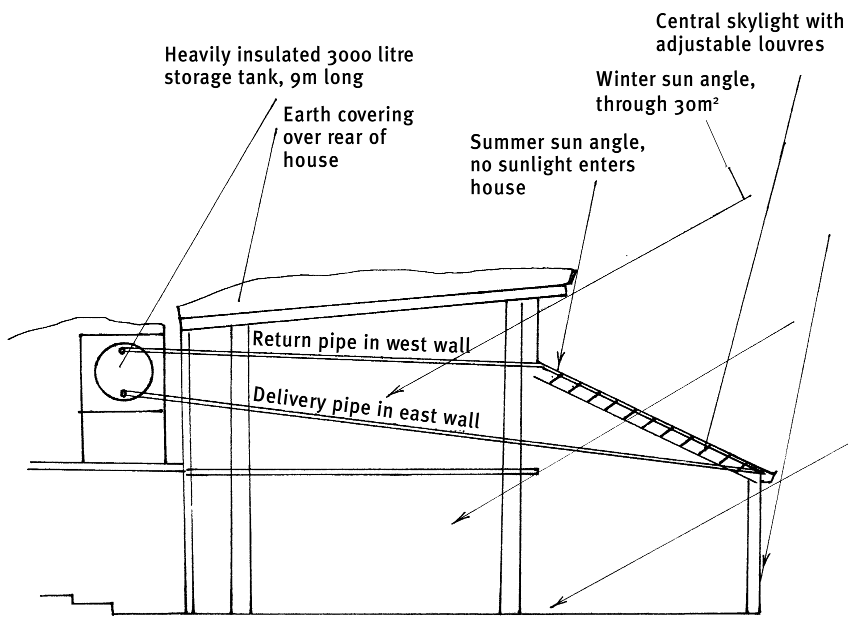


Diagram 4. Showing solar collector, delivery pipes and storage tank replacement.

roof surface is covered with 6mm toughened glass sheets which I acquired cheaply as seconds. The glass is held 20mm above the corrugated galvanised iron by strips of square hardwood, screwed to the top of every sixth hip corrugation (see Diagrams 1 and 2). The glass actually rests on 12mm strips of foam padding. This arrangement forms a very rigid and strong surface that can readily be walked on. The 32 glass sheets were easily handled by myself (1.9m x 0.86m) and none were broken during construction.

Under the large, glass surfaced roof area are three separate solar collectors, the 36m^2 space heater, as discussed, and a smaller 6m^2 domestic water heater at the east end of the roof. In the centre of the roof is a clear skylight, 1.2m wide by the full width of the roof. This skylight has 50mm insulated louvres that can pivot to close, retaining winter heat at night and blocking out summer sunlight. A 12 volt DC motor together with a bicycle chain and sprockets and simple linkages are hidden inside the roof space. Pushing a button switch in the kitchen allows the louvres to be opened and closed. The amount of light it throws into the back of the house in winter is amazing (see Diagram 4).

Construction

I have used galvanised iron for the collectors (not zinc-alume) at a thickness of 0.9mm. It is of minimal extra cost to standard iron at 0.45mm. It has two main benefits: you can jump on it and not bend it, and the extra thickness proportionally increases the capacity of the iron to conduct heat transversely from the iron to the water in the copper riser pipes.

In the fabrication process of these collectors, I used lead/tin soft solder to attach the 81 risers of 3.6 metre length and 10mm diameter, hard drawn copper tube to the underside of every second corrugation in the galvanised iron. This gave the risers a spacing of 15cm and although this distance is slightly greater than what I would have preferred to achieve higher efficiency—that is, a riser soldered in every corrugation—the compromise allowed me to use half as much copper and solder resource. Besides, soldering 280 meters of copper pipe to galvanised iron was quite enough of a challenge! The soft soldering process was simple once the method was established (see the photo with Robyn on the oxy).

The copper pipes that deliver the cold

water to the bottom of the risers and those that take the water away from the top of the risers are termed the headers. This pipework needs to be configured as in Diagram 3 to achieve uniform liquid flow in each of the risers. Uniform flow through all risers is also achieved by using header pipes of large diameter (low pipe friction) and risers of small diameter (high pipe friction). It is most important that the risers and top header maintain a minimum of 20:1 upward slope to facilitate the natural thermosyphon flow and to avoid air and steam traps which will inhibit this flow.

When the floor is being heated, water is taken directly from the top of the 3000 litre storage tank. However, when the pool is being heated the pool water is passed through a heat exchanger mounted along the top of the storage tank. A group of five 20mm diameter and 18 metre long copper tubes (from the scrap yard) are used as the pool heat exchanger. The pool water has chlorine in it, which would accelerate the corrosion of a steel tank. The storage tank's life expectancy is significantly increased by a two per cent solution of a corrosion inhibitor in the form of sodium benzoate. Sacrificial magnesium anodes have been bolted to the inside of the tank to maximise its life span. The steel pipes welded to and passing through the end walls of the storage tank are separated from all copper pipe or fittings by rubber hose or plastic fittings, to avoid corrosion by electrolysis.

The heat distribution pump, which does the work of transferring all this captured solar energy into the house slab is a small 90 watt circulating pump. It circulates around 0.75 litres of the cooler return line water per second and is only needed for a few hours a day. Given that the space heater collector is 36m^2 in area, with a summer radiation level of 1kW per square metre and around half that value in the winter, it is easy to calculate the sort of energy inputs we are receiving from this system. We love it!

Rebate status

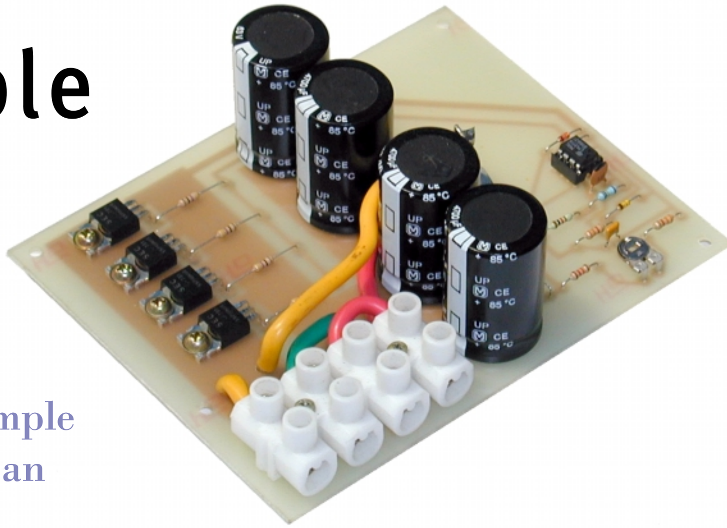
In Victoria, the Sustainable Energy Authority (SEAV) administers the solar hot water rebate program as part of the state government's commitment to reducing greenhouse gas emissions. The rebate offers up to $1500 for solar water heaters installed under the regulations of the rebate program. Only system installations that result in reduced greenhouse gas emissions are eligible for a rebate, and the amount of rebate is based on the performance of the system and the hot water delivery of the unit.

Unfortunately for me I am not entitled to any subsidy at all with my home made installation, despite the system's estimated 60 per cent input of our home heating and domestic hot water, and that the newly installed solar collector has displaced the use of burning wood.

My system fails to meet criteria qualification in two ways. First, all systems included in the rebate program must be assessed to Australian Standard AS 4234. This is a performance standard that enables consumers to compare the performance of commercially available units. My system is not a commercially manufactured product and has not gone through the AS 4234 assessment (which is a fairly expensive procedure). Second, the system was not installed by a licensed plumber and therefore did not receive a Certificate of Compliance, as is required by the Plumbing Industry Commission.

More information about the Certificate of Compliance and the regulations governing plumbing work is available from the Plumbing Industry Commission website: www.pic.vic.gov.au. If a plumber had anything to do with this project, it would never have happened! Through scavenging and not including the cost of my own labour, the system cost around $3000. If you consider yourself fairly capable and want something special around the house, go forth and DIY. ✲

Build this simple Maxi-Maximiser



Greatly improve the performance of solar-powered pumps and motors by building this larger version of our simple mini-maximiser, which was based on an original design by Alan Hutchinson, Plasmatronics, Melbourne

Since the ATA started selling the mini-maximiser kit some years ago, it has been one of our biggest selling items. This is because it is such a useful device, and is far cheaper than any commercially available maximiser on the market.

The mini-maximiser allows solar panels to drive motors directly, effectively matching the solar panel to the load and allowing the panel to run at close to its maximum output. This allows the pump to move more water every day, and to run at times of low light level, when the pump motor would otherwise be stalled.

However, our mini-maximiser is rated for use up to six amps, which is not enough for larger pumps and motors. Having been asked on a number of occasions if we did anything bigger, we decided to put together a kit capable of up to 20 amps at either 12 or 24 volts. This article takes a quick look at the resulting kit and how it works.

How it works

In developing the smaller version of the maximiser, we used a system of a motor-driven diaphragm pump for testing the maximiser. This pump has a 12 volt motor nominally rated at 6 amps. The pump would not start when driven from a single 50 watt panel, even without a load. With 3.3 amps from the panel flowing through the motor, a mere 1.2 volts was measured across the motor. Hence, the power going into the motor was only 1.2 x 3.3 = 4 watts. If the panel was being operated at its peak power point (about 17 volts), it would have delivered 55 watts.

Therefore, the problem is getting the panel to supply its energy at 17 volts and deliver it to the motor at a lower voltage. More expensive maximisers use switchmode down converters to perform this ‘DC transformer’ function.

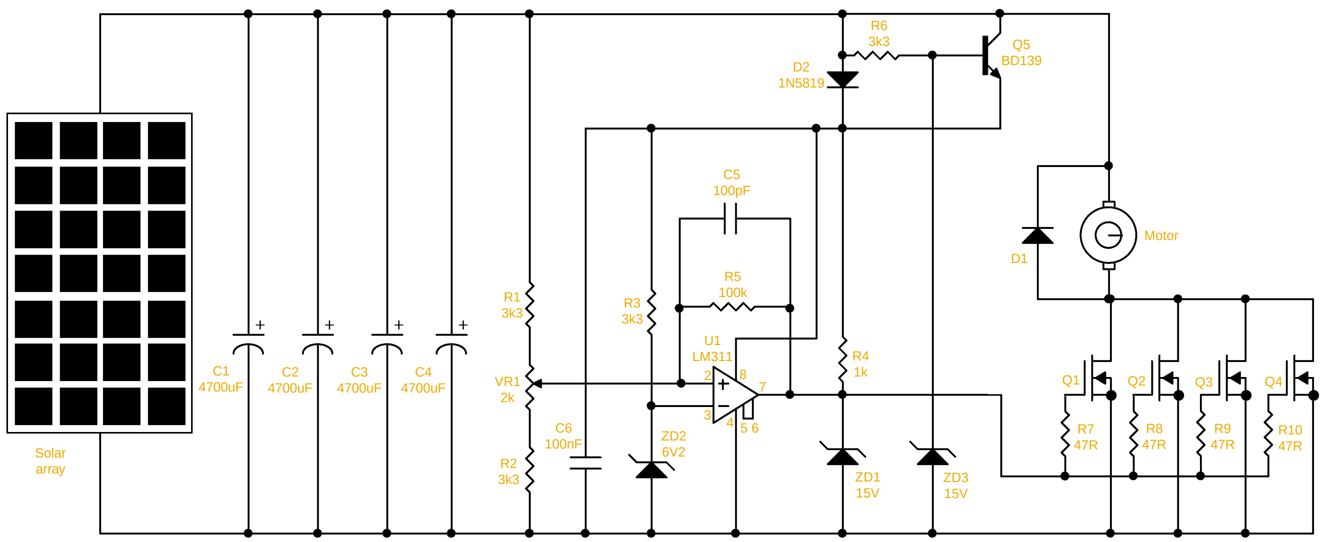


Figure 1. The circuit diagram for the maxi-maximiser.

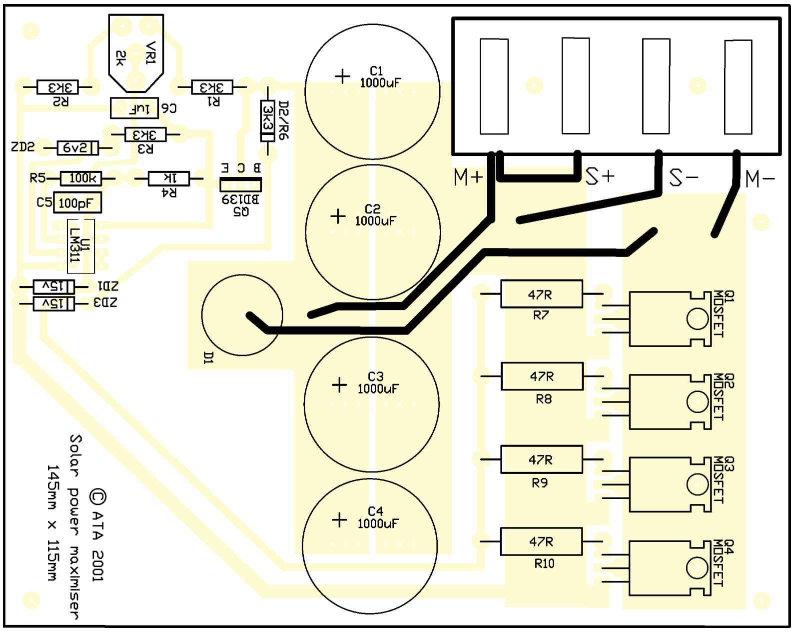


Figure 2. The circuit board overlay (shown here at about 70% full size) shows where the parts are positioned. Note that the trimpot, VR1, may be a short or long device—the circuit board allows for both types. Also note the 12 amp version is only supplied with two MOSFETs, while the 20 amp version has four. They also use different capacitors.

This maximiser is much simpler.

The circuit consists of a large capacitor bank connected across the array, which can be connected by an electronic switch to the motor. When the switch is off, the capacitor bank will be charged up by the array. As the open circuit voltage of the array is usually above 20 volts in a 12 volt system, the capacitor bank can charge to quite a high voltage. When the capacitor voltage rises above an adjustable set point (in the range 10.5 to 17 volts) the electronic switches (the field effect transistors, or FETs) turn on. This connects the motor across the capacitor bank, and a lot of current will flow from the capacitors into the motor.

This will cause the capacitors to discharge rapidly. When the capacitors' voltage falls about half a volt below the set point, the FETs will switch off again and allow them to recharge. This cycle then repeats indefinitely. It is basically a free-running oscillator with the rate of charge determined by the array charge current and the rate of discharge determined by the amount by which the motor current exceeds the panel current. It is therefore possible to get more current flowing into the motor than is coming out of the panel (but not more power, of course).

The array delivers a steady current at close to the set point voltage. If the set point is close to the maximum power point of the array, the array will be delivering as much power as it can.

On the motor side, the motor will be driven with pulses of high current, which is excellent for providing the high torque necessary to get it moving. When it's stalled, the pulses will be large but of short duration. As the motor picks up speed the voltage across it will rise due to the back EMF of the motor and the pulses will be at a lower current but of longer duration. This means that the frequency of the oscillator will fall as the motor gets going.

Circuit details

The circuit is basically the same as the mini-maximiser, just with larger power components capable of handling more current. In case you don't have a copy of the original maximiser article from issue 43 of *Soft Technology*, we have included an explanation of the circuit here.

The four large electrolytic capacitors are charged by the solar panel and then quickly discharged into the load by the FET switches. We used SSP60N06 FETs for the electronic switch. The SSP60N06 will block up to 60 volts, can handle a maximum continuous current of 60 amps and has an on-resistance of 0.015 ohms. Due to the low on-resistance and the multiple paralleled devices, it is not necessary to provide a heatsink for the FETs, though there is space on the board for a heatsink bracket if you wish.

The FETs can be mounted vertically, or with their leads bent at right angles to allow them to be securely mounted to the heatsink bracket and circuit board.

D1 is a fast-recovery diode (normal diodes do not switch fast enough) that is used as a freewheeling diode. This provides a path for the motor current to flow through when the switch is off, thus protecting the FETs from high voltage spikes.

An LM311 comparator is used to compare the capacitor voltage (reduced by the adjustable voltage divider) with a reference voltage supplied by the 6.2 volt Zener diode. The output of the LM311 drives the FET switches. The 100k resistor supplies positive feedback around the LM311 and creates about 0.5 volt of hysteresis between the switch on and switch off voltages. The 100pF capacitor speeds the switching and suppresses transition oscillations.

When designing the new maximiser, we initially thought that we would have to include some form of driver circuit for driving more than one MOSFET together, but after initial testing it became apparent that this was not necessary. The LM311, being able to sink up to 50mA, seems to cope well. All we did was change the 1k5 drive resistor to a 1k. We also included 47ohm resistors on the gate of each MOSFET to suppress any oscillations or 'ringing'.

If you are building the 24 volt version, the extra two components listed, Q5 and ZD3, should be used to limit the LM311 supply voltage to 15 volts, and the top 3k3 divider resistor should be replaced with a 12k. Note that another 3k3 resistor replaces D2. If you are building the 12 volt version, you need to make sure that you place a wire link across the two outer pads of the BD139 regulating power transistor position, Q5 (the transistor is not used in the 12 volt version), and use a 1N5819 or similar 1 amp fast diode in place of R6.

Construction

There will be two versions of this kit, a 12 amp and a 20 amp unit, and they will both be available in 12 or 24 volt versions.

This kit is a bit more difficult to make than the smaller version maximiser, but should take no more than two hours to put together. To make it easier, the circuit is constructed on a piece of pre-drilled circuit board supplied in the kit. The components are mounted on the opposite side from the copper tracks according to the layout diagram. Take care to get all the diodes, the LM311, the FETs and the large capacitors around the right way. Make sure you use the IC socket, as 8 pin ICs can be hard to remove if you haven't done it before. D1 is simply bolted through the circuit board with the nut and tooth washer. You may need to drill out the hole to the size of the diode's stud.

Note that the 12 amp version only has two MOSFETs, while the 20 amp version has four. The main capacitors are also different in the 12 amp version.

We found it best to solder the heavy connecting wires and the large capacitors to the board first, as these will take a fair amount of heat to solder. You will need a soldering iron of around 40 watts capacity or more for these, but use a smaller iron (20 watts maximum) for the electronic components.

When assembly is finished, check that each component is in the correct place, that it is the right way around and that there are no bridges between tracks.

If you put the circuit in a box, be careful to allow holes for adequate ventilation, especially if the maximum switching current of the maximiser will exceed five amps per MOSFET. If you are using a metal box, you may want to mount the FETs to the inside of the box via a piece of aluminium angle as a heatsink bracket to allow for heatsinking of the devices. You need to use an insulating washer between each of the FETs and the bracket, as most FETs have their drain terminals (connected to the motor negative in our circuit) connected to their mounting tab. You may also need to use a heatsink for the power diode, D1, if it gets too hot, though we found very little heating in our tests.

Testing

If you have a current-limiting power supply, connect it across the solar terminals, with the voltage set to 12 volts and the current limit set to half an amp. If you don't have a current-limiting supply, use a 12 volt battery with a 1 amp fuse. Now check the voltage across the 6.2 volt Zener diode (ZD2). This should be roughly 6.2 volts. Set the trimpot to its mid-point and measure the voltage between the trimpot centre leg and the solar negative terminal. This should be about 6 volts. Turn the pot fully anticlockwise, then measure the voltage across the 15 volt Zener diode (ZD1). It should be about 11 volts, indicating that the switch to the motor (the MOSFETs) is turned on. Turn the pot fully clockwise. The voltage across the Zener should now be less than 1 volt, indicating that the switch is off. If you can get it to perform like this, connect it to your pump or motor to see how well it performs.

Operation

Connect the solar array to the solar positive and solar negative terminals. Connect the motor to the motor positive and motor negative terminals. When the motor is stalled, you may hear a high-pitched whine as the maximiser is pouring maximum current into the motor to try and get it moving. As the motor speeds up, the pitch of the whine drops. You can also hear it change pitch as the amount of light falling on the panel changes.

The reason for the adjustment pot is to allow the operating point of the panel to be varied according to the situation. If you are trying to get pumping under overcast conditions, or in the morning or evening, then the operating point needs to be low enough so that the peak array voltage is high enough to charge the capacitors up to the switch threshold. In other words, if the operating point is set too high, the array voltage can never get above it and the maximiser won't oscillate.

