

ReNew

Technology for a sustainable future

Issue 129

COMMUNITY ENERGY ISSUE

**Efficient hot water
buyers guide inside**

Build

with a little HelpX

exchanging skills across the globe

PLUS

Changing the world
one community at a time

People power
community-funded solar

Tale of two wind farms
lessons learnt

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Owner-build: pioneering with hemp
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EVs and the grid: managing demand

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↑ Our community energy special looks at projects ranging from microgrids, page 42, to changing the world through community action on page 62.



← Cover image: Pam Davison

A Melbourne household undertook this sustainable renovation with help from HelpX—a service where working travellers exchange their skills and time for short-term accommodation. Helpers joined in on the renovations, on such tasks as painting and cleaning salvaged bricks. Homeowner Katerina says a hidden benefit has been the improvement of her language skills: one guest spoke little English and "it was like having a live-in French teacher!" Page 58.

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Building with hemp

Pioneering new uses for an old material



Hemp has the potential to become one of the greener building materials on the market. Kiara Pecenko visits Neil and Sandy Garrett to see how they are using hemp in their new sustainable home.



Photos: Pam Davison

↑ Sandy and Neil Garrett in front of one of the unrendered hempcrete walls of their house, and a side view of the hempcrete home.

AVID travellers Neil and Sandy Garrett are currently living in a cosy shed on their six acre property in Violet Town, complete with solar panels and induction cooktop. They built the shed immediately after buying the land, packed it full of their possessions, then began to draw up plans for their dream home—and they are using hemp to build it.

Neil has built a number of houses in his time and been involved in the construction of mudbrick and strawbale houses, but was initially taken by the idea of using rammed earth for their new home. A stay in a rammed-earth home in Mandurang, Victoria, prompted the couple to seek out how they could achieve a similar outcome in their build.

Their research, though, proved a little

disheartening. Neil says, “Although it is a tremendous final product, rammed earth isn’t a great insulator, and required a lot of hard work to build with. I’m 69 years old!” The process of ramming the earth to make the walls is very labour-intensive, and for the retired owner-builder couple it was no longer a viable option.

Through Neil’s research, he had made contact with people who were using a hemp-lime composite to build interior and exterior walls. The practice has a European origin, developed in the 80s by builders refurbishing old French Tudor homes. Builders took the woody interior of the hemp plant (called the hurd), which was primarily considered a waste product, and combined it with a

lime-based binder and water. The hemp-lime composite (now commonly called hempcrete) proved to be easy to construct with and to manipulate, strong yet flexible, breathable and environmentally friendly.

Building performance

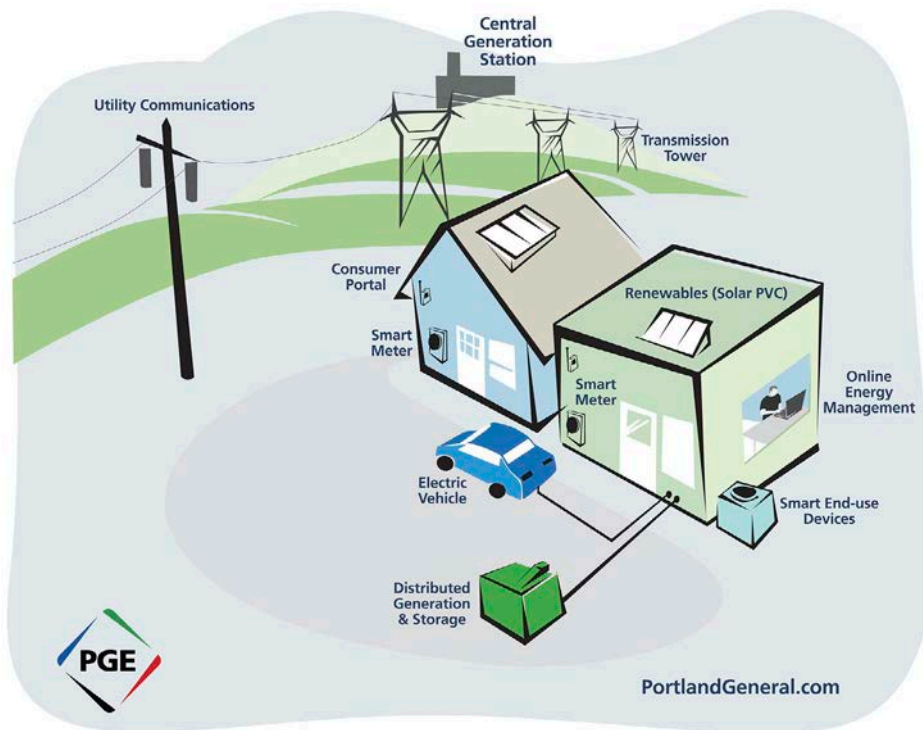
Neil says that every quality one could want in a non-structural wall material can be found in the hemp-lime composite. Hemp hurd is a cellular material that easily traps air and holds it over a long period of time. This means it is a great insulating material, so hempcrete can achieve a rating of up to R4 for a 250 mm thick wall, depending on how much it is compressed. The material has good insulating qualities, and high thermal mass compared to

Electric vehicles and the grid

How EVs affect demand management



Increased EV uptake means challenges for the grid, but the good news is that demand-side management could help. Marcus Brazil and Julian de Hoog explain.



↑ A vision of the future smart grid. Demand-response will allow for smart appliances and electric vehicles to use energy when it is available. Image used with permission.

