ReNew

Technology for a sustainable future

Issue 134

ENERGY EFFICIENCY SPECIAL

WIN a home battery storage system from Enphase

*Australian and NZ residents only; see page 58

Solar + batteries

When will they add up?

PLUS

- Off-grid wind & solar
- Energy audits done right
- A renters guide & more

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DIY reuse: pallets, containers and cables
Tropical take: smart cooling results
On the rebound: countering the sceptics

Solar panel Buyers Guide inside

Contents
Issue 134, January – March 2016

- Read more articles at renew.org.au
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The real efficiency dividends
Energy audits, what renters can do, off-grid living and more

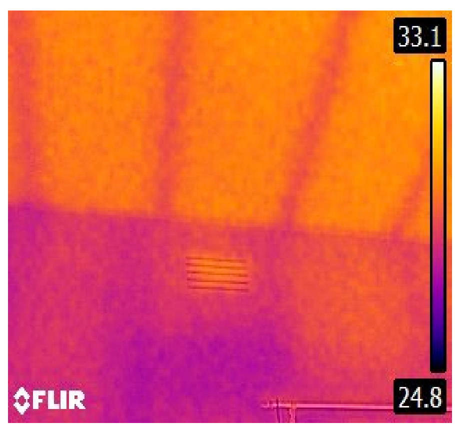
↑ This array in the UK will soon be Europe's largest floating solar plant. Page 24.

↑ Miwa Tominaga at the Women in Renewables lunch held recently as part of the CEC's All-Energy conference. Page 34.

↑ Energy efficiency, including such retrofits as draughtproofing, is often ignored yet is critical for a sustainable society. We talk to Lyn Beinat from ecoMaster about the changes she's seen in the energy efficiency industry. Page 50.

Features

Special feature: energy efficiency



↑ A thermal camera can highlight missing insulation and leaks. Page 60.

← **Cover image: Off-grid wind and solar home, ACT. Photo by Kerry Watson, Watson Studios, Canberra.** This impressive off-grid system near the Capital wind farm is powering what the owner calls a 'standard' home—which includes, among other things, an electric vehicle. That's a *ReNew* sort of standard house! The setup has evolved over time and there's a great deal of meter watching involved. Page 38.

↑ Find a cool corner at home to both escape the heat and reduce the heat load on your house. Page 70.

Guides

Solar Panel Buyers Guide

DIY

Regulars

Editorial

The energy detectives: efficiency pays dividends

AMIDST excitement about the energy market transformations possible when renewables are combined with battery storage—with new products and trials announced almost daily—it can be easy to lose sight of the less glamorous area of energy efficiency.

Yet, for most of us, this is where we can make the most difference at the lowest cost.

In Victoria, for example, heating is a significant proportion of household energy use (some 40%, on average), much of it powered by gas, which can't be made renewable and also has issues around fugitive emissions. With good insulation and draughtproofing, and more efficient electric heat pumps, people can cut their bills and emissions in one fell swoop.

To get more of an idea as to why energy efficiency struggles to get its voice heard, we talk to several people working in the field. A recurring theme is the lack of understanding about energy use. This could be changing as people install solar systems and smart meters, and energy retailers start to provide better information. But for many people, even knowing what's a reasonable level of usage per day is tricky—so how can people then go about effecting change? We try to address that here with energy usage stats, alongside tips from energy assessors for homeowners and renters on what people can do in their own homes. Get draughtproofing is one key message.

Alan Pears also considers the question of a 'rebound effect': where savings from energy efficiency are lower than expected, because people either spend the money they save on new high energy activities, or start using an appliance (such as a heater) more because it's now costing them less to run. This has some basis in truth, but it's also much more complex—in fact, the opposite can happen, with money saved being put into more energy-efficient actions. He even argues there could be a new 'keeping up with the Joneses' emerging, with households competing to have the most energy-efficient products.

As governments pat themselves on the back in Paris about support for renewable energy research, we go on a tour of some of the large-scale solar projects that are just getting on and getting built. Australia could be a renewable energy superpower, says Beyond Zero Emissions—we have the best combination of solar and wind resources and know-how—but unfortunately that's not quite the case just yet, with our largest solar farm (102 MW) dwarfed by those in Asia, USA and Europe.

Plus: an off-grid wind and solar setup near that 'offensive' Capital wind farm; how women are faring in renewables; a solar+battery trial in New Zealand, our updated solar panel buyers guide; DIY reuse projects; and our holiday reading guide. Thank you to all our readers for your support and input over the past year, and wishing you all a lovely summer break.

Robyn Deed
ReNew Editor

In *ReNew 135*, out mid March

Water-efficient gardening, heating buyers guide, battery systems + more.

IT WAS wonderful to see so many people at the People's Climate Marches across Australia and the world in late November. The Alternative Technology Association (ATA) was one of hundreds of groups that supported the mobilisation, calling on our political leaders to take strong action on climate change at the Paris Climate Conference and beyond.