A setting in the range of 12 to 14 volts for a 12 volt system seems to be appropriate. If there is sufficient power from the array to bring the motor voltage up above the set operating point the switch will simply remain on, effectively taking the maximiser out of the circuit until the array power reduces to the point where it is needed again.

Kits

The maximiser kits are available from the ATA, PO Box 2001 Lygon St North, East Brunswick VIC 3057, ph:(03)9388 9311, fax:(03)9388 9322, email: ata@ata.org.au, www.ata.org.au. The 12 amp version is priced at $80 ($75 for ATA members) and the 20 amp version is $140 ($130 for members). The kit includes the circuit board and all components, but no case. Remember to specify your current and voltage requirements in your order. ✲

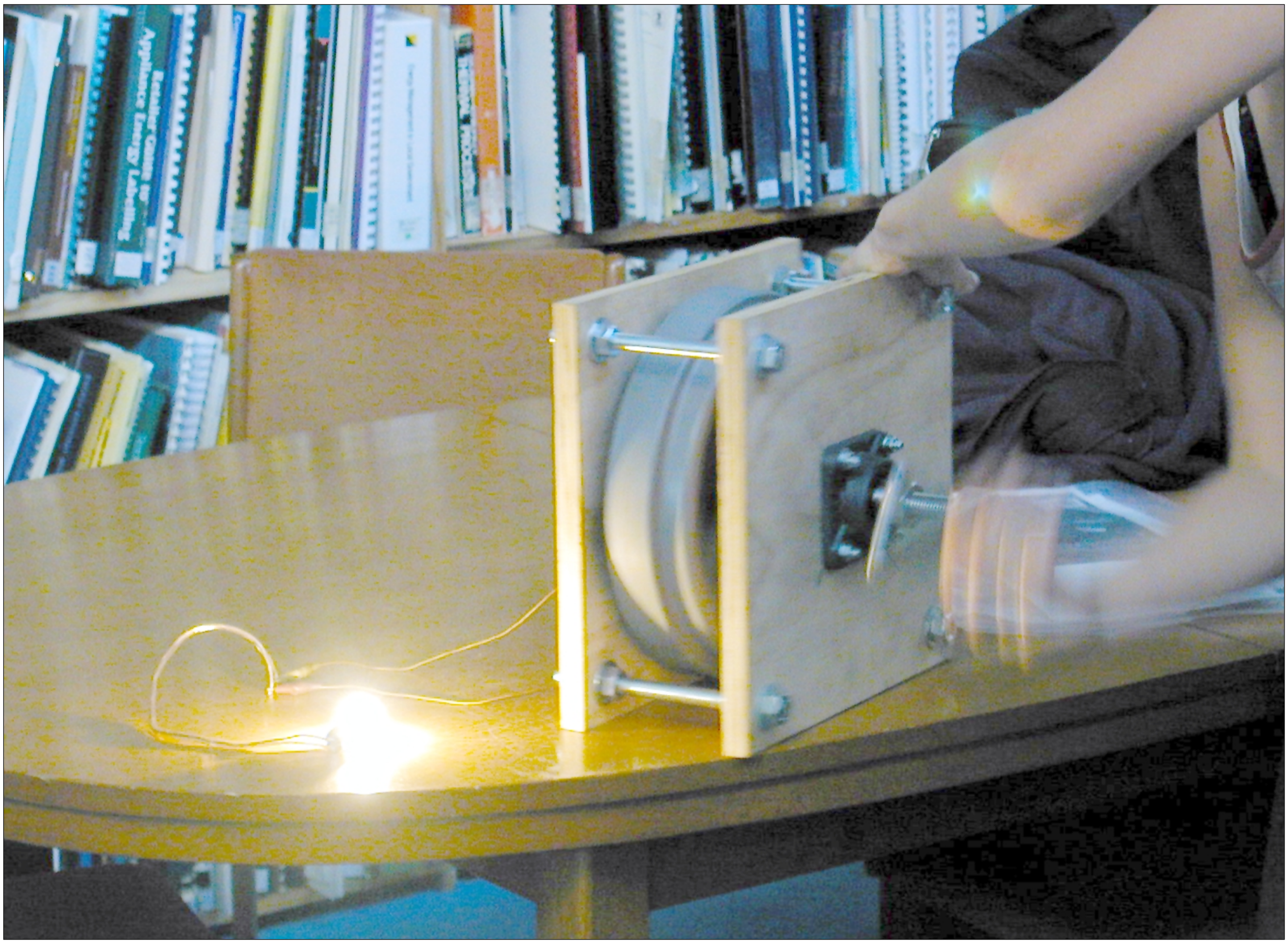
Parts list

1	LM311N comparator IC	IC1
4 (2)	Power FETs SSP60N06 or equivalent	Q1, Q2, (Q3, Q4)
1	20 amp ultra-fast diode	D1
1	1N5819 fast diode	D2
1	15V, 1W Zener diode	ZD1
1	6.2V, 400mW Zener diode	ZD2
3	3k3, 1/4W resistors	R1, R2, R3
1	1k, 1/4W resistor	R4
1	100k, 1/4W resistor	R5
4 (2)	47R 1/4W resistors	R7, R8, R9, R10
1	2k horizontal trimpot	VR1
4	4700uF (1000uF) low ESR electrolytic capacitors	C1, C2, C3, C4
1	100pF, 50V ceramic capacitor	C5
1	0.1uF, 50V ceramic capacitor	C6
1	4-way terminal block	TB1
1	8 pin IC socket	
1	MAXI Circuit board	
4 (2)	3mm x 10mm bolts, nuts and tooth washers	
2	3mm x 20mm bolts, nuts and tooth washers	
2	250mm length $4mm^2$ insulated wire (red and black)	

For a 24 volt version these extra or alternative components are required:

1	15V, 1W Zener diode	ZD3
1	3k3, 1/4W resistor	R6 (replaces D2)
1	BD139 power transistor	Q5
1	12k, 1/4W resistor	R1 (alternate value)

Note: figures in brackets refer to components in 12 amp version



Low-speed generator

Lance Turner

Here at *ReNew* we get a large number of requests for sources of low-speed generators for use with home-built wind generators, hydro turbines and other energy sources.

Unfortunately, good quality electrical generators that will operate at low speeds are almost non-existent, unless you make them yourself. Even for an experienced do-it-yourselfer, this can be a daunting task, requiring the manufacture of coils, rotors, sourcing appropriate magnets and materials, and getting the whole thing assembled and balanced.

This has long been a hurdle that we have not found a way around, until one of our readers suggested that we try a motor from a Fisher & Paykel Smartdrive washing machine, as these machines use a high-efficiency brushless DC motor instead of the more common AC induction motor.

The questions now were, how well would one of these motors really work, how easy would it be to set up, and how much would the resulting generator cost?

Not having a dead washing machine of the appropriate type, I priced a new motor from the local appliance repair shop. They are sold as several parts: the rotor; the stator; the shaft; the bearings; and a few other small bits. However, even with these parts, the rotor and stator require part of the washing machine itself to support them, so it was looking more complex all the time.

If you can source an old one of these machines, you are in luck—just cut it up for the appropriate section.

The cost of the rotor (part number 425620P) and stator (part number 426 181P) combined was $170, so I bought those two items, as they are all that is really needed in terms of using original parts. The standard shaft was another $95, so I opted for something a bit cheaper.

Instead of the original shaft, I just used a length of ¾ inch threaded rod from the hardware store. The rod, two nuts and washers cost around $12.

Also needed were two bearings for the shaft to run in. These were sourced from our local bearing supplier, for a total cost of $46.

To make the 'frame' of the generator I used an offcut of 17mm plywood, a 1.8 metre length of ½ inch threaded rod and 16 washers and nuts from the hardware store, costing around $32.

Building the frame

The stator diameter of the motor I used was about 249mm, the rotor diameter about 250mm, giving very little clearance. This meant that the generator had to be made fairly accurately in order to work. You will most likely need a drill press to drill the various holes to provide reasonable accuracy.

I started by cutting two 300mm squares from the plywood. I then marked a corner of each one so that they could be re-aligned later. I marked 30mm in from the edge of each corner, clamped them together and drilled the holes through both pieces at the same time. I also cut a 25mm hole in the centre of each piece for the shaft to go through.

One of the pieces, the base that has the stator mounted to it, must have a section cut from it for access to the stator terminals.

Once these parts were cut, drilled and lightly sanded to remove splinters, I set about mounting the stator to the base. To do this, I needed to make a spacer insert for the stator. It needed to be at least 15mm thick, and had to fit inside the stator's moulded centre mounting section. This can be seen in the photos. I cut this spacer from a piece of white plastic board, but a piece of the 17mm ply would have served just as well.

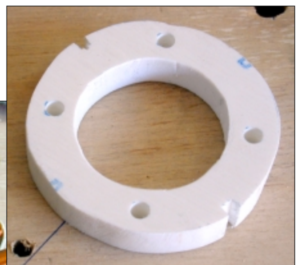
Once done, I aligned the stator on the base, with its terminals centred in the cutout, and marked the four screw holes. I drilled these to ¼ inch, and used four $\frac{5}{16}$ x 1½ inch coach screws to hold the stator in place. The stator comes with a pair of steel mounting plates—I used one of these after breaking off the little hole tags and drilling the holes out for the coach screws.

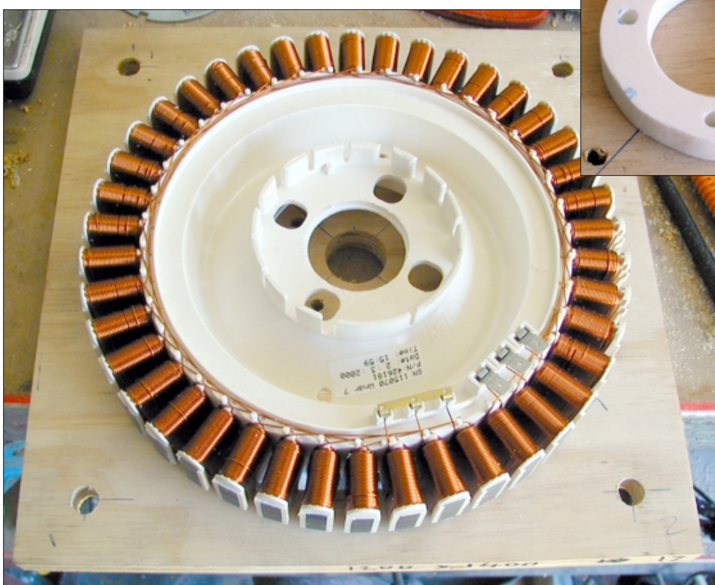
I then cut four pieces of the ½ inch threaded rod about 180mm long (in retrospect they could have been 30mm longer to allow for attachment to mounting brackets later). I screwed a nut onto one end of each of these, then slipped over a washer, pushed the end through the wooden base, added another washer and then a final nut to lock the rod into place. The photos show how this is done.

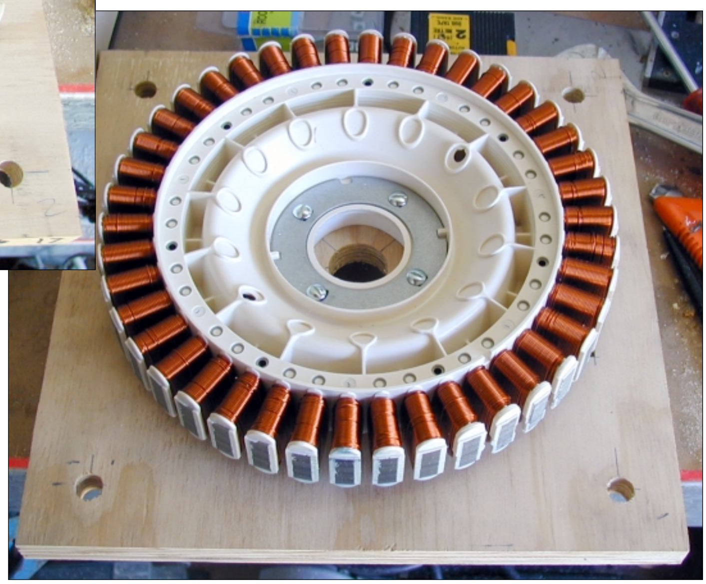
The rotor

The rotor can be seen below. It is basically a plastic moulding with magnets embedded into its inside edge.

I mounted the rotor on a length of ¾ inch threaded rod. This is a slide fit inside the splined section of the rotor, but needs to be screwed through the last







Above is the stator sitting on the base board. Note that it is facing up in this photo, so that you can see the terminals and the mounting area that requires the spacer.
At right is the stator after mounting. The spacer can be seen at top (not to scale).

part of the plastic moulding. Once in the right position on the shaft, I placed a washer and nut on each end of the shaft and tightened them up against the rotor. Even though the shaft was a fairly loose fit in the rotor, the rotor ended up nicely centred on the shaft.

Next, I mounted the bearing blocks on the outer face of the stator base and the other piece of ply. These were held in place by ¼ x 1½ inch coach bolts, nuts and washers. The bolt heads for the stator base bearing needed to be recessed under the stator, so I drilled and recessed these holes before mounting the stator.

With all this done, it was just a matter of assembling the generator to see how well it worked.

I started by resting the base plate, stator facing up, on the top of an empty 20 litre paint drum for stability. I then screwed a nut onto each of the protruding threaded rods, winding them down so that the top of each nut was about 110mm from the baseplate. On top of each nut I placed a washer.

I then slid the rotor shaft into the stator base bearing until the rotor 'grabbed' the stator. Next I placed the top section of the generator (the other piece of ply and its associated bearing block) over the rotor shaft, and slid it down until the threaded rods started to pass through the holes in the top section. Now it was just a matter of juggling the rotor, top and bottom sections until the motor was mostly assembled and the top section was resting on the washers. Then the top washers and nuts were placed loosely on each of the threaded rods.

Setting up

When it gets to this stage, the rotor will have firmly attached itself to the stator and can't be rotated. You need to tighten the nuts on the threaded rods until the whole frame becomes rigid. The rotor will probably still be stuck on the stator, so the next step is to loosen the nuts holding the bearing block on the top piece of ply, and gently tap it around until the rotor rotates freely.

With my unit, I had to adjust both the top and bottom bearing blocks. It was a bit of a juggling act but, after about half an hour of making adjustments, the rotor rotated freely. Once this was acheived, all the nuts were tightened, and the rotor once again checked for free rotation.

The only other thing required was a way to drive the rotor. This was solved, at least for basic testing, by making a crank handle from a bike pedal crank. I drilled out the crank hole to fit the generator shaft, and drilled and tapped the crank to take a 6mm bolt to allow it to be tightened against the shaft.

Testing

The first test was to measure voltages and currents available from the generator. The DC resistance of each winding was around six ohms, which told me the motor was likely to put out relatively high voltages and lower currents. This proved to be the case.

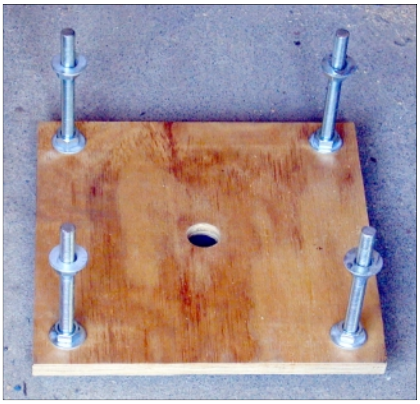
Connecting a meter to one of the three phases (there are three connection terminals plus a common bussbar on the stator. One end of each phase is connected to a single terminal, while the other end of all three phases are connected to the common bussbar.) showed that cranking the shaft like a maniac would produce an open-circuit voltage of up to 60 volts, and a short-circuit current of a couple of amps or so.

Next, I attached a 5 watt, 12 volt lightbulb to a single phase. This bulb didn't last long at the hands of an over enthusiastic generator cranker who promptly shoved about 20 watts through the bulb before it blew. A 28 watt, 24 volt bulb was more durable, and it is this bulb that can be seen glowing brightly in the lead photo.

More usable power

The next step was to connect all of the phases to a bridge rectifier in order to collect all available current for use on a

Right: The rotor, as seen from both sides. It is simply a plastic moulding with embedded magnets. Above you can see a closeup of the magnets.



The baseboard with threaded rods attached (before the hole was cut for the stator terminals). The top board is the same as this board.

single load (such as charging a battery). Of course, this produces a DC output that can be used for many things, including charging batteries directly, driving motors, heating elements or anything else you can think of.

The results of the testing were interesting and quite promising. With all three phases connected, the open circuit output of the generator easily reached 150 volts at around 200rpm. However, short-circuit current was still only a few amps. This means that the generator needs to be run at high voltage and low current, not vice versa.

But how do you charge a 12 or 24 volt battery from a 100 volt power source? Easy, use a switchmode power supply to do the charging. The efficiency will be quite high, and switchmode supplies are fully regulated, so there is no possibility of overcharging. What's more, the higher generation voltage allows the power to be transmitted over thinner cables and greater distances than would be possible with a 12 or 24 volt generator.

Finding a suitable power supply for me was not hard—I had an old 50 watt, 13.8 volt switchmode supply that would work on any AC or DC voltage above 100 volts (virtually all switchmode supplies will work on DC). This 'universal' type power supply is becoming more common now, as manufacturers make supplies that can be used anywhere in the world, not just for one specific voltage.

Anyway, hooking up this supply to the generator and cranking it fairly quickly, the supply started producing output current and charging my test battery at around 3 amps of output current. What's more, the supply maintained this output current even when the generator voltage had fallen to 50 volts. However, the slower I cranked, the harder it became to crank. As I sped up, and output voltage increased, it became easier.

I also tested the generator with a couple of other loads. A 240 volt light bulb could be made to glow fairly well, and a 240 volt, 1000 watt heating element could be made to run at 75 volts. At this voltage, it was absorbing close to 100 watts (this is a good way to tire your arm very fast!), so the generator looks capable of producing at least 100 watts on a continuous basis.

This generator would be suitable for use with many energy sources, such as wind turbines (including the slow-revving but very torquey Savonius rotors), micro-hydro turbines and pedal power machines. While it can be used to charge 12, 24 or other voltage batteries directly, the available current seems to be fairly low (just a few amps), so it would make sense to use it at around 100 volts or so with a suitable switchmode converter.

A brief check of the Jaycar Electronics catalogue showed several power supplies that would be suitable up to around 150 watts for under $150, with smaller units starting from around $60. There are also other suppliers of these types of devices, so you should have no trouble finding a suitable supply. Just remember that it should be capable of converting the full expected output power of the generator. For a wind turbine, this may be 200 watts or more.

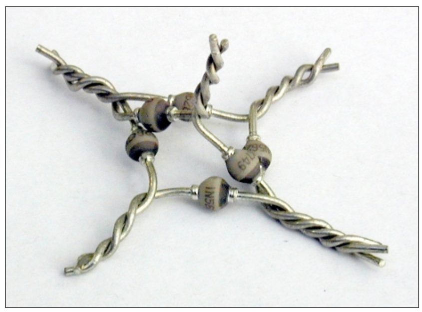
In conclusion

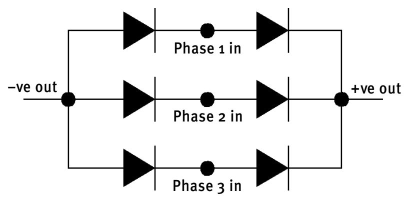
While developing this generator, I mentioned it to Malcolm Barko of Southwest Solar. To my surprise, he told me that he had already made one and had it working, so this was not a new idea!

Overall, this was an easy device to make, and if I had owned an old washing machine, it would have been even easier (and cheaper!).

Because this was mainly a test to see if it would work, I used materials that were easy to work and cheap, but probably not as suitable as others. The boards, for instance, would have been better had they been 10mm thick aluminium plate or 20mm phenolic resin board, or some other waterproof material. Using plywood limits the places this unit can be used in. The threaded rods could have been stainless steel—for corrosion resistance.

Despite the limitations of the test unit, we will still be making good use of this generator somewhere on the CERES site. It is a great example of putting everyday devices (or parts of them, at least) to work in other useful roles. ✯





The bridge rectifier is made from six diodes with a suitable rating. 200 volt, 3 amp diodes would be adequate in most cases.

Build a water pump timer

Bruce Tonkin, winner of this issue's build-your-own prize, describes the pump controller he built that helps provide water to two homes on his land

About 18 months ago we replaced a petrol driven pump with a windmill in order to raise water into a header tank which then gravity feeds two houses on our property. This system has worked extremely well but does occasionally need an electric pump as a backup to fill the header tank after periods of little or no wind. Initially, we just used a switch to turn the pump on when the tank was low and off again when enough water had been pumped into it. However, sometimes, well actually a lot of times, we would forget to turn it off, resulting in the water overflowing back into the supply tank and a wastage of electricity.

