ReNew

Technology for a sustainable future

Issue 136

AUSTRALIAN-MADE SPECIAL

Beauty of bales

Build your own strawbale home

PLUS

Unlocking the value of batteries

Life after feed-in tariffs

Eco-paint buyers guide & more

Issue 136 July–September 2016
AU $8.95 NZ $9.90
www.renew.org.au
ISSN 1327-1938
03
9 771327 193010

Homegrown tech: leading the world
Textiles and clothing: recycling options
Community energy: projects in progress

WIN

a Daikin US7 super-efficient 7-star reverse-cycle air conditioner

*Australian and NZ residents only; details p80

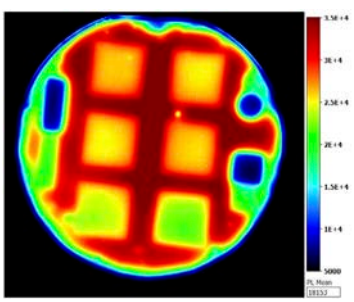
Contents
Issue 136, July – September 2016

Read more articles at renew.org.au
Follow us on Twitter: twitter.com/ReNewMagazine
Like us on Facebook: facebook.com/ReNewMag

Homegrown design and tech
Investing in innovation, solar leading the world and more

↑ Thinking about building with straw? Meet like-minded people while learning how to do it yourself at a strawbale workshop. Page 24.

↑ Being a city dweller doesn't mean you have to be out of touch with nature. Discover the rewilding movement. Page 38.



↑ Australian solar technologies have led the world for decades. We take a look at some of those advances and see where PV manufacturing is headed. Page 50.

Features

↑ Solar One was Australia's first grid-connected solar home. Check out this piece of solar history. Page 46.

Special feature: Australian-made

↑ Cultivating grain is not a modern concept. Learn how it was done millennia ago. Page 48.

← **Cover image courtesy Viva Living Homes: It takes a community to build a strawbale home!** A lot can get done in a four-day building workshop when you've got a team like this. As one of the owners of this home, Andy Stevenson, notes, a great thing about strawbale building is the community-minded people who get involved with "dirty, muddy, earthy hands, connected to the materials and each other in a way you don't get with a traditional build." In this issue of *ReNew*, we cover the building workshops that can help make your strawbale dream a reality, alongside three case studies, starting on page 24. Community also features strongly in our Australian-made theme starting page 42, with articles on investing in innovation, community energy and much more.

Guides

Eco-paint Buyers Guide

↑ Factory-built homes have many advantages over on-site builds. Page 70.

Regulars

Editorial

Aussie, Aussie, Aussie! Homegrown design and tech

CHEERING on Australian-made research and production in this issue has proved something of a conversation starter. Everyone has a favourite product or company, or an opinion on what we're doing well or not so well. But the 'we' has stumped me at times: against a backdrop of stalled climate policy and the way the on-again, off-again support for renewables has affected the industry, it can be hard to speak proudly of that 'we'.

Yet there is a story to be told of innovation (an overused word perhaps!) in Australia that is slightly different from the one we often hear. The stories of lost commercialisation opportunities and industry heading overseas are certainly one strand, but there's also a (very *ReNew*) story of DIY activists getting a renewables industry started in Australia, of researchers leading the world in solar cell design—with the Australian-invented PERC cell now featuring on about half of new solar cell production lines—and of a fast-growing community energy sector taking on the unique challenges of the Australian energy market, making projects work, then advocating for change to make them work better. And, of course, of architects slowly, slowly bringing sustainability into the mainstream of building design. Sustainability is another overused word, but it's been exciting finding these stories of research, investment, production and development.

It's not all about energy or household systems. One of the best stories comes from Bruce Pascoe, based on the research for his book *Dark Emu*. The oldest grain grinding stone in the world has been found in Australia, evidence of breadmaking 12,000 years before the Egyptians. As Bruce asks, why don't "our hearts fill with wonder and pride" in such innovation?

There's much beyond our Australian-made theme. Building with strawbales is one, with guidance on the workshops that can help, and case studies on people who love their houses 'built of straw'. We look at the important issue of keeping textiles out of landfill, and we also cover ways to reconnect with nature in the city. A reader tests whether battery-powered leaf blowers can compete with petrol ones (many may think that the job could be done with a broom, but the author suggests otherwise), and we look at what to consider to ensure you buy or build the most efficient computer possible. With gaming PCs using up to 350 watts just for the graphics card(s), it's particularly important information for parents of young gamers!

Many households are about to lose their higher feed-in tariffs, so we (via the ATA, *ReNew*'s publisher) look at what solar customers should do. Finally, our buyers guide this issue is on eco-paints. It's a good news story with many sustainable changes in the industry since our last buyers guide in *ReNew 107*, including a new scheme for recycling paints. It's a packed issue, enjoy!

Robyn Deed
ReNew Editor

In *ReNew 137*, out late September
A focus on off-grid and hybrid systems.

THE Australian-made green innovations in this issue of *ReNew* are a great testament to home-grown ingenuity. The ATA has been fostering sustainable technology since 1980, when a group of enthusiasts concerned about fossil fuels and pollution came together to form our organisation. Their can-do, practical approach has been at the heart of the ATA ever since.

The ATA has had many Australian firsts including owning a community wind turbine at Breamlea in Victoria, national sustainability education tours with our energy-mobile and Australia's first trial of greywater systems in response to growing interest in water saving during the millennium drought. We also led the way in making it easier for home solar systems to be connected to the grid by actively lobbying for consistent agreements and financial incentives. The now 1.5 million households in Australia with rooftop solar have benefitted from the ATA's pioneering work.