THE last few years have seen a rapid increase across the globe in the uptake of electric vehicles (EVs). A recent report by the US Department of Energy points out that sales of EVs are increasing faster than those of hybrids, if you compare the same stages of the technology life cycle. One of the leading manufacturers of EVs, Tesla, is now valued at more than \$30 billion and has been projected to be a major disrupter of the automotive industry. Many major car makers are planning

to introduce electric and hybrid models into the Australian market in the near future.

An important question that is often overlooked in discussions on electric vehicles is: what will be their impact on the electricity grid? An EV with a typical daily commute of 40 km requires roughly 6–8 kWh of energy to recharge; this is equivalent to the daily needs of a small household. In other words, if you buy an electric vehicle, the impact on the local electricity network is about the same as

adding a small house to the neighbourhood. Furthermore, in an unregulated environment, most EV owners are likely to plug in when they arrive home, around 6 pm, at exactly the time that residential electricity networks experience peak demand.

This could lead to real issues for the electricity grid, even with modest levels of EV ownership, as the uptake of electric vehicles is likely to happen in a clustered way. Early EV buyers will generally have similar levels of income, education and environmental awareness, meaning that they are likely to live in the same neighbourhoods. In the early phases of EV uptake, certain neighbourhoods are therefore likely to see much more significant penetration of electric vehicles than others.

The impact of EVs on the electricity grid

An industry-supported research project at the University of Melbourne, led by Professor Iven Mareels, is exploring the potential problems for the grid posed by the mass adoption of EVs. The focus here is on the low voltage electricity distribution network—that is, the part of the grid ‘downstream’ from local transformers that directly supply electricity to homes and businesses. This includes the grid infrastructure that we see around us every day, such as residential power lines and pole-mounted transformers.

The main challenges to the grid arising from the increased uptake of electric vehicles fall into three categories.

- **Peak load.** Perhaps the most well known of the problems, peak load occurs at the time of day when the highest demand for electricity occurs. Our networks are sized to withstand peak demand, but if electric vehicles are added to the network, then the

River power

A hydro power station in your backyard



Dr Catriona McLeod reports on a project harnessing a large renewable resource, at a smaller scale, in Tasmania.



↑ Humboldt River power station and tailrace with the river in flood.

IN SOUTH Tasmania, Nigel and Josh Tomlin, founders of River Power Tasmania, have designed, and custom built, a hydroelectric generator. This might not seem so unusual as the market is awash with domestic and micro-generators. These small-scale operations are designed to power one domestic site; however, even Nigel's first 'backyard' working prototype, built several years ago, powers about 30 houses, near his property at Ellendale.

The prototype takes water from the Jones River, which runs through the Tomlin's property. This small generator generates about 80 megawatt hours per year and is powered by water falling 30 metres along 500 metres of pipeline.

The newer, second and larger hydroelectric generator is on the Humboldt River, which starts below Tyenna peak, in Mt Field

National Park, at an elevation of 896m, and ends at an elevation of 248m. The Humboldt River drops approximately 648m over 10.3km. The fall and water content of this river make it ideal for a hydro scheme.

The generator captures water in the last 2km of river, where it flows through forested areas used for industrial-scale softwood plantations; over the last 2km it falls 98m vertically. It demonstrates the efficiency of physics: the energy of falling water is enormously powerful in terms of generating electricity, even at a smaller-than-commercial scale. This new system is expected to generate 2.2 gigawatt-hours per year.

A bit of history

Of course, this 'technology' is not new. Water mills have operated since the Roman

"He notes the system is actually incredibly simple: an induction generator converts the water's energy, much like a large washing machine motor being run in reverse."

Empire. The remains of two mills, found in modern-day Tunisia, date to the late 3rd or early 4th century AD. Apart from the sail, the water mill is the earliest example of a machine harnessing natural forces to replace human physical effort. In the original mills, the energy of the falling water was directly diverted to the task; however, their main shortcoming was size, which limited the flow rate and therefore the amount of energy that could be harnessed.

The advent of the Industrial Revolution changed the 'course', so to speak, of the water wheel. With developments in scientific principles and methods, the water wheel was greatly improved to include a swirl component of the water, which passed energy to a spinning rotor. Extensive use of new materials and manufacturing methods developed at the time also engendered a new robustness, and the intake could be increased.

Conversely, the additional component of a swirling motion meant the turbine could be smaller than a water wheel of the same power. The turbine could process more water by spinning faster and could harness a much

Microinverter potential

Pros and cons of AC solar panels



Are microinverters a passing fad or a serious contender in the solar inverter market? Industry analyst Nigel Morris from Solar Business Services looks at some of the common issues people ask him about.

A MICROINVERTER is quite simply a very small inverter which converts DC electricity from solar panels into AC. The major difference between micro and string inverters is that microinverters convert the power from each solar panel individually, whereas string inverters convert the energy from a string of solar panels connected together in series. Microinverters are typically attached to the back of a solar panel whereas string inverters are usually mounted on the wall near your switchboard.

There are pros and cons to each type of technology, but after being involved in the industry for more than 20 years, one thing is clear: microinverters have a rightful place—and that place is growing.

A good place to start with the microinverter story is a bit of history. Many people don't realise that they have been around for a long time; my former employer was supplying a company who successfully sold them in the late 1990s. True, they struggled a bit with reliability but the majority are still out there plugging away on Australian roofs. So they aren't new and there has been some good long-term experience with the technology.

Having said this, string inverters have dominated sales and it's only in the last few years that microinverters have come back with a vengeance. So what's changed?

Clearly, technology has evolved a lot in the last 20 years.