This led to the idea of fitting a timer to the pump to automatically turn it off. This seemed simple enough, but we also wanted it to be manually turned on and for it to be able to run for different periods of time. We also did not want there to be any current being drawn while the timer was sitting there waiting to be activated. So I came up with the design shown in Figure 1.

Basically, when the momentary type switch is pressed it operates the relay, which then supplies the power to the timer circuit and the pump. Once the timer has gone through its preset time it switches off the relay, disconnecting the power from the whole of the circuit. Thus the power can always be connected to the circuit but does not draw any current until the switch is pressed.

The circuit shown works off 240 volts, but it can easily work on 12 volts by leaving out the components inside the dotted lines (T1, C1 and DB1) and connecting the wires A to A and B to B. The rating of the switch (SW1) needs to be appropriate for the voltage being used and capable of handling the start-up current of the pump motor. The relay (RL1) must have a 12 volt coil and have contacts rated to suit the operating voltage and current of the pump.

More details

The timer circuit was built up on a piece of Veroboard with all components being readily available from any local electronics hobbyist shop.

The timer is based around the common 555 chip (IC1), with the time range of operation being determined by the adjustable resistor VR1, resistor R1 and the capacitor C2. The values shown give a timer range of five to 25 minutes. When

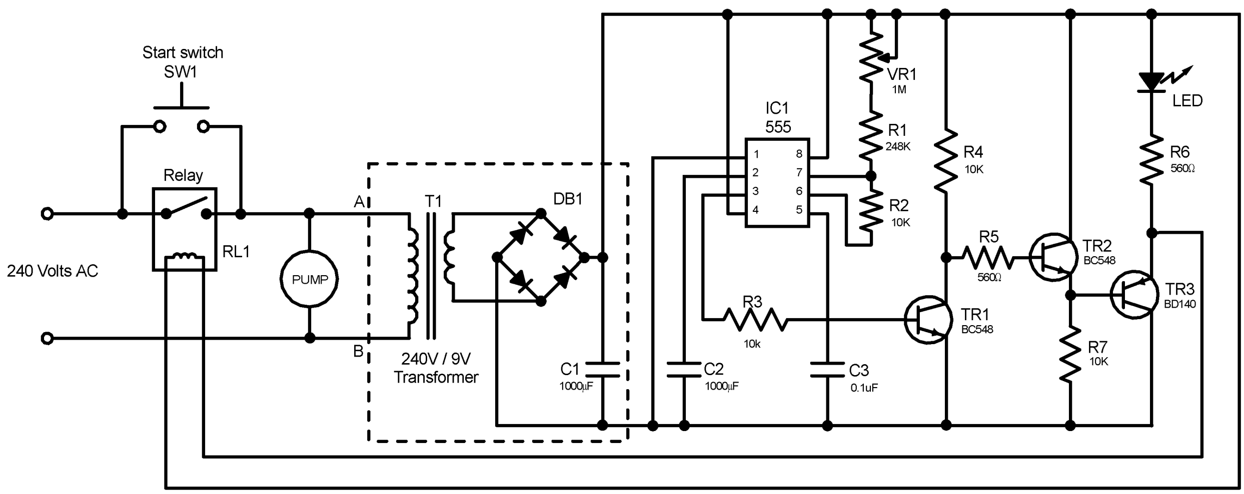


Figure 1. The circuit diagram of the pump controller.

the switch, SW1, is pressed, the output of IC1 switches TR1 on, which turns TR2 off and then finally a higher power transistor, TR3, is turned on and so operates the relay. (Note that using a BC338 for TR1 you should be able to switch most relays without the need for the other two transistors. There should also be a diode across the relay contacts to clamp any high voltage spikes and protect the rest of the circuit—Ed.) When the timer switches off, the reverse happens with the transistors and so turns off the relay, disconnecting the power to the whole circuit until the next time SW1 is pressed.

Performance

This timer has been used for nearly 12 months now and has performed faultlessly, allowing us to pump a preset (by time) amount of water into the header tank. In summer, we get afternoon breezes which generally are enough to fill the tank, so if we are low in water in the morning, this timer enables us to easily pump only enough to get by until the winds arrive, making the whole system more energy efficient.

Safety

If you are building the timer to switch a 240 volt pump, then make sure you know how to do safe 240 wiring. All 240 volt wiring and connections must be fully insulated and well separated from the 12 volt side of the circuit. Ensure that there is no possibility that the 240 switching side of the relay can come into contact with the 12 volt relay coil contacts. ✲

Component list

Switch	SW1	See text
Relay	RL1	12 volt, see text
Transformer	T1	240V/9V, see text
Potentiometer	VR1	1M linear
Resistor	R1	248K, 0.25W
Resistor	R2	10K, 0.25W
Resistor	R3	10K, 0.25W
Resistor	R4	10K, 0.25W
Resistor	R5	560R, 0.25W
Resistor	R6	560R, 0.25W
Resistor	R7	10K, 0.25W
Capacitor	C1	1000uF, 16V electrolytic
Capacitor	C2	1000uF, 16V electrolytic
Capacitor	C3	0.1uF, 100V polyester
Integrated circuit	IC1	NE555 timer
Transistor	TR1	BC548, npn
Transistor	TR2	BC548, npn
Transistor	TR3	BD140, pnp
Diode Bridge	DB1	WO4, 1.2A, 400V, see text
Light Emitting Diode	LED	5mm standard

A water level indicator—that works the right way!

While not exactly a new idea, the counterbalanced water indicator usually works in reverse—the indicator is high when the water level is low, and vice versa. Wesley Trotman describes another version of this simple water level indicator—with a twist

The water in the tanks adjacent to my house is supplied from a well 600 metres away, pumped up by a solar-powered pump. I need to control the pump manually, as part of my water supply system is used for both supply to the tanks and to animal and horticultural watering points. The line to my pump has an inline valve close to the house, so when the tanks are at the desired level the pumping can be stopped by turning off this valve. The pump controller senses the increase in pressure and switches off the pump.

I like to keep the tanks above ¾ full during summer to cater for water needs during overcast periods, as well as having a reserve for fire fighting. When the rain starts in late autumn or early winter I let the water levels drop to about ¼ full so that overflow from my separate rainwater tanks can be stored. While the well water is okay, having a salt content of about 500ppm, it has a high calcium content, so I prefer to reticulate rain water when I can. So, a reliable, easily read water level indicator is needed.

Construction

I made my indicator from bits and pieces from the scrap box. The sealed bearing (with a foot mounting housing) was supplied by a mate, and he also kindly turned a piece of round stock to match the shaft diameter of the bearing to that of the 150mm diameter V-belt pulley. If you are making one of these indicators, you may

The pulley allows the indicator to show water level the correct way, rather than in reverse.

be lucky enough to find a bearing with the same shaft diameter as the pulley.

The float was made from a 600ml soft drink bottle with a short neck, half filled with water.

The top hat (the flanged pipe on the top of the tank) is pop riveted above a hole in the tank lid and allows the float to be inserted into the tank as well as providing clearance between the float and the tank lid when the tank is full. This top hat has a 30mm diameter hard plastic pulley at the top to take the cord from the float to the pulley.

The counterweight is a M12 x 150mm galvanised bolt loaded with washers to adjust the weight.

The indicator is an offcut from a piece of 50 x 20mm galvanised RHS with a piece of red tape as the level marker.

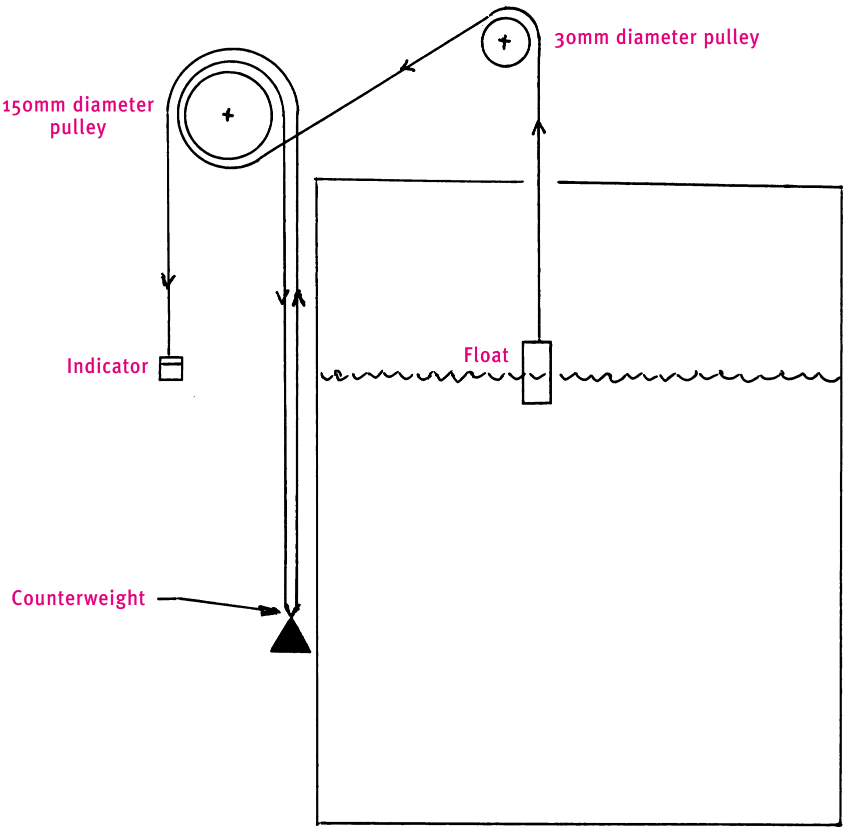
The weights didn't need very much tinkering and I just added or decreased the weight of the components to make it work reliably. When completed I measured the weights so as to be able to give you an idea of the size of weights required. The float weighed 400 grams, the counterweight 400 grams, and the indicator 200 grams.

The counterweight runs up and down inside a piece of rectangular downpipe—this prevents it tangling with the indicator. The L-shaped angle iron bracket has a slot cut in it to take the two cords to the counterweight and is held onto the tank with self tapping screws. On a plastic tank the bracket may need to be held on with nuts and bolts, in which case the indicator should be mounted adjacent to an access hole

Setting up

My tanks are approximately two metres deep, so around four metres of nylon cord needed to be threaded as per the diagram. I started at the float, then out of the tank, around the V-pulley and down to the counterweight. The loop to the counterweight should have a tie placed around it after its position has been adjusted. Coming up from the counterweight the cord loops over the top of the pulley and down to the indicator. Allow some spare cord at the indicator to provide adjustment. Position the cords on the pulley to minimise interference between them.

I have found the indicator works well, and indicates to within 10mm of the tank level. ✲



ATA — *ReNew* is just the beginning

ATA is Australia's leading not-for-profit organisation promoting renewable energy, energy efficiency and water conservation in households.

ATA is best known as publisher of *ReNew* magazine and for its practical, independent information. ATA's 12 member branches and 2000 members across Australia and New Zealand make up the region's largest network of people who share these interests.

ATA works at both practical and policy levels. Practical activities include installing demonstration sites, practical energy saving in community buildings, running mobile education displays at events, open houses and field days. Policy work includes advocating householders' and ATA members' perspectives in a range of government policy forums.

Tax deductible

ATA is listed on the Register of Environmental Organisations and can accept donations which are tax deductible (over $2).

Supporters are sent a receipt at the end of each tax year so they can claim it in their tax return.

Climate facts

- Nine of the 10 hottest years on record have occurred since 1990.
- Australians have the highest per capita greenhouse gas emissions in the world—which is directly related to our reliance on coal-fired electricity.
- Worldwide greenhouse gas production needs to be reduced by about 80 per cent to avert dangerous climate change.

Become a regular donor, sign up as an *ATA Supporter*

ATA Supporters donate on a regular basis to make it possible for ATA to help change policy and increase the uptake of practical sustainable technology in the community.

Becoming an *ATA Supporter* is over and above membership, and allows ATA to undertake policy and practical work that would otherwise not be possble. *ATA Supporters* are kept up to date with ATA's activities every two months by email or mail, but they are not automatically members.

It is important to ATA that contributions from *Supporters* results in a tangible reduction in energy use, which is why ATA's practical energy-saving projects are so important. ATA also sees advocating for renewable energy and energy efficiency at a policy level is an essential part of averting global warming.

Upcoming projects include energy saving in *The Big Issue's* offices and input to the Australian energy market reform process that is currently underway.

Order on page 62

Join ATA and *WIN* a solar water heater

ATA Supporters, Members and Subscribers who join or renew their support for ATA and *ReNew*, all have the chance to win a 300 litre Edwards solar water heater (see details on page 5).

Becoming an *ATA Supporter*

ATA Supporters make regular donations to the ATA. With the help of its *Supporters*, the ATA can reach more people with practical advice on reducing energy consumption, and can expand the amount of education and policy work it is involved with.

Benefits of ATA membership

ATA membership ($49, $35 concession) includes:

- A subscription to *ReNew* magazine
- Discounts from selected outlets
- Chance to take part in member practical activities
- Over-the-phone technical advice
- The bi-monthly *Sun* members' newsletter

Subscribe to *ReNew* magazine...

and you'll never miss an issue! Only $28 per annum.

Discounts for ATA members

Current discounts available are:

- New! Advanced Energy Systems 10%
- New! Australian Corres Schools 5%
- New! Birkenhead Batteries and Solar 10%
- BP Architects 5%
- B/W Solar 10%
- Cycletrek Bunbury WA 5%-10%
- EcoSouth $150 off power systems
- New! Environment Equipment 10%
- Federal Batteries 10%
- Going Solar 10%
- K & C Stork 10%
- New! Natural Paint 10%
- New! Pearcedale Conservation Park 10%
- Sandford Electronics & Solar 10%
- Sharpe & Jephcott 10%
- Sola-Kleen 10%
- Solar Charge 10%
- Solar Energy Australia 10%
- Solco 5%
- Sustainable Impact 5%
- New! Talisman Design 5%
- New! Winter Windows 9%

Important: the latest issue of *The Sun* newsletter has full details.

Expand your *ReNew* collection

All available back issues up to issue 77 $6.50 inc. postage within Australia. Issue 78 onwards $7.50 inc. postage.

Soft Tech Issue 41

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

Soft Tech Issue 46

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

Soft Tech Issue 47

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

Soft Tech Issue 48

The 'green' small office; Kit homes with character; Human-powered speedsters; Detergent buying guide; Mudbrick cavity wall construction; Build a solar still; Power from hot air engines; Low-voltage washing machine controller; Regulator buying guide.

Soft Tech Issue 49

Nontoxic alternatives: cleaning, cosmetics and gardening; Make a model solar boat; Inverter buying guide; Cut your energy bills; D-I-Y solar hot water; Loft housing; The Green Grid; Build a portable power pack; Sewage treatment with UV; Cruising on an electric boat.

Soft Tech Issue 50

Ethical investments; Sustainable life in the city; Tips for conserving water; Make your own sundial; Solar garden lights; Convert your Esky to a fridge; The solar-powered college; Windpower for the community.

Soft Tech Issue 51

Selling power to the grid; Chemical-free pest control; D-I-Y solar caravan; Insulation buying guide; Build your own inverter; Gardens with less water; 101 uses for a dead tyre; Harnessing kinetic energy; Solar-powered caravan.

Soft Tech Issue 52

RAPS buying guide; Build your own battery charger; Storing the sun with salt; Green living centre in Wales; Earthships; Renewable-energy credit card; Why economic growth is bad; Passive solar house with a twist; Car of the future; Solar power in the developing world.

Soft Tech Issue 53

Solar roof tiles; Water-powered pump; Build with 'good' wood; Hydrogen fuel cells; Battery charger buying guide; Earthworms: turning waste into profit; The history of solar technology; Fuel cells: past, present and future.

Soft Tech Issue 54

Soft Tech hits the Internet; Make a solar garden light; Solar salt ponds; Building with bamboo; Fuels for the future; Household recycling; Refrigeration buying guide; Electric car.

Soft Tech Issue 55

Critical mass; Solar renovation on a budget; Wave power's turbulent history; A solar-powered bicycle ferry; Run an office printer on 12 volts; Hemp: a new Australian industry?; Make a model wind turbine

Soft Tech Issue 56

Turning a tip into a recycling centre; Keep your home warm in winter; Energy efficient landscaping; Canberra's Solar Boat Race; Sydney's green Olympics; Electric vehicles; Portable sawmills in PNG; Good firewood; Green Jobs; Tully Millstream; Buying back the bush; Convert a desk lamp to 12V; Make: a hand powered spin-dryer and a torch that runs for 10 hours.

ReNew Issue 57

Moora Moora- solar powered community; Jackie French's water powered house; Companion planting; Hydro-powered eco-resort; Home energy efficiency tips; Solar sailing; Electric bicycles; Recycling the dead; Solar food drying; Living with chemical sensitivity; Ecosub- replanting seagrass; Solar panel buyer's guide; What's new in batteries; Making solar Xmas tree lights.

ReNew Issue 58

Feeding power into the grid; Bush food garden; Eco-tourism resorts; New Zealand wind farm; Green computing; Renewable energy worldwide; Solar hot water buyer's guide; Model solar boating; World Solar Challenge; A solar powered workshop; Smart Builders; Keeping your house cool in summer; Make your own: solar water feature, wind speed meter.

ReNew Issue 61

Solar cooking; Self-sufficient family; Electric delivery van in Melbourne; Sustainable office; Green Power in NSW; Composting toilets—avoiding pitfalls; Vortec wind turbine; Cathodic protection using micro-hydro; Fighting for wind power; Living in the '70s; When the oil runs out; Phantom loads; 12 or 240 volts—the pros and cons; Build your own: Compost tumbler, low-voltage converter, fixing a Suntron tracker.

ReNew Issue 62

Solar hot water; Wind and solar at Wilson's Prom; Composting toilets in the city; Solar cooking tips; Monument to migration at Point Cook; Energy efficiency on a low income; Fuel cells; Cogeneration; Renewable energy course guide; Sustainable schools; Tools; Build-your-own: Ceiling fan, backup generator.

ReNew Issue 64

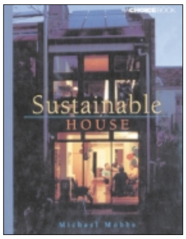
Green renovations; Solar struggle in Warrnambool; Building Australia's biggest solar suburb; Solar at the zoo; Life without a car; 20 years of Going Solar; Ethical Investment; Making milk paint; Sinewave inverter buyer's guide; Should environmentalists eat meat?; Uranium mining; Monitoring your system; three-way fridge review; Wind buyer's guide addendum.

ReNew Issue 65

The Veggie Van; Solar sailing; Sustainable real estate; Australian solar still; Simple solar herb dryer; Victorian wind farms; Wind farms in California; 200kW solar power station; Regulator buyer's guide; Sinewave buyer's guide addendum; Flies in composting loos; The Grameen Bank; Product review: Davy Industries solar tracker; Waterwheel-powered pump; The C-Tick fiasco.

ATA shop by mail

Want the dream house?



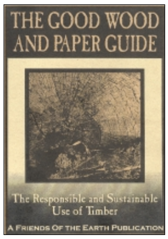
Sustainable House

Author: Michael Mobbs

Price: $38.50, Paperback, 188pp

The sustainable house in Sydney provides all of its own power and waste water recycling on-site. Contains many great ideas on how to make your house less of a burden on the planet.

Item code: SHB



The Good Wood and Paper Guide 9th edition

Anthony Amis (ed) Friends of the Earth, 1999

Price $20, Paperback, 172 pp Reviewed in *ReNew* #71

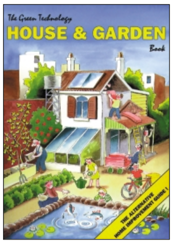
Whether you are building a house or buying copy paper for the office, this book provides essential information to help you make the best environmental choice. *Item code: GWPG*

The Green Technology House and Garden Book

Price: $11.00, Paperback

A comprehensive guide to improving your home's energy efficiency. Includes do-it-yourself projects, real life experiences and a comprehensive listing of suppliers.

Item code: GTH&G

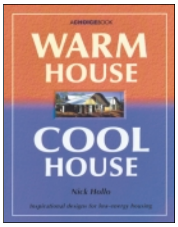


Strawbale Homebuilding

Price: $19.95, Paperback, 156 pp.

