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Issue 133

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Low-cost owner-build: keeping it simple
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↑ Fancy staying in an earthship? One is about to launch in the Adelaide Hills. Page 56.

← **Cover image: Earthship Ironbank, a B&B in the Adelaide Hills. Photo by Philip Glitheroe.** Earthships are constructed from recycled and reused materials. Approximately 800 tyres were reused in the construction of Earthship Ironbank, with another 300 for the rainwater tank. Along with its tyre walls and earth-bermed structures, Earthship Ironbark is wired up to collect data—it has temperature sensors throughout in a bid to better understand the heat flows in an earthship. Earthships were invented in New Mexico, where the climate is very different from the Adelaide Hills, but owner-builder Martin Freney has tweaked the design for local conditions. One of the challenges Martin faced was sourcing bottles and cans for the walls; container deposit legislation in South Australia means used bottles and cans are hard to find! Page 56.

↑ The PET greenhouse. Page 68.

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Comfortably ahead
A tale of two heaters

Turn on your air conditioner—and knock hundreds of dollars off your heating bill. Tim Forcey describes the learnings (and savings) gained from his experiment with reverse-cycle electric heating.

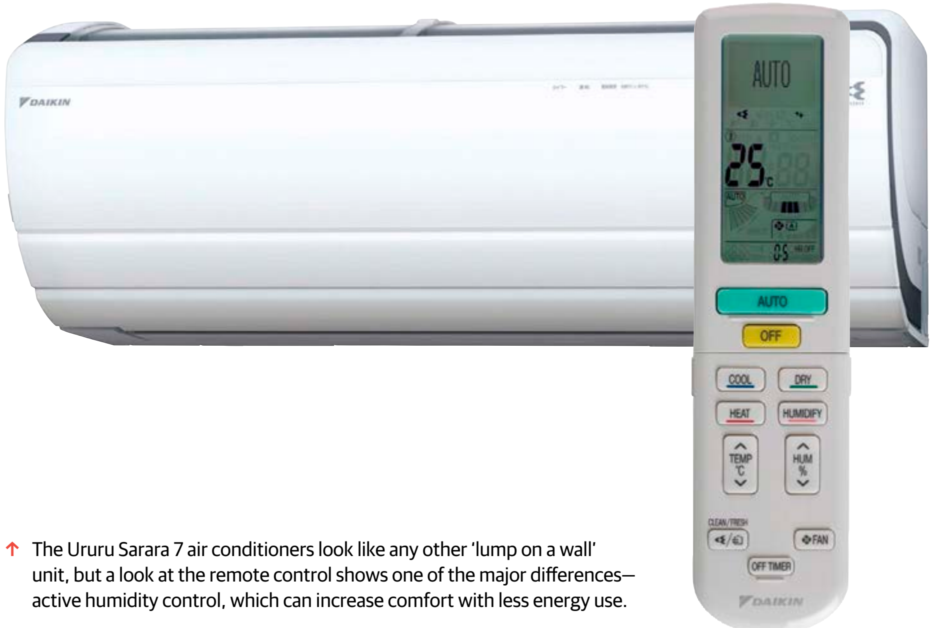
OVER the last 20 years my wife and I have raised a family in our 100-year-old Melbourne bayside weatherboard home. Last spring, following our third partial renovation, we installed two air conditioners in preparation for the hot summers to come—particularly so my wife and I could stay comfortable when working at home.

The two air conditioners we chose did just that, easily cooling our full ground-floor living space (128 m² consisting of seven rooms and a hallway). Based on advice from Matthew Wright (founder of www.pure-electric.com.au), we opted for two top-of-the-line Ururu Sararas (US7s) manufactured by Daikin: one small wall-mounted unit in our front bedroom (2.5 kW rated for cooling) and one medium unit (3.5 kW) in the lounge room.

The total US7 rated cooling capacity of 6 kW contrasts with a 14 kW multi-headed unit that the salesperson said we would need. So lesson number one: avoid the up-sell if your house is reasonably well-shaded and insulated (see box for more on sizing).

Come winter, I was keen to learn how these reverse-cycle units would compare with our 20-year-old ducted gas heater in terms of health, comfort, convenience and operating cost, particularly following on from research by Beyond Zero Emissions and the ATA (*ReNew*'s publisher) into the potential for economic and environmental benefits from going off gas.