It stands to reason that both string and microinverters have benefitted from this evolution. However, it could be argued that, in



↑ Microinverters mount on the back of the solar panel or on the panel mounting frames. Enphase inverters simply plug into the solar panel leads with AC output via a plug-in bus system, making installation quick.

recent years, miniaturisation and electronics development has had a far bigger impact on the potential for microinverters, and that's part of the reason they have taken off.

To put it in context, around 40% of all inverters sold in California (one of the world's largest residential solar markets) are now microinverters, and locally, more than 10% of all sales are now microinverters. The world's biggest microinverter company recently announced it had sold its five millionth microinverter; so the numbers are becoming very substantial.

To help understand more about microinverters, here are the issues I am most often asked about.

1: "It's really hot on the roof. It doesn't make sense to put electronics there and their life must be shorter as a result."

This is sound logic and pretty rational thinking. However, the reality is that well-designed microinverters can deal with this stress and most have 10 to 20 year warranties as standard. The big companies making good products recognised this challenge and set out to build in very high levels of quality and so dominate the market. Also, being smaller, microinverters don't create or have to dissipate as much heat.

There are also a number of independent studies that demonstrate how microinverters perform under high-temperature situations which show that the reliability is very high.

ATA and community energy

People power



In a year of milestones for community energy in Australia, Craig Memery takes us on a tour of how the ATA is helping projects with the strategies and resources they need.



↑ Delegates at the inaugural Community Energy Congress in Canberra in June this year. There was a lot of great (community) energy! After attending, one delegate said, "We're fired up. Clearly, anything is possible and the RET isn't actually gone yet."

IT WON'T come as a surprise to *ReNew* readers to hear that *ReNew*'s publisher, the Alternative Technology Association (ATA), is excited about community energy in Australia. Having been the collective owners of the Breamlea wind turbine two decades ago, some ATA members are probably more surprised that community energy is yet to take off here!

There are a handful of groundbreaking community energy projects up and running today, and here are a few of the ways we are doing our bit to help more than 50 communities bring future energy projects into being.

C4CE

ATA is a founding partner and steering group member of the Coalition for Community

Energy (C4CE), alongside some stalwarts of the community energy sector. C4CE exists to empower and grow the community energy sector. The Coalition is moving from its formative stages to incorporate new members, with membership and governance arrangements being formalised as this goes to print. Find out more at www.c4ce.net.au.

With welcome support from ARENA (Australian Renewable Energy Agency), C4CE is developing a national strategy for community energy. This work is being led by the Institute for Sustainable Futures and Community Power Agency, with ATA providing specialist input in areas such as energy policy, markets and regulations. Look out for the strategy, which will be released later this year.

In July, C4CE held the inaugural

Community Energy Congress in Canberra, bringing together over 300 community energy supporters from across Australia, as well as international delegates. The event was a resounding success, and I think we will look back on the congress in coming years as a milestone for the community energy movement.

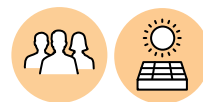
Getting a better deal for local generation

Our friends at Total Environment Centre (TEC) have been working hard to improve the incentives for generating energy that is sustainable, locally consumed, improves competition and minimises burden on electricity networks.

ATA is helping TEC's work on virtual net metering (see box after this article) as

Community solar

Energy from the ground up



With support resources now readily available, Taryn Lane from Embark explains how individuals, groups and businesses can work together and benefit from setting up community solar projects.

ALREADY a mainstream model internationally in countries such as Denmark, USA, Germany and Scotland, community solar is about to hit Australia in a big way. There are around 50 active projects in Australia and it is a tangible pathway for all communities—whether they be urban, regional or remote—to participate in transforming their energy supply.

Community solar can take on a myriad of identities, depending on a community's exact needs and opportunities. From community bulk-buy rooftop models, through to small crowd-funded systems, up to more sizable solar parks, they provide real opportunities for installation efficiencies and more inclusive ownership.

Several models of community-owned solar projects feasible within Australia's current legislative and energy market boundaries will be explored in this article. Although we can learn from international models, we also have unique restrictions in the Australian landscape that we all need to navigate. Our aim at Embark is to both create innovative business models and collate from the broader sector what's been learnt from the first generation of systems—thereby accelerating the uptake of, and social licence for, renewable energy in communities in Australia.

Why community solar?

The move to a low-carbon economy requires a magnitude of capital that charity alone cannot provide: community investment with reasonable returns will provide a necessary part of the solution.

There is still a significant portion of the community who can't invest in solar



↑ Donation model: Corena's first installation at Tulgeen Disability Services in Bega, NSW, of a 7kW system, in 2013. The repayments on the loan to install the system have been put into purchasing another system for Gawler Community House in SA.

technology. This includes renters, apartment owners, those living in homes with shaded roofs or heritage overlays, and those who can't afford to install a residential system on their own home.

Community solar projects enable neighbourhoods to develop and own their own renewable energy infrastructure. It answers the calls for social equity for solar in Australia, as renters, apartment dwellers and low-income households can have the opportunity to make a direct investment in solar PV.

Shared ownership schemes will soon drive significant growth in the medium-scale solar space. A business installing 100kW on a factory roof will result in the same abatement as a community that installs 100kW in the same location, but the latter has the opportunity to engage a hundred (or more) community members on an ongoing basis.

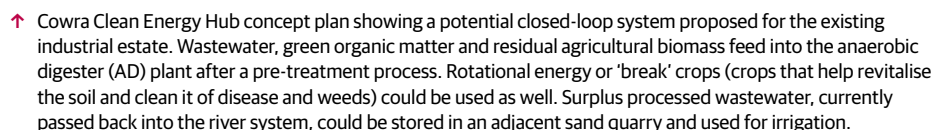
What can it look like?