This book details practical strawbale building practices you can use to build anything from a small cabin in the bush to a mansion in the city. A great book that details many homes that have been built around Australia.

Item Code: SHB

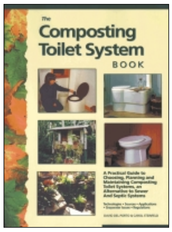


Warm House, Cool House

Author: Nick Hollo

Price: $33.00, Paperback, 172pp

An easy-to-read introduction to the principles of energy-efficient housing design. Covers a broad range of topics and contains an abundance of drawings, plans and photographs. *Item code: WHCH*



The Composting Toilet System Book

Authors: David Del Porto & Carol Steinfeld

Price: $43.90, Paperback, 234pp

Covers many different composting toilet systems, including those available in Australia, and thorough general information about composting toilets. Includes a chapter on greywater. *Item code: CTSB*

...*ReNew* back issues continued

ReNew Issue 66

Free showers from the sun; Solar hot water for small business; Crookwell wind farm; Solar house on Phillip Island; Clocking up a solar surplus; More on the Newhaven Village; Solar air-conditioning; Sustainable development in the South Pacific; History of solar boating; National energy competition policy; Stirling engines; RAPS fridge buyer's guide; Air-powered water pumping; Build your own electric go-cart.

ReNew Issue 67

Citipower Sunrace '99; ReNew's new office; Solar charging into the suburbs; Sailing around the world on renewables; Going Solar fair; Energy-efficent house design; Using your fridge efficiently; Getting more out of ceiling fans; Motor-assisted HPVs; Farming on city rooftops; Water pump buyer's guide; The millennium bug.

ReNew Issue 68

Wind Co-ops; Wind and solar powered home; Wind and solar on French Island; Solar vs heritage issue; Two wind turbines on one tower; Sewerage treatment systems; Wood smoke pollution; Wood heater buyer's guide; Are you buying more power than you need?; An industrial sized solar food dryer; Investing in renewables; Build your own: Heat shifter, solar box heater, solar water heater, methane digester.

ReNew Issue 69

A house for $10,000; Genetic engineering; Veggie oil fuel; Veggie oil powered tractor; Electric bike rally; Large wind turbine maintenance; Generator buyer's guide; Hidden Phantom loads; Wind energy conference report; Compact Fluoros; LED lighting update; Build your own greywater system.

ReNew Issue 70

Solahart PV solar concentrator; Suburban Earth covered house; Studying renewable energy; Environmental education for kids; SHW at the zoo; Renovating for hot weather; Renewables in the bush; Solar panel buyer's guide; Sustainable Energy Foundation; Pulsing LEDs; DIY: Composting toilet, small Savonius wind turbine.

ReNew Issue 71

Sustainable house ideas; YHA eco-hostel; Solar-powered school; Bushfoods; Independent power in suburbs; BYO electric bike; Make biodiesel in a dishwasher; Wood-fired power stations; Insulation buyer's guide; Going Solar fair; Solar TAC billboards; TEAP; Converting old computers to data loggers.

ReNew Issue 72

Sustainable inner city living; Electricity industry deregulation; Indonesian environment centre; DIY micro-hydro; Micro-hydro buyer's guide; Community gardens; Products index; Articles index; Oatley regulator modifications; ATA's power system; Home-made solar bread.

ReNew Issue 73

Servicing remote power needs; Renewables for renters;Renewables in Germany; On the road with renewables; Avoiding RAPS mistakes; Diverting rubbish from landfill; ATA turns 20; Solar hot water buyer's guide; Solar turbine; DIY: datalogger.

ReNew Issue 74

Biodiesel for sale; Corporate green revolution; Save 100,00 litres of water; Driving LEDs from any voltage; A 3-phase workshop on renewables; Car-free days; Giving old bikes their second wind; Birds and wind turbines; Australia's largest wind farm; Sinewave inverter buyer's guide; How much is a solar system; DIY: solar light dimmer, freezer to fridge conversion, solar air conditioner.

ReNew Issue 75

1MW solar power station; ReNew inspires new house; Fuel cells; Hybrid vehicles; A dialysis centre's solar backup power supply; YHA solart hot water; Solar heated spa; Light pollution; Getting into a SCRAP; Grid connect hassles; Deregulation and contestability; Green Power buyer's guide; Wind powered water pump; Automatic solar lighting system; Solar scarecrow.

ReNew Issue 76

Appropriate design in Arnhem Land; Energy efficient retrofit; Buying a sustainable house; Renewable energy investments; Solar powered entertainment system; Solar & wind powered mobile cinema; Fruit trees for passive solar; Energy efficiency ideas; Battery buyers' guide; Solar office part 2; Datalogger add-ons.

ReNew Issue 77

Solar windows; Gothic strawbale in the suburbs; Wind industry consults community; Sydney Earthcare Centre; Victoria's first wind farm; NEM fails energy efficient households; RECs; Coolangatta school farm; LEDs on the seafront; Solar powered darkroom; 'Free energy' bike light system; Simple pumping solutions; DIY solar space heating; Windpower buyer's guide; Hideous solar houses.

ReNew Issue 78

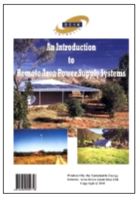
Community power; Rural wind power; Low energy home in the Kimberleys; Fixing contaminated tank water; Solar water features; LEDs in Nepal; Teaching sustainability; Newcastle's Ecohome; Rechargeable batteries; Singing biodiesel's praises; Solar panel buyers' guide; Earthing your power system.

ReNew Issue 79

Sustainable house with a view; Retrofitting in the Sunshine State; Biodiesel car buyers' guide; CERES celebrates 20 years; Renewables off-road; DIY solar water heater retrofit; Ranking green power products; Revisiting the $10,000 cottage; Managing climate change; RAPS fridge buyers' guide; DIY: Solar roof ventilator; 12/24 volt timer.

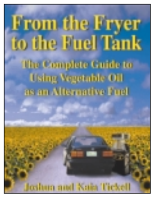
Order on page 62

For remote properties



Remote Area Power Supply Systems: An Introduction
Price: $33.00
New edition! Enables the average person to gain a good grasp of what RAPS systems are all about. Covers individual system components, correct sizing, safe installation and maintenance. *Item code: RAPSS*

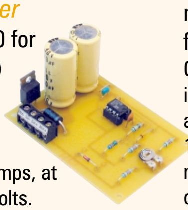
Vegetable oil for fuel



From the Fryer to the Fuel Tank
Author: Joshua Tickell
Price: $34.95, Paperback, 160pp
A great book that shows the reader how to make a clean-burning renewable fuel from waste vegetable oil. Includes detailed instructions on making and using the fuel in a standard diesel vehicle. *Item code: FFTFT*

Maximiser kits

Mini-maximiser
Price: $35 ($30 for ATA members)
Our popular mini-maximiser kit will handle pumps up to 6 amps, at either 12 or 24 volts. Remember to specify the voltage you require when ordering. *Item code: MINIMAX*



Maxi-maximiser
Price: 12 amp: $80 ($75 for ATA members), 20 amp: $140 ($130 for ATA members)
Our new larger maximiser is available in 12 or 20 amp versions, either 12 or 24 volt. You must specify current and voltage rating when ordering. *Item code: MAXIMAX*

Business

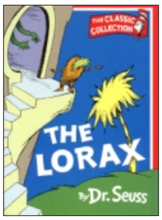
Natural Capitalism
Author: Paul Hawken
Price: $42.95, Paperback, 396pp
Details the change in attitudes occurring in the corporate world regarding the environment and the potential to make money by protecting it.

Solar hot water

ATA Booklets series: Solar Hot Water
Price $6.90 each (inc postage)
Solar hot water is possibly the best way to get started with renewable energy. This booklet outlines all of the different available system types and which one will best suit your needs.

Just for kids

The Lorax
Price: $7.95
This Dr Seuss classic is a great story teaching about the need to care for the environment. *Item code: LORAX*



Eco-fun
Price: $18.95
A fun-filled activity collection from David Suzuki and Kathy Vanderlinden. Activities include measuring pollution, creating a forest ecosystem, making recycled paper, building a worm composter, and many others. *Item code: ECOFUN*

Solar electricity

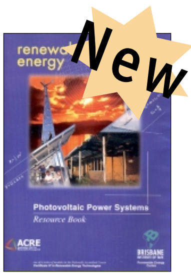
ATA Booklets series: Solar Electricity
Price $6.90 each (inc postage)
Covers all the basics you need to know when designing a solar power system.

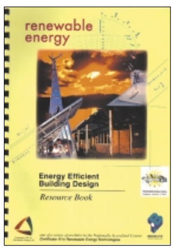
Renewable energy and energy efficiency in detail

Windpower Workshop
Author: Hugh Piggott
Price $30.80, Paperback, 160pp
The ultimate resource for anyone who has ever wanted to build their own wind turbine. Provides practical advice on how to design and build a machine up to five metres in diameter. *Item code: WPW*

SoftROM 1
Price: $33.00
Our CD ROM of the first 40 *Soft Technology* back issues is a great searchable resource. Just $33 plus $4 postage inside Australia.
Item code: CDROM

Photovoltaic Power Systems Resource Book
Brisbane Institute of TAFE
Price $92.00, Paperback.
Covers photovoltaic device physics and manufacturing, module operating characteristics, system configurations, batteries and other components, water pumping systems, stand-alone PV system design, installation, maintenance and fault finding.
Item code: PVPSRB

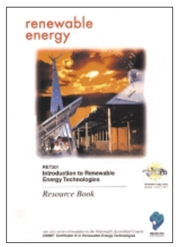




Energy Efficient Building Design Resource Book
Brisbane Institute of TAFE
Price $73.70, Paperback, approx 300pp
Covers basic principles of passive solar and energy efficient building design with sections on thermal mass, insulation, building orientation, landscaping and much more. *Item code: EEBD*

Solar Water Heating Systems Resource Book
Brisbane Institute of TAFE
Price $92.00, Paperback.
A thorough and comprehensive guide to solar water heating. Covers domestic and commercial solar water heaters and solar pool heating.
Item code: SWHSRB

Introduction to Renewable Energy Technologies
Brisbane Institute of TAFE
Price: $73.70 Paperback, approx 300pp
This book contains a wealth of information on renewable energy systems, their sizing and design.
Item code: IRET



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ATA order form

Name   Year of birth:

Address

State   P/C

Phone (BH)   (AH)

Fax/Email: (MOB)

I want to be an *ATA Supporter*

Becoming an *ATA Supporter* is a tax deductible donation. For member benefits such as discounts and *ReNew*, also join as an ATA member.

EACH MONTH, please

❒ Debit my credit card ❒ Debit my bank account

Amount: ❒ $10 ❒ $20 ❒ $50 ❒ Other (min $10) $ ____

ATA will send a tax deductible receipt in July each year.

OR accept my ONCE-OFF donation of

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Please fill in payment method details on right.

Join me up as an ATA Member

Includes *ReNew* magazine four times a year, *The Sun* member newsletter (bi-monthly), discounts on a range of products and services, chance to take part in ATA branch activities

- ❒ Full membership $49
- ❒ Concession membership $35
- ❒ Household membership $60
- ❒ Membership NZ & PNG $57
- ❒ Membership rest of world $62
- ❒ Non-profit group/School $80
- ❒ Corporate/Government $250
- ❒ Gift membership/subscription .... $______

*** For gift subscriptions or memberships, please provide both the recipient and giver's addresses.**

I want to subscribe to *ReNew*

❒ Australia........$28   ❒ NZ & PNG........$32

❒ Rest of world........$39

This is a ❒ new or ❒ renewal membership/subscription.

Send me books or products

Item or code	Qty	Price $

Postage Postage for books is $8 for the first book plus $2.20 for each additional book. All membership and subscription prices include postage. $

Donation Donations are tax deductible. A receipt will be issued. $

Total (NB. All prices in $AUD. Prices subject to change) $

Note: Please allow up to 28 days for delivery.

Payment details

Join now to WIN

Attached is my:

❑ cheque

❑ money order

❑ credit card

❑ direct debit payment request.

Credit Card

Card type: ❑ Visa ❑ Mastercard ❑ Bank card

Cardholder's name

Card no. |__ __ __ __|__ __ __ __|__ __ __ __ |__ __ __ __|

Expiry ___/___   Signature

Direct debit payment request

(Automatic Membership renewal or *ATA Supporters* only)

Month / year of first payment   /02

Financial institution name:

Account name

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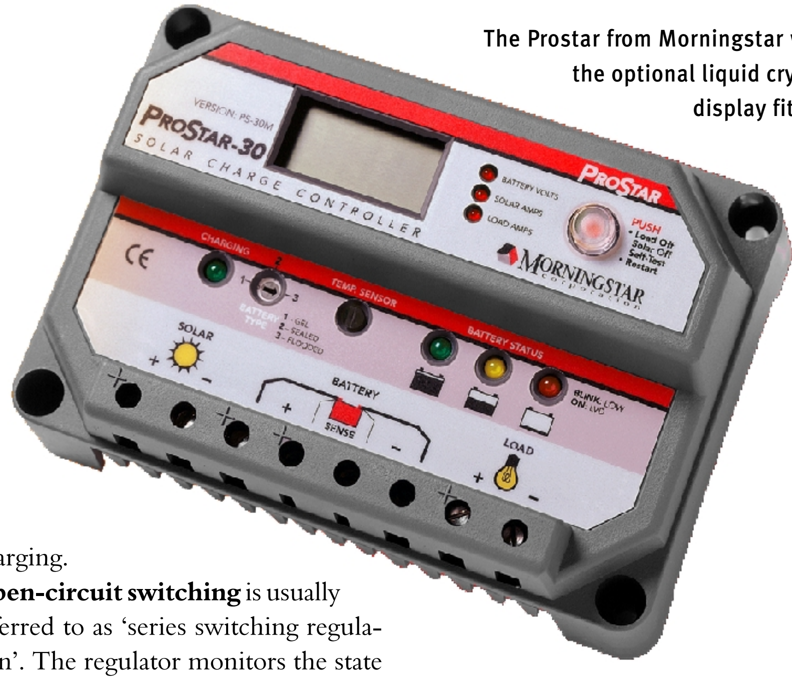
M&H POWER SYSTEMS
M&H 21269

Regulator buyers' guide

Using the right regulator in an independant power system is very important—if you want your batteries to live a long and healthy life

The battery regulator is usually the least thought about component in an independent power supply system. After all, it is only a fraction of the cost of the other components—photovoltaic (PV) panels, batteries and inverter. However, the regulator is worth thinking about because it can have a significant effect on the correct operation of your system. In order to select the right battery regulator, you need to understand a bit about them and the choices that are available.



The Prostar from Morningstar with the optional liquid crystal display fitted.

What does a regulator do?

A battery regulator controls the amount of energy going into the batteries that are used to store energy from your PV panels, wind turbine or micro hydro unit. In particular, it is intended to prevent the battery from being overcharged.

There are several ways in which energy flow to the batteries is controlled. The methods that you are most likely to find are open circuit series switching, shunt, or diversion switching, or shunt power dissipation (see Figure 1). There are also other methods, such as switchmode voltage regulation, but these are less common.

The method used varies between manufacturers, and as can be seen in the tables, often depends on the energy source the regulator is designed for.

Series regulation

This involves controlling the energy going into the battery by partially or completely blocking the flow of current. This is done in one of several ways, including series switching and taper charging.

Open-circuit switching is usually referred to as 'series switching regulation'. The regulator monitors the state of charge of the batteries, and when sufficient energy has gone into the batteries, the regulator opens the switch and disconnects the charging source from the batteries. When further charging is needed, the switch is closed again.

Two methods are employed to switch the power: relays, which are electrically operated mechanical switches; and solid-state switching, which uses transistors. Solid-state switching technology is more commonly used, due to its relative low cost and high reliability (there are no relay contacts to burn or wear out mechanically.)

Open-circuit series switching is usually used with photovoltaic panels because they can be left open circuit (that is, not providing power to anything) without damage. This type of regulation is also quite cheap to implement, as no load dumps are required for the excess power.

However, potential generating capacity is wasted, which means that your investment in PV panels is not being fully realised.

Change-over series switching. In this form of regulation, the charging source is not just disconnected from the batteries, its energy is diverted to another load, such as a water pump, water heater element or a second set of batteries. Some series switching regulators may provide an additional feature for load diversion, which is actually change-over switching.

Change-over switching would normally be used with PV panels. However, if the change-over switching is done using fast electronic switches, the regulator could be used for other loads, such as wind turbines. This is achieved by rapidly switching back and forth between the two loads with an appropriate percentage of connection time for each load, providing an apparent smooth load without voltage ripple (small, rapid fluctuations in the output voltage which can effect the operation of appliances). If your regulator has a change over facility, establish what it is capable of.

Taper series regulation involves gradually reducing the amount of energy flowing into the battery as it approaches a full charge. The excess energy is usually dissipated as heat by the regulator itself.

Shunt regulation

With shunt regulation, the excess energy is diverted, or shunted, by the regulator into an alternative load which is connected in parallel with the batteries. The voltage across the alternative load is the same as the voltage across the batteries. Depending on the degree of control sophistication, either all the energy is diverted—that is 'on/off'—or an appropriate proportion of the energy is diverted through the dummy load.

The method of controlling and dissipating excess energy varies but is generally one of the following.

Low-power shunting is done using Zener diodes which allow current flow through the Zener when a certain voltage is achieved. The excess energy is dissipated as heat in the diode.

Medium-power shunting is done using a transistor or similar electronic device. The excess energy is dissipated in the transistor.

High-power shunting is also done by a transistor or similar device, but the energy is dissipated in another load, usually a bank of resistive heating elements, water heating elements or, sometimes, incandescant light bulbs.

If you want to use the excess energy from your power source when using a shunt regulator, then regardless of power level, the last method is used.

Because the voltage is consistent across the system, shunt regulation is usually used with wind generators. As a result, the wind generator does not have any sudden loading or unloading which can cause undesirable structural stresses.

There is no reason why PV panels could not be operated using this type of regulation, but it is usually more expensive than series switching due to the cost of providing an alternative load.

Maximisers

These are a different type of device that use high frequency switching to convert the varying input voltage and current from the solar panel array to the correct voltage for the battery bank. Because they are capable of maximum power point tracking, they can convert any excess power in the form of high panel voltages into usable current, thus increasing available power from the panels.

The only maximising regulator that we know of, the Australian Energy Research Laboratories range, are claimed to increase average current to the batteries by 20 to 30 per cent.

Regulation control

Regardless of the means by which regulation is achieved, control of the regulation process is required. By control, we mean the conditions under which the energy is allowed to flow into the battery, and in some cases, the rate at which it flows. There are various levels of sophistication but the main controlling parameter used is the battery voltage.

Single stage control

The simplest method of control is single stage regulation. With single stage regulation there are preset upper and a lower voltage limits. The regulator switches power to the batteries when their voltage falls below the lower limit and switches it off at the upper limit. The upper limit is usually set at a value that will approximate full charge, and the lower limit is set at a value that can approximate anywhere between 50 and 80 per cent of full charge. The reason for having an upper and lower limit instead of just an upper limit is to prevent the switch turning on and off rapidly once the upper limit is reached.

However, there are problems with using this simplistic approach. One is that the voltage is not a true representation of the charge condition of the battery, as other factors such as temperature and battery condition can influence the battery voltage. The other problem is that flooded-cell batteries require a regular boost charge to equalise the individual cells. This means charging the battery to a higher voltage occasionally, something a single stage regulator cannot do.

You can have some control over the boost problem by installing a bypass switch that allows you to manually boost charge the batteries or by having a manually adjustable voltage set point. But you must remember not to leave your system on boost, or the batteries could be destroyed. For this reason most set points are determined in the factory, but some regulators are adjustable.

Sealed batteries, however, do not require a boost charge, and indeed may be damaged if charged to too high a voltage. If you have these batteries in your system, a simple single-stage regulator may be all that you require.

Taper control

Taper control involves gradually reducing the flow of energy into the battery as full charge is reached. This can result in a more complete charge being achieved. The rate of charge is determined by the voltage of the battery.

Taper control is typically used with shunt regulators, but it can also be achieved using fast solid state switching technology in a series regulator (this is known as pulse width modulated, or PWM control). The rate of switching is very fast, resulting in no apparent voltage ripple on the load, but this method may produce high frequency interference that may affect sensitive appliances.