The ATA has had a very busy few months showing the way on climate change action. We launched the battery storage update to our Sunulator solar calculator, conducted research into cost-reflective electricity pricing and consumer gas preferences to help with our consumer energy advocacy, held Speed Date a Sustainability Expert at Ku-ring-gai in Sydney, participated at the Sustainable Living Tasmania Festival, and, in collaboration with a number of groups, developed the *Guide to Community-owned Renewable Energy*. A big thank you goes to Australian Ethical for awarding the ATA a $10,000 grant to help train an electrician in East Timor to maintain 600 solar systems on Atauro Island near Dili.

We were also excited to conduct our first pilot project in partnership with the Centre for Appropriate Technology, a not-for-profit Aboriginal and Torres Strait Islander company which improves lives in Indigenous communities via technology. The ATA provided qualified volunteers David Tolliday and John Dickie to install an off-grid solar system in Kowanyama, Queensland. Informed by the ATA's work in East Timor, the partnership means it will be cheaper to install remote stand-alone solar power systems in Indigenous communities. The aim is to reduce carbon emissions and energy costs, increase energy reliability and security, and create more resilient communities.

It's another example of how we at the ATA are working to build an environmentally sustainable and socially just future.

Donna Luckman
CEO, ATA

The future of energy
Large-scale solar worldwide

Not just good for the planet, large-scale solar is now often the cheapest option. Lance Turner looks at some of the impressive projects powering up right now.

Image: SolarReserve.

↑ Rendering of the planned 260 MW SolarReserve Copiapó project in Copiapó, Atacama Region, Chile, which combines concentrated solar thermal power with salt thermal storage to provide baseload electricity. The storage system allows for 14 hours of full output reserve capacity. www.solarreserve.com

AS THE world's governments slowly wake up to the reality of climate change and the need to shift energy generation away from fossil fuels to renewables, the corporate world is just getting on and doing it.

Large-scale wind farms have become common, but large-scale solar farms are less so. However, this seems to be changing, with multi-megawatt and even gigawatt-scale solar generation plants being developed at a considerable pace.

Cheaper than the fossils

The main driver behind this seems to be that solar has actually become one of the cheapest forms of energy generation. In many cases, solar plants are proving to be cheaper than gas, nuclear and even coal-fired power plants, especially when the complete life cycle and environmental factors are taken into account. Indeed, recent tenders in both Chile and India for energy generation have been won by solar because it was the cheapest option. The Chilean auction was open to all technologies, yet solar won the majority of the generation contracts, with other renewables taking the rest. Not a single megawatt of generation capacity went to fossil fuel projects. Further, the auction produced the lowest ever price for unsubsidised solar at just US 6.5 c/kWh!

The huge US renewable energy development company SunEdison won the entire 500 MW of solar capacity on auction in the Indian state of Andhra Pradesh with a record low unsubsidised tariff for India of 4.63 rupee/kWh (US 7.1 c/kWh)—lower than new coal generation, particularly when using imported coal.

It's not just in the developing world that solar is beating fossil fuels. In October, an auction in Austin, Texas, resulted in 300 MW of large-scale solar PV being contracted at less than US 4 c/kWh. Even before tax credits, the price is still under US 6 c/kWh—beating gas and new coal plants.

While many of these contracts involved photovoltaics, other forms of solar generation such as concentrated solar thermal systems also fared well, gaining some contracts and producing prices under US 10 c/kWh.

The technologies

The above examples give you an idea of just how far solar generation has come in the last few years. But not all solar is the same, so let's look at the different technologies.

Photovoltaic (PV) panels: These are essentially the same as the panels on the roofs of over a million Australian homes; the systems are just on a much larger scale. The panels are usually mounted on fixed, ground-mounted frames and are wired into groups, each group feeding its own grid-connected inverter.

The inverters are remotely monitored to ensure the system is performing as it should, and to allow part or all of the solar PV plant to be shut down when needed.

Most commercial-scale PV panel systems use fixed frames; however, some installations have used solar tracking to increase output in the morning and evening. Indeed, tracking

Adding batteries to solar
When will storage stack up?

The latest report from the ATA examines the economic case for solar plus battery storage. Andrew Reddaway explains the results.

IT'S CLEAR that as prices continue to drop, batteries have great long-term potential to transform our electricity grids. And many of us want more independence from big energy companies. But most families need to watch their budget too—would your bill savings be big enough to justify adding batteries to your solar system?

Using our newly-released version of Sunulator (see www.ata.org.au/news/sunulator-update), the Alternative Technology Association (ATA) has crunched the numbers on installing grid-connected solar plus battery systems around Australia—both now and into the future. We found:

- household bill savings from batteries depend on a range of factors including the climate at your location, your household type (e.g. home during the day or not) and grid electricity tariff
- batteries are not fully utilised most days, due to natural variability in solar generation and household electricity consumption
- grid-connected batteries are likely to become economically attractive for many households around 2020, compared to solar only, based on expected battery price reductions (see report for our assumptions).