For example: A large data centre creates a

prototype urban solar park in conjunction with a climate action group. The data centre company signs a 25-year lease for the rooftop of the data centre with the climate action group, to enable installation of a 100kW PV array and agrees to purchase all of the power. A digital sign outside the data centre shows production statistics and advertises the availability of any opportunities to buy into the solar park. A community energy company is established, with shares marketed to members of the climate action group and employees of the data centre. The data centre does not need to access their own (expensive) capital in order to cover their roof with solar panels, and the community investors get a return on their investment.

Benefits of community solar

There are a myriad of benefits for both investors and hosts. Community solar projects empower both local communities and also the host sites to be active in pollution reduction, at the same time as delivering



Residue from the AD process (digestate) has the potential to be produced into local biofertilisers and biofuels for agricultural use. A potential expansion of the plant would be to provide district heating for adjacent housing and proposed new industrial estates. Industries such as canola oil production or veggie packaging could be encouraged to locate in an estate located close to the bioenergy plant as their waste could be used and some of their inputs (energy, biofertilisers) could come from the plant—a true closed loop.

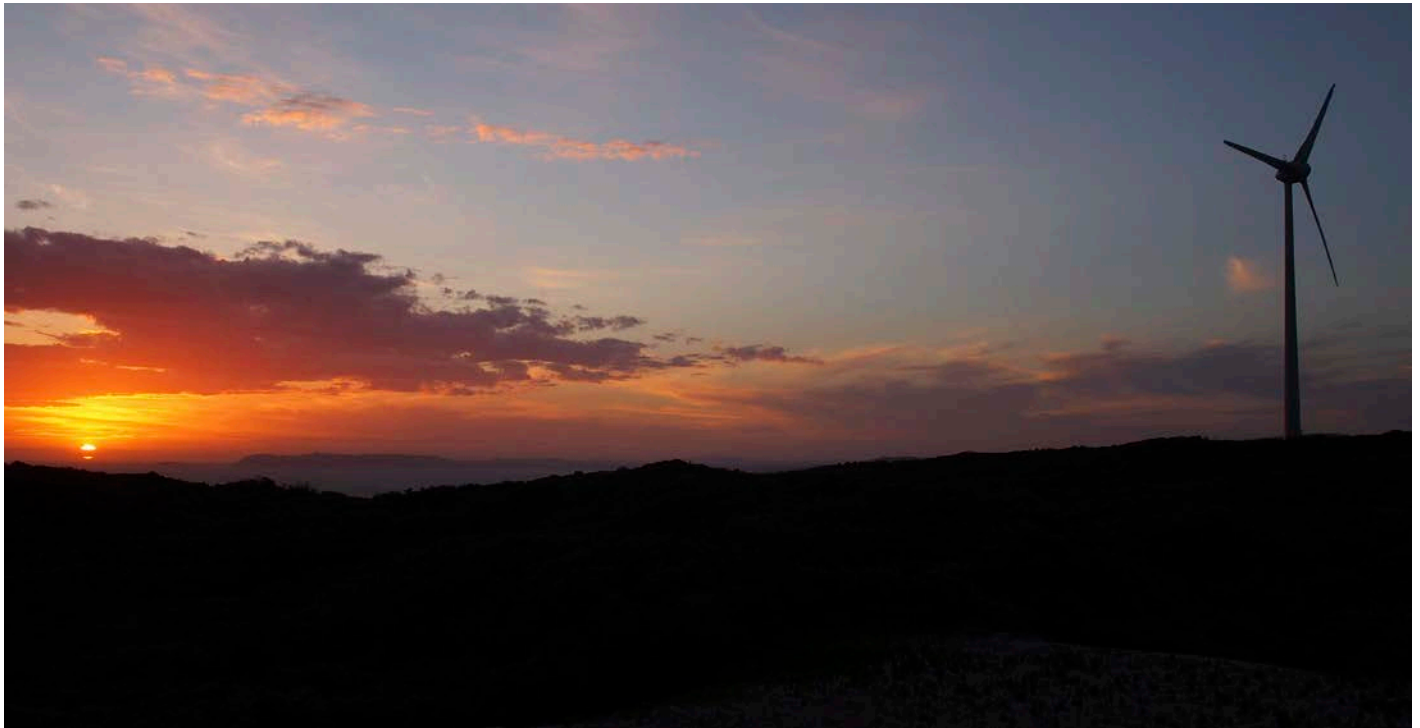
The latter is one reason that the local council is behind the project: pre-treatment of waste



Mt Barker vs Denmark

Tale of two wind farms

What does it take to get a community wind farm up and running?
Andrew Woodroffe from SkyFarming compares two projects.



↑ Sunset at the Denmark site.

FORMED in 2003, SkyFarming Pty Ltd has been involved in two recently commissioned community wind farms in WA: Mt Barker and Denmark.

Both projects took considerable community effort and time. It took six years to get Mt Barker wind farm up and running (in 2011), and 10 years, almost to the day, to get Denmark spinning in 2013 (see *ReNew 121* for the story of Denmark community wind farm).

SkyFarming was involved with both projects from conception to commissioning. We installed a monitoring mast on the Denmark site, helped with the planning, negotiated the electricity takeoff with a retailer, coordinated with the various consultants, ran the tenders, purchased

the turbines and project managed the construction of the wind farm. Denmark Community Wind were our clients. With Mt Barker, we fully developed the project before raising the money for construction.

This article compares the two projects in several key areas: land clearing, the wind resource and grid connection. We hope this background will prove useful to other projects, to help understand what's involved in siting small wind farms.

