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ReNew

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See page 7 for details.
Conditions apply

Solar panel buyers guide

Unconventional wind turbines

Plus wind power for city homes

Putting nappies to the test

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Have a look at these wind turbines on page 32.

It's an electric car! Find out what you should know before converting your vehicle to electric. Page 36.

Solar panel buyers guide on page 48, plus solar photovoltaic windows generating clean energy on page 57.

Thank you to Loopwing Co. Ltd. for use of the cover image, a Loopwing turbine from Japan. See page 32 for more details.

Michelle Morton helps slow the flow of e-waste to landfill. Her story is on page 16.

regulars

Michael Laba (right) shows us his sustainable home (below) in Dunedin on page 44.

From the Editor

About ReNew

ReNew is published by the ATA (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 $65 per year, and offers a range of other benefits.

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Next advertising deadlines: Booking 22 Oct 2007. Advertising copy due 9 November 2007. Next editorial copy deadline: 26 October 2007.

The nuclear election and the environment

It's going to be an interesting couple of months in Australia regarding climate change and renewable energy.

Things can't get much worse with the Howard Government and its non-existent relationship with the environment. In the last decade Australia has become akin to a green vandal rather than an environmental leader with its refusal to ratify the Kyoto Protocol. Internationally, we are seen to be doing nothing about global warming. Instead the government is investigating nuclear power and clean coal rather than the renewable energy that Australia's abundance of natural resources can generate.

If the Howard Government returns for a fifth term, this country is almost certainly heading towards the dangerous and unsustainable prospect of nuclear power, with plans for 25 nuclear reactors on the east coast of Australia, not to mention a foreign nuclear waste dump earmarked for the Australian outback. As Dr Helen Caldicott said at the *ReNew 100* night recently, 'a nuclear reactor uses one million gallons of water a minute. We want to build 25 reactors in a drought stricken country?' What are these people thinking?

With Adelaide reaching its highest ever recorded August temperature of thirty degrees, (unfortunately prompting the first ever fire bans in winter) it's a wonder more use of all this increasing (yet abnormal) sunshine isn't made. Australia could be a world leader in renewable energy generation and manufacture, with solar, geothermal, wind and hydro—clean energy that could even prompt employment growth, especially in regional areas, while at the same time reducing greenhouse emissions.

A number of countries rely almost solely on renewable energy for power generation. Portugal and New Zealand immediately spring to mind. In New Zealand around 70% of all electricity is generated by renewable energy. In Portugal that figure is moving towards 100%. Portugal is a country with similar features to Australia, at least in terms of sun and waves, and chose a renewable future after considering nuclear. Let's hope that this election brings with it a shift in Australia's power generation and a commonsense move away from radioactive waste.

ReNew celebrates

Thanks to everyone who helped celebrate 100 issues of *ReNew*, especially those who helped organise, opened their house or spoke at events. Both *ReNew Open House Day* and the *ReNew*: *Looking Forward* event attracted a large turnout of people. Someone liked one of the Open Day houses so much they went and bought it.

Jacinta Cleary

Tony Hardy from Camberwell, VIC won the Vestfrost fridge (provided by Natural Technology Systems) in the *ReNew 100* subscriber prize. We're excited to announce our latest prize for new or renewing subscribers and members: a 960 watt grid interactive solar power system from The Solar Shop, valued at $13,955.

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- 1 x SMA Sunnyboy SB-1100
- 1 x Mounting frame
- 1 x Installation by Solar Shop Australia

Take out an ATA membership, subscribe to *ReNew*, or renew your current membership or subscription before 23 May 2008 and you could win a grid interactive solar power system valued at up to AU$13,955 including GST. Australian entries only. See the conditions below, and get your membership or subscription in today!

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Terms and Conditions

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

(2) The prize is not redeemable for cash. Price includes GST.

(3) Solar Shop Australia reserves the right to change specifications without notice.

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

(5) The competition runs from 26 July 2007 to 5pm on 23 May 2008, and subscriptions/memberships must be paid by this time and date.

(6) The competition will be drawn at 5.30pm on 23 May 2008 at the Alternative Technology Association, level 1, 39 Little Collins St, Melbourne VIC 3000.

(7) The winner will be contacted by phone and will be notified in writing. The winner's name will be announced in ReNew issue 104, released in mid June 2008.

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

(9) To enter, subscribe or join the ATA using the subscription form in ReNew issue 101, 102, or 103 (or a copy of it), visit our website (www.ata.org.au), or call the ATA on (03) 9639 1500 to pay by credit card.

(10) The competition is only open to Australian entries and includes delivery and installation in Sydney, Melbourne and Perth metro areas. Solar Shop Australia will pay other installer's standard install costs in other locations. This competition is not open to overseas residents.

(11) The winner must be eligible for the PV Rebate Program (ie, you have not received the rebate previously on your current property), with the rebate to be paid to Solar Shop Australia.

(12) The PV system must be installed on the winner's primary place of residence. If the winner does not own an eligible property, then they may donate the prize to the person of their choosing who has an eligible property. It cannot be installed on rental, investment or holiday properties.

(13) Prize includes16 Kaneka GEB 60 watt modules, 1x SMA Sunnyboy SB-1100, 1 x mounting frame and 1 x installation by Solar Shop Australia plus wiring and components valued at $13,955.

The *ReNew*/Solar Shop Australia subscriber competition is proudly sponsored by Solar Shop Australia, 155 Payneham Road St Peters SA 5069, ph:(08) 8362 9992, email: solar@solarshop.com.au, www.solarshop.com.au

Public lighting toolbox

The International Council for Local Environmental Initiatives (ICLEI) and the Australian Greenhouse Office have launched the Sustainable Public Lighting Toolbox, an online resource with information on improving the environmental credentials of public lighting. The national website replaces the Victorian based Sustainable Public Lighting Information Hub.

The interactive site has been designed with Australian councils, state government and anyone who implements public lighting in mind. Public lighting causes between 15% to 70% of Australian councils' annual greenhouse gas emissions and accounts for one third of their energy costs. Public lighting in Australia produces 1.15 million tonnes of greenhouse gas emissions per year. The website brings together information and materials on sustainable public lighting that has been difficult to access in the past. For more information go to www.iclei.org

Emissions increasing

The Australian energy sector's greenhouse gas emissions were 4.3% higher in April this year than last year, according to figures obtained by *The Daily Telegraph.*

Australia was only 0.1% short of the 108% of 1990 emissions Kyoto target in April. The 2006 Federal Government report, *Tracking to the Kyoto Target*, projected Australia's greenhouse gas emissions would reach 603 million tonnes annually between 2008 and 2012.

This would be 109% of the 1990s level, indicating a failure to comply with the Kyoto target. The report projected an increase due to growth in emissions from electricity generation.

An end to electric hot water systems?

A Federal Labor Government would phase out domestic electric hot water systems in a bid to reduce national greenhouse gas emissions by 7.5 million tonnes each year.Under the plan, electric hot water systems could no longer be installed in new homes from 2010. In 2012, the electric systems would be phased out as replacements in both new and existing homes. Labor would also continue the government's $1000 rebate for solar hot water systems which costs $252 million over five years.

Phasing out domestic electric hot water systems could reduce energy bills by up to 60%. Water heaters produce 28% of the average home's greenhouse gas emissions. Labor would also introduce Greenhouse and Energy Minimum Standards to encourage the installation of solar hot water systems at a domestic level.

Recycled water for Adelaide businesses

Adelaide office blocks could be using recycled water after the South Australian Government agreed to fund a pipeline from the Glenelg Wastewater Treatment plant to the CBD. The project is going ahead after being scrapped about seven years ago. The government announced $30 million for the Glenelg-to-parklands pipeline, which will supply 5.5GL of treated wastewater a year to Adelaide parklands and commercial developments in the CBD, and increase environmental flows in the Torrens River. It will also reduce harmful nutrients being released into the Gulf of St Vincent.

Bottled water; the environmental price

Australia's consumption of bottled water is costing 314,000 barrels of oil a year and in the United States it is costing 17 million barrels of oil per year, according to the *Sunday Age*. Australians spend $385 million a year on bottled water; it is 2500 times more expensive than drinking water from the tap.

"There are many ways in which we waste resources in our daily lives, but this has to be one of the easiest to cut down on. Next time you're thirsty, pour yourself a glass from the tap," said Australian Conservation Foundation spokeswoman Sophie Scott.

Cool in a crisis!

So your happily watching a DVD with the subwoofer pumping, suddenly someone turns on the washing machine, the dishwasher, the water pump, the fridge starts, the microwave, and your son decides to practise his welding techniques in the back shed. Your remote power system is stretched to the max, but calmly the new PS1 recognises the large load, starts the generator and smoothly transfers the load to the generator, no fuss, no panic.

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A solution for bottles

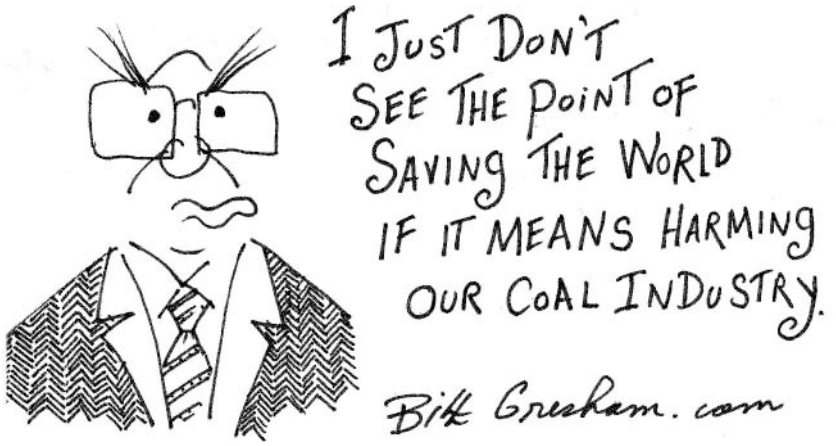
Australians For Refunds on Cans and Bottles (AFROCAB) are campaigning for a container deposit system to be introduced in Victoria, with hopes that it can be implemented in other states too.

This type of system already operates in South Australia and several overseas countries where money is offered in return for containers. AFROCAB says that in South Australia 74% of plastic bottles are recycled, but in Victoria only 35% are recycled. For more information on a container deposit system go to www.afrocab.org.au.

In Western Australia, the beverage industry and Western Australian Waste Management Board have called for expressions of interest to build a glass recycling plant in Perth, the latest move in the state's debate about whether to back container deposits or directly fund recycling infrastructure. It comes as new figures show West Australians were again the country's worst litterers.

Sweden's oil free pledge

Sweden aims to be oil free in 15 years and aims to do so without resorting to nuclear energy. In one of the biggest environmental challenges taken on by a western government, Sweden is the first ever country to pledge an abstinence from oil.



The Swedish Government intends to replace all fossil fuels with renewable energy. Sweden has been phasing out nuclear power since 1980 and 26% of the country's energy use is already catered for by the renewable sector.

Insulation rebates

Insulation rebates have just commenced in Victoria and are available through participating suppliers and installers of insulation. Ceiling insulation can save 2.2 tonnes of greenhouse gas in homes each year and is one of the most effective ways to improve energy efficiency. In winter, up to 40% of heat in the home can be lost and in summer up to 30% of heat can be gained through an uninsulated ceiling.

A rebate of 30% off the total cost of the installed insulation will be available, up to $300. For concession card holders a rebate of 50% of the total cost of the installed insulation will be available, up to $500.

Batteryback recycling campaign

Uniross, CleanAway and Sustainability Victoria have launched a battery recycling program, ultimately preventing rechargeable battery contaminants from polluting soil and underground water reserves.

The Batteryback campaign is a free recycling service for household rechargeable batteries. Batteries from phones, laptops, cameras, electric shav-

ers, remote controlled toys, cordless power tools and video games can be recycled at four different outlets.

Batteries collected for recycling are sent to Europe, due to a lack of facilities in Australia, where their precious metals are recovered. Household rechargeable batteries contain toxic metals such as cadmium, mercury and lead.

More wind in Welly

Meridian Energy's West Wind Project has been given the go ahead for Wellington, New Zealand The wind farm is expected to produce enough power to meet much of the domestic electricity demand for the Wellington region.

The proposal is for up to 70 wind turbines with a total capacity of approximately 210MW. It is estimated that Project West Wind will power up to 110,000 average homes. This would provide enough electricity to power all the homes in central Wellington and surrounding areas.

Electricity generated by Project West Wind will go into the national grid to supply power to the lower North Island and will make the Wellington area a producer rather than a net importer of electricity.

Public opinion also indicates that wind energy is the preferred option for generating electricity in New Zealand. Research conducted by the Energy Efficiency Conservation Authority, showed that 82% of people approve of using wind turbines to generate electricity. This was the highest level of approval given to any of the generation options—wind, hydro, geothermal, gas and coal.

A renewable network

Australian Renewable Grid-interactive Owners Network (ARGON) is an online forum for those who own, are thinking of owning or are interested in grid-interactive renewable energy systems. It's a handy network if you have a problem with or a question about grid-connected renewables. For details go to www.groups.yahoo.com/group/ARGON.

Window rating council

Last issue we reported that the Window Energy Rating Scheme (WERS) was a new initiative. WERS has actually been around for a number of years. It was the Australian Fenestration Rating Council (AFRC) that was newly established, which includes representatives from sustainable building and consumer associations around the country. *

[Letters]

Another downlight solution

I would like to make an observation on your great article, *What to do with your downlights* in *ReNew 100*.

A strategy to dramatically reduce the use of halogen downlights in common rooms such as the dining room, living room and bedrooms, without removing or altering the downlights at all, is to introduce desk or floor lamps. Particularly in low ceiling dwellings, lamps with eight or 11 watt compact fluorescent lamps (CFLs) can have their light bounce off adjacent walls or ceilings, thereby providing more than ample light for all types of activities.

The full force of halogen lamp usage can be reserved for those brief occasions when normal everyday night activities like TV watching, reading, resting, listening to music, playing computer games, entertaining etc. are not occurring.

Desk and floor lamps add atmosphere and can cost so little to run or buy. And most importantly, are as energy-efficient as the CFL bulb that is inserted into them.

Otto Lechner
Kenmore QLD

Not the first wind farm

The article by Alicia Webb in *ReNew 100* is interesting but I believe that her statement that the first commercial wind farm was opened in 1993 in WA is erroneous.

Some years ago I took a day trip to King Island and on a tour was taken to a site where three wind turbines were operating. They were the first commercial units I had ever seen and seemed fairly large at the time. I worked at Telstra and they had a smaller unit that revolved at a great rate of knots but was very noisy.

I don't remember all the details of the King Island installation and I think they were fairly inefficient by today's standards, but the wind in the Tasman blows fairly constantly and although the turbines were not installed for green purposes, nevertheless they served this function. Prior to their installation, the island was dependent on diesel fuel to generate power for the residential and mining operations on the island. The installation of the wind generators reduced their dependence on fossil fuels and the expenditure on same for power generation substantially.

Ron Porteous
catapult@alphalink.com.au

Ultracapacitor feedback

Great magazine by the way, just stumbled across it and it's fascinating stuff. Just some feedback for Lance Turner on the *Batteries that never wear out?* article in issue 98.

I think you have gotten capacitance and energy storage a bit mixed up. For example, the article says 'When capacitors are connected in series, the voltages can be added just like batteries, but the capacitances must be divided by the number of capacitors in series'. The article implies that this means that capacitors can't be efficiently put in series, unlike batteries.

Actually this is not true. The charge storage of a capacitor is proportional to both capacitance and voltage, and the energy in a capacitor is proportional to the square of the voltage. So, if you have a one farad capacitor charged to 2.5 volts, this will give you 2.5 amp-seconds of charge storage (3.125 Joules of energy). If you put two of these capacitors in series, you still have 2.5 amp-seconds of charge storage, exactly the same as how batteries in series works. You also have double the energy stored (6.25J). In the example in the article, the 16 capacitors placed in series and parallel have the same capacitance as a single capacitor, but now also have four times as many amp-seconds and 16 times as much energy storage.

One of the major problems with ultracapacitors that you didn't mention in the article is that they need special electronics to make sure that they charge evenly when in a series configuration.

Richard van Wegen
via email

Richard, thanks for that feedback, you're right, I have no idea why I didn't have that straight in my head when I wrote that article. I've only been playing with electronics for 20 years, geez, that's a worry.

Regarding the balancing issues, I should have mentioned that the supercap manufacturers that make multiple-capacitor modules generally include balancing circuits in their modules. The Maxwell module in the photo has this built in, as do their larger arrays, and there are also high-

Write to us!

We welcome letters on any subject, whether it be something you have read in *ReNew*, a problem you have experienced, or a great idea you have had. Please limit letters to 350 words. Due to limited space, we can't guarantee to publish all letters received.
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er voltage ultracap units available. I have seen them up to 300 volts, you have probably seen these too. The Tavrima capacitor modules look particularly interesting.

Lance Turner

Bubble glazing

Regarding the bubble glazing article in *ReNew 97*, well done Tom, a great idea. I'm already saving all the bubble wrap I can get my hands on.

But I have one small point to make and I apologise up front as it seems very picky to me as I write but, when you test the performance of the windows by placing one hand on the bubble glazing and one hand on the double glazing, you noted the double glazing felt colder. I believe the warmer feel of the bubble wrap was due to it's lower conductance rather than the overall performance of the widow as a whole.

Imagine a kitchen with a marble pastry slab on a wooden bench top. Both the bench top and the marble slab will be at the same temperature—room temperature. You can measure this with a thermometer. Place one hand on the wood the other on the marble. The hand on the marble will feel the marble as colder than the wood. This is due to the marble's ability to accept the heat from your hand, via conduction.

Double glazing works by preventing conduction of heat from one window pane to the other. Irradiation and convection will still allow heat flow across the widow. So the real test is the amount of heat lost across the widow as a whole, not just the feel of the inside lamina.

Given all that, I'm still going to give it a go. Thanks Tom.

Wes Huck
4john@westnet.com.au

Electric bike article

Would you perhaps run an article on electric bikes, as there seems to be a whole range of motors for them, at a range of prices , and all with differing torque charactistics. Maybe the ATA could have the 36 volt hubs for sale in their shop.

I have included a picture of a bike that I built using a wheelchair motor with a 20:1 gearbox and chain drive, which is controlled with a PWM speed controller from an electric scooter. The wheel is a standard steel rear wheel with a bmx freewheeling sprocket.

Larry Minshull, lminni4@westnet.com.au

Pump controller update

While reviewing some Plasmatronics PL60 documentation the other day I realised that I had omitted a couple of configuration settings from my article in *ReNew 99*.

Under **SET > PROG, '4'** should be selected. (This frees the load terminal from being controlled by either battery voltage or time-of-day, as is the case for **PROG 0, 1, 2** and **3**, and gives access to the **SET > MODE** and **SET > EVNT** menus.)

Under **SET > MODE > LSET, '4'** should be selected. This configures the load terminal to be on when the event is on.

Caution: As **PROG 4** enables all parameters of the controller to be adjusted, rather than using the preset values provided by **PROG 0, 1, 2** and **3**, some care needs to be taken to ensure all the values are correct for the particular installation.

These settings are additional to those published in *ReNew 99*, the first, however, being necessary before the already published settings can be accessed.

My apologies for the omissions and I hope it hasn't caused problems for any readers.

I am happy to help if anyone has questions or problems.

Richard Hicks, richard.hicks@qpsu.net

Ten star air-conditioner?

A country friend recently introduced me to the ATA (I am now a member) and gave me part of a letter which appeared in *ReNew 99*, page 12.

In that letter the contributor (it's not known to me who it was) mentions having purchased an air-conditioner with a 10-star rating! I believe I have followed the advice regarding checking with www.energyrating.gov.au but despite my best efforts I cannot identify any products with such a high rating.

Would it be possible for you to forward my query to the contributor. I need to add some air conditioning to a new home and want to do so in the most responsible way possible.

Barry Kendle
bradleys@iinet.net.au

I've had a few people contact me on this—the energy ratings website seems to be a bit of a problem. You have to click the link that says 'show more detail' to get the extra columns in the table, including the SRI (star rating index) column, which basically gives the actual effective star rating of the appliance if the star ratings scheme actually went past six stars. Note that only the smaller units are achieving these amazing levels of performance although I did see a 10kW Panasonic on the list that was pretty good.

Alan Pears

Reducing tonnes of e-waste

Michelle Morton pulls electronic objects apart for recycling. She tells us about her work with E-Cycle Recovery.

Australians are some of the highest users of new technology in the world. Nearly every household has a computer to surf the web or check emails, a mobile phone to talk to friends or run their business, or a stereo, mp3 player or iPod to listen to music. Although distinct items, they all have one thing in common—at some point in their life they will become e-waste, and will need to be disposed of. E-waste is an informal yet popular term used to describe electronic and electrical products at or nearing the end of their useful life. The most common types of e-waste are televisions, computers, mobile phones, VCRs, DVDs and stereos.

The rapid rate of obsolescence is causing these e-waste items to become the fastest growing waste stream nationally and globally, with growth rates over three times that of general municipal waste. The total annual global volume of e-scrap is soon expected to reach roughly 40 million metric tons, enough to fill a line of tip-trucks stretching half way around the world.

A disturbing trend is the disposal of these items with minimal or no evaluation of the social or environmental consequences. Historically and at present, large amounts of these items are being stored, consigned to landfill or shipped illegally to non-OECD countries where they will be processed under atrocious health and environmental conditions. Less than 2% of computers in Australia are recycled by individuals or businesses.

E-waste contains many hazardous materials and also many non-renewable resources such as plastic, glass and precious metals. If they are disposed of or processed incorrectly, valuable materials and resources that are in huge demand are lost and dangerous heavy metals such as lead, mercury and cadmium may cause health and environmental problems through leaching into our waterways and environment.

Michelle Morton from E-Cycle Recovery recycles computers, televisions and other appliances that usually end up in landfill. Photo courtesy of *The Advertiser*. Photographer: Ben MacMahon

At the University of Augsburg in Germany, Armin Reller, a materials chemist, and his colleagues are among the few groups who have been investigating how long minerals will last if every human on the planet were to consume them at just half the rate of the average US resident today. The calculations do not take into account any increase in demand due to new technologies and they also assume consumption equals current production. Keeping this in mind, their conclusions are that without more recycling, antimony, which is used to make flame retardant materials that are used in computer plastics and circuit boards, would run out in 15 years; silver, which is also used in circuit boards

would run out in 10 years; and indium, which is predominantly used in LCD screens and phone displays, would run out in under five years.

The recovery process

To provide a solution, we started an electronic and electrical recycling company called E-Cycle Recovery. Winner of a City of West Torrens 2006 World Environment Day Award, we pride ourselves on recycling all types of e-waste in a socially responsible and ethical manner. This assists Australians to meet zero waste goals by recovering resources which would otherwise go to landfill, as well as minimising risks to human health and the environment from the toxic components contained within many e-waste materials. When you consider that making one desktop computer and monitor uses the same amount of chemicals (22 kilograms), water (1500 kilograms) and fossil fuels (240 kilograms) as a mid-size car, it makes no sense to bury them when we have finished with them. If we recycle them they can be used again to manufacture new items.

To enable this, E-Cycle Recovery manually dismantles e-waste items into individual materials and components. The outcomes for some of the materials are as follows.

Cathode ray tube

Cathode ray tube (CRT) glass, used in computer monitors and televisions, is a major issue because it incorporates many hazardous materials. Lead is the most prevalent toxic material in CRT glass; it is poisonous to the nervous system and can remain in the human body for years. The tubes in a large CRT monitor can contain up to 3kg of lead as well as other toxic metals such as phosphorus and barium. To obtain the highest environmental outcome, glass to glass recycling is the best option. As part of the closed loop recycling program the glass will be processed to specification before being used in the manufacture of new CRT monitors and televisions.

Mercury

Mercury is commonly found within many e-waste items. Highly toxic even in small amounts, it has been known to cause damage to the lungs, kidneys, brain, nervous and reproductive systems. Given the opportunity to leach into water and soil, it can be ingested by aquatic creatures and then move up the food chain into our diet. To avoid these consequences we remove mercury-containing devices and forward them to an EPA-approved mercury recycling plant in Victoria. Here they distill the mercury so that it can be used again, recycle glass into glass wool for home insulation, supply phosphorus powder to manufacturers of fertiliser products, and turn aluminium from tube ends into cast products such as ingots for use in foundry applications.

Printed circuit boards

Circuit boards are sent to ISO 14001 (an international environmental management rating) accredited companies, where they can be processed in specialised smelters to recover non-renewable resources such as copper, gold, silver, palladium and other precious metals.

Batteries

Nickel cadmium, nickel metal hydride and lithium ion batteries are sent to SNAM (Société Nouvelle D'affinage Des Métaux), a French company which meets the European Union's strict environmental standards. The batteries are hulled to remove excess plastic. The metals are then placed in special smelter pots that recover cobalt, cadmium, nickel and steel for reuse in a range of areas such as battery manufacture and stainless steel production.

Toner and ink cartridges

Toner and ink cartridges are packaged in a sealed box and returned to industry recyclers. Some will be remanufactured into new cartridges, and the remainder that can't be remanufactured will be separated into plastic and metal and returned to the recycle chain as raw materials. It takes over four litres of liquid petroleum to manufacture a typical all-in-one-toner.

Paying for recycling

The process of separating the materials is labour intensive and expensive, as difficult waste streams such as glass, mercury, batteries and wood must be forwarded on at a charge for environmentally sound recycling. These costs, combined with labour costs, are higher than the returns from the materials contained within e-waste. Therefore, to provide this service, a fee is charged to cover the gap between the costs of disassembly and revenue earned from the components and materials.