The economics of investing in batteries would obviously be improved if households were paid to provide associated benefits to the electricity grid, such as peak load management.

Until energy companies co-invest in household batteries, or batteries drop further in price, ATA suggests households trying to cut their bills look at more cost-effective options, such as switching to LED lights; gap sealing, insulation and window shading; efficient appliances; going 'off-grid' from the gas network (see bit.ly/CAP_GAS); and solar without batteries. These options also have greater environmental benefits. Batteries consume electricity due to losses, and embodied energy and end-of-life recycling should be considered.

Many households will install grid-connected batteries in the next few years, but they are likely to be driven primarily by non-economic factors such as maintaining power during blackouts, increased independence from energy companies and the fun and games that come with being an enthusiast/early adopter!

Economic analysis—results

Figures 1 and 2 show the economic attractiveness of installing a new 4 kilowatt solar system plus batteries in 2016 and 2020, for a young family on a flat electricity tariff. The small and large batteries have a usable capacity of 4 and 7 kilowatt-hours (kWh) respectively.

These net present value results add up total costs and savings of a solar system versus business as usual (i.e. doing nothing) over 20 years. A positive number means total savings are greater than total costs. We found the savings for solar on its own exceeds savings for solar plus batteries in all locations in Australia if the system is installed in 2016, but, by 2020, a solar plus small battery system becomes competitive with just solar in many locations.

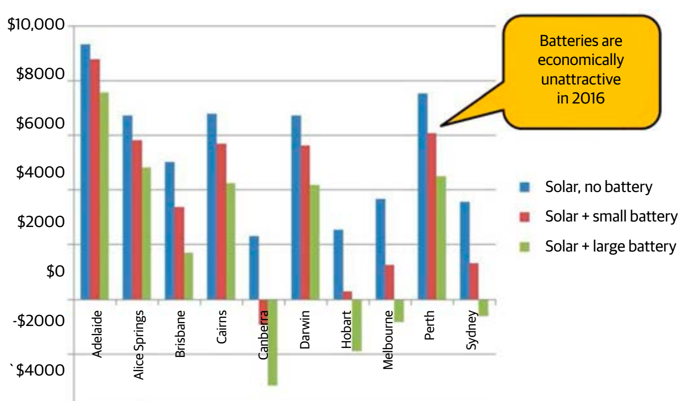


Figure 1: Net present value (over 20 years) compared to 'no solar' for a young family on a flat tariff if installed in 2016. Solar is always better than solar + battery.

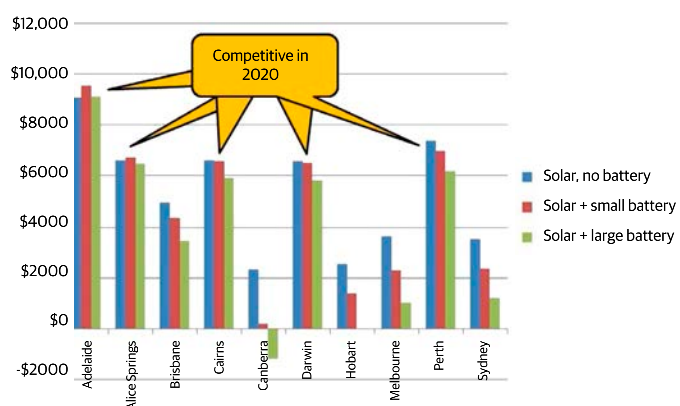


Figure 2: Net present value (over 20 years) compared to 'no solar' for a young family on a flat tariff if installed in 2020. Solar + battery is competitive with solar in several locations.

Solar + battery trial
Going hybrid in NZ

Combining PV and battery storage is often touted as a win-win for householders and energy distributors, eliminating peak demand and providing a way to better use the solar generation on-site. Lindsey Roke shares his household's experience with a trial initiated by his local lines company in Auckland, New Zealand.

IN LATE 2013, our power lines company initiated a PV and battery pilot scheme for households in the Auckland region. The aim was to test how PV combined with batteries could be made to work to the advantage of both householders (by reducing costs and providing backup energy in the case of grid outages) and the grid (by providing additional energy to the network, reducing peaks and providing a way to optimise PV integration into the network).

My wife and I decided to get involved in the scheme and in late January 2014, Vector (the lines company) installed a PV system with battery storage at our house. Almost two years on, there have been issues along the way, but overall it's been a useful field trial, both for Vector's and our understanding of the complexities of running such a system.

↑ The PV panels in place on Lindsey's home in Auckland, New Zealand.

A new lease on energy

Vector offered the system with an installation cost of NZ$2000 and a monthly rental in proportion to the solar PV system size. Three PV system sizes were available—3 kW, 4 kW and 5 kW—each combined with a lithium iron phosphate battery of 11.6 kWh, and a 4.5 kW inverter (de-rated to 4 kW for enhanced reliability). We opted for a 3 kW PV system and a rental period of 12.5 years. For this sized system and rental period, the monthly rental (for 150 months) was NZ$70, covering maintenance and support. At the end of the lease we will own the panels, but Vector will remove the inverter and battery. Given the technology changes likely over that time, we thought this would be a reasonable option.