Land clearing

We were particularly keen to keep clearing to a minimum as we saw this as having the greatest negative environmental impact. However, some clearing was required in both

cases. It was important to understand the terrain and to investigate the potential for using existing tracks for access roads.

Mt Barker wind farm is located 50km inland, just a few kilometres north of the township of Mt Barker, on a hill on a private sheep farm. The sheep farm was half cleared with about 1.5km of existing tracks. The uncleared areas, although somewhat eaten out by sheep, include 10 to 12m tall jarrah and marri, that were never cleared because the land below them was largely 'coffee rock' (lateritic gravel).

Denmark wind farm is located in an uncleared parkland and recreation reserve on a peninsula 10km south of Denmark town. On the ridges, the vegetation is wind-blown, low

Making money when the sun shines

Sunulator solar calculator



The ATA's new tool for calculating the economics of solar installations can use half-hourly consumption and insolation data to give a much more accurate view of the benefits. Andrew Reddaway explains.



Sunulator in action

We don't know exactly how many solar projects have already been assisted by Sunulator but there must be quite a few, as the web page has averaged 50 page views per day! One example of a community solar project using Sunulator is Tathra Solar Farm. Led by Clean Energy For Eternity and the Bega Valley Shire Council, this project is raising funds to install up to 50 kilowatts of solar panels at the Tathra Sewage Treatment Plant. The solar panels will be arranged in a way that spells the word 'IMAGINE' when seen from the air by people flying into Merimbula.

ATA is using an in-house version of Sunulator for an Aboriginal community in Western Australia and for community housing in Northcote. We also used an early version to assess the economic feasibility of a solar system at a potential community redevelopment of the Black Forest Timber Mill in the town of Woodend, Victoria.



↑ At the two training courses run so far, participants have come from across the community, with strong interest from sustainability advocates and councils.

IF YOU'RE trying to get a community solar project off the ground, a major issue is economics. How much electricity would the system generate? What kind of deal might you offer the host site? What rate of return can investors expect, if any? To answer such questions, you need to do some homework.

This is where you can use Sunulator, ATA's free tool, which estimates the economic feasibility of a grid-connected solar photovoltaic system.

Is it like Tankulator?

Readers may be familiar with the ATA's popular tool at tankulator.ata.org.au. Just as Tankulator helps you plan for a rainwater tank based on historical rainfall data, Sunulator helps you plan a solar system based on sunshine data. However, there are more variables in solar systems, so Sunulator had to be more complex.

How it works

Sunulator uses a simulation approach. You provide information on the host site's current electricity consumption, ideally for a full year. You also tell Sunulator some details on the proposed solar system, electricity tariffs and costs. Sunulator then simulates a year in half-hourly intervals.

For each interval it determines the position of the sun in the sky and estimates electricity generation, based on sunlight intensity and the angle at which it hits the solar panels. It then compares this generation to on-site electricity consumption to estimate the amount of electricity imported from the grid and/or exported to the grid. Finally it applies the tariffs to calculate the interval's contribution to the annual electricity bill.

A key result from this simulation is the overall percentage of solar generation that gets exported to the grid rather than consumed on-site. For example, 15% of generation might be exported, or it might be 70%. This percentage has a big impact on economic feasibility, as the typical value of exports (via feed-in tariffs) is only a third to a fifth of the value of electricity consumed on-site. Most other solar calculators require you to estimate this percentage, whereas Sunulator calculates it based on electricity consumption versus simulated solar generation.

After the detailed simulation is complete, Sunulator totals the annual generation, bill savings and investor returns and extrapolates them up to 35 years into the future, based on user-defined future changes in tariffs etc. This future cash flow is used to calculate economic measures such as return on investment, net present value and payback period.

Electricity consumption data

You have a couple of options to provide consumption data. Ideally you will have access to data from the host site's electricity meter, in which case you can format it in another spreadsheet, then copy and paste it into Sunulator. If not, Sunulator will help you to construct data from estimated monthly and daily profiles.

Climate data and locations

Sunulator is currently setup to work for sites in NSW and Victoria (as the funding for its development came from organisations in those states). ATA selected a total of 45 locations throughout NSW and Victoria based on population, climate variability and

Renovating with HelpX

Travellers ready to lend a hand



Photos: Pam Davison

↑ The rear of the house was completed first, with HelpX volunteers cleaning bricks and de-nailing timber boards.

Allowing a steady flow of international strangers to live in your home may feel uncomfortable for some, but Katerina Gaita has had them back-to-back for almost two years. Kiara Pecenko investigates the world of HelpX.

KATERINA Gaita and her husband Joel bought their home in Melbourne's west ten years ago, complete with a rustic old Edwardian shopfront and a train carriage in the backyard. Their shared passion for sustainable living saw them plan a revamp of the property, creating a smarter, more efficient home in its place. But, while juggling paid work, a not-for-profit start-up, two small children and a renovation that forced the family into the small front section

of their house, Katerina decided to search for helpers, which she found in abundance online at HelpX.

HelpX

Help Exchange, or HelpX for short, is a listing service connecting host organisations and families with working travellers looking to exchange their skills and time for short-term accommodation. Katerina registered herself

as a host, and within days had multiple travellers enquiring to come and stay with her. In exchange for a place to stay and food, she asked helpers for 20 hours of work a week.

"I needed help with a variety of things. I would ask them to clean the house once a week, pick my son up from swimming lessons, and sometimes cook dinner—just enough to keep me afloat." Since registering

Changing the world

Disruptive innovations



With the need for action on climate change getting ever more urgent, Samuel Alexander considers just how far community action can go to help build a more sustainable future.