And the innovations continue: we played a key role in the installation of a 36 kilowatt solar system at the Kurrawang Aboriginal Christian Community near Kalgoorlie in WA. The project showed how you can be creative with community energy and impact investment for community and environmental benefits. Thanks go to ATA member Robin Gardner, who was instrumental in the success of the project.

ATA members were also instrumental in developing and assembling the new Village Lighting Scheme solar system that will be installed this year on hundreds of homes in East Timor as part of the Google Impact Challenge grant. Special thanks to Alan Hutchinson and Patrick Eijsvogel for their huge effort on the new system design, and the many volunteers involved. In recognition of our work in East Timor, the ATA recently won a United Nations Association of Australia World Environment Day Award!

Donna Luckman
CEO, ATA

A house built of straw
Learn how with a strawbale workshop

You're unlikely to go from building newbie to strawbale expert after a four-day workshop, but you should come out with basic skills, a better understanding of the process and the 'right' questions to ask. Enga Lokey explains.

Image: Viva Living Homes

↑ Making half bales at a strawbale building workshop.

THERE are many good reasons to choose to build with strawbales—better thermal performance, non-toxic material, agricultural waste product, low embodied energy, very high levels of insulation, beautiful curved walls, etc. But once you have made this decision, it may be difficult to find an architect, engineer and builder to provide the assistance you require in working with this unique medium.

One of the best ways to give yourself the knowledge and skills necessary for a successful build is to do a strawbale workshop. If you have no prior architectural or building experience, a workshop won't prepare you to undertake your own project from start to finish unassisted; however, you will be able to gain enough understanding to ask the right questions of the professionals you choose to employ and also gain basic strawbale building skills yourself.

What should you look for and what should you expect from a workshop? At the most basic level, participation in a workshop should provide you with enough of an understanding of what you are getting yourself into to confirm your convictions or prompt a reconsideration of your building plans. Additionally, most workshops will give you hands-on experience with some of the unique aspects of building with bales, such as alternative framing techniques, bale tying, stacking walls and corners, prepping for render and rendering.

There is a huge variety in the offerings available. Before signing up for a workshop, ask yourself what you are looking to achieve and what level of participation you plan on having in your own project. The more you expect to do yourself on your own house, the more detailed and precise your level of understanding needs to be. Are you just interested in understanding the process so you can decide if this is the type of house you want to build? Are you interested in the theory and principles of good strawbale design? Do you want to participate in every aspect of the building process or just help with the bale walls and rendering? Asking yourself these questions will make it easier to pick the correct one.

Some of the major differences between courses are discussed below, followed by a chart that tries to summarise the various options on offer.

In person or online?

One initially thinks of a strawbale workshop as something that is done in person, and that is the most common approach; however, there are also at least two excellent sources of extensive online and DVD instruction (listed in table). One advantage of an online course is that there is opportunity for plenty of theory and the demonstrations are best-case examples. There is also opportunity to pause, rewind or review anything that wasn't clear and to refer back to it when needed during your building process. With this in mind, if you do an in-person workshop, I would suggest taking lots of pictures and notes for later reference. It is amazing how much of the specifics you will have forgotten after a few months.

Theory or practice?

The proportion of theory to practical hands-on skills training can vary considerably. Workshops that call themselves 'courses' tend to be more theory and the hands-on component is often working on something specifically for the course, while 'wall-raising' workshops may have almost no theory and participants will work on a real building. Many workshops incorporate some general design

Case studies
Owner-built strawbale homes

Robyn Deed talks to three owner-builders about how workshops helped their strawbale building.

Case study 1: Bayside Brisbane

"I thought about having a workshop to help build my own house, but I got too selfish!" says Kurt Piccardi. "Building with strawbales is the fun part, it's nice to do." It's also a relatively quick part of the process. It took just a couple of weeks to put up the bales for his own house in bayside Brisbane, yet the whole project took about three years, one month and 21 days, "but I'm not counting," he says.

Kurt is an architect and also has a permaculture background, which is what led him towards straw. He liked the idea of reusing a waste product, such as straw. He began with an experimental granny flat on his own property in 2007, built using load-bearing construction.

Straw construction can be load-bearing or infill—in the latter, a standard framed construction is used, with the strawbales simply providing insulated infill. Which approach works best can depend on how much rain you're likely to have during construction, says Kurt; in his granny flat build, rain wet the top layer of bales and they had to be replaced. With straw used as infill, you build the frame and roof first, so the strawbales are protected during construction. "Load-bearing can work well though, in a drier climate like in western NSW," he says, though he also notes that building engineers generally prefer infill.

He went on to build two more straw buildings for himself: an office and finally his family's home (completed in 2013), both using an infill approach. He's gone on to specialise in alternative building materials including strawbale in his architecture practice, Studio Green Architects, and he's a member of Ausbale, a group aiming to further strawbale construction in Australia and NZ.

He learnt his strawbale skills through workshops. He went to a five-day workshop run by Huff 'n' Puff Strawbale Constructions and two or three wall-raising workshops, where you're helping out on someone else's build. He had the design skills through his architecture background, and an understanding of building, but through the workshops he gained knowledge of straw and just how easy it is to build with. "Anyone can do it," he says. "It can be very empowering to realise that."

↑ Kurt Piccardi's owner-built strawbale home in bayside Brisbane.

The worst part? "Rendering!" he says. It's hard work, applying 50 mm of render in three coats on springy straw walls. "It almost killed us doing that for the granny flat and office," he says, so for their house they paid someone to do it. Even the commercial company took four to five days per coat, with one person doing mixing and two rendering, with a trowel. A pump to spray on the render can be quicker and penetrate a bit better, he says (the company did have a pump, but it wasn't working for much of the time).