Of 290 installations in the pilot, ours was the 150th to be completed.

Motivations

For us, the primary motivation was to shift to net zero energy (or better). Having designed and helped build our all-electric house in the 70s, we have since made a variety of efficiency upgrades including electric-boosted solar hot water (described in *ReNew 97*), energy-efficient lighting, a high efficiency space heating heat pump and upgraded under-floor and ceiling insulation (the walls were insulated from day one). Our average consumption is now about 7.4 kWh per day, for two of us and a some-time boarder (he's a flight steward and often away).

When it came to sizing the PV installation, we wanted to cover this energy consumption, but weren't necessarily expecting to save money over what we would otherwise have paid for electricity. Given our location in Auckland (at a similar latitude to Bendigo in Victoria), a correctly oriented unshaded PV array would be expected to generate an average of 4 kWh per day per kilowatt installed. Thus, we predicted that even the smallest system offered, 3 kW, would make us net exporters over a year, generating around 12 kWh per day on average.

As an added bonus, if the price for buying electricity were to rise at the rate it has over the last few years and the price for selling it

The double-glazed ceiling
Women in renewables

When asked why it is important to have a gender balanced cabinet, Canada's Prime Minister replied, "Because it's 2015." Sarah Coles looks around in 2015, wonders why Australian women are under-represented in the renewables sector and speaks with leaders in the field about ways to address the imbalance.

↑ "The future is bright fellow women of renewable energy." Miwa Tominaga delivering a rousing speech at the 2015 All Energy Conference. Photo courtesy of the Clean Energy Council.

LAST month the Clean Energy Council (CEC), the peak body for renewables in Australia, held a Women in Renewables lunch as part of the All-Energy Conference in Melbourne. The lunch was organised by Alicia Webb, Policy Manager at the CEC. Roughly 20,000 people work in the renewables sector in Australia. Men outnumber women in all fields: solar, wind engineering, energy efficiency, hydro, bioenergy, energy storage, geothermal and marine. At the 2015 Australian Clean Energy Summit hosted by the CEC there were 93 speakers, 11 of whom were women.

Women are generally under-represented across science, technology, engineering and mathematics (STEM) fields. According to the Australian Bureau of Statistics, of the 2.7 million people with higher level STEM qualifications in 2010–11, men accounted for around 81%.

There are myriad reasons for the low numbers of women in renewables. Gender disparity starts early with cultural stereotypes and lack of encouragement from teachers. Around 25% of girls are not doing any maths subjects in their last years at high school. When I was in year ten and acing science, my biology teacher said to my mother, "Sarah is good now but her grades will suffer when she starts noticing boys." Returning home my mother (holder of a science degree) delivered a succinct verdict, "Mr P. can get stuffed." But discrimination like this is still common.

Some people think a change in governance is needed; that if there are more women in leadership roles this will have a trickle-down effect. As of 2014, women made up 21% of the Rio Tinto board and 22% of Qantas. Stats like these are often bandied about as examples of progress but to my mind if you take a big piece of pie and cut it in half you end up with two equal portions, not one piddley 22% sized piece and one 78% chunk. I decided to speak with some women at the top of their game to find out what should be done to even up the portions.

Miwa Tominaga

Miwa Tominaga knows what it is like to face gender discrimination at work. Miwa's first full-time job was as the only female electronics technician at a radio transmitter site. She moved to Victoria to pursue a career in the sector, first working as a CAD drafter for electrical building services and then landing a job in renewables doing technical support at a company that manufactures electronic solar charge controllers. While she was working she studied renewable energy through an online course. When she provided phone support, hearing a woman, people would often ask to be put through to someone technical.

Later, installing solar panels at Going Solar, a woman said to Miwa, "Don't take this the wrong way, but you do know what you are doing, don't you?" The answer is a resounding yes. Miwa won 2014 CEC's awards for 'best install under 15 kW' and 'best stand-alone system'. She currently works at a solar inverter manufacturer doing sales and tech support: "because it's a worldwide company there are lots of opportunities."

When I ask Miwa about discrimination she says, "A lot of women have experienced renewables being a male-dominated industry." Miwa gave a speech about it at the CEC lunch. "I think it makes a huge

Another world
Light up East Timor

As well as balmy beach-side nights, Tim Adams got lessons in life and new DIY skills on a tour to install solar lighting in East Timor.

WHEN you live in Melbourne, sea breezes, beers on a beachside café balcony and balmy nights don't immediately come to mind as part of early spring. Shift to East Timor though, and this was exactly the experience on the Light Up East Timor tour in September 2015. It was a perfect time to be in East Timor: being late in the dry season, the humidity was not excessive and disease-carrying mosquitoes were virtually non-existent.