Dual stage control

Dual stage regulators serve to address the problem of providing some boost charge. With this method of control there are two charging conditions. One is 'boost' and the other is 'float'. When the battery is being charged from a starting voltage that is below that of the float voltage, for instance, after a discharge, the battery is charged until the boost voltage is reached. Then the regulator drops the voltage to the float level and maintains it until a load is applied.

Once again, the correct voltage for regulation can be affected by other factors and though the boost is available, it occurs on every charging cycle. This can result in excessive gassing and more than normal loss of water from the battery.

'Intelligent' control

This is a rather loose term which includes any regulator that is using more than just the instantaneous voltage of the battery to determine regulation. These regulators may be referred to as 'intelligent', 'programmable' or 'smart', but the basis of all of these regulators is that they provide a complex sequence of control. With modern electronics, these regulators are most likely to use microprocessors, but complex sequences are possible using more basic electronic circuitry.

Some of the things that these regulators are capable of include boost regulating at a particular time of day; determine correct voltage to charge up to, based on rate of charge; know what battery configuration is being used and keep track of the amount of energy that has been discharged from the battery.

If you are seriously considering a more sophisticated regulator you will need to look at the various strategies being used and decide whether they are appropriate (and worth the extra cost). If you are not sure, ask around to see what the people using these regulators think.

Temperature compensation

The battery voltage can be affected by temperature, particularly when cold. Because of this, the voltage set points for control can be inappropriate. Many regulators, including the simple types, offer temperature compensation. This is achieved by using a temperature probe to sense battery temperature and adjusting the voltage set points based on that temperature.

The choice to install a temperature sensor is usually optional, so you can have the feature but not use it if you wish.

Additional features

Though the chief purpose of the regulator is to regulate the energy flow, many regulators provide additional features that allow the user to observe what is happening and to control other aspects of the independent power system.

Status displays

Displays on regulators vary from nothing to the very complex. The range of displays that you are likely to find are:

Status lights. Status lights are usually LEDs (light emitting diodes). The number of status conditions can vary but typical status indicators are for boost, float and low voltage. These are useful as they provide a visual indication of the battery condition.

Meters. Meters can show voltage and amperage. Voltmeters are more common, but ammeters are quite helpful in determining whether the system is producing the energy expected. Meters are often of the analogue type, but liquid crystal displays (LCDs) are now becoming more widely used. There may be a separate display for each function, but a more common approach is to use a

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These incredible, triple junction, amorphous panels are taking the market by storm, and for good reasons ! **Over 20% more actual battery charging amps** than crystalline panels under realistic, high temperature Australian conditions ! Shadow tolerant, **unbreakable construction**, (no glass) very low embodied energy and weight. **20 year performance warranty.**

	Amps @ 14V and 50°C	**Inc GST**
Uni-Solar US-64	4.5A	$ 729
Uni-Solar US-42	3.0A	$ 529
Uni-Solar US-32	2.25A	$ 429

KYOCERA Panels

Ok folks, if you must buy crystalline, at least go for the best, and from one of the planet's leading optical and electronics companies.

Kyocera KC120-1	6.5A	$ 1099
Kyocera KC80-1	4.7A	$ 729

WIND DRIVEN GENERATORS

The first wattage rating is at 20 knots, (realistic) the second figure is peak (rare). Wind power obeys the "cube" law. Double the wind speed = 8 times the power and vise versa. If your average wind speeds are below 8 knots forget it!

Ampair 100	12/24v	60 / 100 watts	$1557
Aerogen 412	12v	72 / 240 watts	$1425
Soma 400	12/24v	400 / 530 watts	$3158
Roaring Forties	24v	1000 / 1200 watts	$3500
Soma 1000	24/48v	1000 / 1200 watts	$4171
Bergey XL.1	**24/48v**	**1000 / 1200 watts**	**$4595**
Westwind 2.5kW	24/48v	1700 / 2700 watts	$10633

PLASMATRONIC REGULATORS

Brilliant Aussie built units, with the edge on performance and value. A digital display presents all essential solar system parameters, volts, amps in / out, amp-hrs in / out. With the optional shunt and PLS, the inverter load amps and daily amp-hrs used can be displayed. Inbuilt 30 day data logger.

PL-20	12/24/48 volt 20 amp smart controller	$ 275
PL-60	12/24/48 volt 60 amp smart controller	$ 575

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		Inc GST
S.E.A SEAP-12-150	12v 150 / 400 watt	$ 399
Selectronic SE-12 / 12	12v 600 / 1500 watt	$ 1117
Latronic 47-BKZ-12	12v 700 / 2800 watt	$ 1169
Selectronic WM1200-12	12v 1200 / 3600 watt	$ 1767
S.E.A SEAP-12-1K3	12v 1300 / 3900 watt	$ 1999
Latronic 412-BKZ-12	12v 1300 / 4000 watt	$ 1861
Latronic 518-BKZ-12	12v 1800 / 5500 watt	$ 2272
S.E.A SEAP-12-2K0	12v 2000 / 5000 watt	$ 2899
Latronic 48-BKZ-24	24v 800 / 3200 watt	$ 1211
Selectronic WM1000-24	24v 1000 / 3000 watt	$ 1459
Selectronic WM1500-24	24v 1500 / 4500 watt	$ 1851
S.E.A SEAP-24-2K2	24v 2200 / 6000 watt	$ 2571
Selectronic SE-32	24v 2400 / 7000 watt	$ 2899
Latronic 525-BKZ-24	24v 2500 / 7500 watt	$ 2515
Latronic 530-BKZ-24	24v 3000 / 9000 watt	$ 2796
Latronic 530-BKZ-48	48v 3000 / 9000 watt	$ 2796
Selectronic SE-42	48v 3600 / 10000 watt	$ 3553
S.E.A SEAP-48-3K8	48v 3800 / 10500 watt	$ 3637
P.S.A. RAP-5-48	48v 5000 / 10000 watt	$ 7828
Latronic 915-GI-72	72v 1500va Grid feed	$ 2861

ENERGY STORAGE BATTERIES

We've supplied these premium grade home power system batteries for 18 years. They're rated at 4000 cycles, ie, an average life span of 10+ years in a correctly designed plant. 5 yr honest warranty from the world's leading battery company. EXIDE ENERGYSTORE have become the industry standard in the past twenty years for reliability, performance and price.

EXIDE 24RP670T	24v 17640 watt-hours	$ 2456
EXIDE 24RP830T	24v 21840 watt-hours	$ 2984
EXIDE 24RP910T	24v 24000 watt-hours	$ 3700
EXIDE 24RP1080T	24v 28320 watt-hours	$ 4179
EXIDE 24RP1350T	24v 34800 watt-hours	$ 5079

Solar Technology Designers Catalogue 2002

Now entering it's 13th year, this compelling 150 page master design manual / catalogue is endorsed by thousands of enthusiasts as their renewable energy bible ! This edition is substantially revised, and written in a clear and innovative style for your renewable enlightenment, by leading solar engineer and pioneer Christopher J Darker. cdarker@unisun.com.au

Estimating your energy requirements; *Power system design; *Solar radiation maps; Solar (PV) panels; * Wind generators; Batteries; Regulators; *Inverters; *Chargers; Energy efficient appliances; Water pumping; Water heating; *Passive solar buildings;

This manual is for consumers, dealers, installers, electricians, educators, administrators, journalists, politicians. From beginners to experts this is undoubtably the first and perhaps the only book to read before designing, purchasing or assembling a renewable energy system. **View table of contents and sample pages at www.unisun.com.au**

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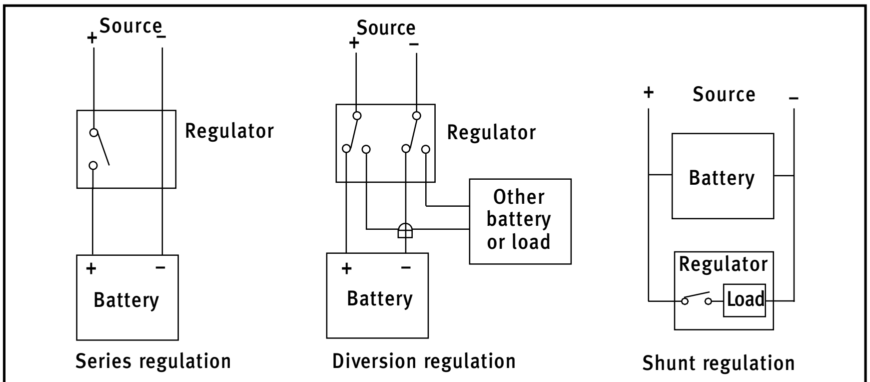


Figure 1. The three basic forms of regulation, shown here in schematic form.

single display with a selection switch to allow you to look at different parameters.

Historical displays. By using microprocessor-based control and data storage memory, some of the more advanced regulators are capable of recording the number of amp-hours or watt-hours being collected and used by the system. This information will not make the system run better, but those who take a keen interest in the system's performance may consider these features money well spent.

Low-voltage cut-outs

If the battery is overused and the voltage drops to a low level, some systems offer an option where all or part of the output load can be switched off via a relay or transistor. This reduces or removes the load and prevents the battery from being run completely flat. This is particularly useful in an unattended system where something may have been left on unintentionally. Some form of time delay is usually included to prevent operation of the low-load cutout due to a sudden large power draw, such as a motor starting up.

Generator start switch

On some regulators a generator start relay or control output is provided to operate a backup generator if the voltage drops below a certain point. Once again delays need to be built in to prevent a premature start and to allow the generator to operate for a reasonable time.

Independent power control systems

Quite a few companies provide many of the above features as part of a full control system where the regulator is only a sub component. Other manufacturers are building the system control and regulator control into one unit. If you want all the bells and whistles, look at both arrangements.

Be aware that an advanced display system may not mean advanced charge control and vice versa—advanced regulation control can exist without advanced display systems. You should also distinguish between the cost of advanced charge control and advanced system control when deciding the value of these systems.

Weather proofing

Your regulator may be subject to a high humidity atmosphere or occasional exposure to rain. The unit should be sealed to prevent internal corrosion of the components. If you are in the tropics, be particular about establishing the suitability of the regulator under high moisture conditions.

Temperature

There are temperature ratings associated with most electronic components. If your regulator is likely to be operating in a hot environment, then check to see that the unit you are purchasing is capable of operating at high temperatures (40°C plus).

Choosing your regulator

The tables included in this buying guide list many regulators with different features. When you take voltage and current rating into account there are lots of regulators to choose from. So which regulator do you choose?

Generally, your system will be configured as a 12, 24 or 48 volt system, though other less common voltages such as 36, 96 and 110 volts are possible. Regulators are generally supplied at one of these voltages, so you would normally select a regulator that suits the voltage of your system. For some of the less common voltages you may have to place a special order.

There are some regulators that can operate over a range of voltages and you are required to select the operating voltage. If it is really smart, it will work out the voltage for itself. Buying a system where the operating voltage is selectable is of value if you anticipate that your system will grow, resulting in the voltage being increased. This is particularly true if substantial investment is made in an advanced system because you don't want to have to replace it later.

Current ratings are more varied than voltage ratings and can range from 5 amps to over 100 amps. The selection of the correct size depends on the size of the power system that you are installing. With PV systems, calculate current rating based on the maximum peak power of the array plus around 20 per

C:	Charging
F:	Float
B:	Boosting (equalising)
LVD:	Low-voltage disconnect
V:	Battery voltage
A:	Input current
AH:	Amp-hours used
W:	Input watts
LCD:	Digital display
LED:	Light Emitting Diode

Manufacturer/ supplier	Model (made in)	Voltages available (Volts)	Current capacities (Amps)	Control method	Application	Adjustable setpoints	Temperature compensation	Battery types	Displays	RRP $	Comments
Arrid (Australia)	R1205	12	5	PWM	PV	Yes	—	Flooded or sealed	C, F, LED	POA	
	R1212	12	12			—					
	R1230	12	30								
Australian Energy Research Laboratories (Australia)	300 B	20-175	16	Switchmode maximum power point tracker with current boosting and auto equalisation	PV	Yes	Yes (sensor optional)	Flooded	LCD, LV, output alive, input alive	$879	Panel voltage does not have to match battery voltage, allowing panels to be wired in series to reduce cabling costs. 2 year warranty.
	600 B	20-175	20							$989	
	900 B	20-175	24							$1319	
	1200 B	20-175	28							$1539	
	800 BLV	20-85	32							$989	As above, plus is designed for 12, 24 and 36 volt battery systems.
	1800 BHV	20-250	20							$1979	As above, plus is designed for 110 volt battery systems.
	2400BXHV	140-350	20							$2089	
BP Solar	GCR/M (Germany)	12, 24, 48	8, 12, 20, 30	Multi-stage series/shunt	PV, wind	No	Yes (sensor optional)	Flooded or sealed	LEDs, LCD display optional	POA	LCD display metering extra.
	FBR (Australia)	12, 24, 36, 48	40 (12-36V) 30 (36-48V)	Multi-stage series	PV	Factory adjust only			Numeric LED (A, AH, V)		100 amp shunt for metering $42 extra. Has generator start ability.
	BPMR (Australia)	12, 24	15	Single-stage series					LEDs		
	BPRNG (Australia)	12, 24, 36, 48	40-80 (12-36V) 30, 60 (36-48V)	Multi-stage series					Numeric LED (A, AH, V)		Has generator start ability.
	BPRNGT	12, 24, 36, 48	40-80 (12-36V) 30-60 (48V)	Multi-stage series					LEDs		
	SR 4	12	4	Series switching	PV	No	No	Flooded	None	$67.10	Epoxy sealed
	SR4-S1	12	4					Sealed		$69.30	
	SR 8	12	8					Flooded		$82.50	
	SR8-S1	12	8					Sealed		$95.70	Designed to be mounted inside Solarex Mega module junction boxes
	SC 18	12, 24, 48	18					Flooded	B, F	$170.50 $192.50	
Futurlec Electronics	10A	12, 24	10	Series switching	PV	Yes	No		LED, C	USD$39	In kit form only.
GP & GF Hill (Australia)	Westwind	24, 48, 120	2.5kW	Taper shunt	PV, wind, hydro	Yes	Yes	Flooded	Voltmeter, ammeter, LEDs	POA	Includes air-cooled load dump.
			5kW								Includes air-cooled load dump and current limiting inductor.
			10kW								
Jaycar Electronics	MP3125	12	12	Switching	PV	No	No	Lead acid, but does not equalise charge	—	$87.95	
Maitland Enterprises	Super solar regulator	12	20	Series switching	PV	No	No	Sealed	LEDs	$69.50	Reverse polarity protection, and disconnection from solar panels at night.
Morningstar (USA)	SunSaver	12	6.5, 10	Constant-voltage series PWM	PV	No	Yes	Flooded or sealed	C, LVD	$145, $198	LCD displays battery volts, array current and load current.
	Prostar	12, 24	12, 24, 30						C, V, LVD	$473	
Oatley Electronics	K009B	12, 24	10	Series switching		Yes	No	Flooded or sealed	C	$21	Kit form, supplied with PCB and all on-board components only.
Pecan Engineering (Australia) .	LRT8	12, 24	8, 4	Series taper	PV street, sign and billboard lighting	Factory selectable	Yes	Flooded or sealed	C, F, LVD	$160	Supplied as bare circuit board for OEM applications. Has 10 amp low-voltage disconnect.
	LSR6	12, 24	6, 3	Series taper	PV					$130	Has 10 amp low-voltage disconnect.
	LSR10	12, 24	10, 5	Series taper						$145	
	PSR30	12, 24	30	Series switching	PV	Factory selectable	Yes	Flooded or sealed	LEDs	POA	Has 20 amp low-voltage disconnect
	PSR60	12, 24, 48	50	PWM		Factory selectable					
	PSR120	12, 24, 48	50	PWM or switching		Float only					Has low voltage alarm output.
Plasmatronics (Australia)	PC Series	12, 24	12, 22, 30	Series switching	PV	Yes	Optional	Flooded or sealed	LEDs	$257.40 $324.50 $380.60	Microprocessor controlled.
	PR Series	12, 24	10	Series 2 stage	PV	No	No	Liquid or Gel	None	$78.70 $79.80	Can mount in module terminal block.
	SPSD series	12, 24, 48	75, 100, 150, 200, 250, 300 to order	Series 4 banks, multi stage	PV, telecoms, large RAPS	Yes	Optional	All types	16 x 2 LCD	POA	Microprocessor controlled. Made to order. Available with any options.
	HVPL	48, 120 to order	25	Series 4 stage or shunt PWM	RAPS, small telecoms		Yes		Custom LCD	POA	Ah, SOC and history.
	PL20	12, 24, 32,	20	Series and/or shunt PWM (selectable)	PV, wind, hydro		Yes (sensor extra)			$335.50	Microprocessor controlled. Can be set to use PWM or slow switching modes. Has 20 amp load control. Vinyl coated circuit board.
	PL40	12, 24, 32, 36, 48	40							$429	30 day data memory aid, lightning protwection, reverse battery polarity protected.
	PL60	12, 24, 32, 36, 48	60	PWM	PV					$429	
Platypus Power (Australia)	B-PLAT20	24	20	Constant voltage taper shunt	PV, wind, hydro	Yes	No	Flooded or sealed	V, A	$1052.70	Comes with one resistive element, circuit breaker, water resistant case.
	BX-PLAT 20	12, 48	20							$1144	Comes with two resistive elements, circuit breaker and water resistant case.
	BX-PLAT 40	12, 24	40							$1245	
Projecta (Australia)	Projecta	12	5	Series	PV	No	No	Flooded or sealed	C, F	$39.95	Suitable for small solar systems.
Selectronic (Australia)	PWM60	12, 24, 48	60	PWM	PV, wind, hydro	Yes	No	Flooded or sealed	LED	$324.50	Works with Selectronic sinewave inverters that have Energy Management MkII software installed. Optional terminal cover $19.80
Solar Charge (Australia)	SC 100	12, 24	6	Taper shunt	PV or wind	No	No	Flooded or sealed	None	$99	Has positive ground on heatsink
	SC200		13							$132	
Steca	SSR5 SSR6 SSR8	12, 24	5 6 8	PWM	PV	Yes	Yes	—	LEDs LVD	POA	Solsum, base range regulators
	SSC8 SSC12 SSC20 SSC30	12, 24	8 12 20 30	PWM	PV	Yes	Yes	—	LEDs LVD LCD	POA	Solarix, mid-range regulators
	STC35 STC40	12, 24	35 40	PWM	PV	Yes	Yes	—	C, LVD, LEDs, AH	POA	STC Tarom series, top range regulators
	STC 30	48	30								
Trace (USA)	C-12	12	12	Series or shunt	PV or wind	Yes	Yes (sensor optional)	Flooded or sealed lead acid, nicad	V, A, AH, W See comments	$110	Automatic monthly equalisation
	C-35	12, 24	35							$119	
	C-40	12, 24, 48	40							$159	Digital display option available for $195 extra.
	C-60	12, 24	60							$199	
Windpower Australia (Australia)	ESR-5	12	5.5	Series switching	PV	Yes	No	Flooded	LEDs	$60.50	
	ESR-10	12, 24	10.5					Flooded or sealed	LEDs	$75.90 $143	
	ESR-20	12, 24	21					Flooded	LEDs	$121 $154	
	XL70	12, 24, 36, 48	70, 65, 45, 30	Series switching	PV	Yes	No	Flooded or sealed, nicad	LEDs	$405.90	Has manual boost charging, concealed cable entry.
	3491/250	12-96	250W	Shunt switching	PV or wind	Yes	No	Flooded	LEDs	$474	Includes shunt load resistor bank. Battery may be disconnected without harming wind generator.
	3491/500	12-110	500W							$526	
	3491/750	12-110	750W							$830	
	3491/1000	12-120	1000W							$925	

cent, and allow for the addition of a few more PV modules later. Wind generators are usually sold with regulators as part of the package, so the regulator will be appropriately sized to meet the maximum generating capacity.

The choice of regulator type is to some degree dictated by the market. Wind regulators are usually shunt type and are prepackaged with the wind generator, thus limiting your choice. Most PV regulators are series switching, which again doesn't leave much choice.

However, if you consider it worthwhile to look after your batteries, then you might find it valuable to mix and match different manufacturers' systems.

One of the main issues to consider is which type of regulator will offer the best battery operation. Taper charging is generally considered to be the best form of charge control, but because of the costs associated with shunt or high-speed electronic switching, is relatively expensive in most cases.

Intelligent control using series switching regulation may prove to be more cost effective while still providing good performance.