Educating the public that recycling electronic waste does cost money is the most difficult part of my job. What people don't realise is that when they pay companies such as ours, the fee is transparent. When they choose other disposal methods, which are cheaper or free, somebody still pays, but instead the costs are externalised to the environment or people in developing countries due to the large volumes of components and toxic materials going to landfill, or for processing under deadly working conditions. There is always a cost.

Globally, e-waste and the rate at which it is generated is a very serious concern, with many countries taking proactive steps to provide solutions for e-waste items. Europe has two directives: the Waste Electrical and Electronics directive, or WEEE directive, and the Restrictions on Hazardous Substances directive (RoHS). California has Advanced Re-

covery Fees, other countries such as Japan, China, Taiwan, Brazil, Argentina, Mexico, and many US states now have legislation making producers of electronic goods responsible for taking back their products at the end of their life span.

Australia, with the exception of Canberra where computer waste is banned from landfill, has no programs at a federal or state level. Most local councils fail to have a policy or consider there to be a need for a policy on e-waste. Within South Australia there is only one council, the City of Unley, that has implemented an ongoing electronic waste recycling program for their residents. In contrast, most of the remaining councils actively encourage residents to place their e-waste items out for hard waste collection. The council then picks it up for them and landfills it free of charge. Not only does this method place hazardous and toxic materials into landfill without any regard to sustainability issues and our environment, but it also fails to educate residents on why these items do not belong in landfill. Testing in the US has shown that 70% of the lead, cadmium and mercury found in landfills come from electronic waste.

By the federal government's own classification, non-working electronic and electrical equipment is defined as hazardous waste under the Hazardous Waste (regulation of exports and imports) Act 1989. This essentially means that to export non-working equipment, expensive permits are required along with detailed information proving that the materials will be processed under sound environmental management. However, this protection offered to other countries unfortunately does not apply here. In Australia, we are able to take these same hazardous materials and bury as much as we like into our own landfills, without any regard for sound environmental management principles.

Future recycling

It is a difficult environment for true e-waste recyclers. A lack of legislation at state or federal level, and the limited standards for e-waste recycling makes free but poor outcomes an attractive option for the public. This limited security and support makes it difficult to invest in the technologies and machinery required. This investment would enable costs to the public to be reduced, which would encourage more recycling. Even in this climate we will continue to provide this service with the necessary fees, and at least give the public a responsible choice for disposing of their end-life electronic waste items.

Michelle Morton is the director of E-Cycle Recovery. For more info go to www.ecyclerecovery.com.au

Putting nappies to the test

Dedicated cloth nappy mums Meaghan Siemensma and Trepheena Hunter conducted their very own nappy trial to find out why families so heavily favour disposable nappies. Here's what they discovered.

Within one generation, new parents have shifted from using disposable nappies only on holidays to using them every nappy change. Australians are using 800 million disposable nappies per year, which end up as 145,000 cubic metres of landfill.

Used by approximately 90% of parents, a single disposable nappy can take as long as 500 years to decompose in landfill. Many people are concerned about the effect this has on the environment. However, up until now there has been little done to reduce this potentially hazardous waste stream.

The Darebin Nappy Trial was designed, coordinated and analysed by Meaghan Siemensma and Trepheena Hunter, two cloth nappy users. They designed the trial based on their own experiences as new mothers and the fact that most new parents they know had selected disposable nappies for their babies. The trial was conceived with the question 'Why do most new parents not consider using cloth nappies?' By gaining a better understanding of why people don't want to use cloth nappies, more useful alternatives can be developed.

The trial in detail

Disposable nappies and home-laundered modern cloth nappies were assessed in the trial. To compare the nappy types, two 14-day trials were completed by the participants. Upon completing the first trial (assessing disposable nappies), the participants were provided with modern cloth nappies for a second trial. An online survey was used to collect the participants' findings from both trials.

The Modern Nappy Pack included several types of cost-effective cloth nappies. The nappies in the pack were selected on merit, with no input from any commercial business.

The participants

Participants had to currently be using disposables full time on a child younger than 18 months, had to be prepared to complete the two trials and to complete and return the online surveys within ten days of completing the trial.

Twenty families enquired about the trial and fourteen participated, although two did not complete the cloth trial. The 12 who completed the entire trial included seven boys and five girls, aged between three and 15 months.

Key findings of the Darebin Nappy Trial

	Disposable	**Cloth**
Average time spent per day	24 minutes	29 minutes
Nappies used per day	5.6 nappies	5.4 cloth nappies each day plus one disposable nappy per day (average)
Average number of leaks	0.2 leaks per day (equivalent of one leak every five days)	0.5 leaks per day for cloth (equivalent of one leak every second day)

All 12 participants said they would recommend modern cloth nappies to new parents. Eight of the 12 participants said they would recommend modern cloth nappies to every new parent. The rest of the group (4) said they would recommend them if the topic was raised.

All 12 participants said they would continue to use cloth nappies. The majority said that they would only use cloth nappies when they were at home during the day and would continue to use disposables at night, although several said they would try to use cloth nappies all the time.

Nine of the 12 participants said that cloth nappies were easier and better to use than they expected.

The average weekly cost for disposable nappies is $14.08 (annual cost $732), compared to a weekly cost of $9.06 (annual cost $470.80) for cloth nappies. The cloth calculation includes initial outlay of $250 depreciated over the first year, plus ongoing costs of laundering ($1.66 a week, plus cost to use disposables at night $2.59). In following years, people would incur only the ongoing costs if they continue to use the same cloth nappies.

Water use during the cloth nappy trial was on average 15% more than during the disposable trial.

The nappies

Modern cloth nappies used in the trial included Bummis super whisper cover, Bummis prefold, Baby Beehinds bamboo one size nappy, Cute Tooshies, Weenees Pouch Pants, Eenee microfibre nappy, plus disposable options such as Eenee disposable pad and Eenee flushable nappy liner. More and more disposable eco nappies are entering the market. Some are 70% biodegradable, and others are entirely biodegradable. Brands to look out for are Safeties Nature Nappy, Ecobots and Natureboy and girl, with some, such as Moltex Eco Nappies, being compostable, meaning they don't end up in landfill. A selection of eco nappies are available from EcoDirect: www.ecodirect.com.au

Darebin Nappy Trial organisers Trepheena Hunter and son Hamish, and Meaghan Siemensma and her daughter Chloe.

Water Use

In this small sample, water usage while using cloth nappies increased on average by 15%.

There was considerable variation between participant's water use. Two participants used less water, one used the same amount of water and six used more water. One participant used 52.1% more water, whereas the other five showed an increase of between 12% and 33.3%. One participant's water data was not included as the participant did not collect the water meter data during the cloth trial.

The significance of these findings is difficult to assess due to the large number of variables involved in household water consumption. The general assumption is that changing to cloth nappies will increase household water use by an extra washing load or two each week. For some of the participants, the trials were conducted in summer and some in autumn. During this time, there were changes in enforced water restrictions and seasonal changes that may have influenced water use. The trial recorded total household water use only, without looking at other factors such as the type of washing machine (top or front loader), whether additional people lived in the house during the trial, whether there were any other changes imposed between the trials such as changes to water efficiency of showers and toilets, changes in baby bathing routine and so on. It would be useful to look at this area in more detail however it was beyond the scope of this trial.

There is a lack of extensive data when it comes to comparing water, energy and CO_2 emissions for modern cloth nappies and disposables. Meaghan and Trepheena made some estimates on water and power use associated with cleaning modern cloth nappies.

Conclusions

This small nappy trial shows that cloth nappies are a viable and good option during the day if families have the time to adjust to a different type of nappy. Disposables were, however, the preferred option for night nappies and holidays.

For families that described themselves as very busy, cloth nappies were not a viable option as patience during a period of transition (ie. learning to put on the cloth nappies and starting a washing regime) is required before efficiencies and capabilities are achieved.

From a behaviour change perspective, this trial shows that parents are prepared to adopt new nappy habits if they have the time and patience to adopt new practices.

The trial organisers found the following answers to their initial question 'Why do most new parents not consider using cloth nappies?'

- New parents think that cloth will be difficult and time consuming
- They don't perceive they have the time to investigate the multiple and potentially expensive cloth nappy options
- They have no impetus to change once they develop a habit that they find effective
- They are very busy and every minute saved on nappies makes a difference.

From a cost and landfill perspective, modern cloth nappies are a substantially better alternative. From a time perspective, disposables are a marginally better option; an average saving of five

Ongoing cost to wash nappies at home

According to the handy Australian Real Nappy Information website, (www.clothnappy.com) energy and water use associated with washing cloth nappies is not too high. Data was obtained from four different retail washing machine stores in Perth. Washing estimates are based on using seven nappies per day and washing a maximum of 24 nappies per load, therefore washing every third day, or 121 times per year.

They found that it costs around $86.12 to wash and line dry nappies each year, and $114.12 to wash and tumble dry nappies. This includes electricity, water and detergent costs. Trial organiser Meaghan Siemensma was surprised by this result. 'I don't know about you, but I think that is quite amazing. I have to admit that I did believe the disposable nappy companies advertising about it being expensive to wash cloth nappies because I would not have been surprised if it had worked out to cost three or four times that amount.'

Energy consumption

According to retail stores, the average top loading washing machine uses 560 to 644kWh based on one wash per day, for a dollar value of $56-64 per year or $0.153-$0.175 per wash. Based on these estimates, a top loading washing machine would cost you between $18.88 and $21.18 per year to wash cloth nappies 121 times. Washing cloth nappy covers the same number of times would cost you slightly less as a shorter wash cycle should be used for covers, so it's estimated that it would cost about $3.00 less per year, therefore between $15.88 and $18.18 per year.

Front loading machines range from 198kWh per year to around 330kWh per year, which equates to approximately $19.80 to $33.00 per year or $0.05 to $0.09 per wash. Based on these estimates, a front loading washing machine would cost between $6.05 and $10.89 per year to wash cloth nappies 121 times. Washing cloth nappy covers the same number of times would cost slightly less; it would cost about $2.00 less per year, therefore between $4.05 and $8.89 per year.

The only cost associated with line or air drying nappies and covers is your time.

Tumble drying

Tumble drying will add to energy consumption costs for cloth nappies, and may shorten their life expectancy. This is an expense that could be avoided, or at least minimised by tumble drying only in winter. Nappy covers should be line dried only; if you want one quickly, ten minutes in the drier is sufficient for most types of covers.

minutes per day was documented in the trial (see box at left).

Project sponsors

Darebin Council's Better Than Chocolate program donated 25 energy efficient light globes to 10 families that participated in the nappy trial. Two local businesses, the Environment Shop and Chris' Dial-A-Nappy, provided nappies to the project at wholesale cost.

A full copy of the report is available from the Environment Shop website: www.environmentshop.com.au/uploads/docs/darebin_nappytrial_finalreport_july2007.doc

Why a nappy trial?

Trepheena and Meaghan conducted the trial because they strongly believe that cloth nappies are a great alternative to throwing tonnes of pulp and plastic into landfill every year. They also wanted to show other local mums how easy it can be to use modern cloth nappies.

While the trial was small in scale, research such as Meaghan and Trephena's adds to current debate about nappies and their impact on the environment. It also introduced a new generation of families to cloth nappies, which have changed considerably from the terry towelling nappies that most of us were reared in.

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The super low energy house

Tom Chalko's household uses about 0.8kWh of electricity per day. If he had to buy electricity from the grid, it would cost less than $50 per year. He tells us how he achieves this extraordinarily low energy use.

Our so-called civilisation is based on waste. Most people assume that all resources (including energy) are unlimited and the only limit is what they can afford. Energy demand grows steadily and our leaders consider only one solution: build more power stations. It doesn't even cross their minds that the more energy people are given, the more they will waste.

I wonder why more leaders don't consider another approach: increasing energy efficiency in an effort to reduce the demand for energy.

Energy production from fossil fuels in Australia is only about 20% efficient. This means that for every 1kWh of electrical energy produced, 4kWh is wasted, mainly via various chimneys. Power transmission lines waste another 7% of the energy they transmit. So, when we waste electricity produced from fossil fuels, our waste is amplified about five times. Electricity is great, but wasting it is an environmental crime.

It is a well-known trait of human nature that we only think when we have to. My own road to energy efficiency started when I had to live with a limited energy supply.

In 2002 I could only afford a combined wind and solar power system with the capacity of about 2.5kWh per day. Having paid no attention to energy efficiency for the previous 50 years of my life, I initially struggled with chronic lack of energy. Today, after numerous improvements to my household appliances (and my lifestyle), my wind and solar power station can power three households like mine, if they existed nearby. I have spare energy for welding, soldering, machining, power tools and a multitude of projects that I enjoy undertaking.

Right: Tom Chalko's solar hot water system with solar collectors inclined for winter sun. Note the well-insulated pipes and the electronically controlled instantaneous gas booster.

Only after minimising energy waste and achieving energy efficiency does transition to renewable energy sources begin to make sense. Those who do not aim for energy efficiency cannot even begin to imagine relying on renewable energy.

Since my energy efficiency ideas apply to almost any household, I decided to share them in this article.

Measuring energy consumption

My first step was to identify 'energy thieves' in my household. This was necessary to develop a strategy that could give me the maximum possible improvement in energy efficiency and the maximum comfort for the limited budget I had available. Initially I purchased a portable energy meter, but eventually installed a permanent one so that I could monitor my total energy consumption at a glance. My permanent energy meter is a modified Altronics energy meter (kit K4600), depicted in the picture overleaf. I changed the transformer in the meter to improve its own energy efficiency, improved the built-in battery charger and installed a NiMH battery with 900mAh capacity so that the meter can reliably remember its measurements whenever my inverter is dormant for many hours.

Reducing electricity consumption

Being able to measure the power consumption for each and every appliance in my household, I took the following steps to reduce my demand for energy.

Lights: I have changed all globes to compact fluorescent lights, because they consume about one fifth the energy of standard globes that produce a similar amount of light. Initially I wast-

ed some money on cheap/underdeveloped lights that were noisy, unreliable or had unpleasant light. I downgraded these lamps to garage and workshop use and replaced them with lights that I tested to be silent and pleasant to use.

Fridge: I have turned a chest freezer into a fridge by adding an external thermostat. The thermostat cuts the power when the temperature of my choice (+5°C) is reached. This solution takes advantage of the fact that cold air is heavy and reduces the energy required for home refrigeration even more, depending on the quality/size of the freezer and climatic conditions. A chest fridge becomes quite insignificant in the household energy budget, because its daily energy consumption is somewhere between 0.1 and 0.2kWh. Details of my chest fridge solution were published in *Renew 90* and *92*, and the summary is available at www.mtbest.net.

Standby power: Many household appliances (TVs, VCRs, microwaves, washing machines, plugpacks, chargers, lamps, clocks etc) consume power even when no-one uses them, even when no-one is home. The energy waste from standby power is responsible for 10% of the total electricity consumption in buildings around the world.

Minimising the standby power consumption turned out to be my greatest challenge. For inverter-powered households like mine, elimination of the standby power waste is actually very important. The reason for this is that a typical 2.5kW power inverter needs about 20 watts to be fully powered up. Most good inverters have a sleep mode that consumes much less energy. However, in order to enter sleep mode there has to be no power demand from household appliances. The problem is serious: 20 watts for 20 hours is about 0.4kWh. As you can see, an inverter alone can consume 50% of my current daily consumption of energy.

I began with my chest fridge and demonstrated to myself and everyone else that zero standby power consumption of house appliances is achievable. My chest fridge consumes zero power when its compressor does not work, and my power inverter can enter an energy saving mode for as long and as frequently as possible.

With other appliances I adopted the following strategies:

- I used power boards for power groups of devices that work together. For example my computer, printer, modem, router etc are powered from one power board so that I can power down the entire group by flicking just one switch. This strategy ensures the printer cannot be left on when I turn my computer off, for example.
- For appliances that are used solo, such as a microwave, I try to discipline myself to turn them off at the power point as soon as I finish using them.
- Before I go to bed and before I leave the house for more than an hour, I check my energy meter to see if something is still powered up. Then I make sure that I achieve zero power consumption by turning off devices that someone forgot to turn off.

Computer: Since I use the computer for at least five hours each day, I decided to use a laptop instead of a desktop. My Dell laptop and two-way satellite internet system (transmitter and receiver) together consume about 52 watts. This is a fraction of the power used by even the best desktop. When I use my laptop I make sure that I power it from the mains so that its battery is always full. Laptop batteries typically have an efficiency of only 50% so that, from the energy efficiency point of view, it makes sense not to discharge them if possible. Powering the laptop from the mains has one more advantage: the laptop battery serves as a reliable UPS (uninterruptible power supply).

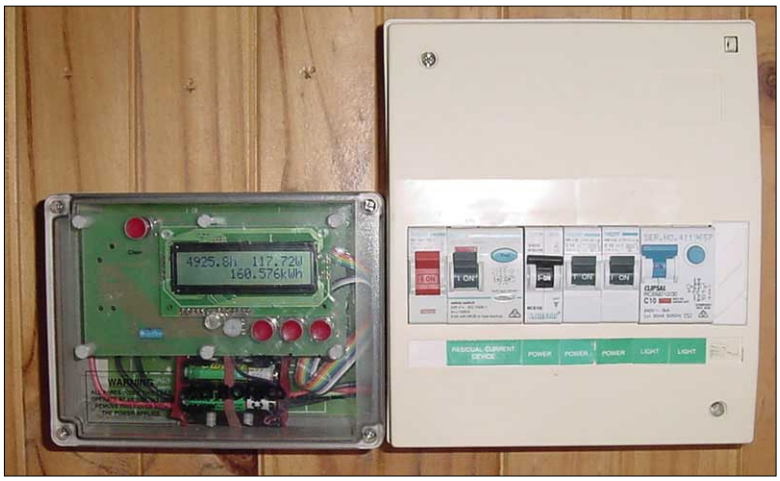
Above: Warming up a stew and water on the Morsø stove.

Other appliances: I have discarded my electric kettle and my toaster because I concluded that life on Earth was better without these two energy thieves. For cooking I use a gas cook top and my wood stove, when it is on. I use the microwave, but only for reheating food. My electric rice cooker and bread maker both have well-insulated double-skin bodies and lids and are thermostatically controlled for automatic operation. Each of these devices is only used a few minutes per day (on average) and hence they do not ruin my energy budget. My Asko washing machine uses 0.5kWh per wash, which is quite negligible when I schedule my washes once or twice a week.

Reducing gas consumption

One of the greatest energy savers in a household is a well-installed solar hot water system. Please let me stress, 'well-installed'. I hear many complaints that solar hot water systems only work in summer. Solar hot water systems installed in a hurry usually miss the necessary insulation around pipes. In summer, the air is warm and the associated heat loss can be small. In winter, however, 10 metres of poorly insulated copper pipe can cool 50°C solar-heated hot water from a roof tank to 30°C at the tap, making it too cool for a shower. If you want to enjoy your solar hot water all year round, you need to:

• Insulate all copper pipes very well, especially those carrying hot water. Just because solar energy is free does not mean that it should be wasted. Our comfort depends on energy efficiency. My approach is illustrated in the photo of the solar hot water system. I used 90mm PVC rainwater tube around copper pipes that are covered with the best available foam insulation. PVC tube prevents UV deterioration of the foam, keeps the foam dry (for best insulation) and creates an air cavity, which in itself is a good thermal insulator. To protect the foam around curved tubes of the solar collector I used black polyethylene irrigation pipes, cut along their lengths for easier installation.
• Mount your solar collector at an angle that is optimal for winter sun.
• Install a solar collector and tank as large as you can afford. Mine has a 4m^2 solar heat collector and a 300 litre tank.
• Install a hot water booster for situations when you need more hot water than the sun can provide. I use an instantaneous, electronically controlled Bosch gas unit that I can power up whenever I run out of solar hot water. When it is off it does not consume any energy. In winter the solar-heated water passes through this unit, whether it is powered up or not. In summer I can bypass the gas heater. The amount of gas that is used in the gas heater is proportional to the temperature difference between the outlet and inlet water. If I did not have a solar hot water system, the gas would need to heat the water from 10ºC (average ambient temperature in winter) to about 40ºC that I need for a shower. On a cloudy winter's day, the sun can heat the water to about 30ºC. This means, that water needs to be heated up by only 10ºC rather than by 30ºC. With solar pre-heating, my Bosch water heater can use just one third of the gas it otherwise would! The practical energy saving is such that a 40kg bottle of gas used for hot water and cooking lasts my family and visitors for two years and two months (26 months). This rate of gas consumption prompts me to think about my own methane-generating plant to gain 100% energy self-sufficiency.



Tom's energy meter (modified Altronics kit), installed indoors next to the switch box, enables him to monitor power and energy use.

Heating and cooling

Winter heating and summer cooling can waste a lot of energy if a house is not well insulated. For this reason I insulated walls, ceiling, floor (from underneath) and equipped all windows with either double-glazing or bubble-glazing (see *ReNew 97* for bubble-glazing details).

My main source of heat in winter is a Morsø wood stove (pictured) that I equipped with a non-vertical flue to retain more heat and increase its heat efficiency to about 70%. This means that my wood stove is 3.5 times more efficient than fossil fuel power stations, simply because I do not attempt to change heat to electricity. My stove does not require a fan and its hot-top can be used to cook food.

In winter I take advantage of every moment of sunshine using reflective solar heating (see *ReNew 88* for details). Reflective solar heating works at the speed of light and reduces my solid fuel needs by about 60%. Not only does this save energy and reduce pollution, it saves me time too, because I only need to source and prepare one third of the fuel I used to.

In summer I use reflective blinds to reduce the amount of solar energy that enters my house (details are in *ReNew 94*). They work very well, providing that I do not forget to use them on the sunny side. For cooling I have installed four windows in the highest part of my house so that I can always let the warmest air out.

Water and waste

My household, garden and the native tree nursery are 100% water self-sufficient. I collect and store rainwater at higher elevation than my house, which enables me to use gravity to deliver pressurised water to my house, garden and the native tree nursery.

All waste from my household is biologically processed in a worm farm. Worms and the associated eco-system turn all solids into a liquid (a bio-processed grey water) that fertilises and waters my lawn. The worm farm uses gravity at all inlets as well as the outlet and does not use any power.

What next?

Conscious awareness of energy efficiency inevitably brings some logical changes to lifestyle, but this is a topic for another article. One aspect of this change I describe in my cookbook (mtbest.net/cookbook). ✶

For updates on Tom Chalko's projects go to www.mtbest.net.

Wind power in the suburbs?

Sustainability Victoria's report on the domestic urban wind market has just been released. The report's author Alicia Webb gives *ReNew* an update.

In March 2007, Sustainability Victoria, together with the ATA, launched a study into the viability of domestic wind turbines for urban environments. They surveyed turbine owners, checked out what machines were available in Australia and overseas, interviewed local councils about planning regulations and researched grid connection requirements from electricity companies. Here are some of the report's findings regarding domestic wind power in Australia and overseas.

Latest UK research

The most recent domestic wind study is based in the United Kingdom and is called the Warwick Urban Wind Trial Project. It is currently underway and an interim report was published in early April 2007. The report found that the public was ready for the systems but a major issue was the market readiness of the various small wind turbine manufacturers. That is, several manufacturers had made delivery promises but had then been unable to meet demand or had withdrawn their machine altogether.

Technical performance was also disappointing. One case study in the report generated only 14kWh (worth approximately $2.00 in Victoria) in about 29 days during February and March 2007. Although this is only the interim report, the writers have already concluded that predicted wind speeds frequently overestimate the wind resource in urban areas.

Australian turbine owners

To gather some local case study information, the Alternative Technology Association (who conducted the report on behalf of Sustainability Victoria) sent an email to members asking for owners of small wind turbines to take part in an online survey. Nine respondents described their experience with 10 turbines.

Most of the respondents lived in windy rural areas and had purchased a turbine that was readily available in Australia. Typically, the turbines were sited on hills or raised areas, and away from houses. All of the turbine owners installed the turbine themselves, and almost none of the turbines were grid connected. Nearly all of the turbine owners had PV systems set up already and decided to add a turbine to complement it. This indicates that solar panels have been the first choice by householders for small scale renewable energy generation, possibly due to the new and emerging nature of the domestic wind industry.

The case study didn't turn up any technical performance information because none of the turbine owners are accurately logging the output from their machines. This could be because they don't care, because they don't have logging equipment, or because the power from the turbine and the PV panels go to the same logging device.

The fact that only five of the nine respondents measured their wind resource before installing their turbine, and that eight of the nine did not care about the payback period when installing, points to the fact that economics is not an important consideration for a typical ATA member and turbine owner.

Urban wind—is the resource even there?

It is an unavoidable fact that urban environments have considerably less wind than open rural areas with flat ground or gentle hills. The obstacles and buildings act as a brake to the wind and create turbulent flow. Additionally, despite the fact that wind resource is the most important factor in calculating the economic viability of a wind turbine, it is very difficult to predict in an urban area. This is because modelling such a diverse and dynamic environment is infinitely complex, and actual wind speed data is only accurate very close to its source.

Wind maps

Home owners can check if they live in a windy spot by consulting the Victori-

The local wind turbine market

There are approximately 10 different brands and 30 different models of domestic wind turbines distributed in Australia. The output of these machines ranges from just a few watts up to the large Westwind 20kW machine, and they're all traditional horizontal axis machines. Product brochures including specifications are available online and the manufacturer websites were listed in the *ReNew 100* wind buyers guide.