The house is brilliant to live in, says Kurt. They rarely use heating (a small bar heater is required by some family members!) and have only fans for cooling, in a climate that gets seven days of frost per year and gets up to low-to-mid-thirties in summer. It's a different climate from central Brisbane, closer to the bay, with both cooler temperatures in winter and a sea breeze in summer, though still humid. They have two or three "stinking hot" nights a year and they just cope with that. The insulation factor is great (R8), though he says the building could be better sealed—"but we like to live like that, with fresh air and everything open." ✱

↑ Kurt giving the bales a 'haircut' prior to rendering.

Life after FiTs
What to do when your feed-in tariff expires

With feed-in tariffs about to drop dramatically for many, what's a solar household to do? ATA's energy analysts Damien Moyse and Nick Carrazzo discuss six steps to consider.

BY THE end of 2016, more than 275,000 households with solar PV across NSW, Victoria and South Australia will receive much lower payments for their solar exports to the grid, as several premium feed-in tariff schemes expire. A key question for these households is how to mitigate the financial impact of the reduced feed-in tariff.

Feed-in tariffs are likely to drop to around 5 to 10 c/kWh for these customers, from around 16 to 60 c/kWh. Full details of the schemes affected and the likely new feed-in tariffs are shown in Table 1.

This article considers how to maximise the return for solar generation given low feed-in tariffs. Many of the considerations here apply not only to these existing solar homes, but also to new solar homes as these will also receive these lower feed-in tariffs.

1. Ensure the correct metering

An important first step for the solar homes about to lose their premium feed-in tariff is to ensure they are using net metering (also known as import/export) rather than gross metering. Net metering recognises the use of solar electricity on-site to reduce more expensive imports from the grid. This isn't possible with gross metering.

Victoria and SA both used net schemes, so a metering change is not required for solar customers in these states.

In NSW, the Solar Bonus Scheme offered a gross scheme. Given the new reduced feed-in tariffs—much lower than the grid rates charged—affected NSW customers will need to change to net metering to maximise the financial benefits of their solar system.

The costs and technical requirements to switch from gross to net metering for Solar Bonus Scheme customers are still under discussion and vary depending on the distribution area (to work out which distribution area you are in, see www.bit.ly/1U6pk0i). As at May 2016 the situation is:

- Endeavour area: Customers will need to install a new meter, at a cost of about $600 if done by the distributor; costs of subsidised options via the retailer are unclear at this time.
- Essential Energy area: Instead of a new meter install (costs similar to Endeavour), customers may be able to use their existing solar meter with a minor wiring adjustment, at an estimated cost of $150, but Essential Energy has not yet confirmed if they will accept this solution.
- Ausgrid area: Instead of a new meter install (costs similar to Endeavour), Ausgrid has confirmed customers can use their existing solar meter after a minor wiring adjustment, at an estimated cost of $150. Ausgrid has also proposed they could use the two existing gross meters to calculate net energy flows, but it is unclear if retailers will accept this option; if this is accepted, no meter change would be required.

Retailers may also offer a subsidised or even free net meter for solar customers. However, at this time little information is available on how much this will cost or the range of tariffs and contracts the retailers will offer in lieu of these subsidised meters.

As noted, the exact solutions on offer are still unclear so ATA advises that customers should review all options at the time of the closure of the scheme, particularly the zero or low-cost options. The last resort should be to request the local distributor to install a net meter at a cost anywhere near $600.

Note: whether the solution ends up being the replacement of the meter, rewiring or changes to billing arrangements, if these solutions are being offered through an energy retailer, then the customer must ensure they understand the full implications of agreeing to a particular solution as this may have implications for that customer's retail tariff or other related considerations.

Image: Lindsay Edwards Photography

↑ More than 275,000 solar homes in Australia will be affected by reduced feed-in tariffs as several premium feed-in tariff schemes expire in 2016. The ATA, *ReNew*'s publisher has recently completed modelling and analysis to help advise consumers during this transition.

Mottainai vs methane
The case for textile recycling

Sarah Coles explores the environmental and social benefits of diverting textiles from the waste stream, looks at industrial fabric recycling and takes inspiration from the Japanese practice of maintaining clothing for a lifetime.

IN THE 1965 film *The Sound of Music*, while the Captain is away in Vienna, Maria makes playclothes for the children out of old curtains. Perhaps taking this iconic filmic moment of upcycling as inspiration, my mother made a kaftan out of bright orange curtains in the 70s. "I was up there with the fashion," she says. The orange kaftan was both fashionable and ethical, it seems.

According to the Australian Bureau of Statistics, Australians throw out approximately 570,000 tonnes of leather and textiles per year, only 12% of which is recycled. This means each year roughly 500,000 tonnes of leather and textiles end up in landfill in Australia. Once textiles are in landfill they decompose and release methane, a harmful greenhouse gas. Dyes and other chemicals may leach into the soil, potentially contaminating groundwater.

The ecological and social burden of new clothes is well documented. The introduction to the 2013 book *Sustainability in Fashion and Textiles* reads: "Considering the whole textile chain, from spinning to finishing... large amounts of water and energy are used and, in general, non-biodegradable wastes are produced." According to the report 'The State of the Apparel Sector 2015', it requires 2720 litres of water to produce one new white cotton T-shirt. In the textile manufacturing sector, sweatshops and child labour are prolific, and working conditions abysmal. The fashion industry promotes continual consumption; according to a Food and Agriculture Organisation (FAO) report, worldwide demand for textile fibres was 69.7 million tonnes in 2010. In short, the textile industry is brutally unsustainable.