My findings? There were pluses and minuses when comparing the two heating methods on comfort and convenience. But when it comes to cost, the reverse-cycle air conditioners beat ducted gas hands down—not only for our home, but possibly for hundreds of thousands of homes around Australia.



↑ The Ururu Sarara 7 air conditioners look like any other 'lump on a wall' unit, but a look at the remote control shows one of the major differences—active humidity control, which can increase comfort with less energy use.

Science—sort of—in the home

Starting in late June 2015 (mid-winter), I sought to heat our home on alternate days using the US7s and then ducted gas.

The US7s are heavily instrumented and can tell you the outdoor temperature, the indoor temperature, the indoor humidity and how much electrical energy they have consumed since you turned them on today, or since you installed them last year! Adding to this, I spread thermometers throughout our living areas. I also referred to our in-home electricity display that relays instantaneous electricity-use figures for our whole house from our smart electricity meter.

And for the first time in my life, often wearing a bathrobe and head torch, I journeyed out behind the bushes to the not-so-smart gas meter to diligently record gas usage.

I will not claim that this exercise was the best example of the scientific method we have seen. Variables and shortcomings had to be managed, such as failure to focus on the task-at-hand at 5.30 am before the morning coffee, Daikin's less-than-fully-illuminating owner's manual, and my co-occupants.

Ducted gas: reliable for years, but now at its use-by date

Our ducted gas system has served us reliably for 21 years. What Star rating our heater could have scored in the mid-1990s is unknown. Using figures taken from the owner's manual plus further measurements and calculations, I learned the unit might be 75% efficient at getting 18.8 kW of gas-combustion heat into

Small changes, big savings
Low-cost, carbon-neutral housing

You don't have to spend up big to get an environmentally friendly home. Glenn and Lee Robinson show us their clean, green cottage based on common-sense principles.

OUR aim was to build a home that was a lot more environmentally friendly than the average in Australia. So we did a bit of homework and found that it's surprisingly simple and economical to build a carbon-neutral house. This article describes what we learnt, how that information was turned into a building and how the house has performed now that we've lived in it for 12 months.

The most important discovery was that most of the techniques for creating a high-performance house cost little more than standard building practices. There are lots of small things in a building that, when done a bit differently, add up to a big difference in comfort and energy use (see our '20 guidelines' on the last page).

↑ This net-zero carbon cottage in Bundanoon, in the Southern Highlands of NSW, cost just $1480 per m² to build!

Finding the right design

Our goal was to minimise dependence on energy from unsustainable sources and create a comfortable, affordable home suitable for occupancy through all stages of life.

We began the design process by making a list of what did and didn't work in all the buildings we were familiar with, listing the features we would like to incorporate. We set a performance standard of net-zero carbon emissions and a budget of just $250,000 for the complete project, including house, garage and landscaping.

We looked at the options available with local builders, project home companies, prefabs and kit homes but found nothing that came near our specifications. A few prefab companies in Victoria could meet our performance spec but freight costs pushed the price above our budget. The one 'net-zero' project home available fell short in the performance stakes. The options were disappointing, but, in a country with the world's highest per capita carbon emissions, perhaps not surprising.

By default we were left with the only viable option being owner-building, which has ended up working out well. We started out by looking at the history of efficient buildings and which techniques and ideas have stood the test of time, and which haven't. We really wanted to see if we could avoid over-complication in the design so we researched low-tech ideas that have been proven to work.

We found a lot of good ideas in the layouts of Earthship buildings. They often have excellent room arrangements for maximum sun penetration, but we weren't fans of all their design principles as they require huge amounts of labour to construct and can overheat and leak.

An excellent resource is the website Build It Solar (www.builditsolar.com), where we found the Montague Urban Homestead, winner of the Massachusetts Zero Energy Challenge. We looked far and wide at hundreds of designs and, to us, this was the most elegantly simple, high-performance, economical design. We used this as the basis of our design, but de-tuned it to match our climate and rearranged the layout to suit our needs.

Many building decisions

Our final design was a single-storey detached dwelling of 108 m² with two bedrooms and one bathroom with a separate toilet. There is an adjacent carport/storeroom of 60 m².