Soma Power Pty Ltd in Copacabana, NSW, is currently the only Australian manufacturer of wind turbines—they manufacture 400 and 1000 watt machines. A few local machines still in the development stage include the Hush Turbine in Victoria, a vertical axis machine called the Altaus Urban Turbine developed specifically for the urban market, and a 5kW machine by Aerogenesis, which is in the final stages of testing. Production of these turbines is expected within 12 months.

an or NSW wind maps, or by logging on to the Bureau of Meteorology website. A typical wind map indicates annual mean wind speeds for a given geographical region at a given height. These can be very useful for gaining a general picture of a large area. These maps are put together using computer models which take into account topographical data (the shape of the land), roughness models (the nature of the land eg. is it smooth pasture, urban area or forest) and wind data from a few point sources. The resulting map is most accurate closest to the wind data sources.

Wind maps are useful for deciding where to site large commercial wind farms because the turbines are at a height to ensure that surface roughness is a less significant issue. Closer to the ground however, and in urban environments, the conditions are much more difficult to generalise.

Sustainability Victoria and the New South Wales Department of Energy, Utilities and Sustainability have both published wind maps. It is important to note the resolution of this data. The Sustainability Victoria software models the wind resource at 65 metres above ground level to a resolution of three kilometres. This means that the resulting map does not incorporate the effects of local landscape features smaller than three kilometres in size, like small hills or, of course, buildings.

The Bureau

The Bureau of Meteorology publishes wind speed data on their website, in the form of wind roses. These illustrate the distribution of wind in terms of direction and speed.

There is an anemometer in Melbourne's CBD, on a 10 metre mounting on the corner of Victoria Parade and Latrobe Street. This means that the data will be seriously affected by city turbulence. The annual mean for that site is 2.9m/s at 9am and 4.0m/s at 3pm. These are very low wind speeds, barely enough to make some domestic wind turbines start turning.

Unfortunately, it is difficult to know whether the measurement device is in a particularly low wind speed area or if these measurements can be generalised further. As mentioned previously, the complex terrain of the urban environment means that nearby locations can have vastly differing wind regimes.

Anemometer measurement

Taking into account the difficulty of predicting urban wind with any accuracy, the best remaining option for accurate wind resource measurement is anemometer logging. An anemometer is a reasonably cheap device for measuring wind speed, usually with three small wind cups and a data logger attached.

Ideally, the wind speed and direction should be measured at the same location as the proposed turbine. This is especially important in the urban environment where highly localised turbulent wind flows can cause significant differences in two nearby locations.

Planning

Due to the fact that so few urban wind turbines have been installed, many councils are yet to establish guidelines for them. Thus, it is difficult for councils to respond clearly to questions of how large/noisy/high a domestic turbine is allowed to be. It seems likely that guidelines will be drawn up when installations of domestic wind turbines reach a critical mass. A previous example of this is television satellite dishes. These were initially installed with no rules or guidelines whatsoever, but once a certain number were mounted on houses, councils responded by drawing up standards.

One council confirmed that their planning scheme does not specifically mention domestic wind turbines, only large wind farms. They would class a domestic wind turbine as buildings and works, and due to zoning and overlays, a permit would be required in the majority of locations within the municipality. Rather than provide general information regarding which permits might be required in various areas, councils will generally only provide this information on a case by case basis.

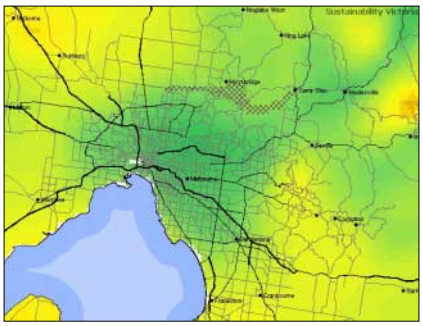


Image: Sustainability Victoria.

This wind map shows slow wind speed (green areas) over Melbourne and faster wind speed (yellow areas) in rural regions.

Grid connection

If a domestic wind turbine is grid connected, the turbine owner can use some grid electricity when their demand outstrips their ability to generate, and feed electricity into the grid when they produce more than they need. Although there are increasing numbers of grid connected PV systems, the vast majority of small wind turbines in Australia are still off-grid and rely on battery banks.

Grid connection is a complex issue because power distributors need to protect the integrity of the electricity entering the grid. Any generator has the potential to cause electrical disturbances to the network, such as voltage fluctuations and harmonics. In reality, the level of disturbance possible from a small domestic turbine is minimal.

To connect a domestic wind turbine to the grid, the following things are required by the electricity distributors

and retailers:

- An approved inverter to condition the power so that it suits the grid
- A bidirectional meter
- A signed distributor contract
- A signed retailer contract
- An approved electrician to connect the system.

There are three main types of metering for a grid-connected generator. The first is net metering, where the meter can roll forwards or backwards depending on whether electricity is being consumed or exported. The second is gross metering, where two separate loggers measure electricity consumed and produced. This allows different prices to be charged or paid for the two different types of electricity. This works in favour of the turbine owner if the electricity retailer is paying a high rate per unit for the renewable energy.

The third type is the subtly different Net Export Metering which involves a bi-directional interval meter, measuring total electricity imports and exports by time intervals.

In some countries, the government forces electricity retailers to pay more for the renewable energy exported by homeowners, to give an incentive for solar and wind power adoption. Unfortunately, Australia isn't going that way just yet.

The problem with grid connection at the moment is it can be expensive. The websites of each of the three distributors details their costs for connection call-outs and meters. The total costs lie between $110 and $500, depending on the time of day of the call-out, and which distributor area the system is in.

Noise

Noise is a critical issue for small turbines, especially in the urban context, as they will always be placed very close to houses. Noise is generally related to blade tip speed, which is why slower moving vertical axis machines tend to be quieter than the traditional horizontal axis ones.

Manufacturers often don't test the noise output of their turbines and such data is quite difficult to gather in a realistic urban setting. Anecdotally, certain turbines are more notorious than others. For example, the Air 403 which preceded the Air X was famously noisy. Recently developed turbines, such as the Swift in the UK and Victoria's upcoming Hush, have modified the traditional design to include a ring around the blade tips. This ring prevents some vibration of the tips and tip vortices, and dramatically reduces noise.

Economics

The cost of installing a grid-connected domestic wind turbine is made up of capital costs and running costs. The capital cost has many components, including the turbine, the tower, the cabling, the inverter, the meter, the grid connection, and the installation. The running costs generally involve maintenance and perhaps insurance. A general rule of thumb is that full installation and connection is equal to the cost of the turbine, plus approximately $10,000.

The payback period for a wind turbine is highly dependent on wind speed. Generally the economics show that capital installation costs are high and the annual return on energy produced is meagre. This situation would be helped by feed-in tariffs, rebates and reduced connection costs.

Maintenance

According to case studies, maintenance is not a significant cost to domestic wind turbine owners. It should be noted, however, that several of the survey respondents were performing the maintenance themselves. The possible future proliferation of the domestic turbine to urban areas may see a decline in the number of owners capable of performing their own maintenance. Trevor Robotham, an experienced wind turbine installer, reports that the annual cost of maintenance is between $300 and $500, plus parts. The variation in costs is defined by the complexity of the job. Standard maintenance includes replacing rusted parts, bearings and leading edge blade tape, and replacing grease and oil.

A developing market

Overseas, the domestic wind energy industry is developing due to increased concern about climate change and consumer willingness to take action. However, there remains doubt as to the suitability of the technology in an urban environment. Field trials show poor results, and yet a study in the UK found that despite this, high levels of public support for the technology continues. It remains to be seen how long this public support remains in the face of poor performance.

Where to from here?

As things stand, significant further work needs to be done to evaluate the technical viability of urban wind turbines for electricity generation. This may involve field trialling of turbines, the installation of anemometers to accurately measure urban wind regimes, and/or additional economic modelling and scoping of potential rebates and economic incentives. In locations with annual average wind speeds of 5m/s or more, wind turbines may prove an attractive alternative to solar PV systems, with similar output and a lower capital cost.

A full copy of Sustainability Victoria/ATA's report 'The Viability of Domestic Wind Turbines for Urban Melbourne' is available from www.ata.org.au

Unconventional wind turbines

Most modern wind turbines available in Australia are of the horizontal axis two or three straight-blade type. But there are many other designs being manufactured around the world that don't fit this model.

In the last few years there have been a number of wind turbine manufacturers who have reinvented conventional wind turbine designs in order to meet perceived needs. And indeed, there are many good reasons why you would design a turbine a little out of the ordinary.

For a start, many 'alternative' designs are quieter than conventional machines, making them more suitable for use in urban environments and areas where they will be located close to homes. This is because many of these new breed of machines are designed to eliminate blade tip vortices, which produce a lot of the noise associated with the current designs.

You will also notice, as you browse through the turbines on these pages, that many of the designs are vertical axis machines. Vertical axis wind turbines (VAWTs) have generally been overlooked by the major manufacturers, yet really this is surprising, as they have a lot to offer.

Aside from the reduced noise levels, they also have the advantage that they don't need to slew to face the wind—they are always facing it! This means no slewing mechanisms, and therefore no slip rings, as the electrical generation part of the machine is fixed to the tower.

You might think that some of these machines are not overly efficient—after all, any machine that uses drag will not be as efficient as one that uses lift. And that is true, but you must be careful not to get too caught up on efficiency—after all, the wind resource is vast, and efficiency only determines how large a machine is, not how well it performs its duties.

Photo: Loopwing Co Ltd

The Loopwing generates twice the torque of conventional three-bladed horizontal axis machines at half the rpm, so it has a lower start-up speed and produces less noise. The blades, made of high tensile aluminium alloy, reduce noise by eliminating tip vortices, and the turbine is self-limiting in speed. The 1.5 metre diameter machine produces 438 watts at 12m/s. While prices are currently quite high at around US$12,700, economies of scale are expected to greatly reduce the price once full production is underway. Two larger models—2kW and 5kW—are also planned. See www.loopwing.co.jp for more information.

A case in point here is solar panels. Crystalline panels are generally more efficient than thin film units, but all this means is that thin film units of the same rated power are larger. In many cases, thin film panels will outperform crystalline panels in the real world.

The turbines presented here are just a sample of what is happening in the wind turbine industry around the world. It's a pity Australia has so little involvement!

The Aerotecture wind turbines are available as both horizontal and vertical axis machines designed for use on top of buildings. They use a spiral Savonius drag-type rotor which is quiet and robust. The turbines are in the final stages of development, but there are already a number of operating installations in the USA. For more information email info@aerotecture.com or go to www.aerotecture.com

Photos: Lucid Dream Productions

The Urbane Turbine from Altaus is an Australian designed vertical axis machine based on a Lenz turbine. It is said to be completely silent, and in optimal conditions can produce 6.4kWh per day, though this might be a bit optimistic in the average urban environment.

It is a grid-connected turbine which is self-starting and self speed limiting, and because of its design it is bird friendly. The turbine will be available some time in 2008 and will have the option of lifetime ceramic bearings for zero maintenance. It will be available in a range of colours to blend in with most homes. Call (03) 8866 8866 for more information.

Solwind of New Zealand make vertical axis Darrieus style wind turbines in several sizes, including 4kW and 6kW models. The machines are designed to run quietly so they can be used close to dwellings.

The blades are made of aluminium, fibreglass and stainless steel for durability, and there is now a new alternator with magnetic bearings for reduced maintenance. Solwind have recently exported their first turbine to Japan (see left). For more information, go to www.solwind.co.nz

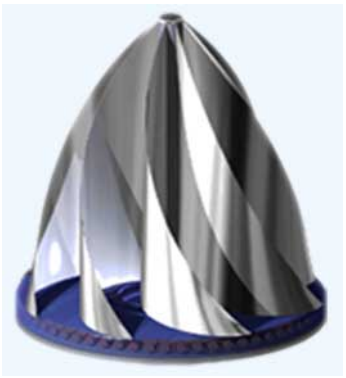
The qr5 turbine uses a spiral Darrieus rotor. Unlike a straight-bladed Darrieus, the qr5 turbine starts easily. It is also very quiet as the blades are tapered to reduce noise.

The rotor measures five metres high by three metres in diameter, and the blades and connection arms are made of carbon fibre reinforced epoxy resin. The turbine is rated at 6kW.

The qr5 is priced at around £25,000 and is made by quietrevolution in the UK. For more information see www.quietrevolution.co.uk

Cleanfield Energy, in Ontario, Canada, make a vertical axis straight-bladed machine that is rated at 3.5kW at 12.5m/s. The rotor of the V3.5 measures 2.75m diameter by 3 metres tall and the blades are made from reinforced fibreglass. The turbine is currently only available to the North American market although Cleanfield Energy have plans to sell in Europe and Oceania in the future. See www.cleanfieldenergy.com for more information.

Alternative Energie Systeme GmbH manufacture a neat little rigid cup/sail-type low-speed vertical axis machine. Again, it is designed for urban environments, and so has been optimised for low noise and safety to birds and people. It is also designed to require minimal maintenance. See www.aes-energie.de for more information, although it is only in German, so you will probably need to use babel fish (babelfish.altavista.com) to translate it.



The Mag-wind MW-1100 turbine is a derivative of the Savonius and similar turbines. It is designed to be a roof mounted machine and uses the 'roof effect' (the increased wind velocity caused by the roof funnelling the wind upwards) to increase power from the turbine. Indeed, mounting it on a tower will reduce its power output!

The MW-1100 is a low speed turbine which is self-limiting in speed and, because it looks like a solid object when spinning, it is bird friendly.

The name Mag-wind comes from the fact that the turbine is available with magnetic bearings. The MW-1100 is currently only available in North America but the company has plans to expand in the future. See www.mag-wind.com for more information.

The Aerojoule is a low speed drag-type electricity generating turbine that is designed to look like an old-style water pumper. They are available in sizes from 1.5 to 65kW, and also come in water pumping versions. The machines are fully microprocessor controlled and are designed to be robust and reliable. See www.aerojoule.com for more information.

Believe it or not, this is a wind generator. The Motorwind is a cluster of plastic-bladed turbines that mesh together and drive a generator at the end of the cluster. They are available in eight and 20 rotor sets (rated at 50 and 170 watts respectively), and you can even buy them online.

The turbines are designed to be very simple and low cost, and can be used just about anywhere. Large arrays of them have even been painted different colours to make them into advertising billboards.

Prices are US$150 for the eight rotor set and US$250 for the 20 rotor unit. The generators themselves are available as spare parts, and so should be ideal for other home wind power projects. For more information and to order, go to www.motorwavegroup.com/new/motorwind

The Ropatec is yet another vertical axis machine loosely based on the Darrieus rotor. It is designed in Italy and is available in sizes from 250VA through to 6000VA, so is suitable for both urban and larger installations.

The Ropatec range have large, rigid blades to make them robust, even in cyclonic conditions—there is a Ropatec installed at The Strand in Townsville, and another on a local school there.

For more information, see www.ropatec.com. The Ropatec turbines are available in Australia from Sustainable Energy Enterprises Ltd in Adelaide, ph:(08) 8267 2366, heinzrechten@bigpond.com

Windside of Finland have been making spiral Savonius turbines for some years. The turbines are designed for use in urban areas, right through to extreme conditions such as in the arctic and out at sea. They are quiet as well as people and bird friendly, and can even be used at ground level.

Windside turbines are currently available from APT in New Zealand, ph:+643 338 6292, or email apt.tech@xtra.co.nz. See www.windside.com for more information.

Small wind turbines can potentially have a much greater role to play in energy generation in Australia and around the world. With so many turbines being developed, *ReNew* hopes to bring you more small wind turbine articles in future issues.

Resources

Sandia Labs vertical axis wind turbine research archive: www.sandia.gov/wind/topical.htm#VAWTARCHIVE

Wikipedia wind turbine page: http://en.wikipedia.org/wiki/Wind_generator

www.ecobusinesslinks.com/vertical_axis_wind_turbines.htm

The ins and outs of EV conversions

With the growing interest in electric vehicles, there is now a demand for electric vehicle conversions. But if you can't afford $40,000 plus for a new one, just do your own conversion. Robert Chew and Lance Turner explain the issues involved.

Converting an old or new petrol vehicle is not only exciting and affordable, but it is challenging, and rewarding for both yourself and the environment.

So, how do you do it? Where do you go to find out how? How much does it really cost? These are the most common questions asked by the public and new enthusiasts about converting a retired gas-guzzler to a brightened up electron-burning machine!

Selecting a car

The next most common question is which car do I convert? This question is perhaps the most debated and varies between people's opinion on choice, functionality, style and brand of car. This also brings me to the start of the journey to convert a gasoline car to electric.

The budget given to an EV conversion really dictates the performance of the vehicle once it is completed. The vehicle that you choose to convert also determines, to an extent, its range, acceleration and top speed.

The biggest decision

Let's look at an example to make my point clearer. We will assume that a 'standard' electric vehicle drive train is used, ie. a Curtis controller, an eight inch series wound DC motor, transformer based battery charger and related balance of system components such as contactors, disconnect switch and heavy current wiring. This means that the choice of traction battery is the single biggest determining factor in the final performance of a converted EV.

From the outside, this Camry wagon looks like a normal vehicle, but it is in fact an EV. The only tell-tale sign is that the rear seats were removed to make way for one of the battery packs. Of course, it isn't necessary to do this in every conversion, it just depends on the type and size of the battery pack used.

A lead-acid EV battery pack is by the far the most common in Australia and around the world. A typical pack consists of 20 to 24 six volt deep-cycle flooded-cell batteries. While these batteries offer the best capital purchase price compared to all the other battery technologies, they also weigh the most for the energy stored. This dictates the type of vehicle you can convert.

Most vehicles with a battery pack that weighs in the order of 400 to 500kg require modifications to the suspension and possibly uprated tyres. Acceleration and top speed can still be very respectable with a heavy lead-acid battery pack, owing to the high output torque of a series wound DC motor at lower RPM. However, the vehicle range suffers. To some extent, the more batteries you put into a conversion, the greater the range you can expect. However, there is a limit to how much extra weight you can add to a vehicle. This limit is dictated by the vehicle's GVM (gross vehicle mass). The GVM can be altered by changing the tyre type and suspension. However, imagine a little Daihatsu carrying over 600kg of lead! It is possible, but not realistic.

Assuming that the price of lithium technology traction batteries drops over the next couple of years and the current lead price keeps increasing, more and

more enthusiasts will incorporate the lighter lithium batteries (one third of the weight of lead-acid for the same storage capacity) into their EV conversions. With the current price of some lithium ion batteries, and assuming that the cycle life stated on their datasheets of around 3000 cycles to 70% DOD (depth of discharge) is valid, lithium batteries are now an economic proposition, providing you can afford the higher initial up-front cost.

Take some time to think about the battery pack. How your conversion progresses will now depend on the battery type you choose to go with.

What to look for in a donor car

The donor vehicle should ideally be strong, with little or no rust, and with a good safety rating, as you may well be adding a lot of extra weight to the vehicle, depending on your battery choice.

It should also have suitable area(s) in and under the vehicle for fitting the battery boxes. For this reason, many conversions are front wheel drive, as there is no driveshaft and rear differential to get in the way. However, if you have a vehicle you really want to convert but it's rear wheel drive, there may still be enough room for batteries if you are willing to compromise in other areas.

Ideally, you should look around for a donor vehicle that has had an engine failure but is otherwise in good condition. This will greatly reduce the purchase price of the car, allowing you to spend the allocated budget on other things. After all, you don't want to be buying a car with a good engine, as you will not only be paying extra, but you will then have an engine that you have to try and recover the money from later, if your conscience will allow you to sell it!

Is smaller better?

The majority of electric vehicle conversions tend to be on smaller cars. There are several reasons for this. Firstly, smaller cars are cheaper to buy and maintain. Secondly, smaller cars are lighter, so they need less powerful motors and smaller capacity battery packs to move them a set distance. This reduces the cost of the conversion, making it attractive to people who would not be able to afford to convert a larger vehicle.

The reasons for selecting a smaller vehicle are perfectly valid, if you are willing to forego other important criteria such as carrying capacity and occupant safety.

Safety is a big issue in electric vehicles. For a start, you are running around with a relatively high voltage battery pack in the vehicle. Battery voltages can range from 48 volts for micro and short-range cars, through to 300 volts or more for high-powered and performance EVs. For example, the Toyota Prius has a battery voltage at the upper end of the scale.

Of course, all potentially dangerous connections are fully insulated, but this can easily be compromised in an accident. The last thing you want to happen is for a rescue worker (or you for that matter) to be injured or killed by the battery of your EV. The stronger a vehicle is, the less likely a situation will occur where this becomes a possibility.

What's more, if you do a conversion using lead-acid batteries, which are still by far the most commonly used battery type, then your vehicle will weigh considerably more than the original internal combustion engine vehicle did. This means that in a crash, the crumple zones have to absorb a great deal more kinetic energy. As a result, a car that is already marginal in safety can become a

Out with the old, in with the new. Before and after shots of a typical EV engine bay. As you can see, the electric system is a lot simpler than the petrol one!

potential deathtrap when it is converted to electric power.

However, the safety ratings of some small cars have improved considerably in the last decade, and there are certainly some vehicles that will still retain a reasonable level of safety even with a heavy battery pack fitted. But of course, being newer, you are less likely to find a donor car with a dead engine, and in general, the newer a vehicle, the more it costs.

To find the crash safety rating for your potential donor vehicle, go to www.howsafeisyourcar.com.au and select your car from the list. If the car has less than a three star rating, you should be looking elsewhere. The more stars, the better of course, so be flexible in this aspect. A similar model vehicle of another brand may be a lot safer than the one you are looking at, and just as easy to convert, even if it is slightly more expensive. After all, how much is your life worth?

Another issue that can come up is brand preference. Many people have brand preferences that outweigh other criteria—this is a bad thing. You shouldn't convert, say, a Holden Barina, just because it is the only Holden of the right size for your needs. After all, it's a Suzuki Swift anyway!

So, put another way, forget your prejudices, if you have them. If the opposition has a more suitable car, then that's the one you should convert.

Try a larger car

You should seriously consider a medium to large car when planning your conversion project. Larger cars are often more versatile, can carry more weight, and are usually safer than smaller cars. What's more, with EV conversions still in their infancy as far as appeal to the general population goes, a larger vehicle shows people that you don't just have to convert a little buzz box. The fact is, EVs won't become the norm until they meet the needs of the majority of the population—and that won't happen unless larger cars are available, either through car dealerships or via conversions.

Starting the conversion

Now comes the fun part—ripping out all the greasy components of your donor vehicle. Be mindful of what you take out and how you remove it. Make sure you take important measurements, such as the correct position of the gearbox in relation to the vehicle body, before you undo any bolts. Record everything, and take lots of photos—they will be invaluable when it comes to reassembly if something doesn't make sense.

So, what to remove? You will not need the engine, engine computer, exhaust system, fuel tank, clutch (only if you intend to go clutchless), emission control hardware, air filter, fuel filter and anything else that is used to transfer fuel to the internal combustion engine (ICE).

You will need the gearbox, as DC series wound motors, which are used on most conversions, suffer from reducing torque as RPM increases.

Because a DC series wound motor generates so much torque at very low RPM, you can drive the car from standstill to 60 or 70km/h in third gear, with spirited acceleration. Top gear is only really used when driving at highway speeds. Shifting gears is a task that is done only occassionally in a converted EV.

Go clutchless?

In most modern gearboxes, changing gears without a clutch can be done by moving the gearshift to the desired gear slowly and letting the synchomesh do the work to align the gearshafts. Shifting down in a clutchless setup requires blipping the throttle to match engine RPM and then shifting to the desired gear. This requires slightly more time to change gears than an EV with a clutch.

If you use a clutch on your EV, shifting is easier and smoother and you can typically change gear more often while driving. The use of lower gears such as second will make your EV consume less battery current during take-off from standstill because the gearbox is providing the extra torque needed by its mechanical advantage of a lower gear ratio—for a given amount of current going into the motor, you will produce more torque at the wheels in second gear than in third gear.

Adding a clutch means slightly higher complexity in the drivetrain. When designing the adapter plate, you will need to pay particular attention to the spacing between the flywheel and the rear face of the motor. This is what is called the 'magic number'. In essence, you aim to mimic the mounting of the flywheel exactly as it was when it was connected to the ICE.

Adding a clutch also means that you have to take care when shifting gears because when you depress the clutch, load is taken off the electric motor, which will make it spin very fast in a very short amount of time. If the motor spins too fast, there is a risk of damage. This is a characteristic of series-wound motors—they can be made to spin past their designed RPM if they are unloaded while there is adequate voltage applied to them.

You should keep the clutch for low voltage vehicles using 72 volts or less. This is because most on-road EV motors are rated at 72 volts. During real driving conditions, 72 volts is never seen across the motor terminals so the motor will never reach its top speed. At high RPMs, little torque is available from the electric motor. As the vehicle builds up speed, it requires more

torque at the wheels to push the vehicle through the increasing air resistance. So, at low battery voltages, there will not be enough voltage across the motor to induce enough current through the motor windings to induce the torque required. Hence, a gearbox becomes pretty handy.

The adapter plate

The next step in the conversion process is to make the adapter plate which joins the electric motor to the existing gearbox. You will need to consult an experienced person to make this plate. It requires particular attention to detail in terms of aligning the electric motor drive shaft with the input shaft of the gearbox. If the alignment is not spot on, you will get vibrations in the drivetrain which will lead to early failure of the gearbox, and possibly the electric motor bearings. The drive hub requires machining and the fitting of the old clutch spline onto the shaft of the electric motor.