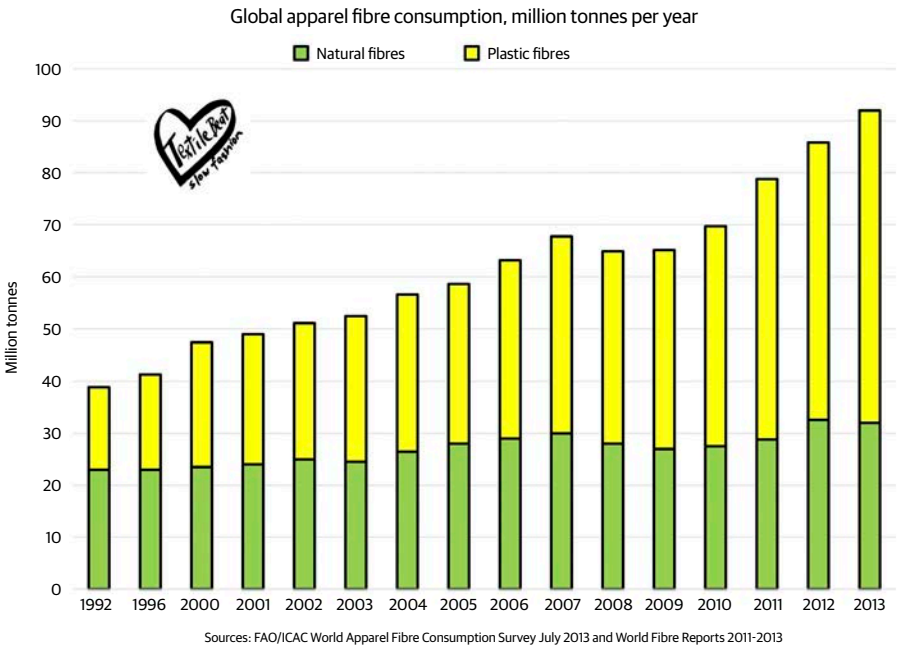


Image courtesy Textile Beat

↑ Global textile consumption is increasing. Jane Milburn from Textile Beat quotes figures from FAO, "On a global average, individual consumption has gone from 7 kg per person of apparel fibre per year to 13 kg per person. That figure is what you're adding to your wardrobe."

In a 2006 report by the European Science and Technology Observatory, 'Environmental Impact of Products', clothing accounts for between 2% and 10% of consumers' environmental impacts. A great deal of what we throw away can be reused and recycled. Significant environmental savings are achieved by choosing recycled textiles over new clothing. A 2010 report by researchers at the Technical University of Denmark 'Environmental benefits from reusing clothes' looks at the life cycle impacts of clothes that are disposed of by incineration compared with that of clothes that are reused by charity groups. (Incineration is a common waste management practice in some countries, where space for landfill is at a premium.) According to the report, reuse of textiles saves 4 kg of CO_2 for every kilogram of textiles saved. Although incineration is less common in Australia, textile waste in landfill still forms leachate and methane gas as it breaks down.

One method of diverting clothes from landfill is donating them to an op shop. Members of the National Association of Charitable Recycling Organisations (NACRO) operate thousands of op shops around Australia and are the largest and oldest recycling/reuse cohort in the country. Kerryn Caulfield, CEO of NACRO points out, "While

Getting back to nature
Rewilding in the city

With technology-focused jobs and lives, we risk losing touch with nature. Claire Dunn explores simple ways to reconnect via urban 'rewilding'.

FOR the vast majority of human history, our environment has been predominantly natural. In a historical tipping point, however, more than half the world's population now lives in urban areas, a proportion that is expected to increase to 66% by 2050 according to a 2014 UN report[1]. We are stacking high and wide in high-rise apartments and suburban sprawls, in a scramble for housing, jobs and resources, in a life that is increasingly devoid of green. The nature most of us now get on a daily basis is seeing a rat or a pigeon. An ABS report in 2003 found 98% of Australian children spent most of their recreational time out of school hours watching TV or videos[2].

American journalist Richard Louv coined the phrase 'nature deficit disorder' to describe the experience of today's generation of children who are missing out on time playing in nature. His book *The Nature Principle* applies the same thinking to the adult world of work and leisure.

Richard's research suggests that in disconnecting from nature we are losing a fundamental source of wellbeing, and perhaps even an essential element of our humanity. How can we maintain our connection with that world we evolved in, as we plunge ever deeper into a man-made technological landscape?

The 'back to the land' movement of the 1970s was an early response to the trend, but available only for those with the opportunity and the predisposition to live simply and in a remote location. More recently, a movement known as 'rewilding' is reframing the project of reconnection to incorporate city living. Originally referring to a conservation biology strategy of introducing top-order predators to a wild landscape, rewilding now also refers to the human movement of returning to a more 'original' or 'wild' state of being.

Image: Emily Herring

↑ Garlic farmers on the edge of the city in Bundoora, Melbourne. Farmer Incubator is using garlic as their first crop to connect locals with growing food.

Popular US rewilding podcaster Daniel Vitalis defines rewilding as "strategies for genetically ancient humans to thrive in a modern world, awakening our instincts, freeing our bodies--and minds—from the degenerative effects of domestication."

Though often associated with traditional skills and knowledge of wild plants and animals, rewilding asks us to redesign and reconsider our lives with "full aliveness" as the mission statement, rethinking everything from our diets and footwear to where to place our attention. Rather than wilderness, rewilding asks us to think more in terms of wildness, reconsidering our individuality and our wider human and ecological relationships.

Finding the wild where you are

Moving back to Melbourne to be closer to her family after a year living on an organic farm in New Zealand and prior to that at an environmental education centre in East Gippsland, Melissa (Mel) Turnbull was full of

Still a clever country
Australian innovation in sustainability

Energy efficiency consultant Geoff Andrews admires Australian innovation, but, as has often been noted, finds the next step—commercialisation—is lacking. Collaboration, governments and risk-taking could all improve that, he suggests.