IT IS becoming increasingly clear that small, incremental changes to the way humans use and produce energy are unlikely to catalyse a transformation to a low-carbon civilisation, at least not within the ever-tightening timeframe urged by the world's climate scientists.

In September 2013, the IPCC published its fifth report, in which it was estimated that the world's 'carbon budget'—that is, the maximum carbon emissions available if the world is to have a good chance of keeping global warming below 2 degrees (a target internationally agreed to in the Copenhagen Accord of 2009)—is likely to be entirely used up within 15 to 25 years, based on current trends. If 'business as usual' continues, the trends indicate that we may be facing a future that is 4 degrees hotter, or more. It is not clear to what extent civilisation is compatible with such a climate.

This calls for an urgent and committed re-evaluation of the dominant strategies for transitioning beyond fossil fuels. If there is any hope for rapid decarbonisation, it

This work is part of the Visions and Pathways Project, supported by the CRC Low Carbon Living and the Victorian Eco-innovation Lab. The article presented here is an edited extract of a fully referenced paper that looked at eight potentially disruptive social innovations; the four not covered here are community-driven urban agriculture projects, the Voluntary Simplicity Movement, alternative indicators to GDP and direct forms of democracy and political protest. Find the paper at: www.bit.ly/VPPLCWR



Photo: marketforces.org.au

↑ The divestment campaign's recent national day of action in Australia saw many gather at banks to close their accounts. Ongoing campaigns are being organised by Market Forces (marketforces.org.au).

surely lies, at this late stage, in movements, innovations, or technologies that do not seek to produce change through a smooth series of increments, but through an ability to somehow 'disrupt' the status quo and fundamentally redirect the world's trajectory toward a low-carbon future. This article aims, then, to review several such contenders.

Admittedly, it is a difficult challenge attempting to choose movements or innovations with genuinely disruptive potential. An element of arbitrariness is inevitable, especially as there are no criteria as such by which they can be objectively ranked.

Further, the 'tipping points' of influential social movements in history have generally come as a surprise to the societies that they came to influence, due to the impossibility of anticipating the confluence of events and social conditions which were needed for them to flourish. Who anticipated the civil rights activist Rosa Parks? Who could have foreseen that a simple act, such as not giving up one's

seat on the bus, would give such momentum to the Civil Rights Movement?

This calls for a healthy dose of humility in undertaking the current task. As the philosopher Ludwig Wittgenstein once remarked about attempts to foresee the future:

When we think about the future of the world, we always have in mind its being at the place where it would be if it continued to move as we see it moving now. We do not realise that it moves not in a straight line, but in a curve, and that its direction constantly changes.

Bearing this message of caution and hope in mind, the following pages consider four social movements or social innovations that at least have the potential to change the current trajectory of history acutely in the direction of a low-carbon world.

Are the socio-cultural conditions for rapid transformation almost here? While it remains difficult to be confident, this review suggests that there are genuine grounds for hope.



Learning for the future

Renewable energy courses guide

With enrolment time for next year approaching, we've updated our renewable energy courses guide. You'll find the table of courses on our website, but here Mischa Vickas investigates what's on offer and the opportunities available.

"THINGS will keep happening, almost regardless of what happens on the political stage," says Associate Professor Alistair Sproul from the School of Photovoltaic and Renewable Energy Engineering at the University of NSW; a promising remark at a time of great uncertainty for the renewable energy industry in Australia.

Despite this uncertainty, there still remain many opportunities to become involved in renewable energy (RE) through study and training, whether you are a school-leaver or professional looking to diversify your career. TAFE, university and distance-education courses all provide avenues to entering an industry bound to flourish as Australia looks for sustainable, reliable and affordable energy.

TAFE qualifications

At the front line of the industry are those who directly handle RE technologies. According to the Clean Energy Council, 21,000 people were directly employed by the industry in Australia in construction, installation, operation and maintenance roles at the end of 2013¹. As a comparison, 27,600 people were employed in oil and gas extraction as of May 2014².

David Tolliday, Renewable Energy Training Coordinator at Holmesglen Institute in Victoria, says the greatest opportunities are for licensed electricians looking to be trained in the design and installation of photovoltaic (PV) systems (both grid-connected and stand-alone) and small wind systems. David says the motivation for undertaking such study is often the prospect of new employment or business development, but at the core of this can be a personal drive to see RE developed in Australia; "I've got a passion for it," he says.

David, who has also worked as an electrician for 35 years, undertook training in RE about 10 years ago, and has since benefitted from opportunities to work and teach in RE both in Australia and overseas.

Importantly, RE training is additional to a basic electricians qualification, meaning electricians can diversify into RE while continuing to offer standard products and services.

These courses are offered at over 15 training schools across Australia. If you are not a qualified electrician, a small handful of schools also offer courses in related areas, such as solar sales, carbon accounting and energy auditing, and wind energy site assessment, as well as generalist RE courses that are most suited to architects, engineers and project managers in the construction industry.

Universities

An engineering qualification at the undergraduate or postgraduate level can also enable a career in RE research and project management, particularly for emerging large-scale solar and wind technologies.

"Renewable energy and energy efficiency is going to be very disruptive to what we are doing now and we need people who can figure it out," says Alistair.

Whilst a mechanical or electrical engineering degree can provide you with the general skills relevant to RE, students can also undertake engineering degrees majoring in RE, PV and solar, sustainable systems, as well as environmental engineering.

Although the majority of students at university are school leavers, Alistair says that some students are already professionals in

engineering or the physical sciences looking to update their qualifications, and some of these go on to start up their own businesses in RE and energy efficiency.