Up to standard
Passive House in Australia

Designing and building your house to the Passive House Standard in Australia is now a viable option. Architect Fergal White visits a certified Passive House home in Canberra to see the house in action and hear its story from owner and designer Harley Truong.

↑ Harley's Passive House, front (north-facing) elevation. Harley built two almost-identical three-bedroom homes on the 1020 m² site, each optimised for passive solar gains.

Passive House Standard

The Passive House Standard (also known as Passivhaus) is an international energy-use standard that requires a house annually use no more than 46 kWh/m² of electrical energy in total, and have no more than 15 kWh/m² of heating and cooling energy demand, while maintaining a constant temperature of 20 °C in each room. The building must be airtight and have minimal thermal bridges. The energy and performance requirements are the same regardless of climate, but the method to achieve them will differ depending on climate.

I APPROACHED Harley Truong's Passive House in Canberra knowing that this freezing cloudy July day would be a real test of the house's certification. Stepping inside, the building was beautifully warm, with no heating system in use. Truly impressive!

The Passive House Standard dictates (low) maximum energy usage per square metre, both overall and for heating and cooling (see box). It does this by specifying a well-insulated envelope and airtightness that is perhaps unprecedented in Australia, where the building code doesn't stipulate any level at all.

There are now six certified Passive Houses in Australia, with many more under construction. But that wasn't the case in 2013 when Harley Truong embarked on his own build, so he made remarkable use of the internet to find his way to successful certification.

Renovation attempt

His family's journey to find a better way of living began with an attempt to renovate their 40-year-old home in Canberra. The house was draughty with cold floors, constant use of ducted gas heating and mould growing on the windows from condensation, all issues that were affecting the family's health and bills. Winter bills were often as high as $600 per month.

Harley attempted to thermally improve the house but to little effect. Replacing steel-framed single glazing with double-glazed windows (non thermally broken aluminium) and adding curtains made the condensation worse. Locating a whirlybird on the roof pulled heated internal air through the 30 ceiling downlight holes into the attic. Harley says, "I slowly realised that the home was almost the perfect inverse to what a passive solar designed house should be. It had the main glazed living areas facing south, minimal insulation, high air leakage and no thermal mass."

So when a large corner site (1020 m²) with no overshadowing came up for sale just down the road, Harley bought it almost instantly. The decision was also quickly made to knock down the poorly sited house on the block, and build two homes, one to live in, and one as an investment property.

Coming around to Passive House

Harley came around slowly to building to a Passive House design. Initially, as perhaps many people feel, he dismissed it as a European-specific standard, not suitable to Australia's milder climate. However, the targets of low energy use, particularly for heating and cooling, were exactly what he wanted after his family's experience in their previous home.

He became aware that the Passive House standard uses site-specific climate data and so

Waste not, want not
A recycling round-up

Lance Turner considers the evolving recycling options for some of the common technologies in households: solar panels, lights and batteries.

Solar panel recycling

Up until recently there have been no official schemes for recycling solar panels in Australia. However, as the number of broken and otherwise failed panels begins to grow, so has the need for recycling.

But how much solar panel waste is there at present, and what are we looking at down the track when the current explosion of solar panel installations come to the end of their working life?

Although figures are hard to come by, one typical example is that of Japan, which has seen considerable growth in PV installations in recent years. According to the Japanese Ministry of the Environment, by 2040 770,000 tonnes of solar panels will need to be recycled. The ministry has stated that, in conjunction with the Ministry of Economy, Trade and Industry (METI) and industry organisations, it will begin to implement measures for "removal, transportation and processing of solar power generation equipment" before the end of this fiscal year, in March 2016 (from www.bit.ly/1PwRFfC).

In Europe, requirements have already been added to the Waste Electrical and Electronic Equipment (WEEE) directive, bringing in a take-back and recycling scheme to deal with solar panel waste. The program, PV Cycle (www.pvcycle.org), provides fixed collection points, collection services for large quantities, and collection via distributors.

The WEEE directive means that solar panel manufacturers not only have to ensure collection and recycling of their products when they have reached their end of life, they will also be required to ensure the financial future of PV waste management.