Part holiday, part community development

The Light Up East Timor tours run by Timor Adventures and supported by *ReNew*'s publisher, the Alternative Technology Association (ATA), are part holiday, part community development. Timor-Leste is still recovering after centuries of occupation by the Portuguese and then decades of turmoil under Indonesian rule. The people are rightly proud of their recently won independence, but the full repair of structures, systems and souls will take a very long time.

The ATA has been making a contribution to that repair process for some time with a program that installs solar lighting systems. Although electricity generation and distribution has reached larger centres, there are no plans to extend the network to many remote hillside villages. For those villages, ATA's approach of installing 20 watts of photovoltaic generation capacity, battery storage and two lights in each house means that many activities can happen after dark, including cooking and reading. The impact on the ability for children to study is profound.

Lessons learned from other well-meant aid programs have not been lost on the ATA.

↑ Installation team at a thatch house. Daytime activities are carried out on the lower platform. A sleeping space and living room are in the upper level within the roof space. The addition of some lighting within this windowless space is a great advantage. A bamboo ladder is drawn up into the house at night for security.

↑ Pre-wiring activities at our village base outside the eating and sleeping hut. Technicians and team members all pitched in.

On the rebound
Countering the sceptics

Does energy efficiency lead to energy use that offsets some of the savings, via a 'rebound effect'? It's not that simple, says Alan Pears, and in fact, the opposite can happen.

MANY 'energy efficiency sceptics' argue that saving energy simply leads to increased energy use that offsets the savings. Some go as far as suggesting energy efficiency is a waste of time and a sham.

Indeed, there is a large body of literature that documents the existence of a 'rebound effect'. But there is wide disagreement about how large it is—estimates range from a 10% to 70% reduction in net savings. Studies find that the extent of this rebound varies across sectors and activities.

On the other hand, other studies have shown that estimates of potential savings from energy efficiency policies have often been conservative, and costs have been over-estimated. For example, recent analysis of the effectiveness of Australia's appliance efficiency programs, using improved field data and analytical methods, increased the estimated benefits by a factor of two (as measured by cost per tonne of avoided carbon).

The International Energy Agency has shown that, if the multiple benefits of business energy efficiency measures are considered, total savings can be up to 2.5 times the value of the actual energy saved. These benefits can include productivity improvement, health benefits, reductions in costs in infrastructure and more.

Like many issues, the rebound effect has an element of truth underpinning it. But, overall, it is not a game changer. Indeed, with the right policy settings and in many situations, investment in saving energy can amplify overall energy savings. This article aims to unravel the story.

→ As TV manufacturers move to far more efficient technologies such as OLED, a bigger TV (with a high Star rating) can use a lot less energy than your old one.

What is rebound?

The term 'rebound effect' itself reflects a bias against valuing energy efficiency. It implies that some or all of the claimed savings from energy efficiency are inevitably taken back through increased energy use. This can certainly occur, but the opposite, amplification of savings, can also occur. The outcome depends on the policies, the behaviour of decision-makers, and the technical detail.

Broadly, the critical factors influencing the size and direction of the overall change in energy use due to energy efficiency improvement are how big the financial savings are, how they are spent, the overall impact of that spending as it flows through the economy, and technical system effects.

A more balanced term might be 'flow-on effect'.

Consider an extreme example. If I use the money I save through energy saving actions to buy a block of energy-intensive aluminium, overall energy use may increase, as more energy will have been used to produce the aluminium than I am likely to have saved. But if I invest my savings in more energy saving actions, or to support the growth of an energy saving industry, I will amplify the energy savings.

In practice, the overall outcome is difficult to estimate: if the aluminium I buy is used to reduce the weight of a car, the fuel savings may exceed the lifetime energy 'cost' of the aluminium—if I believe the aluminium industry's research! And, if the aluminium is eventually recycled, up to 90% of the energy 'invested' in its production will be recovered, reducing future energy consumption.

A tropical take
Smart cooling in the tropics

A Northern Territory program that works with low-income residents to reduce their energy bills and improve their comfort is starting to see results. Robyn Deed talks to one of the energy assessors about his approach and how the project is progressing.

WITH a background in environmental education, Glenn Evans was well placed to step into the role of energy assessor for the Environment Centre NT's COOLmob program, a groundbreaking project that's helping low-income households in Darwin keep comfortable while reducing their energy costs (see box at right for more details).

Glenn refers to the work as home visits rather than energy assessments. A critical aspect for Glenn is building rapport with the people whose homes he's assessing. "They may be feeling nervous or guilty about how often they use the air conditioner, and may try to hide this unless they trust me and feel sure that I'm going to help them rather than assess them."

Instead of going through a list of questions to get the information he needs, he has a conversation with the householders while looking at a couple of bills. He explains how to read the bills, and how to compare energy use at different times of the year.

He then goes for a walk with the householder, and gets them to point out what they've noticed: which rooms are hotter, and when and where they get cooling breezes. "It's their home and I want them to realise that they understand much better than me what it's like to live in," he says. It's important that they realise he trusts them too.