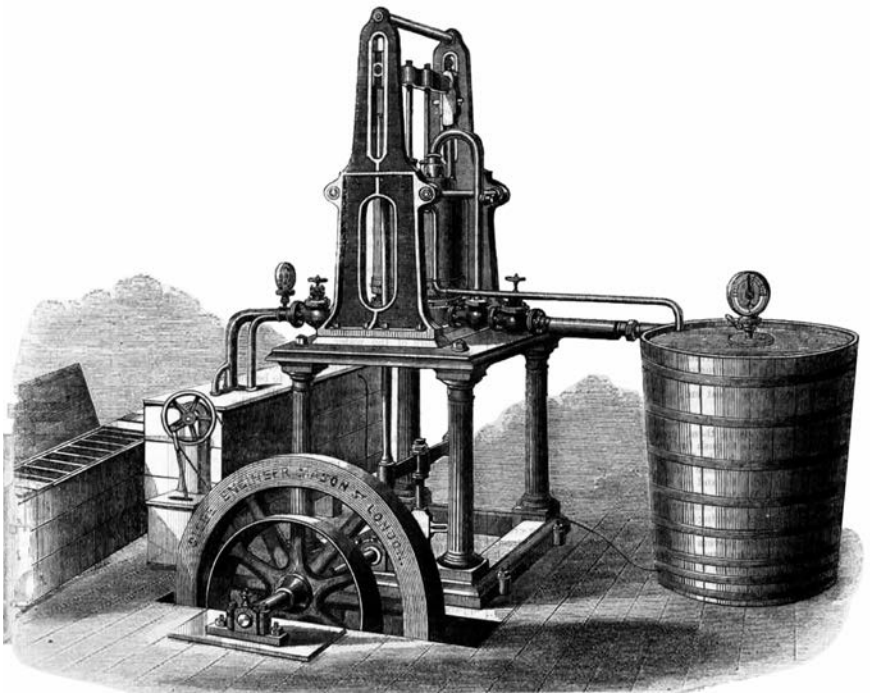


Image courtesy The Engineer

↑ James Harrison designed and built one of the first successful ice-making machines in Geelong, Victoria, and went on to commercialise his design. Parts of one of his early working machines have been recovered and are planned for display at a museum in Geelong (a working model is on display at Scienceworks in Melbourne, driven by electricity rather than steam, and without the refrigerant). James worked in printing in Scotland and established and edited the Geelong Advertiser; it's the printing link that led to his discovery: he noticed that sulphuric ether, a fluid used to clean the printing type, left the type freezing cold as it evaporated, thus paving the way for its use as a refrigerant in his invention.

I VIEW innovation as change for good, so change which improves sustainability clearly qualifies. Most readers of *ReNew* would agree that we have to improve the sustainability of our society, so we must innovate. But, how do we do that, and what lessons can we draw from Australia's sustainability innovation performance to date?

There is no question that Australia has provided the world with more than its share of innovations, including in sustainability. In renewable energy alone, Australia has led the world in PV efficiency for decades, pioneered many improvements in solar water heaters, and is now developing wave energy. We've been first or early implementers of two flow battery technologies (vanadium redox by Maria Skyllas-Kazaco at UNSW in 1980 and zinc bromine by RedFlow). Scottish-born James Harrison built one of the first working refrigerators for making ice in Geelong in 1851 (before that, ice was imported from Canada), and we invented wave-piercing catamarans and the Pritchard steam car. We even had manned (unpowered) flight by heavier-than-air craft a decade before the Wright brothers with Lawrence Hargrave's box-kite biplane.

Of course, Australian innovations are prevalent in many other sustainability areas including medicine, construction, agriculture and fisheries, but space is limited here. What we could have done a lot better is commercialising those innovations in Australia. Imagine if Australia led the world in the manufacture of solar panels, refrigerators, air conditioners, wi-fi devices and evacuated tube heat exchangers, the way we do with wave-piercing catamarans and bionic ears.

Improving commercialisation would provide funds to improve our budget bottom-line and allow us to do even more innovation and more commercialisation. To achieve this, I think we need to do several things.

Collaborate more, and I don't just mean between industry and universities. We need to talk about and work on our ideas with friends, colleagues and potential funders and collaborators (with appropriate IP protection), and accept that a small piece of a huge pie is better than 100% of a brilliant idea that goes nowhere.

Build the innovation and commercialisation eco-system, including both physical infrastructure (incubators etc.) and systems (standard agreements, networks of innovators, investors (Angel investors, venture capitalists, banks, ethical funds, green superannuation and government), and service providers such as IP professionals, designers and manufacturers.

Be brave, accepting that a low success rate with some spectacular successes will result

From engineer to activist
A renewables industry is born

ATA member Trevor Berrill has been involved in the renewables industry in Australia since it began, as an engineer, academic, trainer and 'alternative technologist'. He gives a personal take on the slow emergence of an industry.

Image: Richard Gifford, www.flickr.com/photos/rgifford

↑ The White Cliffs solar power station in NSW, constructed in 1981, was Australia's first solar power station.

MY OWN interest in alternative technology sprang from disillusionment with the engineering education I'd received at QUT in the early 1970s. It was a time for challenging the establishment, but engineering seemed all about fostering the status quo. I worked as assistant to the maintenance engineer in a coal-fired power station near Ipswich, and also down Mt Isa Mines. I saw and smelled the pollution, and I wasn't impressed.

I entered an essay competition on energy futures run by Engineers Australia. My essay outlined a decentralised power system run from renewable energy. I came second in the competition. The winning essay promoted the status quo, more fossil fuels.

There had to be a cleaner, greener way. With Friends of the Earth, I was involved in activism, campaigning hard against nuclear power. But I thought we shouldn't just be against something; we had to present an alternative energy future.