Simple regulation systems are generally cheap, but may not provide as good performance from the batteries. If substantial investment is made in batteries, then using a cheap regulator may not be a good idea.

And as a final point, all methods of regulation and control can be used for all types of batteries, but sealed batteries can be more easily damaged by overcharging, thus requiring different control voltages. Some regulators allow for this through different factory settings or user adjustment of the control voltage. As for the various advanced features—particularly display features—the question is, how much are they worth to you?

This guide was adapted from the regulator buyer's guide in issue 65 of *ReNew*.

Suppliers' details

Arrid regulators are available from The 12 Volt Shop, ph:(08) 9458 1212, fax:(08) 9458 1977, www.12volt.com.au

Australian Energy Research Laboratories, MS 660 Lawsons Broad Rd, Proston QLD 4613, ph:(07) 4168 9308, fax:(07) 4168 9197, email: aerl@hotkey.net.au

BP Solar, ph:1800 802 762 for nearest distributor, www.bpsolar.com.au

Futurlec Electronics are at 24 William St, Paterson NSW 2421, email: sales@futurlec.com, www.futurlec.com

GP and GF Hill, 29 Owen Rd, Kelmscott WA 6111, ph:(08) 9399 5265, fax:(08) 9497 1335, www.westwind.com.au

Jaycar Electronics, ph:(02) 9743 6144, fax:(02) 9743 2066, order line: 1800 022 888, email: mailorders@jaycar.com.au.

Maitland Enterprises regulators are available from Dick Smith stores, ph:1300 366 644, www.dse.com.au

Morningstar regulators are available from Solar Sales P/L, PO Box 190, Welshpool 6986, ph:(08) 9362 2111, fax:(08) 9472 1965, email: john.hall@solarsales.com.au and through Solar Charge P/L, see details below.

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

Pecan Engineering, 13 Acorn Rd, Dry Creek SA 5094, ph:(08) 8349 8332, fax:(08) 8260 6643, www.pecansolar.com.au

Plasmatronics regulators are widely available through renewable energy equipment suppliers. Alternatively, check out their web site at: www.plasmatronics.com.au or ph:(03) 9486 9902, fax:(03) 9486 9903

Platypus Power, PO Box 301, Wandiligong VIC 3744, ph:(03) 5755 2383, fax:(03) 5750 1777, www.netc.net.au/platypus

Projecta Australia P/L, Factory 3 Rooks Rd, Nunawading VIC 3131, ph:(03) 9874 7911 fax:(03) 9874 7966, www.projecta.com.au

Selectronic Australia, ph:(03) 9762 4822, email: sales@selectronic.com.au, www.selectronic.com.au

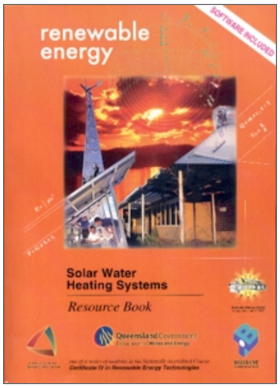
Solarex regulators are available through BP Solar.

Solar Charge, 115 Martin St, Brighton VIC 3186, ph:(03) 9596 1974, fax:(03) 9596 1389, www.solarcharge.com.au

Steca regulators are available from RF Industries, PO Box 2301, Fortitude Valley BC QLD, ph:(07) 3252 7600, fax:(07) 3252 5505, www.rfindustries.com.au

Trace regulators are available from Solar Sales P/L, PO Box 190, Welshpool WA 6986, ph:(08) 9362 2111, fax:(08) 9362 3231,

Windpower Australia P/L, 200 Ninth Avenue, Austral NSW 2171, ph:(02) 9606 0033, fax:(02) 9606 0720, www.windpower.com.au



Solar Water Heating Systems – Resource Book

Brisbane Institute of TAFE Renewable Energy Centre, ISBN: 1876880015. Available from the ATA (see page 61). RRP: $92.00

Solar water heating is a simple and robust technology and the installation of a solar water heater is one of the most effective ways to reduce greenhouse gas emissions. The range of solar hot water rebates that are available in Australia, and the inclusion of solar water heaters in the Mandatory Renewable Energy Target means that it is now a more affordable option for residents and businesses alike. As a result more people are becoming interested in how these things really work.

The resource book is a thorough and comprehensive guide to solar water heating that covers domestic and commercial solar water heaters and solar pool heating. The book goes into detail about the solar resource, the performance of collectors, the way that different systems should be designed and installed and how they work.

It is not necessary to have a technical background to find this book of interest, however there is considerable technical detail in the heat transfer and thermodynamics appendix and the chapter on the performance of collectors for those who wish to have a more scientific understanding of the concepts.

Resources such as the *Solar Hot Water Brochure* from the Sustainable Energy Authority and the *Solar Hot Water Booklet* from the Alternative Technology Association will provide people with a basic description of how solar water heaters work and a description of the different types of systems that are available. This resource book would be of use to people who are interested in going further into the science of how they work and methods of system design. The target audience would range from students to plumbers and engineers.

This book forms part of the series for the Certificate IV in Renewable Energy Technologies that was produced by the Renewable Energy Centre at Brisbane TAFE and supported by the Australian Cooperative Research Centre for Renewable Energy (ACRE) and the Office of Sustainable Energy, Department of Mines and Energy (QLD).

Review by Megan Wheatley

ECO-FUN

Authors: David Suzuki, and Kathy Vanderlinden
Allen & Unwin, ISBN 1 86508 635 5
Available from all good book shops and from the ATA (see page 61).
RRP: $18.95

Education is about knowing and about being, reading or doing, so that it becomes part of ourselves. With easy photocopying and a computer, printed and pictorial information is easy to acquire, but it is much harder and expensive to produce books that enable us to learn by doing. David Suzuki's *ECO-FUN* is one of these books.

The book is clear in its directions and explanations, with large print, well-spaced lines and simple sketches to illustrate what is to be done. Sentences are short, with numbered directions. The book lies flat on the desk with each experiment taking two facing pages so there's no need to turn pages to see the next step.

The book opens with a personal story of David's own childhood from nine to 15 years which reminds us that we are all children of the Earth. The introduction has the effect of reminding readers that they too have responsibilities and are part of the world. 'Be safe and sound' gives the lesson on safety then follows an introduction on the topic air with eight experiments on air pressure, weight, the effects of plants on the air all with intriguing titles: 'what you need', 'what to do', 'what's going on', 'safety hints' and 'more ideas'.

There are eight experiments on water, 13 on 'earth', seven experiments on 'heat' and 12 on 'birds and plants' and a glossary of terms. There is a strong bias towards biology but overall the book is attractive and would be very useful as a class book or as a gift to an alert nine to 15 years of age.

Review by Noel Jeffery

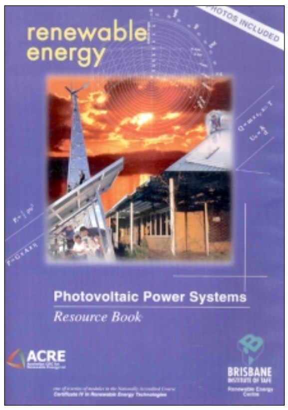
Photovoltaic Power Systems Resource Book

Brisbane Institute of TAFE Renewable Energy Centre. Available from the ATA see page 61 of *ReNew*.
ISBN: 1876880139, RRP: $92.00

The *Photovoltaic Power Systems Resource Book* is based on class notes for the photovoltaic power systems subject of the Certificate IV in Renewable Energy Technologies as taught at the Renewable Energy Centre of the Brisbane Institute of TAFE.

The Certificate IV in Renewable Energy Technologies course was developed to train people who are interested in renewable energy technologies or who are intending to work in the renewable energy industry. The course is nationally accredited and is available at many TAFE Institutions throughout Australia.

This resource book includes units on photovoltaic device physics and manufacturing, module operating characteristics, system configurations and applications, batteries, balance of system components, water pumping systems,



stand-alone PV system design, installation and commissioning and maintenance and fault finding.

Each unit provides a detailed and comprehensively illustrated coverage of its topic and ends with a summary of main points and a bibliography for further study if the reader so desires. There are also many highlighted examples to reinforce the reader's understanding of important points.

As a resource book this work is not only suitable for the student studying PV power systems, it is also a valuable reference for people who are working in the industry and who may wish to update or extend their knowledge or work practices. There are many references to relevant Australian Standards, particularly in the design, installation and maintenance units, as these standards form the 'ground rules' to which designers and installers must work.

The unit on water pumping may be of particular interest to people already working in the industry as they may be very familiar with battery charging systems but may not have had much experience with systems where the PV array is directly connected (or via a maximiser) to a pump motor. Water pumping system design also requires an understanding of hydraulics, including the different types of 'head' involved, pipe work and friction losses and the different types of pumps and their applications, all of which are covered in this unit.

The *Photovoltaic Power Systems Resource Book* provides a comprehensive and practical coverage of the subject of photovoltaic power systems and would be a valuable reference for both student and practitioner.

Review by Ross Hortin

Power system design standards

In this, the first 'Up to standard' column since issue 71 of *ReNew*, Paul Monsour explains the new Australian Standards for RAPS

The design of stand-alone power systems (SPS), otherwise known as RAPS, requires a knowledge of the practical and the theoretical, dealing with qualitative issues as well as 'number crunching'. The publication of an Australian Standard on system design guidelines brings the AS 4509 series of Australian Standards to completion. Part 2 of this series, formally known as AS 4509.2—2002 *Stand-alone power systems Part 2: System design guidelines*, was published at the end of March, and provides a platform for further development of the industry.

The set consists of :

- AS 4509 Stand-alone power systems
- AS 4509.1—1999 Part 1: Safety requirements (including Amendment 1:2000)
- AS 4509.2—2002 Part 2: System design guidelines
- AS 4509.3—1999 Part 3: Installation and maintenance (including Amendment 1:2000)

Part 1 of the series gives basic safety requirements for stand-alone systems. Part 3 provides requirements for safe and reliable installation and maintenance of stand-alone power systems.

These two parts were released in 1999, and formalised the 'best practice' being used in the industry at that time while addressing other emerging issues.

Part 2 deals with the most contentious and least well defined topic, that of system design. It takes a holistic approach to the design of energy systems—meaning that it looks at the supply of electrical power in the context of *all* of the energy services required at a site, and all possible energy sources. It deals with all aspects of system design, including user preferences, load assessment, resource assessment, selection and sizing of electrical components, system configurations, mechanical and civil works, and documentation—to name a few areas. It weighs in at just over 100 pages.

Part 2, like the previously released parts, is intended to be used principally by designers and installers of stand-alone power systems, but it is important to the end users as well. Having a standard available means that someone wishing to purchase a system has a benchmark which they can trust and will give them what they want. They can ask their supplier whether the system is designed and installed to AS 4509 and, have some assurance that if it is, they will be getting a quality system that meets their expectations. It is also likely to be a requirement of government rebates that systems are designed and installed to this standard.

In general, AS 4509.2 specifies *guidelines*, not a hard and fast answer to everything. A designer can do something different to the recommendations given in the standard but, if so, it becomes a fair question as to what the justification for that is. One important part of AS 4509.2 is that it sets out how the performance of the power system should be specified. If two different suppliers provide quotes which conform to AS 4509.2, the prospective buyer then has a basis to compare 'apples with apples'. For example, any statement of performance must mention the daily load that the system is designed for, the renewable energy resource figures that the design is based on, and the contribution of each source in meeting the load (for example, array, genset, et cetera).

Other standards such as AS/NZS 3000 *SAA Wiring Rules* and AS 4086.2 *Secondary batteries for use with stand-alone power systems* Part 2: *Installation requirements* complement what AS 4509 contains and are still very relevant.

The standards committee EL-042 has invited users of the AS 4509 series of Standards to submit comments on these. The intention is to review the complete set of standards later this year. Comments can be forwarded to Standards Australia by post to: Projects Manager EL-042, Standards Australia, GPO Box 5420, SYDNEY 2001 or by email to: mail@standards.com.au, with the first line stating: 'Attention Projects Manager EL-042'.

Paul Monsour is technical writer and teacher at the Renewable Energy Centre, Brisbane Institute of TAFE.

ReNew articles index

This index, an addendum to the one published in issue 72 of *ReNew*, includes every article published in *ReNew* issues 72 to 79. The index is divided into relevant subject areas and lists the issue number followed by the page number. That is, issue 76, page 14, reads 76:14. For specific products, see our 'Products index' which starts on page 77.

Independent power supply

Indexes

Lighting

Micro hydro

Organisations

Policy

Pumps

Renewable energy off-road

Retailers

Small home renewable systems

Solar energy

Solar hot water

Transportation

Water conservation/greywater

Wind energy

ReNew products index

This index features items reviewed in our 'Products' section and is an addendum to the products index which appeared in issue 72 of *ReNew*. It lists by name the products featured in issues 72 to 79, and provide a brief description of each product's function and features.

Politicians face crunch time on energy and greenhouse

Alan Pears brings us up to speed on Australian government energy policy

We're beginning to see the stakes raised in the sustainable energy debate. This seems to be 'crunch' year for the Kyoto Protocol—the push for ratification at the *Rio+10* conference later this year is strong. And the Australian government is in a bind. If we don't ratify, after playing a leading role in the watering down of the Protocol, we will be labelled as spoilers. Plus, Australian businesses will be deprived of access to emissions trading, Clean Development Mechanism and other systems designed to make compliance with Kyoto easier and cheaper.

Tying ourselves to the Bush approach may look easier, but it would still involve reducing the greenhouse intensity of the Australian economy faster than previously—not a task that can be achieved without an uncomfortable level of market intervention. It also brings unknown consequences in the short term, due to the possible negative reactions of countries continuing to pursue Kyoto. In the longer term, as the need to cut emissions becomes even more extreme, we will not be as well positioned as others to respond. There are now serious differences across business groups about which way to go. Greenhouse is moving rapidly from economic and political theory to real world policy and action in Canberra. This is not a comfortable place for people who truly believe the conservative economic mantra—that interfering with 'natural' energy growth must be bad for the economy.

Meanwhile, the evidence supporting the serious nature of global warming just keeps on mounting. The experience of countries that have been prepared to tackle global warming seriously shows that you can get good results without wrecking your economy. The UK, for example, has introduced a climate change levy, incentives for investment in energy efficiency, and stronger regulatory frameworks.

At home, governments at all levels are being forced to face up to the contradictions they have allowed to continue – not always with a positive outcome. Recent newspaper reports in Melbourne flagged a proposal for introduction of a skewed stamp duty scheme for cars, with fuel guzzlers paying more and fuel efficient cars paying less. Rumour has it that Cabinet very quickly dumped the idea. Not surprising, really, when Ford (who manufacture fuel-inefficient cars, and claim they can't profitably make fuel efficient cars in Australia) are major employers in a few critical electoral seats. Maybe the government could encourage Toyota to move its plant to Geelong? Or Ford could work with CSIRO to produce advanced hybrid cars locally?

When the Victorian government offers millions of dollars to help Ford tool up to make fuel guzzling four-wheel-drive vehicles locally but does not support the wind energy industry or other sustainable energy industries, the anomaly must eventually be noticed. You've also got to wonder what information government is using to drive its transport policy. A colleague of mine recently received a reply to a letter to the Premier in which a senior bureaucrat claimed that Ford had improved the fuel efficiency of Falcons by 30 per cent since 1982. A quick review of the Commonwealth Government's Fuel Consumption Guides showed that the Falcon's city-cycle fuel consumption had improved by eight per cent over that period. I wonder who provided that information to the bureaucrat?

In New South Wales, the government has issued a discussion paper looking at ways of introducing penalties for electricity retailers who fail to meet their greenhouse targets. There is some interesting history to this. The NSW legislation introduced in late 1995 included a requirement that electricity retailers prepare demand management strategies and meet per capita greenhouse targets. However, the legislation didn't include any penalties for failure to comply. This is a classic example of the economic fundamentalists' naïve, 'light handed', regulatory approach that relies on electricity suppliers being good corporate citizens.

The NSW government seems to have finally admitted that regulations with no penalties don't work, so it is now trying to work out how to implement penalties. Of course, the problem is that there is now a backlog of several years' failure to comply by some retailers, and retailers claim they will have to pass through most of the cost of penalties to their customers. Predictably, large energy intensive industries are mobilising their enormous lobbying power to minimise the impacts on them. It will be interesting to see what emerges.

Energy market reform

The pressures are also building in energy market reform. It's becoming increasingly difficult to claim that energy markets deliver lower prices. And this year the Victorian government has had to allocate $118 million to subsidise electricity prices for rural consumers to avoid massive price increases. What will happen in future years? Will the government provide compensating assistance for the sustainable energy options this subsidy has undermined in rural regions? This dilemma faces all governments, not just Victoria, and will be a major test of the market framework.

At the national level, the CoAG (Council of Australian Governments – the committee of all Premiers and the Prime Minister) is progressing with its energy market review. A discussion paper (downloadable from www.energymarketreview.org) has been released. Comments are due by 19 April 2002 and a draft report is to be published by December. This is a big test of the capacity of governments to redefine the market rules in order to achieve the community's objectives.

A number of fundamental issues seem to arise when you look at the application of markets in energy, as in telecommunications, water and other fundamental services. A key problem seems to be how to get the signals from 'user pays' right. At present, electricity generators make windfall profits when supply is tight, but most users receive negligible signals in their bills at those times – so they are just victims. And somehow the market needs to give energy users strong signals at the time they invest in energy-using equipment regarding the impact of that equipment on their future energy costs: no-one has worked that one out yet.

Building energy regulation chugs along

The process of developing and introducing energy requirements into the Australian Building Code is continuing. A combined *Regulatory Document and Regulatory Impact Statement* has just been released (download from www.abcb.gov.au) for public comment until 28 June 2002. It is very important that progressive people contribute, as there are many people and organisations keen to ensure that requirements are minimal. Even the options proposed fall short of what I and many others consider to be cost-effective.

This process has certainly highlighted the staggering lack of good data on how to make buildings energy efficient, especially in hot climates. Hopefully this situation is being recognised, and we will see more funding for research and more interest from research organisations.

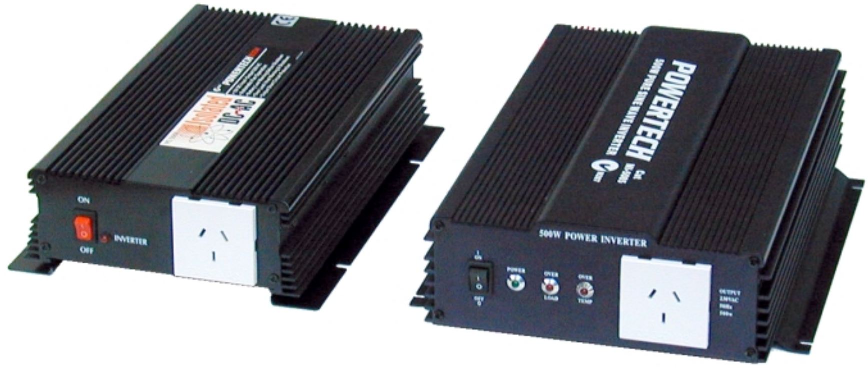
The Australian Building Codes Board has also noticed the strong support for improving the sustainability of new buildings. In a separate process, it is working on this area with a view to possible future regulation. It would be good to see people encouraging this action.

Regulators, bureaucrats, industry and politicians are beginning to notice the swelling support for sustainable buildings. A recent, national lecture tour on sustainable housing organised by the Australian Greenhouse Office and other associations attracted enormous audiences—in Melbourne over 600 people attended! Politicians are at serious risk of being left behind in the rush. ✲

[Product review]

Modified square wave and sinewave inverters from Jaycar Electronics

Review by Lance Turner



It seems that almost every week we receive information on new inverter models. This often comes from one of the excellent Australian based manufacturers like Selectronic, SEA or Latronics. However, more recently there have been an increasing number of inverters coming out of Asia with not only more features than previous models, but also better build quality and safety.

One such range is available from Jaycar Electronics, which now has quite a few of both modified square wave and true sinewave inverter models available. The modified square wave inverters range from 100 watt continuous (200 watt surge) through to 1500 watt continuous (3000 watt surge). The sinewave models are available in 300 watt (500 watt surge) and 500 watt (1000 watt surge) models, with larger models to be added to the range soon.

Jaycar sent us three of these inverters to play with, 100 watt and 800 watt modified square wave units and a 500 watt sinewave model. We wanted to see how they compared to other units on the market, so we put the two larger models through a few tests to see what they could do.