The COOLmob program involves an initial visit, usually around an hour, to discuss ways the clients could be more comfortable and reduce electricity bills, followed by a written report and assistance to organise and fund a retrofit for issues identified, such as fixing flywire screens to enable better ventilation, or installing external shading.

Glenn has performed about 120 initial assessments, and has just started on follow-up visits to see how the households are going with making changes. He has seen a pattern emerge already. As you'd probably expect, homeowners are making more changes than renters; it can be more difficult for renters to get permission or buy-in from landlords for extensive changes. The lower income households are struggling too; they get some products and work done for free as part of the program, but there are some extra things that they could do but can't afford.

Varying levels of air conditioner use

"You can tell the recent arrivals by their air conditioner use!" says Glenn. After they've been in Darwin a while, say 20 to 30 years, many people don't use one at all.

Many of COOLmob's clients limit their air conditioner use because of the cost. Those on a very low income, often refugees and migrants, don't use it at all. The majority don't use it in the dry season, or maybe just weekly, but they do use it for around six hours a day in the 'build-up' and during the wet season.

It does depend on the house. The newer homes are "built for air conditioning," says Glenn—concrete, with sliding windows rather than louvres, and no focus on orientation or breezes. The older lightweight houses don't tend to use it, or need it (at least not for the longer term residents).

Residents with health issues may use air conditioning 24 hours a day. One thing he suggests for them is to look at shading and gradually increase the temperature they set the air conditioner at, to see if they can stay comfortable for less energy use/cost.

↑ An important part of a home energy visit is helping people track their energy usage. Here, Glenn is reading the energy meter with clients John and Lea Mungbando.

Box air conditioners (sitting in windows) are still common; about 30% to 40% of systems they see are box units, 60% are split systems. They recommend replacing a box unit as split systems are generally more efficient, but that's not always possible; cheaper options are to limit usage or to put it on a timer and use a HeaterMate thermostat to control when it comes on. They also fix the gaps around them, as they're often poorly fitted.

They look at gaps and sealing if the household relies on air conditioning. They particularly look at curtains in lightweight homes, making sure they're heavy enough to keep in the cool.

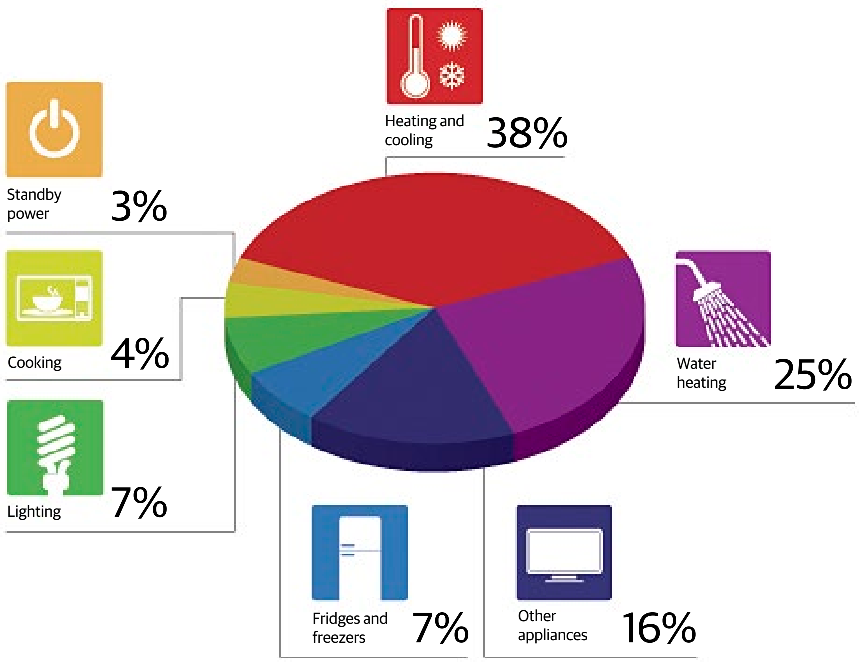
It's in the Stars
The importance of efficiency ratings

With household appliances the main contributors to a home's energy use, it makes sense to 'buy smart' and 'use smart'. Eva Matthews investigates how to achieve savings and help save the planet.

WHEN buying anything for the home, the item's upfront cost, look and functionality are prime considerations. For some of these—furniture, for example—this is where the buck stops. But when it comes to 'big ticket' household items such as whitegoods, computers and home entertainment systems, heating/cooling units and hot water services, another element comes into the mix: ongoing running costs. Whether powered by electricity or gas, these costs accumulate over the life cycle of an appliance or system, and so the energy efficiency of these items becomes an important consideration in the purchasing decision. It's not just about the money, of course—greater energy use means greater greenhouse gas emissions.