Then I was given a copy of *Radical Technology*, edited by Godfrey Boyle and Peter Harper. Therein lay the foundation of a future I could believe in—renewable energy, energy-efficient buildings, organic food production and sharing resources in self-sufficient, ecologically sustainable communities.

Defining alt tech

It was one of those editors, UK scientist Peter Harper, who coined the term alternative technology, to refer to "technologies that are more environmentally friendly than the functionally equivalent technologies dominant in current practice." Peter went on to be a leading researcher and educator at the Centre for Alternative Technology in Wales, a centre that's been showcasing sustainability since 1973.

Birth of an alternative technologist—and an industry

I went on to become a technical officer at the University of Queensland in the mid-1970s, and there I worked for leading academics in renewables research, Dr Steve Szokolay, a solar architect, and Neville Jones, a wind energy researcher. We tested solar collectors and built low-speed wind tunnels, an artificial solar sky and controlled environment rooms. In my spare time, I became an 'alternative technologist' at home, building solar water heaters, pedal-powered contraptions and small wind generators—perhaps in common with many ATA (*ReNew*'s publisher) members!

Then I got invited by Adrian Hogg, owner of Alternatives to work part-time designing and installing small PV systems throughout south-east Queensland. Adrian was a founding member of ATRAA, (the Appropriate Technnology Retailer's Association of Australia) along with Stephen Ingrouille and Tony Stevenson (Going Solar in Melbourne), Brian England (Self-sufficiency Supplies, Kempsey) and Sandy Pulsford (Solaris Technology, Adelaide).

These business owners were leaders in the

Making batteries viable
Boosting the value of storage

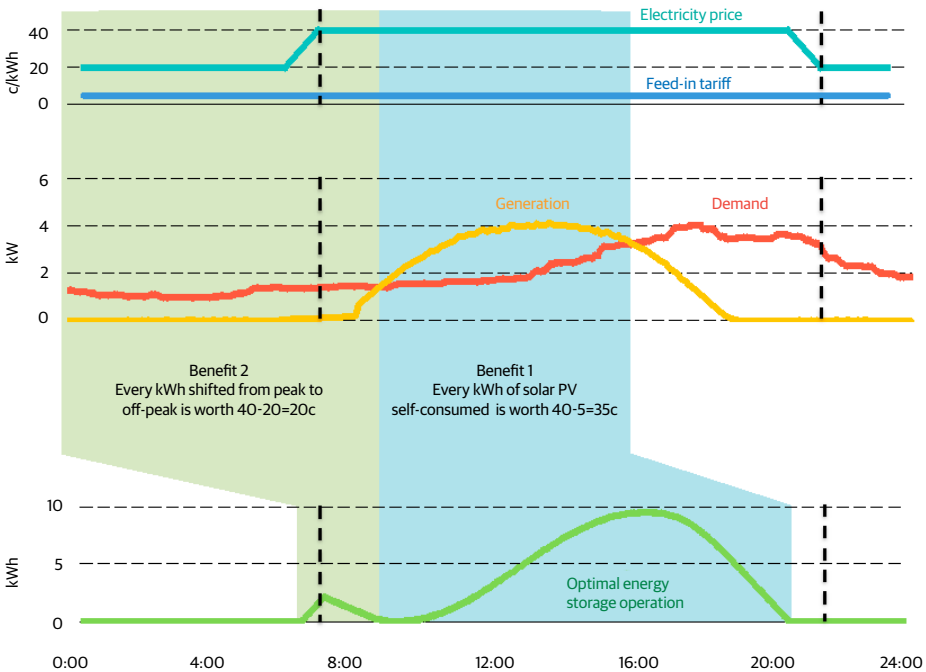
Julian de Hoog and Khalid Abdulla explain how energy consumption and weather forecasting can improve the financial equations for domestic energy storage.

MANY residential householders are now exploring the possibility of installing energy storage in their homes to reduce their electricity bills and better manage their energy needs (see 'Energy Storage Market Heats Up' in *ReNew 135*). This is true in particular for solar PV owners currently benefitting from feed-in tariffs that are due to expire: from January 2017, hundreds of thousands of customers (in particular in Victoria and New South Wales) will receive considerably less for any energy exported to the grid, making the idea of storing excess energy for later use more attractive.

The excitement and interest isn't just limited to residential solar PV owners though—across the energy industry there is an expectation that large batteries and other forms of energy storage will be installed at increasing rates. Many industry analysts predict that the rate at which energy storage is taken up will be greater than the rate at which solar PV was taken up at the same stage of technology maturity, suggesting that an energy storage boom may be imminent.

However, energy storage still remains a fairly expensive proposition and householders looking to install a battery can expect to spend $10,000 or more, even for relatively small systems. As with solar PV, these costs will come down with increasing uptake and technology developments, but for at least a couple of years the cost of a battery will be hard to justify in most cases. The same is true for many utility-level and large-scale energy storage projects.

However, the economic case for batteries may be improved significantly using 'value stacking'—in other words, using the battery for as many different benefits as possible. At the utility level, this means that the cost of a battery may be justified if it can be used for several of the following: shifting peak load, regulating frequency, managing voltage, and deferring network investment—all of which basically mean reducing the cost or improving the reliability of the network.



↑ Figure 1. A common tariff structure (top) and averaged demand and solar generation (middle) for a typical customer in NSW. The best way to operate a battery (bottom) is to mainly take advantage of solar self-consumption (Benefit 1), while adding just a little bit of tariff optimisation (Benefit 2).

At the residential level, value stacking is typically simpler: batteries can help you save on your bills by (1) allowing you to 'self-consume' any solar energy you generate, (2) conducting tariff optimisation (charging when the price of electricity is low, discharging when it is high), and (3) in more advanced scenarios, trading energy on the wholesale market (an area in which Australian company Reposit Power is a global pioneer). There are other benefits too, of course, such as having backup power or a measure of independence from the grid, but these are more difficult to quantify.