Once the adapter plate and drive hub is made, the gearbox and electric motor can be mated together and bolted. The whole assembly can then be lowered or raised into the engine compartment of the vehicle. The electric motor mounts will not be required to secure it to the chassis of the vehicle. Preferably, the original ICE mounts should be kept and new adapter brackets made to secure the electric motor to these original mounts.

Locating the batteries

The battery placement throughout the vehicle must be well planned so that the vehicle's weight distribution is as close as possible to the original. Generally, in a passenger vehicle, the batteries are placed underneath or in place of the rear seat and some are placed under the bonnet. In a utility vehicle, the batteries can be placed on top of the tray or, for better handling and utilisation of the space available, placed between the chassis rails underneath the tray. The average EV conversion will have the most weight biased to the rear of the vehicle.

Here you can see a battery box finished and ready for the batteries. Note how it has been set into the floor of the vehicle between the subframe rails.

The battery racks that hold the batteries in place can be made from mild steel angle iron welded together to form a frame on the base of the battery box. This frame can then be welded to the chassis of the vehicle where a cut-out through the floor has been made (see photo above for an example).

The battery racks can be mounted directly onto the floor through bolts, however the centre of gravity from the height and weight of the batteries is higher than the original centre of gravity when the car was ICE powered, and may cause the car to steer and handle a little oddly.

It is important that the battery enclosure is painted with acid-resistant paint on the inside. A substance like bitumen is great for this and provides added rust protection to the mild steel framing. Fibreglass can be used to enclose the sides of the battery enclosure and also the top. It provides an excellent lightweight insulating material for the battery enclosure. It is also easy to work with and holes can be drilled on the sides for forced ventilation fans.

Battery ventilation

As part of the RTA requirements in NSW, it is important to have a fan operate automatically when battery charging commences. Most conversions have the charging socket installed inside the old petrol filler enclosure. A microswitch can be installed in the petrol filler opening which is operated by the filler flap. When the flap is opened, the fan starts and provides a flow of air throughout the battery enclosure, exhausting any generated gases to the atmosphere.

It is also a requirement from the RTA that the auxillary (12 volt system) can be used while the car is unpowered (ie. the traction system is shut down). This requires a 12 volt battery to still be installed in the vehicle, however a smaller sealed version can be used in place of the original starter battery, since the 12 volt battery will no longer be used to provide large cranking current. Do not modify the 12 volt accessory system of the vehicle—this is one part of the car that should not be changed too much.

It is recommended that a DC to DC converter be installed in the vehicle to provide supplementary charge to the accessory battery. This is because most electrical components of a car are designed to run at 13.8 volts or so. A stand-

ard charged battery measures approximately 12.8 volts, and when under load this voltage will sag down to 12.3 volts or so, depending on the load. This will cause the headlights to become slightly dimmer and the indicators and wipers to operate more slowly. It is imperative to maintain the electrical characteristics of the EV as it was as a petrol guzzler. Installing a DC to DC converter maintains the auxilliary battery voltage at approximately 13.8 volts, keeping both the battery topped up and providing bright lights and correct operation of the car's electrical system.

A DC to DC converter operates from power tapped from the car's traction battery pack. It is important to obtain an isolated type of DC to DC converter, as non-isolated units present an electrical shock hazard—the ground of the 12 volt system and high voltage system-would be tied together, so if someone were to touch the car's chassis/body and a battery terminal or connection in the main traction battery pack, they will get a nasty electric shock which may potentially be fatal.

It is illegal to have only a DC to DC converter supplying power to the accessory system without a battery, as in the event of failure of the DC to DC converter, the hazard lights and other safety systems cannot be operated. An auxilliary battery must be installed.

Other details

This includes all of the little details for the rest of the project—such as the controller and battery charging system, the vacuum pump for the brake booster, heating and cooling, and lots of other little details.

Sounds like a lot, doesn't it? Well, it is, but there are ways to simplify things. For a start, with some items you will find that other people who have done conversions will all recommend the same brand or model. This is because they have all found it to be the best, or the only one suitable on the market. Either way, you are best to stick with what works, so there is no choice to be made.

Potentially the most important thing you can do before you start your conversion is to contact the closest branch of the Australian Electric Vehicle Association (or equivalent organisation in your country) and talk to other EV owners. They are a mine of information and can save you making a lot of silly mistakes. They will most likely be able to help you source parts for your conversion, and may even offer to help you get your conversion done faster.

Also look around for publications on the subject, they can have a great deal of useful information. The *Convert it* book/video package from Electro Automotive, while a bit on the home grown side, has some excellent information and ideas. There are plenty of other publications and websites to help you too. In short, get informed, don't try and do a conversion blind.

Other equipment

Vacuum pumps can be bought in small 12 volt or higher voltage units, as they are used for commercial purposes. You don't need a lot of vacuum to operate a braking system, but it has to be able to keep up with the task.

You may decide to use the original power steering pump and just operate it from a small DC motor running from the auxilliary or traction battery. Alternatively, you can change the steering rack over to a non-power-assisted one. Even better, use a donor vehicle that doesn't have power steering in the first place.

Heating for the cabin can come from a dedicated heater running from the main battery pack. You may need a heater up to 2000 watts, depending on the climate you live in and how often you use the car in bad weather.

Driving an EV

When you drive an EV you are always conscious of the range of the vehicle. When using lead acid batteries, the Peukert effect comes into play. This effect works as follows: as you discharge current from the batteries at a certain rate, you will get a corresponding capacity in amp-hours. If you discharge at a higher rate, your available capacity drops.

Therefore, it is important to drive conservatively or design your vehicle with a higher battery voltage. Doing this means the average current draw from the batteries is low enough so that the Peukert's effect does not hinder the range of the vehicle to any great degree. The greater the current you draw, the less range you have. Low-voltage cars suffer from this a great deal and require either larger capacity batteries, which means more weight, or a lighter right foot!

Thanks to Grant Burke for the photos of his EV conversion.

Contacts and resources

Australian Electric Vehicle Association: www.aeva.asn.au
Australian Electric Vehicle Association Sydney branch: sydneyaeva.googlepages.com
Australian Electric Vehicle Association Perth branch: www.waeva.asn.au
Bylong Industries—Curtis controllers etc: www.bylongind.com.au
EV Motors Australia: www.evmotors.com.au
Wattashock—EV motors and controllers: www.wattashock.com
AC Propulsion—150kW AC drive systems: www.acpropulsion.com
Cafe Electric—Zilla controller manufacturer: www.cafeelectric.com
Electro Automotive—EV information and parts: www.electroauto.com
EV Parts USA: www.evparts.com
Thunder Sky lithium-ion batteries: www.thunder-sky.com

ReNew celebrates

ReNew and the Alternative Technology Association recently celebrated an impressive milestone—100 issues of this magazine. John Watson tells us about _ReNew 100_ open day at his place on Great Keppel Island.

Solar power's wow factor never fails to impress as *ReNew 100* open day at Beach Shack on Great Keppel Island demonstrated. We agreed to open our house because of the article about our home in issue 60, and were looking forward to hosting visitors. As we own *Spectator News Magazine* we expected other media to keep their distance, but ABC local radio's Craig Zonca interviewed us, which lasted about five minutes on a Wednesday morning. Then the wow factor really kicked in.

Our phones rang at home with inquiries from listeners. *The Morning Bulletin*, Central Queensland's daily newspaper, devoted a half-page, in colour, to the story. We were off and running, handling more phone calls. In the end, 12 people were curious enough to make the trip from the mainland to see our sun-powered beachfront family home. Steve and Rhonda Robinson made a special trip from Gracemere, which is about 80 kilometres from the harbour, caught a Freedom Fast Cat and walked about 500 metres to Beach Shack where the *ReNew* laminated sign told them they had arrived. They have a property with a liveable shed and want to use solar power. Steve took notes and phone numbers, leafed through the complimentary *ReNew* magazine and asked endless questions. Rhonda spent more of her time with Suzy and the two talked about life with bicarbonate of soda and vinegar for cleaning, which is all we use at Beach Shack; played with the Wonderwash (hand-operated washing machine); and joined the tour looking at the solar arrays, regulator, batteries and Selectronic 1200 watt sine wave inverter. Both were also interested in the 3.5kVA generator which is powered with biodiesel made from used fish shop oil.

ReNew's laminated sign on a pole in front of Beach Shack guided visitors to the open day.

Bill and Judy Hudnott from Brisbane heard of the open day while crossing Keppel Bay on Freedom Flyer. Weekend skippers Max Allen, senior and junior (father and son take it in turns), embellished a message I wrote out for them, and their talks got the Hudnotts, and others, thinking about combining the pleasure of solar with the pleasure of seeing the island as day trippers. The Hudnotts were thinking about solar panels for the grid so the chance to see what they are and what they do was too good to pass up. They knew the sun's power can save money because they installed a solar hot water system 20 years ago and it is still giving them a warm start to every day.

William Scott from Yeppoon, the coastal town directly opposite Great Keppel, used wind power to sail over with his sister, Emily, in their MG14 skiff called Windfire, after reading about the open day in our *Spectator News Magazine*. William said he wanted to look at our house because he planned to study electrical engineering at university with special emphasis on renewable energy. He's also been trying to convince his parents to put panels on their house to feed power into the grid.

Top: Steve and Rhonda Robinson and Bill and Judy Hudnott were happy with their copies of _ReNew_ when they visited the Beach Shack. Bottom: Ralf and Carol Zeller from Germany liked the fact that the Selectronic 1200 watt inverter converted (inverted?) battery power to pure 240 volts.

We extended our open day to Sunday, and Jim and Rhonda McNamara spent a great deal of time taking a look. They have a house on Kangaroo Island, about eight nautical miles off the coast of South Australia. They have mains pow-

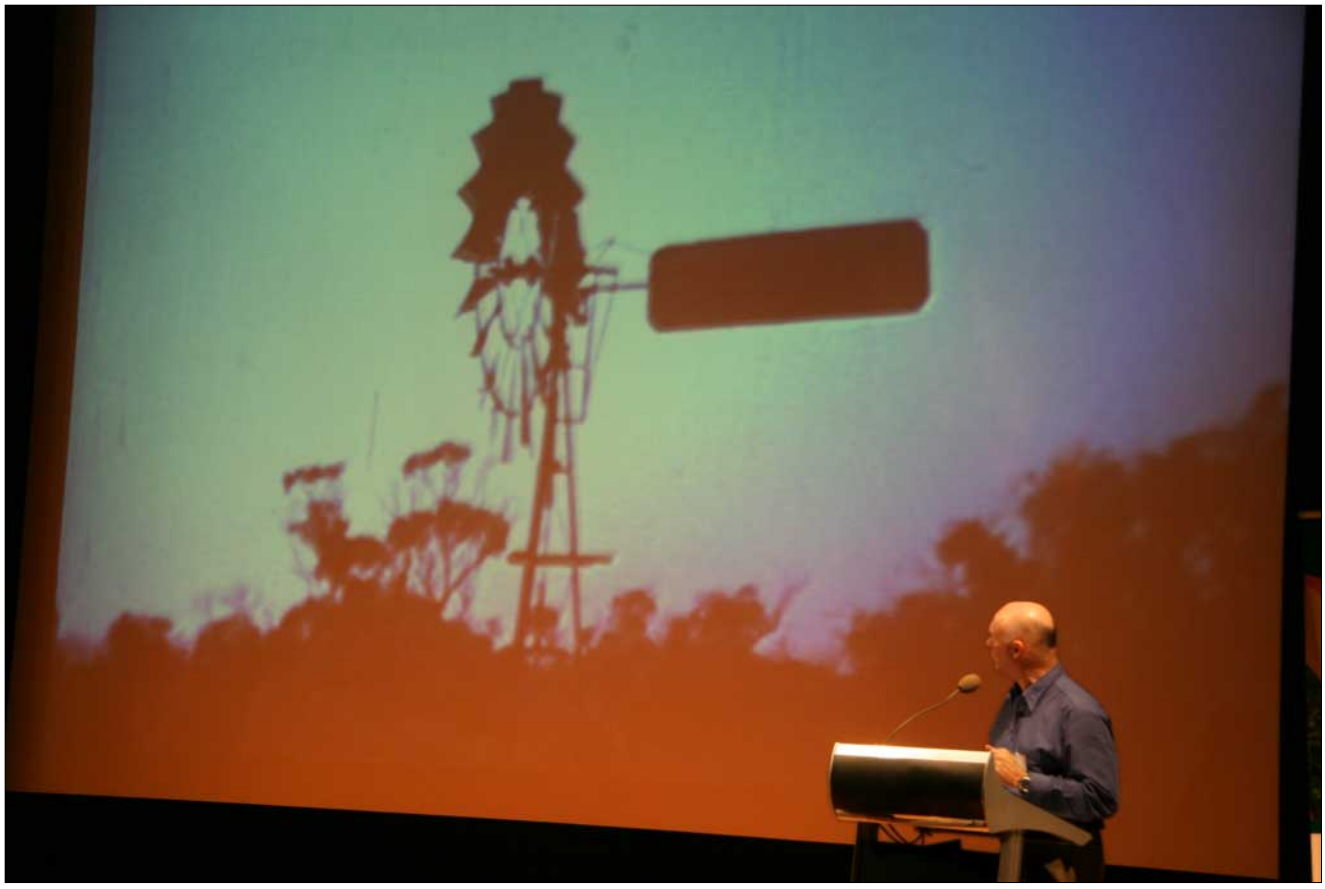


Photo by Matt Davis.

And another way to celebrate 100 issues of *ReNew*: nearly two hundred people came to the *ReNew 100* celebration night to listen to *ReNew* founder Michael Harris (pictured), anti-nuclear campaigner Helen Caldicott, economist and author Richard Denniss and *ReNew* policy columnist Alan Pears discuss what's happened in the past with renewable energy and sustainability in Australia and what might happen in the future. MC for the night was the ABC's Tim Lane. Full details and audio files: www.ata.org.au

er but want the freedom of their own system, complete with batteries.

Simon and Cathy Lavender are from Howard, a lovely little town just off the Bruce Highway near Maryborough in Queensland. They were touring with vehicle and trailer and Simon was particularly interested in refrigeration. They heard about the open day on the boat to Great Keppel on the Sunday. Simon wanted information about solar panels running a three-way fridge (gas, 240V and 12/24V). We showed him our Westinghouse 220-litre two-door fridge we bought new and modified with an Indel 12V compressor, but he was more interested in mixing gas into the equation. They were also interested in the solar arrays because they had previously bought two secondhand panels.

The final pair were German tourists Ralf and Carol Zeller who were walking along the beach when Carol spotted the *ReNew* open day sign we had on a stick. Ralf and Carol's English was better than our German (none) and they were just as interested in seeing inside an island home—the solar tour was a bonus. Ralf was quite acquainted with the technical side of the talk about regulators and batteries. They, like all other visitors, were impressed when we unveiled our 12 huge gel batteries lying on their sides in their pale blue aluminium frame. We bought the batteries from an advertisement in *ReNew* some years ago. They were part of the proceeds of the sale of One-tel's assets after the mobile phone company went belly-up. They were meant to spend their life powering an antenna on a hill somewhere, but came to Great Keppel from Western Australia. They have given wonderful service and we worry every now and again about how we will afford to replace them when they go to battery heaven.

When the Zellers left we took down the sign and spent from 4pm to sunset marvelling at the view over the bay, recalling the many wonderful people who had called for the open day, and promising ourselves to contact *ReNew* and say how much we enjoyed the experience. Both of us feel quite attached to *ReNew* and its previous incarnation, *Soft Technology,* because of the great articles, Lance Turner's technical help and every advertisement. It's eagerly devoured as it appeals to anyone living with solar or any type of alternative power.

A comprehensive overview of Mission Cove, Dunedin, NZ

Michael Laba guides us through his new home in Dunedin in New Zealand's south, a place with enough chill wind to test the insulation.

The home faces north with solar panels on the ground, protecting them from the cold wind. A solar clothes dryer is to the left, and the Windside wind turbine is to the right.

Our house was designed to make full use of the sun's natural heating abilities and to use the best insulation available at the time of construction in 2005. It goes without saying that careful consideration was given to selecting a block of land that faced due north.

The slab

Starting with the floor, we have a 200mm insulated concrete slab that acts not only as the key structural member, but is also our main passive solar heatsink. The exterior walls are precast concrete panels called Thermomass. Their construction is 150mm of reinforced concrete on the internal face, then 50mm of high-density polystyrene as insulation and a further 100mm of reinforced concrete on the external face. This three-piece-sandwiched concrete panel achieves better than R5 insulation value. The house has been designed in such a way that a complete thermal break has been achieved between outside and inside walls. This gives us a warm house in winter and a cool house on hot summer days. In fact, we have never been so comfortable, because the inside temperature range has a small differential all year round. This makes for a healthier house too. The 300mm thick external walls combined with the 200mm floor gives us a very sturdy structure, hopefully against earthquakes and our sometimes very strong south-westerly winds. Gusts can be up to 35m/s (126km/h).

All exterior aluminium joinery (windows and sliding doors) are 'thermally broken', ie. with no connection between outside and inside aluminium. They are also double-glazed, filled with argon gas and have low-E film applied to achieve a high standard of heat retention. The roof space has R4.2 polyester insulation and R2.7 Air Cell between the roofing iron and roof support beams, instead of the standard building paper.

North facing with PVs

The picture above shows the house facing north with the PVs and hot water solar panels. The bathroom is on the front left side (east) then a short hallway feeds the three bedrooms. The master bedroom is behind the bathroom. Middle right is the kitchen/dining room and laundry with the study/workroom on right side (west). The two sliding doors lead to a small deck just behind the solar panels. The 16 Unisolar US-42 electric (672W) and Apricus AP-20 (20 tube) hot water panels face due north and are inclined to maximise output between the winter and summer sun angle, in our case at approxiamately 45degrees. Integrating the solar panels into the house design and keeping them at ground level has a few advantages; they are easy to clean, there's less wind loading than if mounted on the roof, and they would otherwise obscure the rear neighbour's view.

From the photos it's easy to see how the house will capture all the winter sun, storing it in the bare concrete floor and on all internal concrete walls. Conversely, the wide eaves effectively limit the summer sun to prevent over-heating. Note our solar clothes line and one of our wind turbines, a WindSide WS-0.30c at opposite ends of the house. It goes without saying that this view faces due north.

Solar hot water

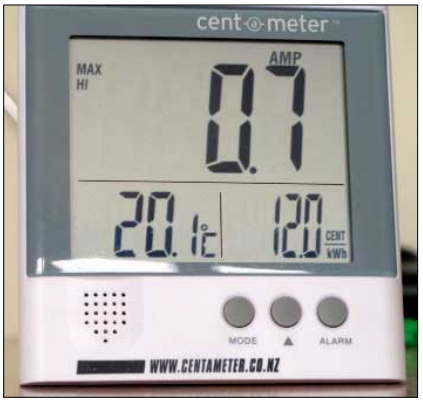
The Apricus solar hot water collector comes with an indoor controller (a Resol Delta Sol B) with display and a variable speed pump. We have a 220 litre Combo stainless steel hot water tank with a heat transfer coil. The hot water tank insulation is 50mm thick polyurethane.

Most of our hot water is generated via the transfer coil (from the wetback stove in the garage) or the solar collector when the sun is shining. A gas LPG boiler (an Ariston Ecosystem) is used to heat the house, all controlled with a 'room unit' Honeywell Smartfit controller.

The bathroom and or kitchen/living rooms are heated with water pipes embedded in the concrete floor. We used this floor heating system for only 15 days for about four hours each time in 2006 to maintain our comfort zone. Two gas storage bottles (45 litres each) are stored outside and replaced as required. A visual display on the mixer valve shows red when one bottle is empty, then we phone the supplier for a replacement. The gas boiler is housed in the garage and two well insulated water pipes run from the garage (flow and return) underground to the house into our valve/control system.

Mains power for our house can be from either the national grid or from our own battery supply. If the sun and wind have been unavailable for a few days we have the option of switching over to grid power. This convenience comes at a small extra cost, but this is

The kitchen bench lit with seven 1 watt LEDs. All the LED mounting hardware and accompanying power supplies were constructed by Michael because no stock items were available at the time of construction.



Top: This controller can set temperatures in the storage tank and in the main living area, offering up to three on and off times per day.
Bottom: A Cent-a-metre gives a constant readout of how much power the house is using. In the photo it is reading 0.7 of an amp with an indoor temperature of 20.1 degrees.

cheap insurance. Otherwise we would need a petrol/diesel generator to charge our batteries. Our power company offers us a reduction in line charges because we are considered a low user, but all power used is at a slightly higher charge out rate. Our average monthly electric power bill is about $25, and the LPG is averaging about $60 per month.

Both charges will be significantly less this year because our solar panels (PV and hot water) plus our wind turbines only came on stream in May last year.

Having a Cent-a-meter instrument gives us a constant read out of what power the house is using. It's great for instant feedback.

Cooking with gas

Our Miele G2830 SCi dishwasher and our Miele W 2653 WPS washing machine both have a unique program allowing us to use our own hot water instead of heating the cold water with electric power. Cooking is with gas on a Bosch four-burner hob and a Parmco gas oven. We also have a small half-size electric oven. This electric oven is only used when we are on grid power. For cold storage we have a low energy fridge/freezer called the Gram KF320. Our microwave oven is a Bosch HMT 9656AU; it can be used sparingly depending on our battery's state of charge. The same goes for the Nilfisk X100 vacuum cleaner.

Lots of LEDs

Lighting is a combination of LEDs and two types of compact fluorescents. In the bedrooms we use standard compact fluorescent lamps, and in the living/kitchen area and study room we use Megaman downlights GU10. Rated power consumption of these lamps is 11 watts, with a light output equivalent to a 50-watt standard lamp. They're not cheap, but these lamps boast a life of 15,000 hours. Eight of these lamps are mounted in the ceiling as downlights.

In the east hallway (servicing the path between bedrooms and bathroom) we have a ceiling mounted 360 degree infrared sensor (PDL 100CF360) and six one watt LEDs set to automatically switch on, illuminating the floor after dusk. This is a very useful feature and I wish I had planned for more of this combination around the house.

A roof for the sea air

The roof is zincalume, well suited to New Zealand conditions and salt sea air. The corrugated look is synonymous with New Zealand and Australia's pioneering past, something that we have always liked. The clean, low profile roofline with no chimney flues provides the least obstruction for the neighbour's harbour vistas.

Water aplenty ... for now

Water supply is not an issue yet in Dunedin, but I think that water meters will be fitted to every house soon, and it is

Top: The house under construction with a view over Company Bay. Bottom: The one mature native tree on the property (called a Rata, top right side of photo) flowered profusely last year for the first time, attracting two types of New Zealand native birds (the Tuis and Bellbirds). Note the two wind generators (second one on garage) and the weather station on the left side of the house roof. Harnessing the wind with the generators is a challenge, balancing visual size and noise against maximising power output. A high priority is to keep the neighbours happy on both counts. These generators are used for charging the battery bank.

predicted that the South Island of New Zealand will become drier with global warming. So with this in mind, and trying to conserve the precious liquid, we collect some rainwater, storing it in a 1800 litre tank, which is solely used for flushing both toilets. The low-pressure gravity system works very well and we have not yet run out of tank water, even with all the functions and parties we have had. Our toilet flushing pans are a minimum water use type.

The satellite dish has a small motor enabling us to lock onto five satellites offering some 60-odd stations, although one third of these are in foreign languages. Most of these channels are free to air. We really enjoy the two Australian stations that we get—SBS and Channel 7, with SBS offering some excellent ethnic films and documentaries. New Zealand TV stations are received with the standard aerial system.

The hub

All of our electronic alternative energy hardware is housed in the garage, including the solar regulator (Outback MX-60), the inverter (SEA 230V 1800W sine wave), a 24V DC battery system using 12 Sonnenschein batteries at 750Ah. Wind turbines are an Air 24V 400W at 12.5 m/s, plus a Windside model WS 0.30 with maximum output of 120W. We also have two analogue meters to monitor (mains) AC current and voltage. Grid AC voltage in New Zealand is 230 volts at 50 Hz.

Native Kiwi landscaping

The rock walls at the back of the house have just been completed and planted with New Zealand native shrubs, which we hope one day will attract more native birds. Note how the two bedroom windows sit just above ground level, giving them a very quiet ambience inside, especially when the weather is nasty outside.

The one mature native tree on our property (called a Rata) flowered profusely (bright red) last year for the first time, attracting two types of New Zealand native birds. It was great to see and hear the Tuis and Bellbirds.

After living in our house for over one year we have found it more than lives up to our expectations for keeping us warm. Builders say that after two more years the concrete floor will dry out even more, slightly increasing the indoor temperature. I still have some fine-tuning to do on our alternative power systems. This might mean adding more solar panels and replacing one wind turbine with a higher output model. Other than that we just have the landscaping to finish.

Contact Michael Laba by email at mikeedith@clear.net.nz

Solar panel buyers guide

There are many solar panels on the market, but which one is suitable for your needs? Lance Turner takes a look at the options.

This buyers guide covers photovoltaic panels, which produce electricity directly from sunlight to power houses (on and off the mains grid), water pumps, and remote communications systems.

In its most common form, a solar panel consists of a number of photovoltaic cells connected together. These cells are usually coated in a plastic such as ethylene vinyl acetate (EVA) and sandwiched between layers of glass and/or plastic, or sometimes plastic and metal. The collection of cells is usually surrounded by a metal or plastic frame for strength and to allow easy mounting of the panel. A junction box is often mounted on the back of the panel to allow easy electrical connection, though some panels have flying leads for connection.