We started with the 800 watt unit. This model has a 2000 watt surge capacity, and is supplied with $14mm^2$ leads and alligator clips, which actually proved fine at these power levels. A number of loads were run on it, and the inverter performed quite well, with a couple of exceptions.

The first load was a large heating element rated around 800 watts. This the inverter handled okay, but the output voltage did drop to around 220 volts at a battery voltage of 12.0 volts (the inverters are rated at 230 volts), and this meant that there was only around 750 watts going into the load. At this power level the inverter got pretty warm, almost too warm to touch, but was able to provide this power continuously for over half an hour, and the temperature seemed to stabilise, so its continuous rating seemed pretty close to the mark.

Other loads included a 700 watt power drill, which was also easily powered. However, it was while testing this load that we discovered an annoying feature of these inverters. They have inbuilt overload protection, but this is not auto-resetting. If the inverter cuts out because you have stalled a power tool like we did with the drill, the inverter has to be switched off and then back on again. If you are on the roof or another place where it is difficult to access the switch when it cuts out, it could be a real pain.

We also tried it on a ¼hp drill press, which was no problem. Indeed, it was during this test that the inverter's surge capacity showed up. We could still start this drill press even with the large heating element connected, which was quite a surprise.

However, some loads it could not start were a ½hp bench grinder and an 800 watt blower motor, which would no doubt have had a huge startup surge requirement. We did manage to get the blower going by turning the inverter on and off, increasing the speed of the blower motor each time before the inverter's cutout activated. Once the blower was running, the inverter ran it without a problem.

We also tested the low battery cutout voltages. This inverter activated its warning beep at 10 volts, and disconnected at 9 volts with no load on the inverter. This is really too low, as the battery is pretty much dead flat at these voltages.

500 watt sinewave

The sinewave inverter was supplied without leads, but included a proper earth lug and screw terminals for power leads up to around $16mm^2$ on the rear of the inverter, indicating it is designed for permanent installation.

We didn't have a suitable element to test this inverter with, so we went straight to the drill press, which was no problem, as it started very quickly. The 700 watt drill also worked well, and could be loaded reasonably well before the inverter cut out. It should be noted here that there was no alarm beep from this inverter, but there is a LED indicator for overload.

The next load was a 450 watt drill, and this could be stalled for several seconds before the inverter shut down.

After that I tried a 26 inch (around

66cm) Pye TV and VCR, the sort found in many homes. The inverter had no problems with these at all, with power consumption around 230 watts. A PC, drawing around 180 watts, was similarly tested with no problems.

While we did not look at the waveform of the sinewave inverter, we tested it on several noise-sensitive devices, and unlike when being run from the modified square wave inverter (where some buzzing was apparent) they performed as if running from the mains.

To sum up

These inverters seem to be able to provide their rated powers, both continuous and surge, and would be suitable for many small homes, motor homes and boats with modest power needs.

A lot of the testing was done in my home workshop, and both of these inverters would have met 95 per cent of my needs and I would have been happy with either, because I also have mains power available for the one or two problem loads.

The manual reset overload cutout may be a problem for some people, and neither inverter had autostart as a feature, something that may put many people off. However, the larger 1000 and 1500 watt models are available with a remote start switch as an option if desired.

All of the inverters in this range are electrically isolated from DC to AC, and so can safely be wired into MEN systems for permanent installation in homes. The modified squarewave models are all 12 volt operated, however the 400 watt modified square wave model is also available in a 24 volt version. Jaycar has also recently added to the range with 1000 watt 12 volt and 1500 watt 24 volt sinewave models.

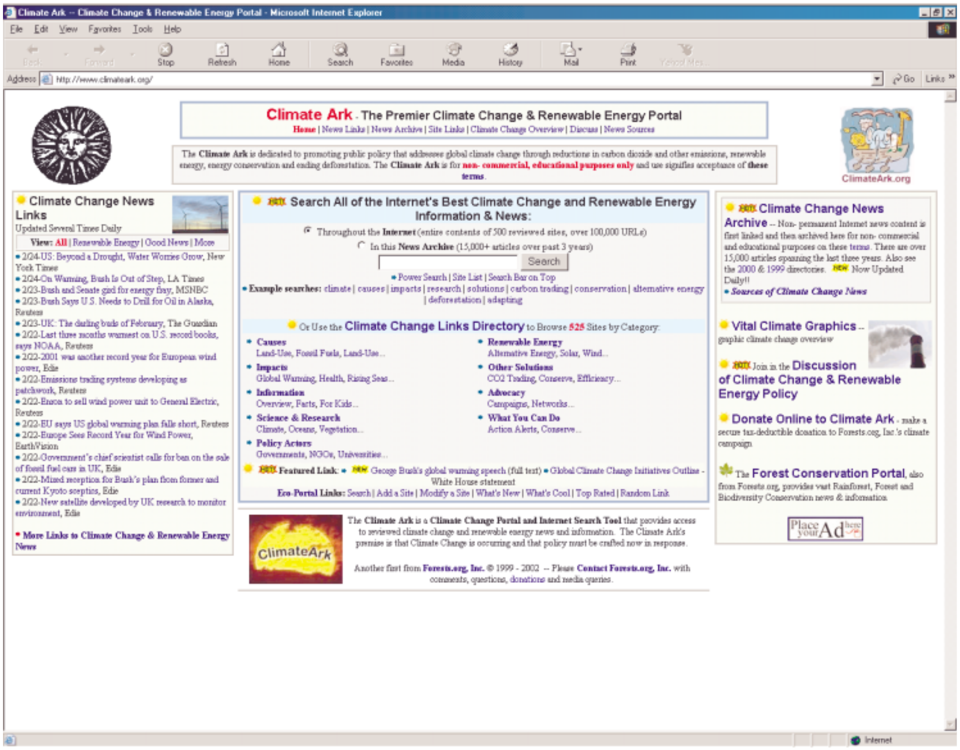
These inverters use high frequency power conversion techniques, making them light and compact for their capacities. They are protected from short circuits and overload, as well as over temperature and low battery voltage. They also come with a one year warranty. I should mention that the instruction manuals with these inverters were nothing more than a leaflet with basic instructions. This is an area that could certainly be improved.

Overall, these devices represent good value for money. The price for the 800 watt model is just $389, while the 500 watt sinewave is priced at $499. While they certainly don't have the features and surge capability of brands like Selectronic, SEA and Trace, they may be ideal for systems where a degree of manual operation is acceptable and price is a factor.

We recently received an article from a reader on how to add remote switching to these inverters, so look for it in the next issue of ReNew.

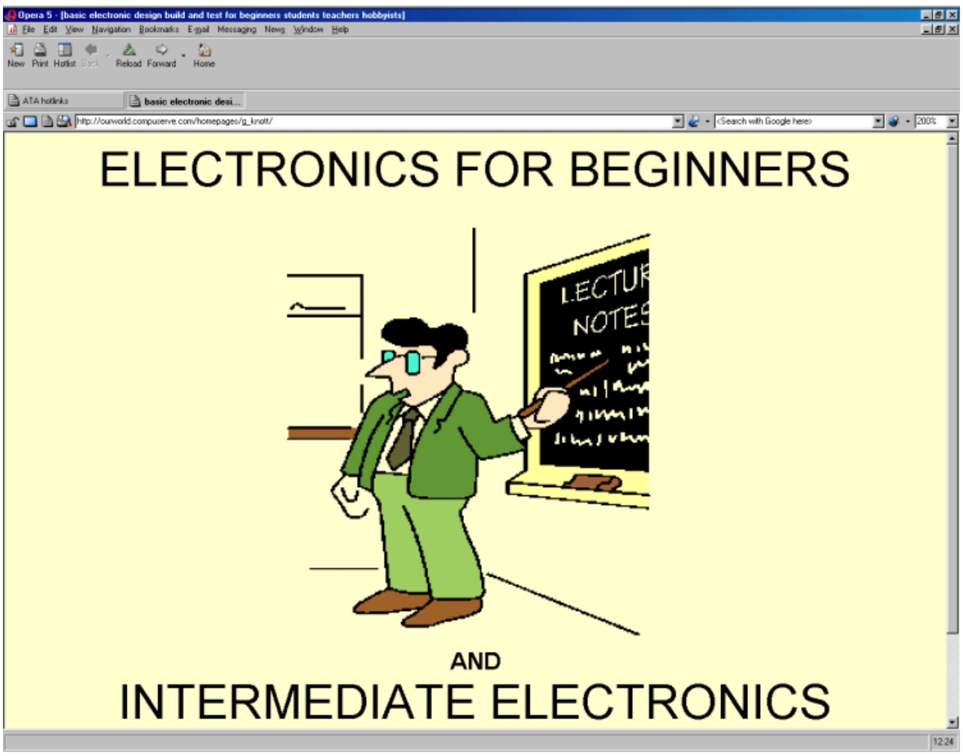
Browser

www.climateark.org



Climate Ark is a climate change portal and internet search tool that provides access to reviewed climate change and renewable energy news and information. Climate Ark's premise is that climate change is occurring and that policy must be crafted now in response.

The site is a great resource for all things involving climate change and is well worth a look. The site includes links to news items, as well as a news archive, a search window to many climate change resources, a categorised, climate change links directory and a discussion forum.



ourworld.compuserve.com/homepages/g_knott/

This site has two areas—electronics for beginners and intermediate electronics. Both areas are broken up into numerous sections to make understanding electronics simpler.

The basic electronics area includes sections on general theory, practical skills and projects, components, test and measurement, digital electronics, DC theory, and block diagrams.

The intermediate electronics area includes sections on diodes, transistors MOSFETs, op-amps, decibels, thyristors and various circuit types (such as multivibrators), and Schmitt triggers. A great place to start your learning.

[Sustainable technology events]

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

ATA workshops (Victoria)

CERES site, Lee St, East Brunswick, VIC

- Rainwater, greywater and composting toilets: 21 July, 18 August
- Solar electricity: 11 August
- Wind power: 2 June, 1 September
- RAPS Batteries: 16 June
- Low energy homes: 28 July
- Solar hot water: 4 August

Fee: $110 for ATA members/concession, $120 for non-members (inc GST). Contact: CAE on ph:(03)9650 1111, email: courses@cae.edu.au, www.cae.edu.au

SEDA seminars (NSW)

- Wind farm development: 13 June
- Regional Bioenergy: 25 July
- Maximising the value of renewable energy projects: 29 August
- Financing renewable energy projects: 29 August
- Waste mine gas capture and use: 19 September
- Exporting sustainable energy: 17 October
- Waste to energy: 21 November

Seminars cost either $275 or $395

Contact: Sonya Williams, ph:(02)9249 6122, email: swilliams@seda.nsw.gov.au, www.seda.nsw.gov.au

Environmental seminars

Through to November, 2002

Run by the City of Whittlesea, most of these seminars are free. There are too many topics to list here, but include recycling, composting, land management native gardens and many others.

Contact: exh@whittlesea.vic.gov.au, ph:(03)9217 2471.

Solar Sisters events

Through to December, 2002

Alternative power and water systems, strawbale and mud building.

Contact: Solar Sisters, 8 Fifteenth St, Hepburn Springs VIC 3461, email: solarsisters@giant.net.au, www.giant.net.au/users/solarsisters/

Sustainable Industry Expo

5-8 June, 2002, Lismore, NSW

Of interest to anyone who appreciates the importance of sustaining our ecosystems. From large enterprises to the running of a household, explore how to make a positive change in your environment, lifestyle and the way you do business.

A major philosophy behind this event is that environmental responsibility is not a luxury that we indulge in if we can afford it, but a necessity that need not eat into our budget nor make our lives more difficult.

Contact: email: expo@bigscrub.org.au, www.bigscrub.org.au/expo

WindEnergy International Trade Fair

18-21 June, 2002, Hamburg Exhibition Centre, Germany

An independent specialist fair covering all aspects of the wind power industry.

Contact: Hamburg Masse, ph:+49 40 3569 2120, fax:+49 40 3569 2171, email: heiden@hamburg-masse.de, www.windenergy-hamburg.de

Renewable energy course

July 2002, Rockingham, WA

Designed for people who are considering installing a renewable energy system. Fee: $55.

Contact: Naragebup Environment Centre, ph:(08)9591 3077, email: rrec@southwest.com.au

The Lurujarri Dreaming Trail

1-10 July, 2002, Broome WA

The trail follows the coast 80km north of Broome from Minyirr (Gantheame Pt) to Minarriny (Coulomb Pt). It traces part of a traditional song cycle that maintains the living memory of people who have been in the country for thousands of years.

Cost of the trail is $1000, $750 concession, $440 for children 12-16 years old (includes all food).

Contact: Joseph Roe and Margie Cox, ph:(08) 9192 2959, Frans and Des, ph:(08) 9192 3337 or, in Melbourne, Judy Rogers at RMIT, ph:(03) 9925 3518.

Life-cycle assessment conference

17-19 July, 2002, Gold Coast, QLD

The aim of the conference is to explore the development and application of decision-making tools for environmentally sustainable production and consumption.

Contact: Judy Nankiville, ph:(07) 3365 6536, email: j.nankiville@uq.edu.au, www.lca-conf.alcas.asn.au

Biodiesel meeting

29 September, 3 October, 2002, Christchurch, NZ

Titled 'Biodiesel: Technical and Non-technical States of the Art'.

Contact: Richard Gapes: rgapes@mail.zserv.tuwien.ac.at or Werner Koerbitz: wkoerbitz-abi@netwat.at

RACV Energy Breakthrough

22-24 November, 2002

Technology and environmental educational program catering for a range of ages, abilities and actively encouraging female involvement. Includes pushcarts, HPVs and hybrid classes.

Contact: Martin Mark, ph:(03)5461 0621, fax:(03)5461 0665, email: martinm@cgoldshire.vic.gov.au or John Stafford, ph:0419 316 337, email: staffos@vicnet.net.au

Sustainable Energy Day

Wednesday July 17, 2002

Monash University, Clayton Campus

This symposium will devote one whole day to considering important aspects of renewable energies. Speakers include international experts from Australia and overseas who are leaders in the field of renewable and sustainable energy.

Contact: Dr. A. Zahedi on 9905 5957 or visit:

http://www.ecse.monash.edu.au/prof/sustenergyday/index.html

MONASH UNIVERSITY

[Kid's stuff]

Noel's Treasures from Trash

To make your own Heliograph you will need:

- a shiny compact disc
- a metal jar lid
- a piece of wood about 600x50x19mm
- a nail about 70mm
- a flat –head self tapper screw 20mm
- a piece of spounge rubber 80mm square 20mm thick
- some contact or fast setting glue

As we recently had Anzac Day I thought it would be good to make a signalling machine that soldiers used before radio to send messages by reflecting sunlight. It would be useful to learn Morse Code which is still used by radio amateurs. You will need to make two heliographs, one for each of you so that you can communicate with each other.

Heliograph comes from 'helios' meaning sun and 'graph' meaning writing. The heliograph uses the CD disc to reflect the sun onto the nail head which acts as a sighter to the receiver. The sponge enables you to press the lid to send a flash to the receiver and when you are not pressing, the receiver cannot see the reflected sun.

Above you can see the details of how the CD and can lid are mounted on the foam.

The finished heliograph allows you to talk to someone else using morse code made from flashes of reflected sunlight.

Construction

Make a hole in the centre of the lid big enough for the screw to go through. Bend up 25mm of one side of the lid to about 45 degrees and flatten this. Spread glue on this and on the back of the non-shiny side of the CD. Screw the lid and sponge to one end of the wood, flatten the head of the nail then drive it into the other end. A spot of white paint helps to make the sighter clearer.

To use the heliograph, face towards the receiver, rotate the disc until you see the spot of reflected light going to them. Press the lid and line up the sighter and the receiver person, who should see the flash. Take your finger off and they won't see anything.

In the morse code make the dashes twice the length of the dots and learn them as a sound: A is 'dit dah' (dit is a short flash, dah is a long flash); B is 'dah dit dit dit'; C is 'dah dit dah dit' and so on.

A	•—	V	•••—
B	—•••	W	•——
C	—•—•	X	—••—
D	—••	Y	—•——
E	•	Z	——••
F	••—•	1	•————
G	——•	2	••———
H	••••	3	•••——
I	••	4	••••—
J	•———	5	•••••
K	—•—	6	—••••
L	•—••	7	——•••
M	——	8	———••
N	—•	9	————•
O	———	0	—————
P	•——•	.	•—•—•—
Q	——•—	,	——••——
R	•—•	=	—•••—
S	•••	?	••——••
T	—	/	—••—•
U	••—	-	—••••—

Morse code: A dot (or 'dit') is a short flash, a dash (or 'dah') is a long flash.

Noel's Treasures from Trash Index

Below is every Noel's Treasures from Trash that has appeared in *ReNew* or *Soft Technology*.

Noel Jeffery—the man behind the ideas

Noel Jeffery is one of those people that is an inspiration to those around him. His appreciation of technology and the application of simple concepts gives him the ability to impart knowledge to those around him in a way that both encourages participation, but also awakens a deeper curiosity.

His Noel's Treasures from Trash column is one of the longest-running sections of *ReNew/Soft Technology*. For more than 10 years Noel has arrived, usually by bicycle, at the ATA offices around magazine deadline time with a collection of commonly found items which he has transformed into a useable, sometimes mechanical, demonstration of science or energy concepts (see index for full listing of his column).

By drawing from his experiences of teaching science and mathematics for 30 odd years, and a decade of touring around Victoria with one of ATA's mobile education trailers, Noel puts a lot of thought into the concepts he is trying to communicate, as well as the skills the kids are to gain from the activity.

'Hands on learning, and learning by doing is a good way to get kids involved. "Treasures from Trash" originated from when I was taking the trailer around to schools. The first one I made was a windmill out of aluminum cans to show the kids that they could make one too.'

While Noel thinks that some of the Treasures from Trash were good, and others weren't so good, it's the process that he believes is most important.

'Kids like using their hands and doing things. I like to sow the experimental thing into their brains and encourage that way of thinking. The periscope is a good example. They build it and only use it a few times and think "I've done that", but hopefully they've learnt a bit about reflection.'

Noel's personal favourite is the Cretan Windmill which is simple to make—just a few sticks, some cloth and a cork, but it works well to demonstrate wind technology.

Everyone has their favourite Treasure from Trash, either because it makes a clever item out of a common piece of rubbish, or because the process of making it has helped them improve their soldering skills, or demystified motor construction.

Send us your questions

If you have a problem you just can't solve, or want to know the answer to a general question about sustainable technology, drop us a line and we will do our best to answer your query.
Send your questions to:
ReNew, PO Box 2001, Lygon St North, East Brunswick VIC 3057
Ph:(03) 9388 9311
Fax:(03)9388 9322
Email: lance@ata.org.au
www.ata.org.au

Charging SLA batteries

Firstly, let me say that I have for about three years now been getting the *ReNew* magazine and look forward to it every time it arrives and read it from cover to cover. I decided to become a member recently and have for some time now considered the options of 'other' power.

My reason for writing is that in the latest issue there is an opportunity to buy sealed lead-acid batteries and with reading the latest edition of Silicon Chip there is a review about the Oatley kit K009B. In that review and other places I have read, including *ReNew,* there have been mention of the charging rates for SLA batteries, giving me the impression that there needs to be a slightly different charging regime than that of ordinary flooded cells.

I have an A'van (caravan) which has a 12 volt system on board and have successfully made the K009 kit with the mods as suggested in *ReNew* issue 72.

With respect to the K009B kit, could it be modified to charge a 36 volt bank of batteries from solar cells?

My reason for asking is that I intend to use 36 volts as I already have a 32 volt Dunlite wind generator and engine driven generator. It seems that one only needs to increase the number of MOSFETs and Schottky diodes to upgrade the capacity in amperage. Is the chip able to be configured for a 36 volt system?

In *ReNew* issue 76, in the article about measuring big currents in a RAPS system, there is reference to a 5-volt supply for the meters, but no reference as to how you got the supply. Is the other board with the big jiffy box heat sink the 5-volt supply? If so, is there a circuit for it and would the whole lot be adaptable for 36 volts? No reference is made to the value of RG1 or RG2. Presumably, 500 amp shunts are available from the various stores?

Ross Dawkins,
rdawkins@mail.kapunda.net

SLA batts need to be charged differently to flooded cells. It also depends on the type of SLA, whether it is a gel cell or an AGM type. The AGM type (absorbent glass mat) have a liquid electrolyte like a flooded cell, but less of it, and it is contained in a glass fibre separator between the plates. These batteries are generally charged to 13.6 to 13.8 volts for a float charge, and up to 15 volts for a cyclic charge. Gel cells have the electrolyte as a thick gel, and must not be charged above 14.4 volts generally, as above this voltage gassing can occur that will push the gel away from the plates, thus causing capacity loss, at least temporarily.