Naomi Stringer, who is in her final year of a Bachelor of Renewable Energy Engineering at UNSW, has already benefitted from 18 months of work experience during her studies, enabled by an industry scholarship. Naomi has had the opportunity to work in PV research labs in both Sydney and Singapore, as well as working as assistant project manager during construction of the 1MW Capital East Solar Farm near Canberra.

"Trying to get out in the industry as well as studying is really important," says Naomi, especially given the currently small size of Australia's RE industry. As well as the engineering skills learnt at university, Naomi also benefitted from the 'soft' skills provided by industry work experience, including collaboration and working to deadlines. "It was more like, 'OK, I have a technical base, I can understand what is going on, now let's go and actually build something!'"

Uncertainty and excitement for RE

At least in the short term, the RE industry in Australia is vulnerable to regulatory uncertainty surrounding the Renewable Energy Target and the winding down of solar feed-in tariffs, as well as saturation of the PV market. This, in turn, is affecting the demand for training and the availability of employment in Australia. "There are still good customers out there, but they're fewer," says David of the demand for small-scale solar and wind systems.

Impacts on the industry may also flow to

Hot water savings

Efficient hot water buyers guide



If your old hot water system has seen better days, maybe it's time for an efficient replacement. We show you how solar and heat pump hot water systems work, what's available and how to choose one to best suit your needs.

AS THE price of energy keeps escalating, the idea of being able to reduce energy use has never been more attractive. One of the biggest energy users in any home is water heating—it can account for around 21% of total energy use (on average, according to YourHome). Water-efficient appliances are one way you can reduce energy use, but far greater energy reductions are possible if you replace a conventional water heater with a solar or heat pump system.

Such systems have the added advantage of also reducing your greenhouse emissions. For example, for an average family the reduction can be as much as four tonnes of CO₂ per year—the equivalent of taking a car off the road!

Currently only SA and Victoria offer state government rebates for solar and heat pump water heaters, but STCs (small-scale technology certificates; each STC is equivalent to the one megawatt hour of electricity the system will displace over a 10-year period) are still available across Australia.

STCs can save you a great deal on the cost of a new water heater, making it more economically viable. Note that the rebates and STCs are usually arranged by the supplier so you don't need to do any paperwork to receive the discount. The price will probably still be higher than a similarly sized conventional water heater but the savings made in running costs will pay for this difference in 5 to 10 years in most cases.

How they work

SOLAR HOT WATER SYSTEMS

A solar hot water system usually consists of a hot water storage tank connected via pipework to solar collector panels. These collector panels are placed on a (preferably) north-facing roof. The tank can be situated



immediately above the panels on the roof (a close-coupled system), above and a small distance away from the panels within the roof cavity, or at ground level (a split or remote-coupled system). For split systems, a pump and controller are required to circulate water through the panels. The collectors are usually mounted at an angle of no less than 15° from the horizontal (the minimum angle for close coupled systems to ensure correct thermosyphon operation), although often a lot steeper to optimise the system performance for winter.

As the sun shines on a collector panel, the water in the pipes inside the collectors becomes hot. This heated water is circulated up the collector and out through a pipe to the storage tank. Cooler water from the bottom of the tank is then returned to the bottom of the collector, replacing the warmer water.

Some systems don't heat the water directly but instead heat a fluid similar to antifreeze used in vehicle cooling systems. This fluid flows in a closed loop and transfers the collected heat to the water in the tank via a heat exchanger.

HEAT PUMPS

A heat pump is a process used in refrigeration where heat is moved, or 'pumped', from one medium into another. Air conditioners and refrigerators are the most common forms of heat pumps. For example, in a refrigerator, heat is pumped from the food and dumped to the air outside the fridge via the coil at the back.

Heat pump hot water systems are electric water heaters that concentrate low-grade heat from the air and dump it into the water storage tank. They are much more efficient than conventional resistive electric water heaters: compared to resistive heaters, they are generally capable of reducing year-round energy requirements for hot water by at least 50%, and by as much as 78% depending on the climate, brand and model.

The most common systems are air-source heat pumps, but ground-source heat pumps are also available. While their efficiency can be even higher than an air-source heat pump, they are a great deal more expensive and are often not economically viable. But if efficiency is the primary goal then they should be considered, especially if you are in

Fridges for caravans

Transforming fridge performance



Collyn Rivers looks at simple ways to improve the performance of fridges in caravans—particularly important when they're running off batteries.



↑ Compressor fridges, such as the Engel unit above, work better with less energy use than absorption fridges. Fridges with eutectic cold store plates, such as the Autofridge (far right) can maintain internal temperatures even when turned off for many hours.

Fridge brands

Chescold: www.dometicrvcentre.com.au
Dometic, Coolmatic: www.dometic.com/enau
Engel (including Eclipse): www.engelaustralia.com.au
Evakool: www.evakool.com
Indel, Isotherm: www.bit.ly/webasto
National Luna: www.nationalluna.com.au
Norcold: www.thetford.com.au
Novakool: www.oceansolutions.com.au
Oze fridge: www.ozefridge.com.au
Thetford: www.thetford.com.au
Trailblaza: www.norcoast.com.au
Vitrifridge: www.vitrifridge.com.au
Waeco (owned by Dometic): www.waeco.com/au

THE energy use and cooling performance of fridges installed in caravans and motor homes is related more to installation than technical differences between the fridges. Few are fitted as makers advise, leading to increased energy draw and hence cost; this also applies to domestic fridges, many of which are enclosed on three sides and inadequately ventilated.

Fridges are simply boxes from which heat is removed from inside the cabinet and dumped outside. It is vital this dumped heat is removed effectively. Owners, many builders, carpenters and even some electricians perceive fridges as 'back to front' ovens that generate cold. This approach often leads to ventilation being ignored, resulting in poor installation—the bane of fridge makers.