Let's look at what this really means for a householder: Figure 1 shows the example of a possible NSW customer. This customer pays a peak electricity price, per kilowatt-

Agents of change
Making batteries go the extra mile

Taking distributed generation a step further, household battery systems will become active network agents in a world-first trial happening now on Bruny Island in Tasmania. ANU's Evan Franklin explains.

THE buzz surrounding on-grid residential battery storage systems has been deafening of late. In fact some market analysts, notably among them Bloomberg New Energy Finance (BNEF), predict Australia to become a global leader in battery storage deployment. BNEF forecasts the majority market-share to be residential 'behind-the-meter' storage, with an installed storage capacity of about 20 GWh expected by 2040. This will equate to around 2.5 million homes—about one in five—being equipped with batteries. Battery deployment is very much in its infancy, but there seems little doubt that battery storage is set to become a key feature of our energy system.

Battery storage, if deployed and managed appropriately, can present a win-win scenario for battery system owners (householders), network service providers (the 'poles and wires' guys), renewable energy developers, power system operators and the Australian community at large.

This is because batteries can take on many important roles—time-shifting to balance behind-the-meter generation and demand being just the tip of the iceberg. Batteries can help network operators to do their job by providing improved network visibility, improved reliability and up-time, and managing voltage levels and load flows across the network—and by doing so deferring or avoiding costly network upgrades. Batteries can also help power system operators (in Australia this is AEMO) and transmission network operators by strategically charging or discharging to help regulate system frequency, rapidly responding to system disturbances and helping guarantee stability given increasing generation from renewables.

Image: www.flickr.com/photos/gun254

↑ Bruny Island's undersea cable connection to Tasmania's main grid gets overloaded at peak times, such as summer holidays, leading to a reliance on diesel generation. In a world-first trial, household battery systems will be used as mini power stations to reduce diesel use and avoid costly cable upgrades. The project uses sophisticated distributed optimisation software to balance household and network benefits.

Optimal ways to deploy batteries

To date, the different services that battery systems can offer have largely been viewed separately and independently—homeowners install batteries for time-shifting and self-consumption only, while utilities install them for a specific network or power system purpose (South Korea for example is installing 500 MW for the express purpose of frequency regulation). But they can and should be viewed together. Understanding how to optimally coordinate the various roles across thousands or millions of battery installations in the grid will be challenging to say the least. However, this will be the key to unlocking the full potential of battery storage.

This challenge, coordinating millions of small on-grid battery systems to achieve optimal outcomes, points us then to where the next wave of innovation is required and where research and development dollars can yield the 'best bang for the buck'. And this is precisely where part of a recent ARENA funding announcement has been directed. The Australian National University, along with TasNetworks (the network operator in Tasmania), Canberra-based Reposit Power, University of Tasmania and The University of Sydney, has been awarded $2.9 m for a research project which will address how batteries can be used by householders to manage their energy while simultaneously being used to help manage the network. The project also aims to work out exactly how best to reward battery

Investing in community
Where solar makes sense

A remote Aboriginal community and investors came together to cut bills, reduce emissions—and generate investment returns. ATA's Andrew Reddaway describes how this innovative project went from proposition to implementation.

Image: © West Australian Newspapers Limited

↑ Pictured are Kurrawang board member Rowena Leslie, Tristan Leslie, 3, and Zasco Solar's Scott Nichol.

THE IDEA for a solar system at Kurrawang Aboriginal Christian Community in Western Australia began with Alternative Technology Association member Robin Gardner (ATA is *ReNew*'s not-for-profit publisher). Over several years he's assisted the Kurrawang community with administration through his involvement in Indigenous Community Volunteers and, in the process, he identified the community's strong potential for solar power.

With the Kurrawang not-for-profit community located between Kalgoorlie and Coolgardie, about 600 km east of Perth, that solar potential is excellent. Until this project, Kurrawang obtained all its electricity from the main Western Australian electricity grid, which is fossil-fuelled and charges relatively high electricity tariffs (around 36 c/kWh peak). The community is billed as a single entity and then recovers costs from its 120 residents through meters on each of the 31 houses.

Robin consulted with Kurrawang's board of directors to gain support for the solar project, particularly Rowena Leslie and Denise Lynch who made the project happen.

Sunny scenarios

The first step was to find out just how much a solar system could benefit the community. Robin sought assistance from the ATA, and we helped model the community's energy use and potential generation using Sunulator, ATA's in-house-developed solar calculator.

After exploring several scenarios, the ideal system size was found to be around a 30 kW system. Such a system would displace about 20% of Kurrawang's grid electricity and is small enough for relatively easy approval by the local electricity distributor. Since all the buildings are billed as a single entity, total demand is quite smooth and it was predicted that exports to the grid would be rare. This helps the economics of the project because the electricity retailer pays little for electricity fed into the grid.

In this sunny location, the solar system is expected to generate an average of about 160 kWh/day and offset about 60 tonnes of CO_2 each year, equivalent to removing about 17 cars from the roads. A workshop and nearby machinery shed were identified as the best locations for mounting solar panels.

Solar system selection

Robin and Andrew helped the Kurrawang board to obtain and evaluate quotes from several installers. Prices varied widely—it was clear that some were merely ambit claims!

Zasco Solar's quote was selected, due to a combination of price, components and Scott Nichol's professional approach with the Kurrawang board.

The final solar system includes:

- 2 x 15 kW SMA Sunny Tripower inverters
- 139 x 260 watt Jinko panels
- racking, cables, isolators etc.

The system is oversized, with 36 kW of panels feeding 30 kW of inverters. This maximises solar generation while staying below the distributor's 30 kW limit for relatively easy grid connection. When solar conditions are excellent some panel generation will be wasted, but such occurrences will be rare.