Where glass is used as a covering for solar panels, it is usually low-iron glass, to allow as much light transmission as possible, thus maximising power output.

Many panels have glass on the front and a plastic, such as Tedlar, on the back to seal the panel. There are also panels that are designed to replace windows and other glass panels in architectural uses, and they may have glass on both sides of the cells, depending on their intended use. This allows the home owner to offset some of the cost of the solar panels, as the panels themselves double as building materials. The PV Solar Energy roof tiles and some of the ASI series panels from RWE Schott Solar fall into this category.

PV applications

Most other solar panels are designed to be mounted on external frames, themselves mounted to a building's roof or other frame, such as a solar tracker, but there are also flexible stick-on panels that can simply be stuck to suitable roofs or structures.

The different technologies

There are three common types of solar cells: monocrystalline, polycrystalline and thin film.

Both mono and polycrystalline cells are made from wafers cut from blocks of silicon, which are then modified by a process known as 'doping'. This involves heating the cells in the presence of boron and phosphorus, which changes the structure of the silicon in such a way as to make it a semiconductor. This is the same method which is used to make computer chips.

Once the wafers have been doped, they then have a fine array of electrically conductive current-collecting wires applied to each side of them.

Thin film technology uses a different technique, and involves the deposition of layers of different materials directly onto metal or glass. The most common thin-film panels are the amorphous silicon type, which are found everywhere from watches and calculators right through to large mains-grid connected PV arrays.

Flexible panels are a spinoff of amorphous technology. These are manufactured on a plastic or thin metal substrate and can be rolled up or attached to curved surfaces. They are commonly used for camping and boating, but are generally quite expensive on a dollar-per-watt basis, although larger ones designed for mounting on buildings are competitive with conventional rigid panels.

As far as material use is concerned, crystalline panels use a great deal more semiconductor material than an equivalent output thin film panel. This is because a lot of material is lost in the

process of cutting the silicon boule or billet into slices (wafers). The cutting is done with a diamond saw, which may well have a blade thicker than the resulting wafers, so more than half of the silicon may be lost in this process.

Amorphous panels don't have this problem and so may use less than 1% of the semiconductor material as a crystalline panel. An example is the Kaneka thin film modules. These have an active material thickness of just 0.3 micrometres. Compared to a typical crystalline cell thickness of 100 to 200µM, this is as little as 1/600th of the silicon, and that doesn't take into account the silicon wasted by the cutting process for crystalline cells.

Why is silicon use such an issue? There are two reasons. The first is the embodied energy of the silicon—it takes a lot of energy to make the highly-purified silicon used in solar panels. The second is the fact that high-grade silicon suitable for this sort of use is often in short supply due to the demand for it in both solar cells and integrated circuits, which keeps the price higher than it should be. The miniscule amount of silicon used in thin film panels should allow them to be more cost effective, and you have to wonder why this isn't the case at the moment, although the high demand for solar panels in general most likely has a lot to do with it!

Panel ratings

There are a number of different ratings on solar panels, so let's have a look at what they are and what they mean.

Rated (peak) power: This is the maximum sustained power output of the panel, assuming a level of insolation (strength of light falling on the panel) of one kilowatt per square metre. In general, the solar panel's rating is the rated peak power.

Nominal voltage (Vn): The system voltage that the panel is designed to be used in. A 12 volt panel is designed for a 12 volt system, but will produce voltages well above 12 volts. Some panels can be rewired to suit six or 24 volt systems. Other panels are designed for

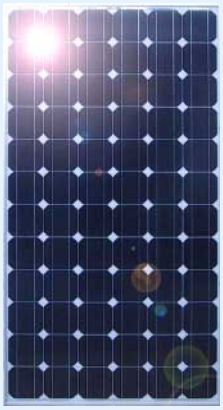
Solar panel types

There are three common technologies used in solar panels, all of which are based on the common element silicon, which makes up a large proportion of the earth. Note that the panels below are not shown to scale.

Monocrystalline cells are made from a thin slice or wafer cut from a single large crystal of silicon. The cells are then doped and the fine current collecting wires printed on or in the surface of the cell.

Generally monocrystalline cells have the highest efficiency, but this comes at a price. This type of cell takes more energy to make than any other, and so has a greater energy payback period, though this is usually still within five years.

A number of manufacturers make monocrystalline panels, including BP Solar and Sharp Solar.



Polycrystalline cells are made from thin wafers of silicon cut from a large cast billet. The billet is not a large single crystal, but many crystals clumped together, hence the name.

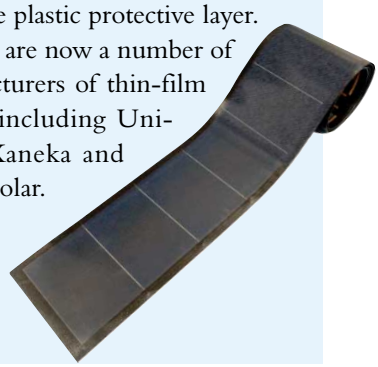
Polycrystalline cells are usually slightly less efficient than moncrystalline cells, but because they are square, can be fitted into the rectangular frame of a solar panel with high space efficiency, although polycrystalline panels are still slightly larger than monocrystalline panels of the same rating. Polycrystalline cells must also have current collecting grids printed onto them.

Kyocera panels use this cell technology, as do many other panels.

Amorphous/thin film panels involve deposition of very thin films of silicon or other materials directly onto a substrate such as glass or stainless steel. This technique produces a cell with a lower efficiency than the cut wafer varieties, but has the advantage of eliminating the need for inter-cell connections.

Uni-Solar makes triple-junction, nine-layer thin-film amorphous panels with a much higher efficiency than the older types. The layers of silicon are deposited directly onto a stainless steel substrate and are then coated in a flexible plastic protective layer.

There are now a number of manufacturers of thin-film panels, including Uni-Solar, Kaneka and Schott Solar.



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The future of advanced energy solutions starts with SCHOTT today.

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grid-interactive systems, and have nominal outputs of 48 volts or even higher.

Voltage at peak power (Vp): This is the voltage measured across the panel when the panel is producing peak power.

Current at maximum power (Im): The maximum current available from the panel at peak power.

Open circuit voltage (Voc): The maximum voltage available from the panel with no load attached. This is usually around 21 volts for a 36 cell, 12 volt unit.

Short circuit current (Isc): The current obtained when the output of the panel is short circuited with an insolation level of 1000 watts per square metre at a panel temperature of 25°C.

Temperature at rated power: This is the temperature that the solar panel manufacturer rates their panels at. Most panels are rated to put out their maximum power at 25°C, which is a rather unrealistic figure given that the panel temperature under typical Australian conditions can be up to 70°C. Figure 1 shows how cell temperature affects power output for crystalline panels.

Current-voltage (IV) curves: These are graphs of output voltage versus current for different levels of insolation and temperature. They can tell you a lot about a panel's ability to cope with temperature increases, as well as performance on overcast days. Examples of IV curves can be seen in Figure 1.

Obviously, the most important ratings when doing calculations for a power system are the voltage and current at maximum power. A system is rarely calculated using panel wattage ratings, as this is a function of both the voltage and current. Some panels are rated at slightly higher or lower voltages than others, and this affects the amount of current available.

The open circuit voltage and short circuit current ratings are important from a safety point of view, especially

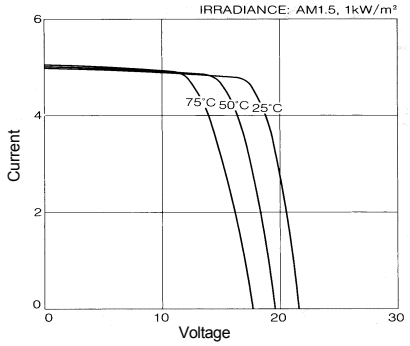


Figure 1. These curves, for a typical 80 watt polycrystalline panel, show how power output is affected by increasing temperature. This needs to be taken into account when buying panels.

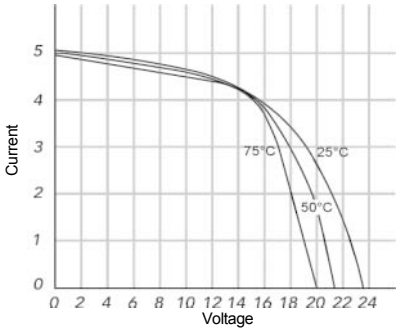


Figure 2. The IV curves for a 64 watt amorphous panel. Note how the maximum power point at the knee of the curves barely moves with increasing temperature.

the voltage rating. An array of six panels in series, while having a nominal 72 volt rating, can output over 120 volts DC—more than enough to be dangerous.

Self-regulating panels

There has been much debate about self-regulating panels over the years. Self-regulating panels have fewer cells, and hence less output voltage, than normal ones—typically 32 cells instead of the 36 found in most 12 volt panels. Basically, a self-regulating panel will not give the performance under all conditions that a panel with higher voltage will.

A self-regulating panel will often not have enough voltage to allow for drops in the wiring and regulator, so they rarely run at their peak power point. Also, because of their reduced voltage, performance will suffer on overcast days.

Some manufacturers claim that no regulator is required with these panels. This is wrong in most cases, as even a self-regulating panel can bring a battery voltage up to 17 volts or so, which is clearly overcharging it. The only situation where you may be able to use a self-regulating panel without a regulator is when it is attached to a large battery and is only being used to keep the battery topped up.

Heat and shading

These are two factors that can greatly affect solar panel performance. In general, solar panel performance decreases as temperature increases, and a panel rated at 25°C will not perform as well when operating at the temperatures experienced in most parts of Australia. A typical operating temperature in summer can be up to 60°C or higher.

Some companies also supply ratings for temperatures higher than 25°C, so check to see whether these are available. Also bear in mind that, generally, thin film panels perform better when hot than crystalline panels do, and in many cases a thin film panel will perform as well or better than a crystalline panel which is rated at up to 10% higher wattage. For example, a Uni-Solar 64 watt panel will often perform as well as a 70 watt crystalline unit on an 'overall energy produced per year' basis.

Shading affects different panels in different ways. The reduction in performance of the crystalline panel types, even when a single cell from a panel is shaded, is quite considerable.

Amorphous panels often perform somewhat better, especially panels which have bypass diodes built into each cell. Also, because amorphous panels usually

have cells that are long and thin, they are less likely to have individual cells fully shaded by birds and debris buildup.

However, shade falling on the panels should be eliminated if at all possible—there is not much point investing large amounts of money in power generating equipment if you don't allow it to do its job!

Embodied energy

This is the amount of energy required to produce the panel in the first place and includes all energy used to make every part of the panel, including cells, frame, cable or junction box and assembly. Some panels, especially the thin-film units, will repay their energy 'debt' within a year or two, while others, especially monocrystalline panels, take a lot longer—up to five or six years. However, all panels on the market will produce more energy than they use over their lifetime, if installed and used correctly.

What to look for

You need to buy a panel that has the correct ratings in both voltage and current, with consideration given to their performance as determined by their IV curve. You also need to look for a few other things when buying, such as construction quality, frame type and panel shape and weight. Some panels may be more suited to your roof shape than others, especially when used on small buildings such as sheds or outdoor toilets.

Panel quality is very important. Many of the small amorphous panels manufactured in Asia are of variable quality—some last many years, others die a quick death—so be wary of these.

Any solar panel worth buying will come with quite a long warranty. If the manufacturer doesn't have enough faith in their product to offer a good warranty, then why would you buy it? Most panels come with a warranty of at least five years, and some warranties are up to 25 years. We have chosen not to include any panel with less than a two-year warranty in this guide.

Warranties come in different forms. Some are just a power output warranty but don't cover things like construction quality, while others are a bit more comprehensive. Ask questions before you hand over any money.

Another factor is whether the panels are made locally. As far as we know, BP Solar, Conergy and PV Solar Energy are currently the only local solar panel manufacturers. Origin Energy is working on their Sliver cells, but they are not yet available.

About this buyers guide

ReNew buyers guides are intended to provide general information about the types of devices available on the Australian market. They are not intended to be a Choice magazine style testing review of each device, as we do not have the resources to test each make and model available.

ReNew does not endorse any particular device over other similar units, and the appearance of information and photos of particular products should not be seen as a promotion of that device over any other.

About the table

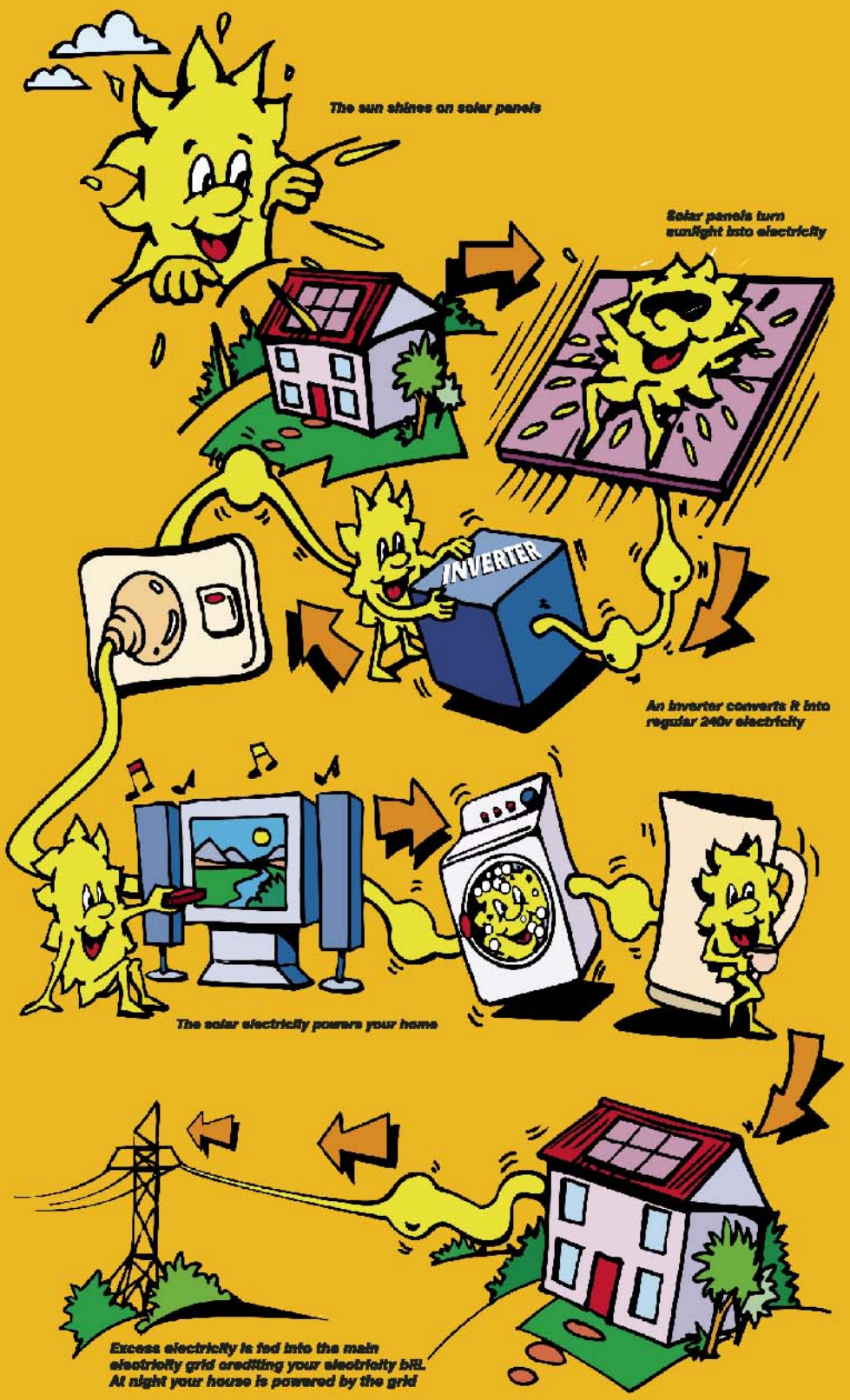
The table in this article lists all of the panels suitable for solar power systems that we were able to find. It includes all of the important information, including maximum power voltage and current (usually rated at 25°C) cell type, and panel construction and dimensions, including weight. Also included are recommended retail prices including GST, and the cost of each panel in dollars per watt. However, prices should be taken with a grain of salt. Many dealers will offer panels at lower cost, so don't settle for the first price you are given—ring around! ✶

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which maximum power is tested at	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
BP Solar (Hong Kong) BP Solar Australia ph:1800 802 762 www.bpsolar.com.au	HX 2M	2	16	0.135	Polycrystalline	25, corrected	Glass, EVA, Polyester	275 x 145 x 23	0.5	12, 2	103.00	51.50	2 to 4 for complete system, less for module only	25+	Envirocashback of 50 cents per watt available on all systems greater than 115W in power. Ask your BP Solar retailer for details and pricing.
	HX5M 6V	5	16.5	0.57				269 x 251 x 23	0.8		147.00	29.40			
	SX305M	5	16.5	0.3				269 x 251 x 23	0.8		126.00	25.20			
	SX310M	10	16.8	0.6				421 x 269 x 23	1.5		183.00	18.30			
	HX10M 6V	10	16.8	0.6				421 x 269 x 23	1.6		225.00	22.50			
	SX320M	20	16.8	1.2				501 x 421 x 23	2.5		304.00	15.20			
	SX320J	20	16.8	1.2				502 x 424 x 50	3		304.00	15.20			
	SX330J	30	16.8	1.8				594 x 502 x 50	3.9		378.00	12.60			
	BP 340J	40	17.3	2.3				655 x 537 x 50	5.75		488.00	12.20			
	BP 350J	50	17.3	2.9				839 x 537 x 50	6		572.00	11.44			
	BP 365J	65	17.6	3.7				1111 x 502 x 50	7.2		740.00	11.38			
	BP 380J	80	17.6	4.55				1209 x 537 x 50	7.7	25, 12, 5	840.00	10.50			
BP Solar (Australia) BP Solar Australia ph:1800 802 762 www.bpsolar.com.au	BP 3125J	125	17.3	7.23				1510 x 674 x 50	12		1295.00	10.36			
	BP 3125S	125	17.3	7.23				1510 x 674 x 50	12		1295.00	10.36			
	BP 3165S	165	35.1	4.6				1593 x 790 x 50	15.4		1639.00	9.93			
	BP 3165J	165	35.1	4.6				1593 x 790 x 50	15.4		1639.00	9.93			

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which maximum power is tested at	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP Inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
Conergy (Australia) Conergy Pty Ltd ph:1300 551 303 www.conergy.com.au	Solar-Port SP100-12	100	17	6	Polycrystalline	25	EVA embedded cells, tempered glass, satin finished marine grade aluminium	1080 x 870 x 35 (open) 565 x 870 x 75 (closed)	15	5	1430.00	14.30			Portable solar power suitcase.
Conergy (China) Conergy Pty Ltd ph:1300 551 303 www.conergy.com.au	JM 030	30	18	1.77	Polycrystalline	25	EVA embedded cells, tempered glass, aluminium frame	666 x 412 x 33	3.6	25, 12, 5	374.00	12.46			Fly lead.
	Q 130 MI	130	17.5	7.43	Monocrystalline			1482 x 676 x 35	12		1430.00	11			MC IV connection.
	S 170 M	170	35.6	4.8				1580 x 808 x 35	15.5		1782.00	10.5			
	SC 170 MA	170	35.5	4.79				1575 x 826 x 46	16.3	25, 5	1782.00	10.5			MC III connection.
	S 175 M	175	35.8	4.9				1580 x 808 x 35	15.5	25, 12, 5	1804.00	10.3			MC IV connection.
	SC 175 MA	175	36	4.86				1575 x 826 x 46	16.3	25, 5	1804.00	10.3			MC III connection.
Conergy (India) Conergy Pty Ltd ph:1300 551 303 www.conergy.com.au	Q 5 P	5	16.5	0.31	Polycrystalline	25	EVA embedded cells, tempered glass, anti-reflective coating, aluminium frame	300 x 185 x 22	0.7	25, 10, 5	77.00	15.4			J Box connection.
	Q 10 P	10	16.5	0.91				385 x 340 x 22	2.2		148.50	14.85			
	Q 20 PA	20	16.5	1.22				500 x 340 x 22	2		264.00	13.2			
Conergy (Japan) Conergy Pty Ltd ph:1300 551 303 www.conergy.com.au	C 125 PI	125	17.2	7.3	Polycrystalline	25	EVA embedded cells, tempered glass, anti-reflective coating, aluminium frame	1499 x 662 x 46	14	25, 2	1375.00	11			MC III connection.
	C 167 P	167	34.6	4.83				1575 x 826 x 46	17		1749.00	10.4			
	C 175 M	175	35.4	4.95	Monocrystalline			1575 x 826 x 46	17		1804.00	10.3			
GE Energy (USA) Solar Sales Pty Ltd ph:(08) 9477 5888 sales@solarsales.com.au www.solarsales.com.au	GEPV-200	200	27.1	7.4	Polycrystalline	25	Glass, EVA, Tedlar	1485 x 981 x 35	17.7	25	1732.00	8.66			
	GEPVc-170-ms	170	36.5	4.65	Monocrystalline			1588 x 796 x 35	14.6		1470.00	8.65			
	GEPV85	85	18.4	4.8				1201 x 483 x 35	8.2		972.00	11.44			
Jaiwei (China) Solar Sales Pty Ltd ph:(08) 9477 5888 sales@solarsales.com.au www.solarsales.com.au	JW-GO100	10	16.5	0.61	Polycrystalline	25	Glass, EVA, Tedlar	435x265x26	20.6	25	$80.00	8.00			
	JW-G1700	170	36.5	4.41	Monocrystalline	25	Glass, EVA, Tedlar	1576x798x35	16.5	25	$1,250.00	7.35			IEC 61215.
Kaneka (Japan) Solar Shop 155 Payneham Road St Peters SA 5059 ph:(08) 8362 9992 sa@solarshop.com.au www.solarshop.com.au	GEB	60	67	0.9	Amorphous		5mm glass/Tedlar/ aluminium frame	950 x 960 x 40	13.9	25	583.00	9.72	1.6	Same as for crystalline	Rated at +10%/-5%. Better temperature coefficient than crystalline. Excellent shade tolerance.
	PLC	13	16.5	0.79				495 x 465 x 38	2.9	10	180.00	13.85			Electric fences, gates, pond pumps, automotive battery maintenance, etc.
	PLD	26	16.5	1.58				950 x 465 x 38	5.5		300.00	11.54			A good panel for telemetry and irrigation systems.
	PLE	50	16.5	3.03				952 x 920 x 38	13.5		565.00	11.30			Good for campers and boaters.
Kyocera Solar (Japan) Kyocera Solar www.kyocerasolar.com.au	KC200GT	200	32.9	8.21	Polycrystalline	25	Cells are encapsulated between tempered glass cover and an EVA pottant with back sheet.	1425 x 990 x 36	18.5	20	2171.00	10.86	<1.5 years when installed in Japan. Less in Australia.	25+	Grid tie module.
	KC175GT	175	29.2	8.09				1290 x 990 x 36	16		1900.00	10.86			
	KC130GT	130	21.9	8.02				1425 x 652 x 36	12.2		1411.00	10.85			
	KC130TM	130	21.9	8.02				1452 x 652 x 56	11.9		1411.00	10.85			
	KC85T	87	21.7	5.34				1007 x 652 x 56	8.3		992.00	11.40			
	KC65T	65	21.7	3.99				751 x 652 x 56	6		774.00	11.91			
	KC50T	50	21.7	3.31				640 x 652 x 54	5		596.00	11.92			
	KC40T	43	21.7	2.65				526 x 652 x 54	4.5		528.00	12.28			
Mitsubishi Heavy Ind. (Japan) Ecosouth Solar Electricity ph:(08) 8371 5655 info@ecosouth.com.au www.ecosouth.com.au	MA-100	100	108	0.93	Amorphous	25	Glass, EVA, Tedlar	1412 x 1112 x 35	21	20	785.00	7.85	2.1	30+	Four parallel fly-leads for connection. Grid-connect. Stand-alone supply with suitable regulator.
Powertech (China) Jaycar Electronics ph:1800 022 888 techstore@jaycar.com.au www.jaycar.com.au	ZM-9073	10	21	0.66	Polycrystaline		Aluminium frame with tempered glass.	406 x 286 x 23	1.5	20 year performance	149.00	$14.90	Variable - Depends on climate and usage	25+	-
	ZM-9074	20		1.4				651 x 296 x 23	2.4		$239.00	$11.95			
	ZM-9076	65		4.7				1217 x 546 x 35	8.5		$549.00	$8.45			
	ZM-9078	80	21.6	4.9				1217 x 546 x 35	8.5		$699.00	$8.74			
	ZM-9079	120	22.2	7.37				1494 x 678 x 35	12		$1,050.00	$8.75			
PV Solar Tile (Australia) ph:(02) 9558 0512 info@pvsolar.com.au www.pvsolartiles.com	PVST 167	167	34	4.9	Poly	~50	Powder coated aluminium, Santoprene sealing and UV resistant plastic.	~1600 x 870 x 15	18	Manufacturers warranty on PV component. Frame warranty 15 years	POA	-	2-3 years	30+	Available with a range of PV brands and sizes – see web site.
	PVST 175	175	34	5.15	Mono										
	PVST 85	85	17	5				~1200 x 600 x 15	9						