Image: pvcycle.org

↑ Old PV panels contain large quantities of valuable materials such as aluminium, silver, tin and glass.

Looking at Australia, there is currently (as of March 2015) 4.1GW of installed capacity of solar PV. Assuming around 250 watts per panel (a common size), that's around 16 million solar panels. With an approximate weight of 18kg per panel, you are looking at 288,000 tonnes of solar panels, or around 11,500 tonnes per year (assuming a lifespan of 25 years) needing to be recycled. Of course, many PV panels will have a greater lifespan, while other, lesser quality panels will die sooner, so these figures are really just ballpark.

Regardless, that's a great deal of materials needing to be recycled, most of which is glass, silicon cells (a glass-like material) and aluminium.

Aluminium framing is easily recycled in existing aluminium smelters. However, without a system of collection, transportation and dismantling of solar panels, these materials are currently going to waste, usually ending up in landfill.

But things are changing, with both Canadian Solar Australia (www.canadiansolar.com/au) and Yingli Solar (www.yinglisolar.com/au) recently announcing that they are teaming up with Reclaim PV Recycling (which started in 2014, see www.reclaimpv.com) to provide solar panel recycling in Australia.

What's interesting about Reclaim's recycling system is that they don't just pull the panels apart and recycle the various materials; instead, they have developed a process that allows them to disassemble panels down

Bear Grylls with spanners
Making use of urban resources

John Hermans explains how to live, and live well, on minimal income by reusing the vast array of high-quality waste generated by the average suburbanite.

↑ John in his workshop, repairing a commercial induction cooktop. Two drops of vegetable oil on the control dial had rendered this unit (worth a few thousand dollars) almost worthless. A little degreaser and a clean rag soon fixed it. They now cook on solar-powered induction.

IN CASE you haven't noticed, there's been a lot of interest lately around city people's ability to survive away from the world of the supermarket—to survive in the wild like Bear Grylls, for example.

To some this is no more than entertainment, honing a skill set with minuscule probability of any need. I would agree. But I feel some affinity to those taking up this challenge, given my own challenge to live, by choice, with little income.

My daily chores revolve around making, fixing, growing and processing. My wife has paid work two days a week, so we need to get by on an income that could only be described as well below the poverty line. The job title that I've used for the past 10 years is 'Cost of Living Minimisation Worker', unwaged!

Yet we live well, on a large bush property, with an earth-covered home and highly productive garden.

There is so much going on at our place beyond having 100% renewable energy for both home and vehicles, so I thought it might be worthwhile to share some of our tactics for living well without it costing the earth.

An excess of waste

We did not jump into this situation, it evolved over time. The multi-skilling we've needed takes time and determination, but the rewards have been high. Confidence in your skills and ability to learn is essential, but the biggest boon has been living at this time and in this place.

In Australia, we live in a time of unprecedented excess. We have more than we need of all the things necessary for a comfortable life, and a whole lot more that is completely unnecessary. As a consequence, discarded goods are also in excess. It is this 'waste' that makes my family's life so comparatively acceptable on such low income.

Mass production has played a major role, bringing with it the low cost of new goods, making repairs seem unreasonably expensive. With most goods being made overseas in low-income countries, when Australian-waged workers are asked to repair these goods, the economics fail.

Consequently, I just keep getting better at fixing things myself. Many items are now discarded when they have the simplest of faults, even more so than in the past, so the skills needed to fix them are actually decreasing; in years past, goods were treated as repairable when they had much greater levels of 'brokenness'.

Here's a typical example. Ten years ago I purchased a metal cut-off saw (new value $200) at a Sunday market, which was sold as 'not working' for $50. I was fairly sure it would be a loose electrical wire, and it was. Today I would never pay this much because I can easily find one at the scrapyard for much less. I recently did just that, buying an even better one (with the same problem) for just $5.

A toxic legacy
E-waste recycling in Australia

The mountains of e-waste continue to grow, and much of it is still ending up in landfill. Kirsten Tsan looks at what's happening here to address the problem.

AUSTRALIANS are among the most prolific technology users today—and some of the most wasteful. From 2007 to 2008, an estimated 15.7 million computers reached their 'end-of-life' in Australia, but only 1.5 million were recycled. The rest went to landfill.