Energy efficiency is determined not only by the inherent mechanics and technology of an item, but also by its location (in Australia, as well as within or around the home), its age, the use of its various features and its level of maintenance. Achieving the best energy efficiency, then, becomes a combination of buying the item that uses the least amount of energy to achieve the functionality you require, as well as operating it in a way that maintains optimal efficiency over its life cycle.

A 2008 Australian government study on residential energy trends forecast ongoing growth of around 5% per annum in appliance energy use. However, the latest study suggests consumption will be fairly flat: our appliance efficiency programs and other factors are working. But to maintain and improve on this trend we need to keep working to improve efficiency to offset population and economic growth.



↑ Figure 1. Breakdown of average household energy use for the whole of Australia, based on Baseline Energy Estimates 2008; percentages will differ by state/climate and fuel types. This graph includes all fuel types; note that electricity is under half of total household energy. An updated report has been released in 2015; heating and cooling has increased to 40%, water heating reduced to 23% and appliances (including fridges and freezers) increased to 25%.

Buying efficient appliances

So how do you buy energy-efficient appliances and then use them most efficiently?

Regulatory measures have been put in place to encourage manufacturers to improve the efficiency of the products they send to market, and to help consumers make the best choice to meet their needs. These are the Minimum Energy Performance Standards (MEPS)—which specify the minimum level of energy performance required of appliances, lighting and electrical equipment before they can be offered for sale or used commercially—and Energy Rating Labelling, which uses the 'Star' energy rating system to help consumers compare like products in terms of their energy efficiency.

Australia was among the first in the world to introduce mandatory energy rating labelling, pre-dated only by Canada (1978) and the USA (1980). It was introduced in Victoria and New South Wales in 1986, and a national scheme agreed to in 1992. However, it was only 15 years ago, in 2000, that it was fully legislated in each state and territory.

We are all familiar with Energy Rating Labels

Buy your gran a cool corner
A low-cost climate refuge

With many homes ill-designed to cope with extremes of heat, how can the most vulnerable in our communities stay safe as heatwaves become more common, and more extreme? Community refuges are one option, but another is to retrofit a small part of a home as a low-cost climate refuge. Sue Roaf explains.

↑ Sue had lunch on a hot afternoon in this house near Buenos Aires. The cool corner has a roof and canvas blinds that keep the ground and air beneath it cool, and also cool the adjacent walls and rooms. The blinds can be raised in winter when the sun is welcome.

IN JANUARY 2014, a heatwave affected south-eastern Australia. In Adelaide, daytime temperatures rose to over 42 °C on five days in a row, and, on the hottest afternoon, there were power outages as the grid failed to cope with extreme air conditioning demand, from both offices and people arriving home from work (though the high levels of domestic PV installed in South Australia helped to meet daytime demand on most days). Deaths in Victoria doubled during this period, and, in SA, there were 100 more heat-related incidents per day than usual.

In a warming world, as such heatwaves become more common and more extreme, many governments are planning community-level climate refuges. Such refuges can take many forms from cool centres in a community building or the local shopping centre, to sunken gardens and spray-cooled parks. In Jakarta, for example, there are 194 air conditioned shopping malls, used as refuges in hot weather.

However, for people to go to community refuges (or shopping malls) involves travel that may be costly, or difficult in extreme heat, particularly for the elderly or very young. A cool retreat in the home would be preferable in many cases, if it can be done cost effectively. With many homes in Australia poorly designed for comfort in extreme summer conditions, and many people owning inefficient air conditioners that cost a lot to run and load the grid at peak times, what can be done?

This article proposes that, as a complement to community-level refuges, we work on adding a low-cost cool retreat to homes, so that, in many cases, people can safely sit out an extreme heat event, even if the power fails. This would benefit those less mobile at a lower cost than converting the whole house. Such an approach would also serve to educate householders (and planners!) on ways to reduce heat stress without resorting to expensive central cooling systems.

The basic premise is to retrofit a single room so that it will be easier to actively cool. Applying these changes to a single room will be cheaper and easier than applying them to a whole home. My proposal has at least three prongs: making the room as naturally cool as possible, storing coolth overnight for use the next day and using low-cost, effective cooling equipment.

1. Keep the room as naturally cool as possible

Choosing a corner room can be good, as you can create a cool microclimate outside the room as well, which will help to cool the room and also provide an outdoor retreat when the weather is milder. If you can, choose the coolest corner of the house, the one that doesn't get sun on it for the most time. This is usually the south-east corner.

Keep the sun off the external walls of the room. For example, add a verandah, wide enough to avoid the sun hitting the wall, or a vine-covered pergola. Or simply add an awning or shadecloth, preferably movable to allow flexibility. Have good external blinds.

Isolating the room from the rest of the house will also help. Heat pouring in from windows on the north or west sides of the home may swamp the coolth in the retreat, unless it can be shut off. If the retreat is a separate room, consider insulating the walls between it and other rooms, or use heavy

PV power
A solar panel buyers guide

We've contacted photovoltaics manufacturers for details on warranties, cell types, size and price to help you decide which solar panels are best for you.