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which maximum power is tested at	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP Inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
SCHOTT Solar (Germany) SCHOTT Australia Pty Ltd Unit 1, 9 Rodborough Road NSW 2086, Frenchs Forest Ph:(02) 8426 1607 www.schott.com/solar and Going Solar ph:(03) 9348 1000 retail@goingsolar.com.au www.goingsolar.com.au	ASE-165-GT-FT/MC	170	36	4.71	Polycrystalline	47	Glass, Tedlar, aluminium frame, thermoplastic cell embedding	1620 x 810 x 50	15.5	25	1500.00	8.82	4.7	25+	
	ASE-165-GT-FT/MCI	169	36	4.7		NA					1491.00	8.82			New product with MAIN isotext cells (MCI), available from October 2007. Specifications subject to change with increased performance, evaluation of NOCT in progress.
	ASE-165-GT-FT/MCI	173	36	4.81							1526.00	8.82			
	ASE-220-GT-FT/MCI	≈220	≈30	≈7.33	Polycrystalline	NA	Glass, Tedlar, aluminium frame, thermoplastic cell embedding	1685 x 993 x 50	≈20	25	1940.00	8.82	4.7	25+	As above, but available from April 2008.
	ASE-260-DG-FT	260	57.1	4.55	Polycrystalline (EFG)			1605 x 1336 x 50			2314.00				Double-glass modules, using energy-saving cell manufacturing technology.
	ASE-260-DG-FT	268	57.2	4.69							2385.00				
	ASE-275-DG-FT/MC	275	59.1	4.65	Polycrystalline	45	Double-glass, aluminium frame,	1605 x 1336 x 50.8	41	25	2450.00	8.91	4.7	25+	Suitable for ground-based arrays in tough environments.
	ASE-275-DG-FT/MC	285	59.7	4.77							2540.00				
	ASE-300-DG-FT/MCI	≈300	≈40	≈7.33	Polycrystalline	NA	Double-glass module	1685 x 1313 x 50	≈42	25	≈2700.00	8.91	3.7	25+	New product, available from August 2008. Specifications subject to change with increased performance, evaluation of NOCT in progress.
	ASI-F 32/12	39.3/32.2	16.8	1.92	Amorphous thin-film	49	Encapsulated, framed	1005 x 605 x 34	6.2	20	300.00	9.32	2.5	20+	Wp indicated is initial/stabilised.
	ASI-F 90	106/86	17.8/16.8	5.9/5.12		NA		1108 x 1308 x 50	19		780.00	9.06			Evaluation of initial power and NOCT in progress.
	ASITHRU-30-SG	33/27	36	0.75	Amorphous thin-film	49	Double glass with PVB foil	1000 x 600 x 10/22	14	20	430.00	15.92	2.5	20+	Wp indicated is initial/stabilised.Thickness of module is without/with connector button.
	ASIOPAK-30-SG	39.3/32.2		0.89				1000 x 600 x 10/22	14		390.00	12.11			
	ASIOPAK-1-L	35/29	68	0.43	Amorphous thin-film	49	Laminate	1027 x 627 x 17	27	20	Prices on application.		2.5	20+	These products are building-integrated photovoltaics on architectural glass. ASI-Glass is available in a range of specifications, dimensions and designs. Used for external façade and overhead glazing.
	ASITHRU-1-L	31/25		0.37				1027 x 627 x 17	27						
	ASITHRU-1-IO	31/25		0.37			Double glazing	1018 x 624 x 34	29						
	ASIOPAK-2-L	71/58		0.85			Laminate	1027 x 1204 x 17	54						
	ASITHRU-2-L	61/50		0.74				1027 x 1204 x 17	54						
	ASITHRU-2-IO	61/50		0.74			Double glazing	1018 x 1201 x 34	57						
	ASIOPAK-3-L	106/87		1.28			Laminate	1027 x 1781 x 17	80						
	ASITHRU-3-L	92/75		1.11				1027 x 1781 x 17	80						
	ASITHRU-3-IO	92/75		1.11			Double glazing	1018 x 1777x34	84						
	ASIOPAK-4-L	141/116		1.71			Laminate	1027 x 2358 x 17	106						
	ASITHRU-4-L	122/100		1.48				1027 x 2358 x 17	106						
	ASITHRU-4-IO	122/100		1.48			Double glazing	1018 x 2354 x 34	112						
	ASIOPAK-4x-L	140/114	72	1.59			Laminate	1204 x 2004 x 17	105						
	ASITHRU-4x-L	117/96		1.33				1204 x 2004 x 17	105						
	ASITHRU-4x-IO	117/96		1.33			Double glazing	1195 x 2001 x 34	112						
Sharp (Japan) Sharp Australia ph:1300 13 55 30 www.sharp.net.au	NTR5E3E	175	35.4	4.95	Monocrystalline	25	Tempered glass laminate, box section aluminium frame. Lead wire with MC connectors.	1575 x 826 x 46	17	25	1490.00	8.51			13.5% module efficiency. Lead wire with MC connector. PET backing sheet.
	NEQ7E3E	167	34.6	4.77	Polycrystalline			1575 x 826 x 46							
	NDL3EJE	123	17.2	7.16			As above with junction box.	1499 x 662 x 46							
	NE80EJE	80	17.1	4.67				1200 x 537 x 46	9.5		720.00	9.00			12.6% module conversion efficiency. Nominal 12 volt output. Fitted with junction box. PET backing sheet.
SunPower (China) Solar Sales Pty Ltd ph:(08) 9477 5888 sales@solarsales.com.au www.solarsales.com.au	SPR-090	90	17.7	5.1	Monocrystalline	25	Glass/Tedlar.	1038 x 527 x 46	7.4	25	1083.00	12.03	-	40	Area efficiency of 16.5%.
	SPR-200	200	40	5				1559 x 798 x 46	16		2463.00	12.32			Area efficiency of 16.1%. All black.
	SPR-210	210	40	5.25				1559 x 798 x 46	16		2498.00	11.90			Area efficiency of 16.9%.
Suntech (China) Solar Sales Pty Ltd ph:(08) 9477 5888 sales@solarsales.com.au www.solarsales.com.au	STP010s-12	10	17.2	0.58	Monocrystalline	25	Glass, EVA, Tedlar	310 x 368 x 18	1.5	25	155.10	15.51	-	-	-
	STP020s-12	20	16.8	1.19				656 x 306 x 18	2.5		282.70	14.14			
	STP040S-12	40	17.2	2.32				537 x 665 x 30	4.5		536.80	13.42			
	STP060-12	60	17.4	3.45				771 x 665 x 30	6.2		790.90	13.18			
Uni-Solar (USA) ARRID Ph: 1300 663 563 sales@arrid.com.au www.arrid.com.au	US-5	5	16.5	0.3	Amorphous	25	Framed module.	491 x 206 x 47	1.1	10	119.00	23.80	1.5	20	Non glass construction, virtually unbreakable. Better hot weather performance compared to crystalline modules.
	US-11	10.3	16.5	0.62				491 x 383 x 47	1.6		219.00	21.26	1.5	20	Ideal for battery charging. Bypass diodes between each cell to enhance performance in part shade. Better hot weather performance compared to crystalline modules.
	US-64	64	16.5	3.88				1366 x 741 x 47	9.2		640.00	10.00	1.5	40	
	ES-62T	62	15	4.1				1258 x 793 x 39	10.9		700.00	11.29	1.5	40	Ideal as grid interactive panels supplied with quick connections. Fewer cells than US series.
	ES-124	124	30	4.1				2459 x 793 x 32	20.5		1250.00	10.08	1.5	40	
	PVL-68	68	16.5	4.13			Adhesive laminate.	2849 x 394 x 2.5	4.1	20	700.00	10.29	1.5	40	Non glass construction, virtually unbreakable. Better hot weather performance compared to other modules. Must be applied by Uni-Solar approved installation technician.
	PVL-136	136	33	4.13				5486 x 394 x 2.5	7.7		1290.00	9.49	1.5	40	
	UNI-PAC 10 12V	10.5	17.6	0.6			Cells sewn into nylon fabric.	1168 x 495 x 2.5	0.95	5	690.00	65.71	1.5	8	Non glass construction, virtually unbreakable. Better hot weather performance compared to other modules.
	UNI-PAC 10 24V	10.5	35.2	0.3				1168 x 495 x 2.5	0.95		690.00	65.71	1.5	8	
	UNI-PAC15	15.8	17.6	0.9				1207 x 711 x 2.5	1.5		990.00	62.66	1.5	8	
	UNI-PAC 34	34	17.6	1.9				1473 x 845 x 2.5	2.1		1220.00	35.88	1.5	8	
USG Energy (India) NENSYS New Energy Systems, Ph: 1300 660 735 sales@nensys.com.au www.nensys.com.au	U5-5	5	17.5	0.29	Monocrystalline	25	Glass/Tedlar	405 x 175 x 22	0.9	15	72.60	14.52	-	20	High efficiency monocrystalline solar cells. Certified to IEC61215, ISO9001:2000. Some models will be assembled in Australia.
	U5-10	10	17.5	0.57				430 x 255 x 22	1.3		123.20	12.32			
	U5-25	25	17.4	1.43				550 x 449 x 35	3.4	20	267.30	10.69		33	
	U5-40	40	17.5	2.28				635 x 550 x 35	4.4		391.60	9.79			
	U5-50	50	17.4	2.83				1014 x 406 x 35	4.8		471.90	9.44			
	U6-50	50	17.1	2.92				1298 x 329 x 35	5.7		479.60	9.59			
	U5-75	75	17.4	4.28				1205 x 535 x 35	7.4		675.40	9.01			
	U5-80	80	17.5	4.57				1205 x 535 x 35	7.4	25	698.50	8.73			
	U6-120	120	17.4	6.76				1436 x 650 x 35	11.3		1040.60	8.67			
	U5-155	155	34.9	4.44				1600 x 800 x 35	15.4		1316.70	8.49			
	U5-160	160	34.9	4.57				1600 x 800 x 35	15.4		1349.70	8.44			
Webel (India) Solar Sales Pty Ltd ph:(08) 9477 5888 sales@solarsales.com.au www.solarsales.com.au	SP20	20	17	1.18	Monocrystalline	25	Glass/Tedlar.	530 x 430 x 52	3	25	323.00	16.15			
	SP65	65	18.05	3.6	Monocrystalline	25	Glass/Tedlar.	1083 x 500 x 34		25	892.00	13.72			

Grid Connect Solar: how it works



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A powerful solar facade

An award-winning building at Ballarat University has some very special windows, with the largest vertical semi-transparent photovoltaic glass facade in Australia.

The northern facade of Ballarat University's new Building and Construction Training Centre is an eye-catching design, but it also features high-tech state-of-the-art construction materials. The row of 85 large glass panels looks like tinted glass from the outside, but a closer look reveals some important technical capabilities. For a start, this glass generates clean electricity: altogether some 8.5 kilowatts peak, producing 7.3MWh every year and saving some 10.2 tonnes of carbon dioxide annually.

Going Solar, in conjunction with McIldowie Partners Architects and builder H Troon, designed, supplied and supervised the installation of the glass panels, which is the largest vertical north-facing building-integrated photovoltaic facade in Australia using amorphous silicon. Schott Solar ASI glass modules were used. The glass is coated with thin films of transparent conductor, amorphous silicon (less than 1/1000 of a millimetre thick), back contact and encapsulating material, which altogether give the unit its photovoltaic properties.

From the inside of the building, a couple of other features become apparent. While thin-film amorphous silicon is normally not transparent, this façade is made up of a semi-transparent version called ASI-THRU, whereby 10% of the surface is left free of silicon. Importantly this means that people can see outside, allowing occupants to connect to their environment yet enjoy considerable privacy from the outside.

There's a view outside, despite the photovoltaic capabilities of the glass.

Thermal benefits

With the sun shining onto the facade, a great deal of sunlight is prevented from entering the building. The glass units are double-glazed, meaning this part of the building is effectively insulated. As a result of these thermal effects, the load on the building's air-conditioning plant has been reduced by 40%.

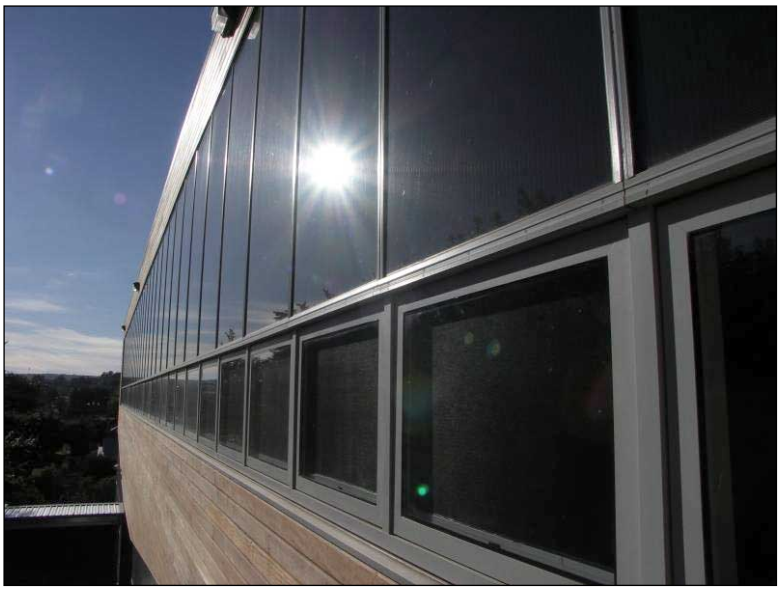
The clean power generated by the 200 square metre glass facade is converted from DC to AC through a bank of inverters and is used in the building or can be fed back into the power grid.

Great care was taken in the design and construction of the facade to minimise shading, as any shade can badly affect the performance of these building-in-

tegrated photovoltaics. Amorphous silicon performs better under high-temperature or low-light conditions (such as during an overcast day) than the more common roof-top crystalline solar panels. How well the system is working can be seen on a custom-built display unit in the entrance foyer.

Energy from indirect light

The amorphous silicon technology used produces energy even from indirect light, making the panels more tolerant of vertical inclination than crystalline silicon panels. A facade orientated at 30° from the horizontal would have been impractical—a vertical facade proved simpler and cheaper for building design and construction. The project recently won the 2007 Business Council of Sustainable Energy (BCSE) Award for Excellence: Designing and Installing a Grid-Connect Photovoltaic Energy System over 5kW.



Power generation in action as the sun hits the photovoltaic glass facade.

A similar project was undertaken by Going Solar, with a solar pergola installed on the 40 Albert Road building in Melbourne. The pergola provides shade and weather protection to the roof-top area of the building, as well as power generation. It won the 2006 BCSE award for a system under 5kW.

Solar Inverters

Renewable Energy a Local Solution to a Global Problem

Apollo Solar

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T80

TurboCharger

The TurboCharger T80 integrates Maximum Power Point Tracking, Battery Charge management, State of Charge Information and Communictions into a single device.

The T80 captures up to 35% more power from the solar (PV) array. The controller uses the same technology that Apollo Solar developed to help NASA harness additional power from their solar arrays.

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The built-in energy monitor tracks energy production and consumption and displays the energy remaining in the battery.

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A 5 year warranty is backed up by Apollo Solar's choice of quality components and design.

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- 5 years Warranty
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The national picture

With an emissions trading scheme on the way, Alan Pears raises the important question of how low income households will fare.

Emissions trading: practicalities emerge

We now have commitments to emissions trading from both major parties at national level. The major differences will be in how fast it is introduced and how generous the scheme is to existing large emitters in terms of allocation of free emission permits. I hope that policymakers learn from experience with allocation of water rights. If they over-allocate, it will cost the community a lot of money to buy back those excess rights to pollute.

The science will also create challenges for emissions trading. All proposals involve providing a fair degree of certainty for emitters for ten or twenty years ahead, so they can confidently invest. But the science is increasingly telling us that Australia needs to cut its total emissions now, with large cuts much sooner than previously expected. We have to hope that business discovers a lot of opportunities to cut emissions, so we easily meet the targets and the price of carbon is low. Certainly, experience with energy efficiency and other pollution issues is that there is lots of potential: the challenge is always how to mobilise everyone to capture it.

As we look more closely at emissions trading, we are also seeing some interesting subtleties. A recent study by the National Institute for Economic and Industry Research estimates that, at a price of $25 per tonne of CO_2, households will experience an increase in living costs of 0.3 to 2.3% of income—with lower income earners experiencing a higher percentage impact—assuming that they (and their suppliers of energy, goods and services) do not reduce their emissions. Less than half of this impact will be due to direct increases in energy prices, and the rest through the 'embodied CO_2' in goods and services purchases. Governments must introduce effective policies to help low income households reduce their emissions in order to manage these costs. Policies to encourage suppliers of basic foods, goods and services purchased by low income earners to cut their emissions will also limit the indirect costs of emissions trading.

Indirect cost effects of emission prices on goods and services will also be an issue for businesses. Prices of goods and services they buy will be slightly increased (on average by 1.4% at a CO_2 price of $25/tonne) as the cost of CO_2 is built into them—unless upstream suppliers act to cut the 'embodied emissions' in their inputs and their own emissions. For many businesses, this will be a bigger cost impact than the direct energy price effects. So purchasing policies will be a major focus.

This is not to say emissions trading will have adverse impacts overall. If the government auctions permits, it will have billions of dollars to encourage emission reduction and to offset cost increases for vulnerable groups. And businesses and households that act to cut their own emissions and shift to low emission inputs will easily save more than it costs.

Can the energy industry change?

The energy supply area is beginning to send some unsettling signals to those who are watching. Wholesale electricity prices have risen dramatically as several large coal power stations have cut their output due to lack of cooling water. And output from hydro plants is also well down, adding to cost pressures. The NSW regulator, IPART, has recently announced a 25% increase in household electricity prices over the next three years, and business contracts are also trending upwards.

A recent cold snap in Victoria led to a shortage of natural gas, as demand exceeded the system's capacity. There are also concerns about electricity supply capacity.

Unfortunately, these indicators are being seen by politicians and the energy industry as reasons to build more energy supply capacity. The real solution would be to introduce much stronger action to limit demand. But that's simply unthinkable to most players in the game of energy. The energy market framework is still not sending the right signals. Our energy policy makers have had fifteen years to get energy markets right: maybe it's time for someone else to have a go.

Cutting demand

We need to seriously contemplate a future where cuts to supply at times of peak demand are more common. To put it bluntly, it costs a lot of money to have lots of spare energy supply capacity available for the occasional extremely hot or cold day. And private energy suppliers find it risky and expensive to make provision for these situations, unless they can pass on the costs to consumers.

Under present arrangements, both those who use energy wastefully and those who are frugal suffer if there is an energy shortage—we all lose supply. It seems to me it would be a lot fairer if, when supply is limited, those who have modest and reasonable requirements were protected, while those with extravagant requirements should be the ones whose supply is limited. If you want lots of energy at peak times, you could pay (a lot) extra to ensure the capacity is there.

With recent developments in smart metering and load management, this is becoming possible. For example, if I had a smart energy management system, a signal from the energy supplier could set a demand limit, and my smart system could shut down the appliances and equipment in the order I have nominated until I was within my prescribed limit. If I wanted a higher limit, I would have to pay a premium to ensure more supply capacity was available.

This approach would send some powerful signals. First, it would mean that households that were efficient would be protected from brown-outs and limits to gas supply—a reward for being sensible. Second, those who wanted lots of energy at times when it is expensive would pay. This would also create incentives for energy storage and on-site energy generation.

This goes beyond the present focus on 'smart' energy meters and time-based pricing. It involves introduction of active smart energy management systems, and sends a clear signal to high energy users: pay more or expect to have limits placed on your access to energy at critical times. It rewards people who limit their demand. There are some potential social justice and transition issues. But this approach could be quickly applied to all new homes and major renovations. It could also be rolled out to buyers of new large air conditioners and central heaters, and to households and businesses with a history of unusually high demand around peaks—although financing packages and incentives for investment in load management and energy efficiency would be important.

The cycles of life

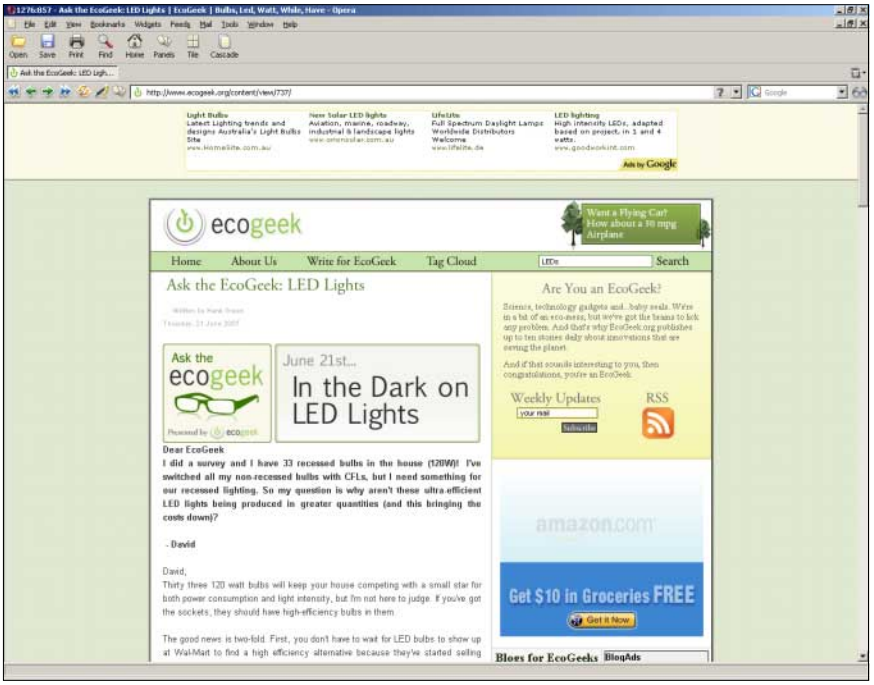
I've been pleased to see the renewed interest in home energy auditing. Not many people realise that from 1983 to 1993, the Victorian government ran an energy auditing and retrofitting scheme for low income households, from which over 90,000 households benefitted. It was shut down during the energy market and privatisation process. I developed the computer software and helped to train advisors. I'm now seeing a lot of interest from people who want to get back to where we were in the 1980s!

www.ecogeek.org

It may seem that advanced technology and true sustainability can never exist together, but many technology companies around the world are making inroads to reduce their ecological footprint, as well as that of their products.

Many computer manufacturers have greatly reduced the toxic chemicals and materials used in their products, and are working towards greater recyclability and reduced energy use. But how do you find out which devices are the best, and which are not so great?

The ecogeek website is exactly that—a source of information on the sustainability aspects of all things geek. Computers, mobile phones, entertainment equipment, and even vehicles are all discussed on ecogeek.

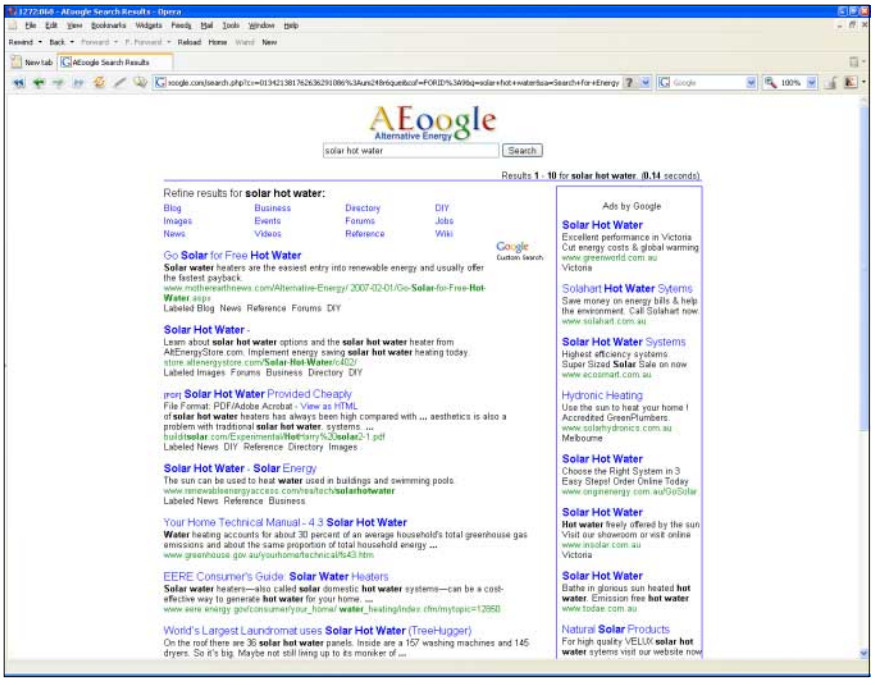


There is product information and news on the latest releases, and readers can leave their own comments on each article, to add to the information available to others.

You can also receive a weekly update from the site, or subscribe to the RSS feed for real-time updates.

www.aeoogle.com

No, you're not reading that wrong, AEoogle is the new alternative energy search engine that has been put together by the people at Alternative Energy News in collaboration with Google, which powers the search engine part of the site.



So why create a dedicated search engine for alternative searches? Anyone who has used Google knows that most searches result in a huge number of hits, most of which have very little to do with what you are looking for. AEoogle has been tailored to pull up those sites that are most relevant to the alternative energy (or really, the renewable energy) field.

What we did notice on using the site is that, just like Google.com, it will list US sites first and, unlike Google, there is no Australian version of this search engine. However, when searching, the site does list Australian Google Adwords advertisers in the right hand column first, so at least that part of it is designed to cater to the location of the person doing the search.

Let's hope versions of this site aimed at countries outside the USA come online soon, as this sort of dedicated search engine makes life a great deal easier when looking for renewables websites.

A festival keeping it green

If you want to run a more sustainable event, why not learn from those who've done it before, such as the Wave Rock Weekender in WA.