Flooded cell batteries regularly (about once per month) need to be charged to 15 volts (for a 12 volt battery, of course) to equalise the state of charge of all cells. Sealed batteries, either AGM or gel, generally don't need this treatment, and indeed, as mentioned previously, this can even be destructive for them, though AGM batteries will withstand overcharging better than gel cells.

Regarding the Oatley kit, I have just checked their web site and it appears that the popular K009 kit has been discontinued, which is a shame, as it worked well and was ideal for many small systems. I have one that is quite a few years old and it has performed flawlessly in my system at home charging an AGM sealed battery. Due to the design of the kit, which used switching of the positive lead of the battery, it may be difficult to modify it for a 36 volt battery bank. It was configurable as either a 12 or 24 volt regulator, and had some basic regulation for the circuitry—a 15 volt Zener diode, ZD1, which will need to be increased to a 30 volt, 5 watt Zener diode. Also, R2, a 180k resistor, will need to be increased in value, probably to around 360k. If attempting this, just remember that voltages in a 36 volt system may be up to 45 volts or so.

I seems the K009B is a very different kit to the K009 kit. I have not seen the details of the K009B kit, so can't really comment on converting it to use on 36 volt systems.

If I were going to use the K009 kit (the circuit diagram is still available for download from the Oatley Electronics web site) for greater currents, I would mount some hefty MOSFETs on a heatsink and use a single large Schottky diode. However, remember that a wind turbine like a Dunlite needs a shunt type regulator to maintain a suitable load on it so that it does not overspeed, and the Oatley regulator is not suitable for this, but I assume you already have a regulator on your Dunlite.

Re the article in ReNew *issue 76, I did get the supply from a LM317 regulator, it was attached to the lump of jiffy box visible in the photo as a heatsink. It runs pretty warm, but has worked well for about a year now. Strange-*

Notes and errata

ReNew issue 79

On page 72 in the Products section, we stated that the Mastervolt grid interactive inverters are made in Australia. They are actually manufactured in Europe and are Distributed by Mastervolt Australia.

The refrigeration cycle explanation in the Fridge Buyers' Guide was incorrect, see the Letters section of this issue for a correct explanation of the cycle as detailed by a reader.

The Dream-Pot in the Products section was stated as being made in Australia, when in fact it is manufactured in Taiwan.

ly, the values of RG1 and RG2 didn't seem to matter much, this chip seemed to get the measurement/conversion fairly accurate regardless of the value of these resistors. I think I used a 47 ohm unit for RG2 and a 100ohm variable resistor for RG1 for removing any zeroing error.

Lance Turner

Wet back installation

I have a few questions regarding wood heater flue and wet back installation.

How do you determine the optimum length for a flue? I know longer is better (because of a better 'draw') but surely this is only true up to a point?

If installing a wet back into the back of a wood heater for HWS boosting, how do you know if your system has sufficient thermosyphon? In other words, what factors in the design will affect the water flow rate and by how much?

Is it okay to install the water pipes, that run from the wet back into the ceiling, between the flue and the outer decorative mesh casing or will the heat from the flue affect the correct thermosyphon flow?

Gerard Payne,
gerard_payne@hotmail.com

The length of a wood heater flue is usually determined by the height it is above the roof. It should be at least 600mm above the ridge of the roof or it must be tall enough so that it is at least three metres horizontally from the roof where the flue protrudes through a lower section of the roof.

I do not agree that the higher the better. The longer the flue, the more draught it creates and often the more difficult it is to stop the heater from burning strongly. If it is hard to get a heater to draw well without leaving the door open a crack, then adding additional flue can help.

Another issue about a long flue is that, when the heater is closed down, a long flue can cause the flue gases to cool and excessive precipitation of tar can occur on the rain cap on top of the flue. This corrosive tar will drip onto the roof. It is very corrosive and will eat out the roof if it is steel.

Installing a wet back in a heater seems like free hot water. However, a wet back does take heat away from the room heating function of the heater and so, if the heater only just does its job without a wet back, you will find with a wet back it does not give out enough heat into the room. If, on the other hand, the heater has lots of capacity, then it may well be possible to install a wet back and be happy with the result.

Before considering a wet back, be sure that the firebox is large enough to accommodate it. If you are using copper tube, use very heavy gauge to reduce the likelihood of the firewood damaging the tubing. A protective plate covering the tube and brazed to it will increase the surface area for heat absorption and provide protection. If you have too much heating surface area you will find that the water boils in the coldest part of the year when the heater is burning hard. Too little surface area will not give adequate heating if the fire is not burning hard, which is for much of the heating season.

Many commercially made wet backs are too small to prevent the water from boiling, and ensure that the heating is not adversely affected by the wet back. Some manufacturers do not recommend wet backs for this second reason.

The flow rate of the water is determined by:

- *The amount of heat going into the water. This is in turn determined by the size of the fire and the area of the water heating surface.*
- *The temperature of the cold water. The colder it is, the faster it will circulate.*
- *The pipe size between the wet back and the hot water storage tank. ¾ inch (20mm) is a common size to use.*
- *The heat lost between the tank and the heater; affected by pipe length and insulation.*

Note that it is important that the pipe slope upwards all the way from the heater to the storage tank, so that any air bubbles can escape up and into the tank. It is a good idea to have the pipes running across the ceiling almost flat and then rising right beside the heater as shown in the diagram. This protects the pipes when people climb about in the roof and reduces the heat loss through reverse thermosyphon when the heater is not operating.

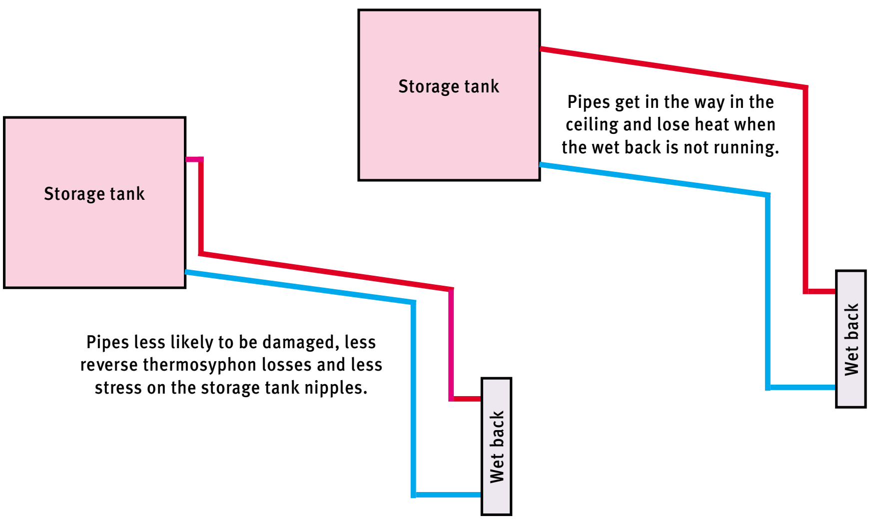
The hot water storage tank should be made of copper. It should be open-vented so that if the water boils the steam can escape.

The pipes between the wet back and the ceiling can be put between the flue and the decorative mess but they cannot be insulated, as the insulation would be a fire hazard. Once in the ceiling space and away from the heat of the flue it is important that the pipes be insulated.

It is also important that the hot water to the house be fitted with a temperature modulating valve as water at 100 degrees Celsius is extremely dangerous. The modulating valve sends a mixture of hot and cold water through the hot pipes to reduce the temperature.

For further details work to Australian Standard AS 3500.4.

Andrew Blair



A tiny maximiser

Model solar car races are held every year, and these cars generally use low wattage 6 volt motors rather than the more common 12 volts of most solar panels.

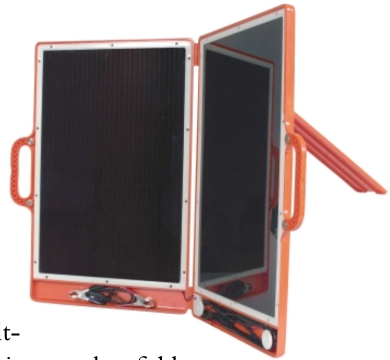
The eLabtronics maximiser can use a standard 12 volt solar panel and step the voltage down for use with a 6 volt model car motor, with a corresponding increase in motor current available. This allows the motor to perform well with less energy coming from the panel than it otherwise would.

The maximiser is available as a pre-built and tested unit, and has an adjustable set-point of 8 to 18 volts. Starting current boost can be greater than three times the panel current.

rrp: $75 plus GST

Manufactured by eLabtronics, 12-20 Gilles St, Adelaide SA 5000, ph:(08) 8231 5966, fax:(08) 8231 5266, email: enquiries@labtron.com.au, www.labtron.com.au

Solar on the go



Solar panels are not the most portable things, but Jaycar Electronics has a new folding solar panel suitable for low power uses while out and about.

The unit consists of two amorphous panels fitted into a moulded plastic case that folds up like a briefcase to allow easy transportation and protection of the panels. Also included in the case are a charge lead with alligator clips and a cigarette lighter socket.

In full sunlight, the panels, rated at 13 watts total, will deliver approximately 750mA at a nominal 12 volts, making the unit suitable for powering all manner of devices, as well as battery charging.

The outside of the case incorporates two extendable supports to allow the panels to be aimed at the sun. Unfolded, the panel measures a total 770 x 525mm and when folded the unit measures 380 x 525 x 35mm.

rrp: $229

Available from Jaycar Electronics, enquiry ph:(02) 9743 6144, order freecall: 1800 022 888, order freefax:1800 810 137, email: techstore@jaycar.com.au, www.jaycar.com.au

12 volt appliances

While many RAPS systems end up being 240 volt AC systems, some people prefer to live on extra-low voltage DC systems, usually 12 or 24 volt. One of the problems with these systems is the lack of appliances suitable for running directly from a battery bank. However, many appliances made for the automotive market are 12 volt DC, and are suitable for such systems.

Waeco, well known for its fridges, sells a number of 12 volt appliances, including a toaster oven, an eight-cup coffee maker, and a microwave oven.

The coffee maker is rated at 200 watts (so draws about 17 amps) and is just 10cm deep, not including the coffee pot.

The toaster over has a five litre capacity, and includes top and bottom heating elements for toasting/grilling and baking. It has a current draw of 16 amps at 12 volts.

A more serious appliance is the 20 litre microwave oven. This unit looks just like a standard 240 volt microwave, and has a green digital display, timer, turntable, auto cooking and auto reheat functions and a power output of 450 watts. Power consumption is 870 watts maximum, or 73 amps at 12 volts, so this unit will need to be close to the battery bank, or have very heavy connecting cables to minimise voltage drop.

rrp: $89 each for the coffee maker and toaster oven, $899 for the microwave oven.

Available from Waeco, Queensland: ph:(07) 5522 1001, fax:(07) 5522 1003, Victoria: ph:(03) 9894 7470, fax:(03) 9894 7480, email: sales@waeco.com.au, www.waeco.com.au

You can't beat a drum

Most people would not think of 44 gallon drums as furniture, but the Northern Victorian Drum Doctors think otherwise.

They take used drums and turn them into various useful items, like chairs, bar stools, cabinets, and a rocking chair called the Cool Rocker, which has a drinks cooler built into the base.

All of the items are powder coat finished, and are available in any colour scheme desired.

rrp: POA

Manufactured by Northern Victorian Drum Doctors, PO Box 332, Kyabram VIC 3619, ph:(03) 5829 0888, fax:(03) 5829 0900, email: mackduff@ozemail.com.au, www.geocities.com/drumdoctors2001

Grid interactive street lights

Conventional street lights have a number of drawbacks, not the least of which is their running costs. Pecan Engineering has a new model in its solar street lighting range—a grid interactive solar street light.

The light does away with the batteries and other equipment found in stand-alone solar street lights, replacing it with an OKE4 100 watt grid interactive inverter. During the day, the panel feeds power into the grid, while drawing power from the grid at night to run the light.

The light eliminates power costs, and allows a larger lamp to be fitted if more light is needed at a later time.

rrp: from $4,290 plus GST.

Manufactured by Pecan Engineering, ph:(08)8349 8332, fax:(08)8260 6643, email: info@pecansolar.com.au, www.pecansolar.com.au

Milk-based paint

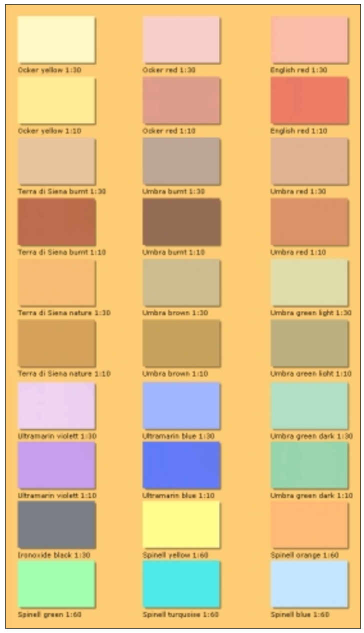
European natural paint maker, Kreidezeit GmbH, has entered the Australian market with its range of milk-based paints and other products.

Most of their products and pigments are casein (milk protein) based, preservative free and are offered in powder form. As the bulk component of most commercial paint is water, it makes sense to buy paint in powdered form and add the water yourself. The paints come packaged in paper bags, reducing packaging and waste.

Pigments are available in all colours, and are added to water then mixed into the base paint. Once mixed, the natural paint has a shelf life of two to three days. Colours in all hues are mixed to suit; you require only a stirrer and a power drill (minimum 600W). When you have finished the job, any left-overs go onto the compost heap.

rrp examples: 2.5kg casein paint: $29.25; 7kg DIY casein paint: $41.95

Available from Natural Paint Pty Ltd, PO Box 287, Port Macquarie NSW 2444, ph:(02) 6550 4394, fax:(02) 6550 4248, email: office@natural-paint.com, www.natural-paint.com



Cheap fuel cells—or are they?

When we first ran across the Greenvolt fuel cells some time back, they seemed more like batteries to us.

Basically they consist of a number of cells that contain anodes and cathodes. You fill the cells with a salt/water solution or sea water, and presto—you have power.

During the discharge of the cells, the anode is eaten away and must be replaced after about 50 hours of use. The cells also need to be emptied every five hours or so and the cells rinsed.

Aside from these limitations, they seem like a cheap source of clean emergency power. According to the manufacturer, there are no poisonous materials used in the system, and the spent electrolyte can safely be poured onto the ground.

The Greenvolt PM120 is specifically designed to provide 12 volts DC at up to 2 amps continuously to power appliances that can be plugged into a car cigarette lighter socket, including laptop computers, mobile phones, portable TVs, and lights. Greenvolt are also developing larger fuel cells systems.

rrp: US$120. Sets of 12 anodes: US$36.50

GreenVOLT Corp, 4055 Digby Drive, RR2 Orillia, Ontario Canada L3V 6H2, email: sales@greenvolt.com, www.greenvolt.com

A much bigger maximiser

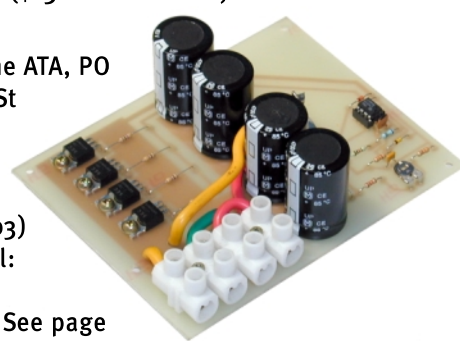
The ATA has sold a solar panel maximiser kit for many years, aimed mainly at the solar pumping market, which is designed for use with 12 or 24 volt motors up to 200 watts. However, we have often been asked whether we do a larger version of this kit, and now, we do!

The Maxi-Maximiser is available in 12 and 24 volt versions, in 12 and 20 amp models. You simply hook the solar array and pump motor to the maximiser, and you are away.

The maximiser is supplied as a short-form kit, which includes the circuit board and all components, but does not include a case or connecting cables.

rrp: $80 ($75 for ATA members) for the 12 amp version and $140 ($130 for members) for the 20 amp version.

Available from the ATA, PO Box 2001 Lygon St North, East Brunswick VIC 3057, ph:(03) 9388 9311, fax:(03) 9388 9322, email: ata@ata.org.au, www.ata.org.au. **See page 62 for an order form.**



Better than forest hardwood

Most hardwood in Australia comes from native forests, either here or overseas—and very few of these forests are logged sustainably. There are a number of engineered softwood products available, but they are almost all either partly or fully owned by overseas companies.

Tecbeam is an all-Australian company that produces structural beams made from radiata pine flanges nailed to galvanised webbing to produce beams as strong as hardwood with less weight and material use.

The beams can be cut on site to any length, and are available in lengths up to 8.6 metres and sizes of 250 and 300mm high by 88mm wide, with 350mm beams available soon. Tecbeam also supplies a range of battens, joist hangers, load spreaders, web stiffeners, wedges and other building materials.

Prices start from $14 per metre plus GST.

Manufactured by Tecbeam Pty Ltd, 58 Dandenong St, Dandenong VIC 3175, ph:(03)9794 8155, fax:(03)9794 7621.

True recycled paper products

There are a lot of companies out there claiming that their products are recycled, when in fact they merely contain sawmill or paper processing waste that has never been used before.

Ecocern produces a range of photocopy paper, paper bags, envelopes, carry bags, litter bags, pallet pads, wrapping paper and many other paper products made from 100 per cent post-consumer recycled paper fibre. A few of the products are imported, but most are made in Australia. The products are fully biodegradeable and can be composted after use. Free printing is available on most of the products if large quantities are purchased.

We looked at a range of their products, which was quite extensive, and were impressed with the quality and prices.

rrp examples: DL envelopes: $35 per 1000; A4 brown copy paper: $10 per ream; 760mm wide x 200 metre counter roll: $40.

Available from Ecocern Pty Ltd, PO Box 59, Watsons Bay NSW 2030, ph/fax:(02) 9337 2737, email: ecocern@ecocern.com, www.ecocern.com

Upgrade your downlights

Architects (and many home buyers) seem to love downlights, even though they are one of the most inefficient ways to light a room. If you really just have to have them, then it makes sense to fit them with energy-efficient globes.

Mirabella has just released a 15 watt compact fluorescent lamp designed to replace R60 and similar lamps in downlights. The lamp is around the same size as an R60, and should fit most downlight and floodlight fittings that have a standard Edison Screw base.

We tried one of these lamps, and the output was quite good, with a nice colour similar to an incandescent, though a bit whiter. The lamp is of the instant-on variety, so there is no delay when turning them on. The compact fluoro tube is covered by a very stylish glass diffuser that spreads the light quite evenly.

The lamp would also be suitable for outdoor lighting applications, providing it is not exposed directly to the weather.

rrp: $19.95

Our sample came from a local Safeway (Woolworths) store.

Local Suppliers' Directory

National

A & A Worm Farm Waste Systems

Single chamber system that takes ALL wastes from toilet, kitchen, bathroom & laundry inc. organic garbage/garden waste.

Safe, ideal for difficult sites, We deal direct with councils in Vic & NSW

Ph:(03) 5989 1088
www.wormfarm.com.au

ADTECH AUSTRALASIA
"Now, let's get serious about wind"

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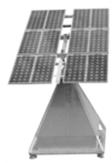

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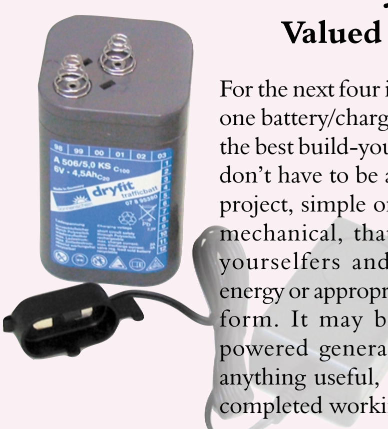

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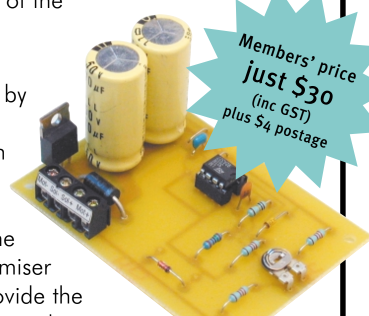

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