Image: Justin Horrocks via iStock

↑ Photovoltaic panels can not only provide energy but can be integrated into the building. In this case they perform a second function as a window shade.

LARGE-scale manufacturing of solar photovoltaic (PV) panels has led to significant price reductions in recent years, to the point where they have become a common sight in the Australia urban landscape. From powering domestic dwellings to providing power for camping or even hot water, PV panels are everywhere.

Or almost everywhere. While there are well over a million homes in Australia sporting solar arrays of various sizes, there are still many homes without solar.

This article aims to provide up-to-date guidance for those people looking at purchasing a solar installation, whether that's a new system or an upgrade. It includes types of solar panels and factors to consider when buying them. The guide focuses on PV panels only. For information on other components that may be used in a solar installation (e.g. inverters), system sizing and economic returns, see 'More info' at the end of the article.

Types of solar panels: monocrystalline, polycrystalline and thin film

Solar panels are made from many solar cells connected together, with each solar cell producing DC (direct current) electricity when sunlight hits it. There are three common types of solar cells: monocrystalline, polycrystalline and thin film.

Both monocrystalline and polycrystalline cells are made from slices, or wafers, cut from blocks of silicon. Monocrystalline cells start life as a single large crystal known as a boule, which is 'grown' in a slow and energy-intensive process. Polycrystalline cells are cut from blocks of cast silicon rather than single large crystals.

Thin-film technology uses a different technique that involves the deposition of layers of different semiconducting and conducting materials directly onto metal, glass or even plastic. The most common thin-film panels use amorphous (non-crystalline) silicon and are found everywhere from watches and calculators right through to large grid-connected PV arrays.

Other types of thin-film materials include CIGS (copper indium gallium di-selenide) and CdTe (cadmium telluride). These tend to have higher efficiencies than amorphous silicon cells, with CIGS cells rivalling crystalline cells for efficiency. However, the materials used in some of these alternatives are more toxic than silicon—cadmium, particularly, is a quite toxic metal.

Each cell type has some advantages and disadvantages over others, but all in all, modern solar panels all do pretty much what they are designed to do. There are no moving parts to wear out, just solid state cells that have very long lifespans.

Crystalline cells are a very mature technology and have a long history of reliability, at least with most brands, so a good quality monocrystalline or polycrystalline

Build it, don't buy it
A DIY temperature controller

Temperature controllers have many uses, from controlling heaters for reduced running costs through to allowing you to use a freezer as a fridge for reduced energy use. Lance Turner describes a simple temperature controller built mostly from spare and surplus parts.

WHEN I needed a simple temperature controller to operate a small resistive panel heater for the bedroom, I had a look around to see what was available. There are some neat little plug-in controllers with LCDs that look much like a mains timer, but they are usually designed as a disposable consumer device and are not repairable.

Besides, I had all the parts to build a temperature controller sitting in the garage. I tend to buy electronic parts when they come up for good prices. One of my favourite shops is Rockby Electronics and over the years I have accumulated quite a few bits and pieces from them, all new from their 'new old stock'. I had a suitable case, a power supply (I bought a bag of 9V mains transformers for 50 cents each some years back), switches, fuse holder, terminal block, mains lead and socket etc. All I needed was the brains of the controller, so I had a quick look through my junk box and, sure enough, there was a temperature controller module I had bought to see what they were like.

↑ This is the unit I built with cover removed and components labelled. The completed controller is fully insulated for safety. It's not as pretty as a commercially made controller but it is more robust and is easily repairable.

The controller

These controllers are quite neat and consist of a circuit board with a small microcontroller IC. The IC checks the temperature measured by the attached temperature sensor (which is on a short cable) and turns a relay on or off depending on the measured temperature and the settings you have entered.

This particular controller has settable parameters, such as start and stop temperature (it can control both heating and cooling units, depending on how those temperature setpoints are set up), hysteresis (the difference in temperature between switching on and off), temperature offset (in case the displayed temperature is not accurate—you adjust the offset until it is) and various others. All I really needed was to be able to start and stop the panel heater to keep it operating within a narrow temperature range (between 11 and 12°C) for sleeping during the coldest winter nights. This module was ideal for this task.

Why a panel heater? Although a reverse-cycle air conditioner is a lot more efficient, they also cost a lot more initially and the noise and air movement can be disruptive to sleep, especially in the confines of a small bedroom. The panel heater is silent and effective for a small space like a closed bedroom, and because it is not used that often, total energy use over the year is quite low. The unit we bought is designed to work mostly from radiant output, like a hydronic radiator, only much thinner and without the plumbing.

I mounted the controller printed circuit board (PCB) inside the case. The module requires a 12V DC power supply, so I added a transformer, rectifier and capacitor to provide this DC supply. The bridge rectifier converts the AC from the transformer to DC, and the filter capacitor smooths out the DC. The rectifier and capacitor are mounted directly on the power input screw terminals of the controller PCB for