In *ReNew 97* we reported on environmental initiatives for the first Wave Rock Weekender, a three-day music festival at Hyden WA. Plans included running vehicles on biodiesel, experiments with solar power, LED and compact fluorescent lighting, the use of GreenPower and careful separation of rubbish into compost and recyclables. So, how did they go? The festival organisers got back to us with their Environmental Initiatives report, which is a good read for anyone planning a more sustainable event in the future.

Compostable containers

All packaging of food and drink sold at the Wave Rock Weekender was compostable. The bar only used cups made of polylactic acid, that break down entirely in compost within about three months. Vendors serving take-away food were supplied at cost with specially sourced potato starch containers which are made from the waste products of potato chip processing and are also completely biodegradable. Compostable cutlery made of plantation wood was also supplied for takeaway food. The containers were separated by patrons and staff as part of the waste recovery initiatives and the compostable material recovered was shredded and supplied to a local farm for composting.

Most music festivals favour premix spirit cans and beer bottles or cans because they are simple, sealed, and take much less time to serve than other options. Due to the small capacity of this event, they were more progressive in waste reduction and limited the bar to keg beer and hand-poured wine, spirits and soft drinks only. This meant much less volume and weight of waste generated by bar service than usual. Even musicians were subject to these policies; drinks were provided from the bar, or in large bottles. The festival reached their diversion from landfill target of 70%.

Biofuel

Organisers aimed for all diesel vehicles and equipment—coaches, trucks and generators used to supplement power for audio and lighting equipment—to be run on Liberty B-20, a biodiesel blend, rather than normal diesel. Liberty B-20 consists of up to 20% biodiesel, which is fuel produced from sustainable vegetable crop sources, creating less emissions than petroleum diesel fuel. The fuel was delivered and stocked at the Hyden Roadhouse to enable vehicles to refill for the journey back to Perth, and they promoted the availability of the biodiesel blend fuel to patrons.

Festival organisers negotiated with Thomson Coachlines to run coaches to the event on biodiesel B-20. Yet, only 19.5% of ticket buyers took the coach to the event.

Solar power and LED lighting

To minimise the event's footprint, organisers considered all the different lighting required onsite and how they could experiment with and promote the use of more efficient lighting technology. They also encouraged patrons to bring any renewable power solutions and gadgets to foster the sharing of ideas.

LED lighting technology was used for onstage special effects lighting, with general ambience/back-up provided by CFLs in decorative shades around the stage area.

The festival is on the edge of the desert in Western Australia, with prehistoric rock formations, eerie salt plains, shiny salmon gums, wildflowers and big, big sky.

Organisers avoided the use of any light fittings over 40 watts throughout the site. Self-manufactured CFL 'street lamps' were used for all pathway lighting, comprising an 11 watt CFL, bamboo pole, yellow water-resistant lamp shade, a lockable lid and a 20 amp-hour battery unit charged from GreenPower mains at the site. Each lamp safely lit a radius of around 20m from the pole, with no power cabling requirements and minimal insect activity around the shade (due to the yellow shade colour). For all campground lighting, a combination of low wattage decorative incandescent festoon lighting, CFLs and LED rope lighting was used.

The Wave Rock Weekender Environmental Initiatives report is available from www.soulhighway.com.au. The next festival is in late September 2007.

Wind for urban areas

While wind turbines in urban locations can be hard to justify in many instances due to turbulence and noise problems, the Swift turbine from Renewable Devices in the UK is aimed at dealing with those problems.

It has an annular ring diffuser to eliminate noise from blade tip vortices and because it has five blades instead of the usual two or three, it can run at a slower speed, thus also reducing noise.

The Swift is rated at 1.5kW at 12.5m/s, and cut-in speed is a low 2.3m/s. Noise is rated at <35dB(A) for all wind speeds, making it very quiet indeed (a whisper heard at five metres is around 30dB).

Renewable Devices Ltd, SAC Bush Estate, Edinburgh EH26 0PH, UK, ph:+44 (0)131 535 3301, enquiries@renewabledevices.com, www.renewabledevices.com

Really, really big compact fluoro lamps

When it comes to lighting large spaces, most people resort to discharge lamps such as mercury or sodium vapour lamps. However, these types of lamp have some major disadvantages, the main one being that they have a very long starting time—often 10 minutes or more. This stops them being used efficiently in situations where lighting really only needs to be intermittent, such as in warehouses—they are often turned on and left on all day, even if no-one is in the area at the time.

The Environment Shop now has a range of giant compact fluorescent lamps that are designed to replace gas discharge lamps in these situations. There are four lamp sizes available—85, 105, 150 and 200 watts—with light outputs from 5000 to around 12,000 lumens. Light colour temperature is 6400K for all lamps.

Because these CFLs can be turned on and off at will, they can be used with automatic lighting controllers so that lights are only running when needed. In large lighting installations, the potential savings are huge.

The 85 watt unit has a standard BC22 base, while the larger sizes use the ES40 base common in larger light fittings. Being compact fluoros, they require no external ballasts, and run directly off 240 volts AC. Lamp life is rated up to 8000 hours.

RRP: 85 watt: $49.90; 105 watt: $70; 150 watt: $95; 200 watt: $150.

594 High St, Thornbury VIC 3070, ph:(03) 9480 1905, fax:(03) 9484 8591, info@environmentshop.com.au, www.environmentshop.com.au

Solar bags and backpacks

If you need to keep devices like mobile phones, PDAs and similar charged while you are on the move, then the Juice Bag range of bags and backpacks with embedded solar panels from Reware, make life easier.

The bags are made from either biodegradable canvas or synthetic fabric made from recycled drink bottles. They each incorporate a 6.3 watt flexible thin-film copper indium gallium diselenide solar panel that can charge the average mobile phone in just a few hours.

Reware also make a few other portable solar devices, including the fold-out Power Pocket range, which comes in 6.5 and 12 watt panel sizes.

RRP: US$249.99 for the beach tote, US$275 for the ES100 backpack.

For more information, contact Reware at info@rewarestore.com or go to www.rewarestore.com

Jewels of the sun

Most glass jewellery is made using gas-powered torches to melt and shape the glass, but the jewellery from Sundrop Jewelry (yes, they're American) is made with glass that is melted by the heat of the sun.

The glass is heated by a large glass lens which produces temperatures of over 1600°C—more than enough to melt glass and most metals. Once the glass is melted, gravity does the rest, pulling the molten glass into teardrop shapes.

The range includes single and double drop earrings, single and triple drop pendants, and belly rings, in single and multi-coloured glass. Note that the multi-coloured glass is produced by melting single colours together in a kiln, so they are less environmentally friendly than the single-colour items.

For more information, contact Sundrop Jewelry, service@sundropjewelry.com, www.sundropjewelry.com

Low-cost solar regulators

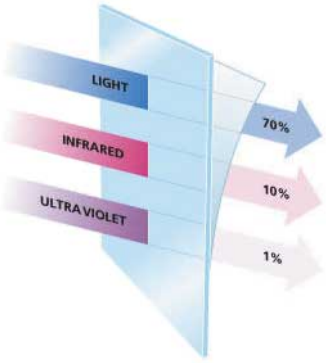
Futurlec has just released a new range of solar regulators suitable for 12 and 24 volt systems requiring a regulator up to 30 amps. There are four models in the EP Solar range—a 5 amp model, a 10 amp model, a 10 amp model with dual timers, and a 30 amp unit. They all feature microprocessor control and PWM (pulse width modulation) charging current control, although the 30 amp model can also be set to simple on/off current control.

Other features include temperature compensation, LED status indicators, and adjustable lighting control outputs to control lighting at sunset. The 30 amp unit also has adjustable voltage setpoints so it can be configured for different battery types, four-stage charging control, an LCD, as well as automatic sensing between 12 or 24 volt systems. The three smaller units must be bought as either a 12 or 24 volt regulator.

RRP: Introductory pricing currently ranges from $34.45 for the 5 amp unit through to $146.30 for the 30 amp model.

Available from Futurlec, 2/136 Broadmeadow Rd, Broadmeadow NSW 2292, sales@futurlec.com.au, www.futurlec.com.au

Be selective



Keeping the heat out in summer can be a difficult task, especially if your home has a lot of glass facing the sun. You can use blinds and other shading, but sometimes this just isn't practical—such as on multi-storey buildings.

V-Kool Australia make spectrally selective coatings for windows that are designed to block out nearly all of the ultraviolet and infrared (heat) radiation while letting the majority of the visible light spectrum through. The result is windows that keep out the heat and UV while allowing plenty of light into the room. As an added bonus, the film, which is applied to the inside of windows, improves the safety of the glass by holding it together should the window be shattered.

V-Kool is available in a number of types and reflectivity ratings, so there should be a film to suit almost any glazing situation. It is also suitable for automotive applications, and according to V-Kool, it can lower interior temperatures and improve fuel economy by reducing the airconditioning load on the vehicle.

Manufactured by V-Kool Australia, 296 Parramatta Road, Auburn NSW 2144, ph:(02) 9748 6842, freecall: 1800 085 665, info@v-kool.com.au, www.v-kool.com.au

Tiny wind turbine kit

Experimenting with wind turbines can be a lot of fun, but designing one from scratch, working out how to build it and then actually doing it can be rather daunting. While only a tiny machine, the three-phase wind turbine kit from Windstuffnow is a great way to get started building a simple turbine.

The kit comes with everything you need, including the rotor materials, alternator components including stator windings and permanent magnets, plus instructions. However, the best thing about the kit is the price!

We ordered one of these kits to test, and while the stator takes a bit of work getting the windings in place (superglue is invaluable for this task!), the kit went together well and does indeed generate electricity, although not a great deal. This kit is a great little educational tool.

RRP: US$29.95 plus shipping (quoted at US$18 when we ordered one).

For more information go to www.windstuffnow.com/main/3phase_turbine_kit.htm. The ATA is also considering importing and selling this kit, so stay tuned!

Stylish double glazing

Double glazing options in Australia have been a bit limited, with most companies only supplying basic frame designs and a limited range of colours and styles.

American Homes, as you might expect, build American style homes which are designed to be energy efficient. One of the features included is double-glazed windows from Weather Shield, which are also available separately for your own building projects.

The windows are available in several types, including argon-filled and with low-E glass. They feature aluminium frames with internal wood trim, to provide good aesthetics and thermal insulation, although you might want to check that the wood is sustainably grown.

Available from American Homes, Factory 5, 24 Longstaff Rd, Bayswater VIC 3153, ph:(03) 9720 9906, enquiries@americanhomes.com.au, www.americanhomes.com.au

EBP revisited

We looked at the Electric Booster Pump from Davies Craig some years back. The pump has now been re-released in a new version by Bosch.

The EBP uses a brushless DC motor magnetically coupled to an impeller to provide water circulation without the problem of shaft seals failing and leaking. The pump is ideal as a circulating pump in solar hot water systems, and indeed, Davies Craig now list this as one of the uses on their brochure!

Rated operating voltage is 9 to 15 volts DC, and maximum current draw is just 1.3 amps. The unit will pump 15 litres per minute at a pressure differential of 10kPa (1.4psi).

RRP is around $200 for the kit, which includes the pump, hoses and clamps, wiring and instructions.

Available from automotive parts suppliers all over Australia. Go to www.daviescraig.com.au to find your closest supplier, or email dcfans@daviescraig.com.au

Ultra low power PC

The average computer uses a great deal of energy, simply because it is often left running for so long. PCs nowadays can easily draw 100 to 200 watts continuously, even when they are only being used for basic tasks.

The Zonbu has been designed as the world's first carbon neutral PC. Not only does it use a tiny 15 watts while running, but the Zonbu company also buys carbon credits from www.climatetrust.org

The unique thing about the Zonbu is that it has no hard drive. It has 4GB of on-board flash RAM to store data. You can also subscribe to the Zonbu service which gives you up to 100GB of storage on their servers. The Zonbu synchronises data between the on-board RAM and the remote server automatically, meaning your data is backed up in the event of fire or theft.

The Zonbu uses open source software, so it is less prone to viruses and other security issues, and there are no license fees. The Zonbu costs US$249 up front, and you can subscribe to one of three different paid plans—25, 50 and 100GB of storage, costing US$12.95, $14.95 and $19.95 per month respectively. If the plan seems like a bit of an imposition, there is a free 2GB plan, or just unsubscribe and use a large USB drive as your local storage, although this means you do lose the automatic updates feature of the subscription service, and the security of having offsite backups. The subscription also provides a free three-year device replacement warranty—quite a warranty when you think about it.

The only drawbacks with this machine are the limited range of software available for it and the fact that it makes heavy use of your internet connection, so you will need an internet plan with decent data allocations. While the Zonbu does come with a lot of software that many users will need, such as email, web browser, instant messaging, Skype, an office suite, multimedia players, desktop publishing and games, you are limited to the applications that Zonbu provide, unless you are a true linux wizz.

However, having said all of this, the Zonbu looked like such a great little device that we bought one to test for ourselves, and it has proved to be a very neat and effective machine so far.

RRP: US$249 plus monthly subscription, or US$99 if you sign up for a two-year plan.

For more information go to www.zonbu.com

Flat batteries? Get cranky!

It seems just about everyone has a media player, whether it be an iPod or one of the many similar devices. One thing they all have in common is that they use batteries. And, of course, those batteries go flat at the most inopportune times!

The wind-up media player is made by the original inventor of the wind-up radio, Trevor Bayliss. It plays all of the common audio files, including mp3, wav, wma and asf, as well as video files in the asv (mp4) format. Other video formats are supported through conversion software (which is common with video players).

The phone uses an internal lithium-ion battery that can be recharged via your computer's USB port, or you can wind the crank handle to charge the battery by the in-built dynamo. One minute of winding gives you up to 40 minutes of playing time, and the player can run for up to 20 hours on a full charge.

Other features of the unit include built in audio recording in mp3 format, at three selectable sampling rates, built-in speaker, 1.8 inch colour LCD, FM radio, e-book support, voice recorder, photo viewer, a 0.3 watt LED torch, and the player can even charge many popular mobile phones using the included cable and adaptors.

Internal storage consists of 2GB of flash memory, and the player has an SD card slot so you can expand this to whatever you need.

RRP: £169.99 including VAT.

Available from Ecodigital, PO Box 5575, Westcliff on Sea, Essex SSO OZQ, UK, estore@ecodigital.co.uk, www.ecodigital.co.uk

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To become an ATA member or supporter go to the ATA webshop at www.ata.org.au or call (03) 9639 1500. Alternatively, fill out the order form on page 80.

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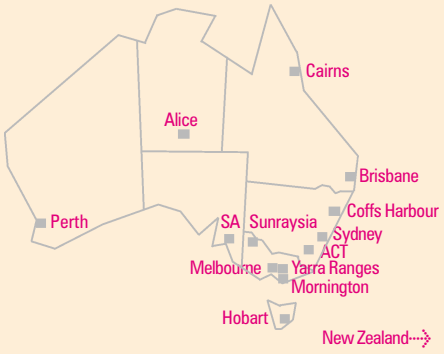
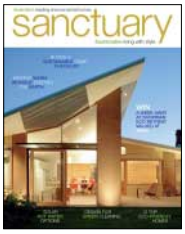
ATA branches



ATA shop by mail



Sanctuary magazine issue 3

Price: $9.95 plus $2.50 postage

The third issue of *Sanctuary: sustainable living with style* is out now. Issue 3 features include: Buying a sustainable home checklist, design your home for green cleaning, keeping warm without costing the earth, plus 12 top eco-friendly homes from across Australia.

Sanctuary magazine issue 2

Price: $9.95 plus $2.50 postage

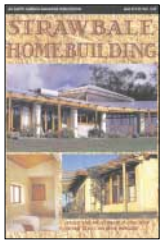
The second issue of *Sanctuary: sustainable living with style* is out now. More beautiful sustainable homes form across the country. Features include; water saving apartments, sustainable kit homes, eco-friendly flooring options, terraced wall garden greywater system and the latest savy, sustainable products.

Sanctuary magazine issue 1

Price: $9.95 plus $2.50 postage

The first issue of *Sanctuary: sustainable living with style* brings together 15 of Australia's leading sustainable architects and building designers. With their cutting-edge ideas, these homes are an inspiration to anyone wanting a modern home designed for style, comfort, health and with the environment in mind.

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: SBH

ATA Booklets series: Solar Hot Water

Price $10 each inc postage ($8 for ATA members)

Solar hot water is possibly the best way to get started with renewable energy. This booklet outlines all of the different system types and which one will best suit your needs.

ATA Booklets series: Wind Power

Price $10 each inc postage ($8 for ATA members)

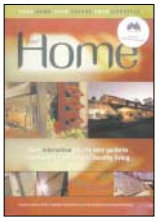
This is our new wind power booklet. In it you will find all the information you need to get an understanding of wind power electrical and water pumping systems, how to size and install them correctly, how to look after them, safety requirements and a great deal of other information.

Your Home Technical Manual

Price: $49.50. NB: $10 postage on this item

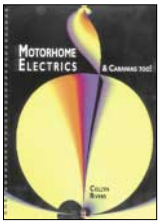
Gives you the information you need to design and build a more comfortable home that is less expensive to run while being more environmentally friendly.
Contains over 60 fact sheets on sustainable solutions for designing and building your home. *Item code: YHTM*

Your Home Technical Manual DVD



Price: $13.00 plus postage

This DVD allows you to virtually visit some of the most beautiful, innovative and low-maintenance houses in the country. Be inspired as you take a visual tour of some of Australia's most comfortable and stylish homes, created by leading architects and designers.
Item code: YHTMDVD

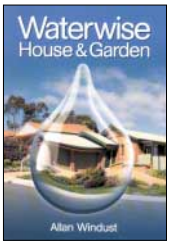


Motorhome Electrics & Caravans Too!

Price: $42.95 ($40.95 for ATA members)

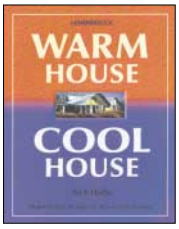
Running motorhome and caravan electrics from solar is neither difficult nor complicated. Planning is relatively simple, and anyone comfortable with basic tools can do it. This book is a down-to-earth guide to getting it right the first time.
Item code: MECT

Waterwise House & Garden



Price: $29.95 ($27.95 for ATA members)

This practical guide show you how to conserve water in your home and garden. The book details water saving using options including rainwater tanks, greywater recycling, and creating a water efficient garden. Included is a list of native and exotic plants that are drought tolerant. *Item code: WWHAG*



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*

ATA Booklets series: Solar Electricity

Price $10 each inc postage ($8 for ATA members)

Covers all the basics you need to know when designing a solar power system. Includes panel types, batteries, controllers, inverters and many other aspects of solar energy systems.

Renewables on CD ROM

ReNewROM II

Price: $65 ($30 for ATA members) plus $4 postage

The third CD ROM in the series, and covers issues 71 to 89 of *ReNew* back issues, many of which are no longer available. This disk is fully searchable with 19 complete magazine issues in PDF format, so it can be used on PCs, Macs and Linux boxes. *Item code: RENEWROM2*

ReNewROM

Price: $65 ($30 for ATA members) plus $4 postage

The second CD ROM of the series, covering issues 41 to 70 of *Soft Technology* and *ReNew* back issues, many of which are no longer available. This disk is fully searchable with 30 complete magazine issues in PDF format, so it can be used on PCs, Macs and Linux boxes. *Item code: RENEWROM*

Kits, LEDs and energy efficient devices

Universal NMH and nicad charger

$59.95 ($56.95 for ATA members)

This charger will recharge four of either AA, AAA, C, or D cells or two 9V cells. It handles both nicad and NMH batteries and uses delta-V detection and cut-off.

For nicad batteries, the charger can discharge the battery first to prevent memory effect. Charging currents for AA, C and D cells is up to 2 amps, while AAA cells are charged at up to 500mA, meaning the charger will charge even the largest capacity cells in just a few hours.

The charger features both LED and LCD displays, and runs from 12 volt DC via the supplied plugpack. It can also run directly from 12 volt DC systems. *Item code: CHARGER3545*

Solar keyring LED torch

Price: $14.95 ($13.95 for ATA members)

A handy keyring torch that will never let you down.

The twin high-brightness LEDs are powered by internal Ni-MH batteries that are kept topped up by the keyring's inbuilt-in solar panel. Just a few minutes exposure per day will beep the torch fully charged and ready for immediate use.

Dimensions: 70mm x 30mm. *Item code: TORCH-KEYRING*

Dynamo torch

Price: $19.95 ($18.50 for ATA members).

This is a super-bright LED wind-up torch that will provide light anywhere, anytime, without requiring batteries or an external power source.

One minute of winding provides light for up to 30 minutes, and you can switch between one or all three LEDs. Ideal for emergency use. *Item code: TORCH_DYNAMO*

Low-power LED halogen replacement bulb

Price: $49.95 ($46.95 for ATA members)

This bulb can be plugged into almost any 50mm halogen downlight socket that uses an MR16 halogen lamp. It uses three Cree X-Lamp XR-E power LEDs (on of the most efficient power LEDs available) as the light source to generate over 200 lumens of neutral white light (around 5000K colour temperature). Two models are available, a narrow angle spotlight, and a wide angle floodlight.

The LEDs are driven by an inbuilt switchmode power supply, and beam angle is around 30 or 150 degrees, depending on the model. The body is made of aluminium for good heat dissipation.

Power consumption is around 3.5 watts at 12 volts, meaning it has an overall efficiency of around 60 lumens per watt—that's better than most compact fluoro lamps!

The bulb will run from any power source of around 12 volts, either AC or DC, so can be plugged straight into many halogen sockets without changing the transformer.

Note: may not work with some electronic halogen transformers. *Item code: LEDHAL3W*

Brilliant new product!

ReNewROM III

Price: $45 ($25 for ATA members) including postage. The fourth CD ROM in the series, and covers issues 90 to 99 of *ReNew* back issues, many of which are no longer available. This disk is fully searchable with 10 complete magazine issues in PDF format, so it can be used on PCs, Macs and Linux boxes. *Item code: RENEWROM3*

Miniature wind turbine kit

Price: $49.95 ($47.95 for ATA members)

This great little kit allows you to make a tiny wind turbine that is both educational, as well as a functioning turbine that can produce power. Maximum output is up to 10 watts, though we would rate it more like a watt or two realistically. *Item code: WINDKIT*

Skylight solar keyring torch

Price $32.95

The tiny (52mm x 28mm x 10mm) Skylight Comfort contains a rechargeable vanadium lithium battery good for up to 10,000 cycles, a solar panel and a 9600mcd, 30° white LED. It will run for up to six hours on a full charge, which requires around a day of full sunlight. This unit is swiss made with the highest quaity components, is waterproof to one metre and comes with a five year manufacturers warranty. *Item code: SKYLIGHT*

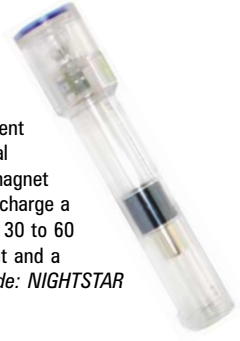
12 volt, 1 amp switchmode plugpack

Price: $25 ($23 for ATA members)

This plugpack is ideal for running our LED halogen bulbs or LED halogen replacement kit. Use it to replace the inefficient transformer supplied with most halogen fittings, or wherever you need an efficient 12 volt plugpack.

Item code: SMPLUGPACK

Nightstar kinetic torch



Price: $50 ($45 for ATA members)

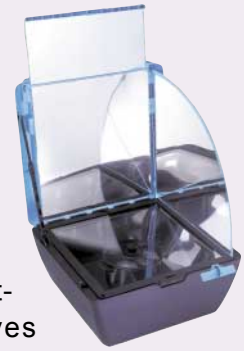
This amazing torch uses no batteries and no incandescent globes, yet will provide light when you want it with total reliability. The Nightstar uses a high power rare-earth magnet passing through a wire coil to provide the electricity to charge a super capacitor that drives the white LED lamp. Around 30 to 60 seconds of gentle shaking gives five minutes of full light and a steadily reducing level for another 15 minutes. *Item code: NIGHTSTAR*

Dynamo multiband radio

Price: $49.95 ($46.95 for ATA members)

Housed in a sturdy rubber and plastic casing, this radio is great for any outdoor activity that requires a heavy duty radio which will withstand a lot of punishment. Features include FM, MW, LW and SW bands and an alarm. It can be self-powered by dynamo operation or two AA batteries. *Item code: SWDYNAMORADIO.*

Win a Sun Cook solar cooker valued at $499



We are looking for good build-it-yourself style articles, and will award a Sun Cook solar cooker to the author of the best article we receive.

If you have a project, simple or complex, electrical or mechanical, that has appeal to do-it-yourselfers and involves renewable energy or appropriate technology in some form, then send it in. Entries must describe completed working projects.

Send your ideas to: *ReNew*, Level 1, 39 Little Collins St, Melbourne VIC 3000,
email: renew@ata.org.au
Competition closes Friday 23 November 2007.

Sun Cook solar cooker kindly donated by Pro Quip International, www.proquip.com.au

Flashable, dimmable CCFL lamp

Price: $29.95 ($27.50 for ATA members)

One problem with compact fluoros is that they usually can't be dimmed—if you try, they die a rapid death. These Microbrite lamps can not only be dimmed with conventional 240 volt lamp dimmers, they can also be used in situations where the lamp is turned on and off rapidly, meaning they can be used just about anywhere a regular Edison screw based bulb is used. We will also soon have this bulb with standard bayonet cap bases.