Ventilation vital

All fridges require adequate ventilation spaces at their rear. However, that alone is not enough. Cool air must be routed to flow unhindered over the cooling coils (also called fins) and the heated rising air must be routed to where it cannot heat the fridge again. With caravans, this is outside the van, and for homes, it is also preferably outside. This is often poorly done in RVs, and all but ignored for self-installed domestic fridges.

Most caravan/motor-home fridges have rear-coil cooling. For this to work, cool air at the fridge base must be directed to flow over the coils. This is assisted by baffles (flat plates inserted into the airflow to change its direction and make it more effective); even baffles made from cardboard will work well. A high exit for the warmed air provides enough suction to draw in cool air.

With such fridges, adding more insulation on their sides, top and (if feasible) to the door also helps hugely. Even 100mm is not overkill.

Skin ventilating

Some caravan and domestic fridges dissipate heat from their outer skin; these fridges have an enclosed back without cooling coils. These need a 50mm side gap and ideally the top area should be vented to the outside. Cool air needs to be directed to the base of their sides, and back if it is used for heat dissipation (you can tell which sides are used for heat dissipation as they will get warm when running). Obviously, you must not insulate the sides and/or back of this type of fridge!

Chest fridges need provision for cool air entry, and ideally nothing located above them to roof or domestic ceiling height. Some have a fan that draws cool air in via vents in their sides and over the compressor's associated cooling fins.

Chest fridges with coil cooling are aided by adding insulation. However, a few (such as the Indel and Oze fridge) dissipate heat from their side walls and so need a minimum 50mm gap around the walls.

Cabling for 12 volt electric fridges

Most 12 volt compressor fridges are installed with inadequate cabling and thus have a large voltage drop between the battery and the fridge, often in excess of 5%. This is not an issue when the van is powered while driving, as the car's alternator produces around 13.8 volts*; with a 5% voltage drop this results in about 12.8 volts at the fridge. However, when camping, even with a fully charged battery, the 12.7 volts (on load) from the battery will mean just 12.05 volts at the fridge. If the batteries are at half charge (say 12.3 or 12.4 volts), the result is 11.7 volts or less at the fridge. The fridge may still just run but it will end up running non-stop in a vain attempt to maintain cooling.



ATA member profile

The stories that matter

Nick Towle and his wife Michelle have found that real-life examples (including their own 'eco-bling') are the most powerful way to initiate change in their local community, writes Emily Braham.

"WE CAN keep talking about climate change, but the atmosphere only sees emissions so we need to take the practical steps." This simple but powerful sentiment has been a mantra of sorts for Nick Towle and a driver to "convert the curious to the committed" for action on climate change. Nick and his wife Michelle run the Home Sustainability Series, co-manage a sustainability hub and provide first-hand sustainability advice in their home town of Heybridge on Tasmania's northwest coast.

"You can introduce ideas about climate change, but I think it is most effective when you can connect with people who are ready to make a specific change in their own lives," Nick says. He has found leading by example is often the most successful way to spur on this action among neighbours and friends. When the Towles first installed their solar hot water system (which they affectionately refer to as 'eco-bling') in 2010, it became a focal point for conversations with neighbours and when combined with a leaflet drop and a series of workshops, led to around 12 similar installations on nearby properties.

"My wife and I have always been really interested in how to translate concern into action, because that's what matters at the end of the day," Nick says. "We're both health professionals so it's something that is close to our hearts—helping people lead healthy, sustainable lifestyles."

And he has certainly walked (or in his case, cycled) the talk. In 2005, Nick was one of 10 cyclists who made the epic journey down the east coast of Australia as part of Cycle for Sustainability, riding 4800 km between Gympie and Hobart and promoting

"I think stories matter. If people can see how others have made use of a technology, they are more likely to adopt it themselves."

sustainable lifestyle choices to over 3000 students through comical theatre and workshops.

His direct efforts in educating and inspiring action on climate change led to his place in the Climate Leadership Training with Al Gore in 2007, and he has since given 60 to 70 presentations to schools, community groups and professional organisations. In each of these, he aims to use real-life examples often taken from *ReNew* or *Sanctuary* magazines. "I think stories matter," he says. "If people can see how others have actually made use of a technology and the costs and benefits of it, they are much more likely to adopt it themselves."

The sustainability hub Renewable Energy, Sustainability Education and Enterprise Development, or RESEED, has its roots in a community-centred arrangement with four friends, each committing their self-managed superannuation funds to buy an old school in the nearby town of Penguin. RESEED was a long-term vision-made-reality for Nick, Michelle, Belinda, Robin and Phillip in an effort to create a "positive legacy" for the community. The centre now has a 10kW solar system and hosts workshops on topics such as forest gardening, permaculture design and electric bike conversion. Penguin's microclimate also allows a thriving urban orchard on the grounds, with its bountiful



↑ Nick, Michelle and son Oliver outside their home on Tasmania's northwest coast. As Nick says, they've found that leading by example is often the most successful way to promote sustainable action: you can just see their 'eco-bling' solar hot water and PV system on the roof in the background.

supply of apples, pears, citrus and avocados, made use of for community harvest days with surplus sold at the local greengrocer.

Nick is also a keen permaculturalist and finds relaxation in the permaculture design classes he leads. Further respite from the responsibility of climate education is close to home—the family's environmentally friendly house is close enough to the beach for impromptu picnics, the bushland near enough for spontaneous walks and the local river perfect for the odd canoeing trip. An appropriate template perhaps—not just for sustainable living, but for living well. ✨