An innovative finance model

Although Kurrawang is debt free and has many property assets, it holds little cash so finance was required. The ATA introduced the idea of having the project financed by 'impact investors'. With permission from the Kurrawang board the ATA developed a proposed financial model and introduced two investors aiming to

Building in a flash
Advantages of prefab

It seems that prefabrication in buildings, whether that's entire buildings or building components, may be about to have its day in Australia. Peter Smyth looks at the advantages of prefab and what's happening in Australia today.

PREFABRICATION of buildings has been attracting more interest in Australia in recent times and is shedding its association with the cheaper end of the industry. However prefabrication accounts for under 5% of housing construction in this country—compared to 9% in Germany, 12% to 15% in Japan and a huge 50% to 90% in Sweden. Although some simple prefabricated components such as roof trusses have become ubiquitous in Australian building, entirely prefabricated buildings or parts of buildings are much less common—although more so in the commercial building sector, where designs are more easily broken into repeating modules.

Prefabrication is being promoted for a few reasons. The construction process is often vastly quicker: a case study looking at the prefabrication system used by the large construction company Hickory found a reduction in project delivery time of 50% to 60%; a smaller construction firm Modscape is able to complete the construction of a whole house in just 12 weeks.

Prefabrication is also more accurate, with factory processes and tolerances being easier to manage and much finer than on-site construction. This accuracy can mean that prefabricated buildings need less maintenance in the longer term and provide a well-sealed, insulative envelope. Builders like the more predictable management of prefabrication as well, with factory processes meaning bad weather and other disruptions are much less of a problem. This environment greatly reduces work at height and increases worker safety.

Waste is also minimised as materials can be ordered more accurately, are more easily stored for later use on future jobs and excess is more easily sorted and recycled. The use of wet trades on site, such as painting and rendering, can be largely eliminated as well, and these can be particularly locally polluting. All of these aspects add up to streamlined design and production processes which increase efficiency and can quickly produce buildings of very high quality. They can also often be cheaper for both the builder and the client.

All of that sounds pretty attractive, so why don't we prefabricate more in Australia? Some of the answer to that lies with a traditionally conservative construction industry that changes only very gradually, and sometimes reluctantly. There are some significant structural impediments in the way as well, with perhaps the most important of these being that the Building Code of Australia (BCA) has generally been written with on-site construction in mind. This means that for a project that uses prefabricated components there are often extra hurdles to clear to ensure the design and construction is compliant with the Australian building regulations. This can be a time-consuming process, can add significant costs and requires more specialised

Image by Craig Moodie, courtesy Hickory

↑ The majority of this nine-storey apartment block, One9, went up in just five days in late 2013 using pre-built modules from the Hickory Group. Hickory uses parallel on/off-site construction to speed and improve the on-site construction process. The resulting building has a 6 Star energy rating and includes double-glazed windows, greywater recycling and solar hot water. www.hickory.com.au/projects/filter-prefabricated

Less noise, no fumes
Testing cordless leaf blowers

ReNew reader Colin Dedman puts the latest generation of lithium-ion cordless leaf blowers to the test and is blown away by how far they've come, though price and run time can be an issue.

WHY would you buy a cordless leaf blower? Why would you buy a leaf blower at all? For the most sustainable living, shouldn't we rake up all our leaves and debris by hand, and clean out our gutters by crawling around on the roof?

For those of us with rainwater tanks, cleaning the gutters frequently is a necessity rather than a luxury, to ensure that precious rainwater ends up in the tanks rather than spilling out of a blocked gutter. For many years I cleaned up the leaves by hand, while cursing the weekly scream of my neighbour's two-stroke leaf blower. Then my aging back convinced me that if you can't beat them, join them, so I purchased my own screaming $88 petrol blower, that does clean the gutters and patio well. But I hate using it on account of the noise, fumes, hard starting and mixing/storing of two-stroke fuel. There must be a better way.

Corded electric leaf blowers are quieter, always start first time and can potentially use renewable electricity, but the inconvenience of a long extension cord rules them out for me. What about the electric cordless blowers then—are they just 'toys' as many people think?

Here I blow away the myths, by subjecting a variety of cordless blowers to a series of standard tests so you can judge which blower, if any, is suitable for your needs. I've included two mid-range petrol blowers and a corded blower in the tests for comparison.

↑ This elite trio (Stihl, EGO, Redback) of cordless blowers matches petrol performance, but think carefully about what performance you really need.

Measuring blower performance

Some manufacturers would have us believe that the all-important parameter is the air flow rate in cubic metres per hour, while others boast of their impressive discharge velocity in kilometres per hour or metres per second. In reality, both are important.

The most useful single parameter to measure a blower's effectiveness is the blowing power in watts (W), being the power of the moving airstream, as this relates directly to the ability to shift stubborn debris and move a lot of leaves and debris in a short time. The blowing power is less than the input power, due to inefficiencies in the motor and fan.

I've measured the air flow rate, velocity and blowing power according to ANSI Standard B175.2 and tabulated this for all the blowers tested, providing a resource for comparison of blower performance. Manufacturer published values of air flow and velocity have not been included, as they are sometimes incomplete and inconsistent.

The method described in the standard for measuring air velocity is known as the 'Blow Force' method, and involves measuring the blowing force on a 350 mm diameter metal disc placed 125 mm from the blower discharge. It is then relatively easy to calculate the discharge velocity and the air flow rate using the formulas given in the standard.

The table quotes industry-standard nominal (rather than peak) battery voltage for all blowers, again allowing meaningful comparisons to be made. Measured run times are for continuous operation, so expect a little longer for intermittent real-world use. Chargers are characterised by the output power in watts, with greater than 200 watts considered 'fast' charging.