We currently have the 8 watt diffuse warm white globe, which has light output equivalent to a 40 watt incandescent. Other colours are available on request in quantities of 15 or more.

The lamps feature a long life cold cathode fluorescent tube, are rated for 25,000 hours of use, and come with a 2 year warranty!

Item code: MICROBRITE8W

Computer connect wireless weather station

Price: $399 ($379 for ATA members)

We now have a new computer-connect weather station available that comes complete with display software which presents all the current weather data on one easy-to-read display on your computer. The weather station monitors indoor and outdoor temperature and humidity, rainfall, barometric pressure, wind speed and direction, wind chill, and dew point.

The software can store unlimited weather data on your computer and you can export the history file for further analysis or for generating graphs in a spreadsheet. The external transmitter requires two AA batteries while the base station runs on a plugpack or three AA batteries. *Item code: WIRELESSWEATHER-CC*

Shake-powered calculator

Price: $9.95 ($8.95 for ATA members)

You will no longer have to buy replacement batteries for your calculator or put up with fading calculator screens. The battery free calculator is powered by shaking the calculator side to side.

Electricity is generated by a magnet passing through a coil of wire. If the screen starts to fade, just shake it again for power.

The calculator features an eight-digit screen and a clear plastic body so you can see the workings. *Item code: CALCULATOR*

Power-Mate energy meter

Price: 10 amp version is $295 ($280 for ATA members); 10 amp heavy duty version is $345 ($330 for ATA members) and the 15 amp version is $405 ($390 for ATA members)

We have been selling the German-made SparOmeter energy meter for some time, but while it does a good job, we have been looking for a locally produced equivalent meter for general household use, and finally we have found it!

The Power-Mate has all the functions of the SparOmeter, as well as quite a few extras. The unit consists of a hand-held meter which can be connected to the appliance it is measuring via a simple piggyback plug and socket set. The meter features an LED display for easy reading and high visibility at all times. The meter can tell you a variety of measurements including: power in watts, voltage and current. The meter can tell you the minimum, maximum as well as instantaneous readings.

The meter can also tell you: cost of running the appliance, how much energy the appliance used in kilowatt-hours and how many kilograms of greenhouse gas emissions it produced. All in hourly, yearly, quarterly and accumulated figures. *Item code: POWERMATE-10A/10AHD/15A*

We also have a Power-Mate for hire for $30 a week inc express post to you.

Solar LED camping lantern

Improved version!

Price: $99 ($95 for ATA members)

This is a well constructed super-bright white-LED lantern with a charging socket that also doubles as a power socket for charging external devices such as MP3/CD players and mobile phones. The lamp can be charged via mains power, car charger or solar panel, all of which are included.

The rotary switch provides five levels of illumination (to extend battery life). The lantern features eight power LEDs (totalling around 3 watts), a 2.5 watt crystalline solar panel in tough aluminium frame, charging lead and adaptors for various devices including Nokia, Motorola, Samsung, Ericsson and Siemens mobile phones. The lantern measures 250mm x 108 mm diameter. *Item code: SOLARLANTERN*

Three-stage solar regulator

$139.95 ($124.95 for ATA members)

The Powertech 12 volt regulator has a three-stage charging profile, with bulk, absorption and float charge stages, and is switchable between flooded cell and sealed battery programs, and has adjustable setpoints. It has a rated current of 20 amps continuous, and charging current is controlled using pulse-width modulation.

Other features of the controller are dusk-to-dawn automatic on-off load control with 10 selectable on-off programs, five-state LED indication of system status, adjustable low-voltage disconnect, reverse battery connection protection, and an optional battery temperature sensor. The in-built LCD displays charge current, battery and solar panel voltage, solar charge energy in amp-hours for the last three days.

New lower price!

Item code: SOLARCHARGER

12VDC/240VAC fast charger with LCD

Price: $49.95

This charger runs from either a 12 volt DC source (via the cigarette lighter lead supplied) or a 240 volt AC (via the plugpack supplied). I features very fast battery charging, with AA charging current up to 2 amps and AAA current up to 500mA. It will charge up to four nicad or NMH batteries at a time, and has four individual charging channels. Using Delta V voltage detection, the batteries are charged to their optimal levels to ensure longest lifespan. Charge state can be monitored on the integrated backlit LCD. *Item code: CHARGER3543*

Wireless weather station

New lower price!

Price: $149 ($139 for ATA members)

We now have a new wireless weather station that measures not only wind speed and direction, but indoor and outdoor temperature, humidity, barometric pressure, and even rainfall.

The data is collected by two sensor packs that are connected to a wireless transmitter. This sends the data back to the base station every minute or so, which then uses the information to give averages, accumulated totals, maximums, minimums and trends of the various data.

The transmitter requires two AA batteries while the base station is mains powered, with three AA batteries for data backup. The base station does not have the facility to connect to a PC, so you can't download data, but it does just about everything else. *Item code: WIRELESSWEATHER*

1 watt and 5 watt Luxeon LEDs

Each 1 watt Luxeon LED is equivalent to a dozen or more high-brightness 5mm LEDs in light output.

With over twice the current draw and twice the voltage of a 1 watt LED, each single 5 watt LED is equivalent to up to 50 or more high-brightness 5mm LEDs in light output. Available in blue, green, cyan and white (**Note: the 5 watt white LED has a rated life of 1000 hours**). For more information, prices and to order, go to the ATA's website at www.ata.org.au or call the ATA on (03)9419 2440.

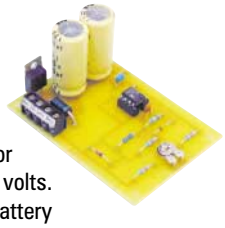
Now available: 3 watt LEDs and 1 watt warm white LEDs! See our webshop for details.

Luxeon optical collimators

Price: $10 each

This 25mm optic with holder solves the problem of how to attach the optics to the LEDs! Available in wide, medium and narrow versions.

Mini-maximiser kit



Our popular mini-maximiser kit will handle pumps up to 6 amps. The kit allows you to build the unit for use on either 12 or 24 volts. Note: not suitable for battery charging use! Price: $45 ($40 for ATA members). *Item code: MINIMAX*

30 amp speed controller kit

Price: $45 ($40 for ATA members)

This controller allows you to vary the speed of 12 or 24 volt DC motors from 0 to 100%. It is also ideal for controlling loads such as incandescent/halogen lamps and heating elements. It is ideal for use on small electric vehicle projects, such as electrically assisted bikes and go-carts.

We have tested it to over 30 amps without problems.

Item code: SPEEDCON

Maxi-maximiser kit

Price: 12 amp: $70 ($65 for ATA members), 20 amp: $80 ($75 for ATA members)

A larger version of the mini-maximiser which is available in 12 and 20 amp versions. The kit allows you to build the unit for use on either 12 or 24 volts. You must specify current rating when ordering. Note: not suitable for battery charging use! *Item code: MAXIMAX*

Simple 1 amp rectifier kit

This very simple kit allows you to build a rectifier for use with polarised LED halogen lamps or for polarity protection of electronic equipment. Uses four Schottky diodes to reduce voltage drop and includes a 1 amp fuse. $5.

Item code: RECKIT

Constant current circuit kit

Price: $8

This short form kit allows you to build a simple constant current circuit for driving LEDs from almost any DC voltage. It is available in four sizes, 20mA, 50mA (for the Superflux LEDs), 300mA (for the 1 watt Luxeon LEDs) and 650mA (for the 5 watt Luxeon LEDs).

Please specify which current rating you need when ordering.

Item code: CCBOARDxxx where xxx is the current rating in mA (020, 050, 300 or 650).

Superflux LEDs

Price: Red and amber: $2 each, green, blue and cyan: $3 each

The Superflux LEDs are about the best value for money available in LEDs today. Each 8mm square Superflux LED has the equivalent light output of several of the best 5mm LEDs, for the same or less cost as a single 5mm device! Available in red, green, cyan, blue and amber.

Chinese Superflux LEDs

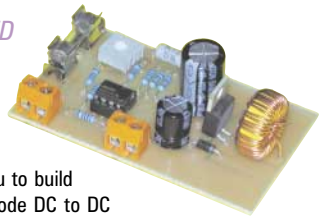
Price: Red and amber: $0.50 each, white, green, blue and cyan: $1 each

These are a cheaper Asian-sourced Superflux LED which are the same size and shape as the Lumileds Superflux, but not as expensive. Although they probably won't last as long as the Lumileds LEDs, they should be great for most uses.

LED halogen conversion kit

This kit uses three 1 watt Luxeon Star LEDs (or any 1 watt star LED such as Cree X-Lamps) and includes a rectifier and constant current circuit to drive the LEDs at the correct current. Note that the light output won't be equivalent to a 50 watt halogen lamp, but the kit uses less than 4 watts! Also note that you may need to replace your halogen transformers, as some need a minimum load of 10 watts. $20 each without LEDs, or $50 including three white Luxeon Stars ($45 for members) *Item code: LEDHALKIT*

Switchmode LED driver kit



Price: $30 ($25 for ATA members)

This kit allows you to build a simple switchmode DC to DC converter with either voltage limiting (for powering small DC appliances from up to 30 volts DC) or current limiting (for driving LEDs directly from up to 30 volts DC). The voltage or current is fully adjustable, allowing the one design to be used for a huge number of appliances or LED types, including the 1 watt and 5 watt Luxeon LEDs. Efficiency is typically over 70% on most input voltages.

Kit includes circuit board, all components and instructions. No case is provided.

Item code: SWITCHMODE.

Expand your *ReNew* collection

All available back issues $8 inc. postage within Australia. For a listing of what is in each issue, see the ATA's web site at www.ata.org.au. Issues available are: *Soft Technology* issues 31, 36, 37, 38, 39, 40, 41, 42, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55 and 56. *ReNew* issues 57, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 92, 97, 98, 99 and 100.

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101/07

News from the ATA branches

***ReNew* speaks to some regional branches of the Alternative Technology Association to find out what's been keeping them busy.**

Sydney West

Sydney West members are presently working on the EarthCare Building in preparation for the Sustainability Expo on 22nd September. The building features mud brick, rammed earth and strawbale walls, and is surrounded by native plant and permaculture gardens.

The expo offers tours of the building and gardens, industry displays (including a large ATA display), keynote speakers, workshops, food stalls and the opportunity for the public to have questions answered by experts in building construction, renewable energy and water management.

The Sydney West branch is located at the EarthCare Centre, University of Western Sydney, Richmond. For information on becoming involved in the Sydney West branch contact Jenny Dibley, (02) 6207 6430 or jenny.dibley@act.gov.au

South Australia

A high point of the SA branch's year is the Eco Living Festival, a two-day event now into its third year. This year the ATA accounted for ten of the 42 presentations. Topics covered by members were 'Retrofitting for sustainability', 'What to consider before buying a solar PV system', 'What to consider before buying a solar water heater', 'Building an energy efficient house' and 'An overview of global warming'.

Our volunteers included two professional house designers and other people who had retrofitted their homes for energy efficiency and all were kept busy answering questions about where to buy, what to do and how to do it. The most frequent topic for questions was greywater collection and use.

Above: The EarthCare Building, home to the Sydney West branch. Bottom: The ATA Cairns branch held a stall as part of the Putting the Chill on Global Warming exhibition.

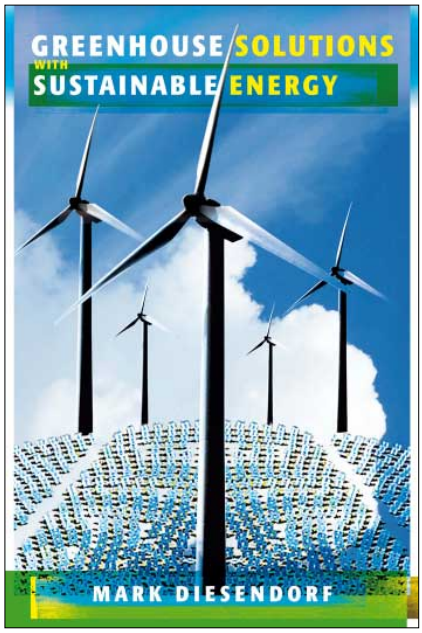
On display were our energy auditing kit for determining where energy and water are wasted in the home, our solar simulator that demonstrates good practice for passive solar design and our energy efficient lighting display. The lighting display was especially popular and relevant because the government had recently announced the phasing out of incandescent lamps. It was constructed by an ATA member using items donated by a major electrical supplier and compared performances and power consumptions of incandescent, fluorescent and LED lamps.

Cairns

The ATA Cairns branch joined forces with the emPower group to organise an exhibition called Putting the Chill on Global Warming. The event coincided with Al Gore's 7/7/2007 concerts. The ATA Cairns branch held a stall at the festival, held at an arts centre called the TANKS. Yes, it really is in a tank. The branch is also involved with the Queensland Sustainable Energy Industries Development Group's display trailer 'Tropical Solar'.

For more info about the ATA branches go to www.ata.org.au

[Book reviews]



Greenhouse Solutions with Sustainable Energy

Author: Mark Diesendorf. Published by UNSW Press. $49.95.

Greenhouse Solutions with Sustainable Energy provides answers as to why Australia is failing to act on the threat of climate change, and highlights just how inexcusable our inaction is. The book reveals in a scientific, but easy to read format, that Australia has all the sustainable technologies it needs to make deep cuts in our greenhouse gas emissions, and then details a comprehensive summary of how Australia can make the change. The logical, well thought out way Diesendorf addresses the myths around the economics and reliability of sustainable technologies highlights how far off the rails Australia's response to climate change is.

If you are confused about some elements of the debate on renewable energy, the economics or the options around sustainable solutions, then this book is a must read. It goes through the issues, the technology, and the arguments for and against, in a simple to understand and logical manner. For example, the chapter on macroeconomic models was a succinct summary (for the uninitiated) and helps to put the economic arguments against the uptake of renewables into context.

Diesendorf proposes policies that Australia could implement at state, federal and international levels that would substantially reduce our greenhouse gas emissions. He also covers individual and collective action that people can take to help the situation, and as Diesendorf eloquently writes, 'facilitate social change to achieve a better society and environment in the face of reluctance and even outright opposition by governments.'

It is a fantastic reference book and an uplifting read. If only every politician in this country would read this book, reflect on why Australia is not embracing sustainable technologies, then do something to change the current situation.

-Kate Allsopp

How Many Lightbulbs does it Take to Change a Planet? 95 Ways to Save Planet Earth

Author: Tony Juniper. Published by Quercus Publishing $29.95.

If media and politics have taught me anything this year, it's that saving the planet is important. Really important. So important, in fact, that I was compelled to buckle on my helmet and cycle to my local independent book shop in an effort to discover how I could go about taking part in some saving myself. Luckily, the world of publishing is keen to help me out. Rows and rows of relevant books, including the familiar yellow and black of *Sustainable Living for Dummies*.

Among the masses of books, you'll find gems such as Joanna Yarrow's *1001 ways to save the earth*, Phillipe Bourseiller's *365 ways to save the earth* and David Bellamy's *101 ways to save the earth*. If these sound exhausting, it will be with great relief that you find that Tony Juniper has come to the rescue with his handy little manual, containing an almost too brief 95 ways to save planet earth.

In the preface, Tony shares the reasoning behind this number. Apparently a period of rapid social and cultural change in the 16th century was in part due to ninety-five theses nailed to a church door by a German monk called Martin Luther. He criticised the religious orthodoxy of the age and described a better and more decent way. Luther's ideas spread quickly in a dissatisfied world and Juniper is hoping for a similar uptake of his ideas.

Juniper's ideas are thought provoking and intelligent. Some of them are reasonably tangible, such as *Solution 55, Ban free plastic bags*. Unfortunately, most of them lie way outside the reach of the average reader. For example, *Solution 69, Governments must agree on an international corporate accountability convention, to govern the activities of international companies more rigorously*. Now, I don't know what sort of readers Juniper is aiming at, but personally I feel a bit left behind by that little piece of advice. It's not quite as handy or helpful as *Solution 57, Save water (and drink less of it out of disposable plastic bottles)*.

Juniper's book is well written and appealing, particularly for those wanting to know what sort of policies they should be lobbying for, or what the government should be doing but isn't. But it's not a book for your average homeowner looking to make a difference at home. Perhaps the rest of us should have a flick through *'Sustainable living for dummies'*.

-Alicia Webb

Australian Solar Radiation Data Handbook (ASRDH)

Published by ANZSES

The latest release of the Australian Solar Radiation Data Handbook (ASRDH)—updating its third edition based on a continued user survey in 2003—brings to hand a most employable handbook containing monthly means of hourly and daily values of the climatic and irradiance data from the Australian Climatic Data Bank (ACDB). It averages the data of interest for solar applications into monthly-tabulated hourly profiles (climatic averages, clearness indexes and incident irradiance on horizontal, vertical, tilted and tracking planes) and consolidates the variables of an energy balance matrix with stochastic factors (for example, worst case weather scenarios like the period of consecutive days over which one can expect cloud cover).

It offers a sound *BestTest* validated information source in the research, design and evaluation of passive solar buildings (requires the solar energy received in winter through northerly glazing to be balanced with the heat lost through all opaque and transmissive surfaces and through ventilation), active and conventional solar heat gain in buildings, daylight design, solar hot water, pool heating, photovoltaic, industrial heat (concentration and/or tracking) and greenhouse scenarios.

I find it a most interesting tool for the query of solar ideas and applications, giving one quick and concise insight into their validity.

-Will Logie

Australian Solar Radiation Data Handbook (ASRDH) 948 pp, some colour pages.
Standard price: AUD$104 for one state or AUD$320 for all Australian sites (hard copy extra).
Associated AUSOLRAD software with manual. Standard price: AUD$40 for one state or AUD$80 for all Australian sites.
The ASRDH is available on CD-ROM and in hardcopy from ANZSES www.anzses.org or ph:(02) 9402 1638.
The ANZSES member discount of 20% has been negotiated for ATA members.

Washing machine power

I run a remote area power system using a Selectronic SE31 inverter. This inverter handles our Hoover Electra front loader washing machine without any problems. In time, the washing machine will have to be replaced. Is there a formula that can be used to calculate the peak demand of a washing machine's spin cycle from the information on the machine plate?

I don't want to buy a new washing machine in a few year's time and find that the inverter won't run it. Also, is there any website that lists washing machines that don't have inbuilt water heaters?

Lastly, is there a website that lists lower demand irons? Many of the irons in the chain stores are now rated between 1500 and 2400 watts. I use a travel iron (Go brand) rated at 700 watts, but it's not designed for normal household use. I used to have a Breville travel iron, which lasted for seven years, but I couldn't get parts for repairs.

Margaret Frederick
via email

There is no formula for this sort of thing, it depends on many factors, including the type of motor used in the machine, how it is connected to the drum (ie. is it a belt drive or a direct drive) etc.

As an example, the Asko machine I owned some years back used a DC motor connected via a belt drive. While the average energy use was quite low, the startup current for the spin cycle was huge—6000 watts peak or more. In contrast, my newish LG machine has a direct drive motor. I have run an energy meter on it and the peak power measured was just 650 watts.

From what I have seen, machines are generally getting better in this respect, certainly the direct drive units seem to be the way to go as the motors are driven directly by 3-phase controllers, which have to handle the full motor load, so the manufacturers try to reduce the peak load as much as possible.

All front loaders seem to have inbuilt heaters, but you need to find a machine that has a true cold cycle. My LG does, I always wash in cold water, the hot water tap is generally left turned off. As an example, a full load on the normal cycle uses 120 watt-hours (approx) and the quick 30 minute cycle uses around 60 watt-hours, so clearly there is no water heating going on there or the figures would be much higher. My machine is an WD8026, but that doesn't seem to be available now; the WD8015 seems to be the closest to it. Of course, all of the models will have changed in a couple of years.

I'm sure there are plenty of brands out there that have true cold cycles, but asking the staff in the average whitegoods store is like Russian roulette, most of them just make it up as they go along I think!

You could check out the energy ratings website (www.energyrating.gov.au) as there are energy figures listed there, although most machines don't have a cold wash figure listed for them.

Lance Turner

Write to us!

We welcome questions on any subject, whether it be something you have read in *ReNew*, a problem you have experienced, or a great idea you have had. Please limit questions to 350 words.
Send letters to: *ReNew*, Level 1, 39 Little Collins St, Melbourne VIC 3000, renew@ata.org.au

Grid-connect or stand-alone?

I have just had a read of your very thorough report on the impediments to private PV electricity production. As someone who is contemplating installation of a grid-connected 2kW system, some questions spring to mind:

Our meter is 40 metres from the road frontage, but 240 metres from the fuse panel at our home where our circuits connect. Since this would presumably also be the point of connection for the inverter output, we could theoretically consume our 'home-made' electricity as it reaches that sub-panel. Ideally, we would also be able to consume electricity (from the inverter) while the grid is down—but I have been told that inverters automatically shut down 'for safety' on losing grid connection.

Now, one would have thought that a simple device at the sub-panel or even the meter could reliably shut down the grid connection in such a condition, allowing us to use the PV electricity when there is a blackout during the day.

In sizing the system, we (two old-age pensioners) have deliberately chosen a capacity that would produce roughly twice our daily consumption of 4.5kWh. In this way we might at least be able to use some form of low-consumption fan heater. (It is now around seven to 10°C inside the house during the day, somewhat less at night) And we have selected energy-efficient appliances where available.

The hassles experienced by your respondents make us despondent—perhaps we should forego grid connection and opt for a stand-alone system? At least until the government/regulator cleans up the regulations a bit, and perhaps even mandates proper feed-in tariffs.

Can one cancel one's contract with the supplier, Country Energy? They have started hiding the so-called 'access fee' in the overall consumption billed, minus the pensioner rebate, of course.

I wonder what your thoughts are on these matters. This might better prepare me for my initial contact with the supplier.

L.M. Huesch
lutz.huesch@gmail.com

In general, grid interactive inverters will shut down when the grid fails. This is called anti-islanding, and is done to prevent the house powering a grid line that linesmen would otherwise think was powered down. If the inverter just

disconnected itself from the grid but continued to try and power that house, it simply wouldn't work as the power available from the (often varying) solar panels is unlikely to match the house demand, which also varies from minute to minute.

However, there are grid interactive systems that use battery backup that can do exactly what you want. We have a system like this at our building, the Solar Workshop, on the CERES site in Brunswick. It uses a Trace (now Xantrex) SW3024 grid interactive inverter/charger, which basically does everything, including controlling a backup genset, as well as isolating the workshop system from the grid when power fails. It all works pretty much transparently, and if you use sealed batteries you won't even have much battery maintenance to worry about.

Of course, this sort of system is a lot more expensive than a straight GI system, as the inverter costs more and there is the cost of the battery bank, extra cabling etc. Also, the system is a bit less efficient as there are battery charging losses, and the solar panels are used to charge the battery bank rather than connecting to the inverter. A normal GI inverter uses maximum power point tracking to get the most energy out of the panels. The Trace and most similar inverters have no control over the battery charging from the solar panels, you normally use a separate solar regulator for that.

As far as your electricity supplier is concerned, if you haven't signed a fixed term contract then you can change to any electricity supplier you like, as we now have full retail contestability, which just means you can choose who you like, regardless of who owns the local infrastructure. Origin Energy seem to be the easiest people to deal with for GI systems, and they give the best price for excess energy generated.

Lance Turner

Grid-connected solar

I'm hoping you can help me with some advice. We are going to install a grid-connected solar system in our house. The website www.greenhouse.gov.au/yourhome/technical/fs47.htm says that the best angle for a grid-connected system is latitude minus 10 degrees. We are near Taree (mid north coast of NSW) with a latitude of 32°, so I guess that makes our best angle 22° which is about the pitch of our roof. The guy who will probably install our system says the best angle is 35°. Which is correct? I'd be disappointed to have it installed and not get the maximum benefit for the full year but don't want to insist on 22° if he is correct. I contacted the Greenhouse Office but they suggested I contact you.

Kath Maze-Neeley
maznee@tpg.com.au

The Your Home Technical Manual *is correct—latitude minus 10°. Steeper angles are used for stan-alone systems to provide more energy in winter when it's needed. However, having an angle which is sub-optimal has surprisingly little impact on the power output of a solar power system.*

If you have a north-facing roof most installers mount the panels straight on the roof. This looks better and substantially reduces the cost of the framing system. Doing a custom frame and installation could add $1,000 to $2,000 to the cost of a system for a benefit of one or two percent in increased energy output. You would be better to spend the extra cost on more solar panels. So, you should keep the installation simple by mounting the panels straight on the roof and save yourself the cost of extra framing.

Mick Harris

Notes and errata: *Issue 100*

In the Pears Report it stated that the Democrats demanded almost three to four billion dollars funding for sustainable energy in 1999 during GST negotiations. This was incorrect, the figure was actually three quarters of a billion dollars.

Energy-efficient refrigerators

In his book *Heat* George Monbiot says on page 75 'A fridge or freezer which uses vacuum-insulated panels to stay cold burns about 12% of the energy of the average model used today' and continues 'but simply cannot be found for sale through the usual channels in the United Kingdom.'

How about in this country?

Dick Varley
dick.varley@bigpond.com

I had a look around and could find very few vacuum-insulated units anywhere, let alone in Australia. There were a few available in the USA, but mainly for the RV market.

However, I came across a website with a great fridge design which uses vacuum insulation and several unique features, although it isn't in production yet. See www.reorient.com/coolview

Lance Turner

Classifieds/ Suppliers Directory

When selecting an installer get 2 or 3 quotes and check accreditation/references. § = ATA Member discounter.

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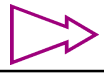
Home exterior/ interior



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