E-waste is any electronic equipment that requires electric currents or electromagnetic fields in order to function that has reached the end of its useful life. Up to 2011, we were sending over 90% of our e-waste to landfill, endangering not only the environment, but ourselves; computers and televisions contain materials that are hazardous to humans, such as lead, cadmium, mercury and zinc.

Worse, we were wasting the materials in this electronic junk—the majority of which could be fully recycled and used in other products. To give an example: the amount of gold recovered from a tonne of electronic scrap from PCs is more than can be recovered from seventeen tonnes of gold ore! These valuable and non-renewable resources are lost when they are thrown into landfill, and so are the resources that were used to make them, like water and oil.

↑ Ghanaians working at an e-waste dump in Agbogbloshie, a suburb of Accra, Ghana.

National recycling scheme

To address these issues, in 2011 the federal government launched the National Television and Computer Recycling Scheme (NTCRS) under the Product Stewardship Act. The scheme states that the companies and businesses making computers and televisions are also, to a certain extent, responsible for funding their product's recycling programs around Australia.

The NTCRS is a stepped implementation and will take place over a number of years. It started in 2012–2013, with the aim that industry would take responsibility for 30% of the collection and recycling of their products. The ultimate goal? By 2021–2022, industry will have taken 80% of the responsibility for the recycling of computers and televisions.

Before the NTCRS was launched, a 2010 report stated that industry funded 17% of the recycling for that year. In the first year of the scheme (2012–2013), a total of 40,813 tonnes were recycled by industry—98.8% of the scheme target and almost double the estimated levels of recycling prior to the introduction of the NTCRS. In the latest report (2013–2014), out of 131,607 computers and televisions that reached their 'end-of-life' in Australia, industry was required to fulfil a 33% target (43,430 tonnes). By the end of the year, industry recycled 52,736 tonnes, which was 7% over the scheme target, and 40% of the total recycling that year—a marked improvement. Liable parties—the companies within the television and computer industry—were also reported by the Department of the Environment to have mostly complied with the scheme, with an impressive 99.2% complying in proportion to the weight of liable imports.

E-waste often contains materials that are hazardous to human health, and therefore

Peak plastic
The proliferation of plastic

Dorothy Broom tells a personal story of the history and sociology of consumer plastics. She is 70 years old; her lifespan encompasses the development and proliferation of petroleum-based consumer plastics.

Photo: Andri Tambunan, Greenpeace

↑ Abah Dayat is a former West Javan fisherman who now collects rubbish from the river instead. The number of fish has significantly declined due to industrial pollution.

MY TRAINING is in social science, not natural science or chemistry, so I won't try to tell you anything about marine biology, biodegradation versus photo-degradation, how big the Great Pacific Garbage Patch has become, or why we have minute plastic beads in toothpaste and face wash.

When I was a child, we had practically no modern plastics—certainly no single-use plastics. I remember food packed in plant-based cellophane, waxed (not plastic-coated) paper, alfoil, glass and cardboard. Grocery bags were paper. Food and beverage containers were returned and refilled, including the metal pie plates from the local bakery. Drinking straws were glass, metal or cardboard. Take-away drinks were sold in glass bottles or metal cans or cardboard cups with no lid. I remember getting my first few plastic bags in the 1960s which were scarce and robust so we washed and dried them so they could be reused. Cling wrap was around, but it was an expensive luxury. If anybody was concerned about pollution or harm from plastics, I didn't know about it.

By the late 1960s there was an awareness of air and water contamination. Having grown up in Los Angeles, I knew about air pollution from personal experience. Rivers in industrial areas were catching fire. After university, I read books such as *The Population Bomb* (1968) and *Limits to Growth* (1972) and began to worry about what we humans were doing to the planet. I joined small, grassroots community organisations which lobbied for environmental protection, retaining deposits on beverage containers and municipal recycling. One group took a field trip to the local tip. It was deeply disturbing to see the astonishing quantity of potentially useful material being discarded by a university town of only 30,000.

My activism on environmental issues continued after migrating to Australia in

How much plastic do Australians use and recycle?

Over one million disposable plastic grocery bags are produced every minute on this planet. They are made from fossil fuels and only one in ten of them will be recycled. Plastic use is on the rise—1,535,200 tonnes of plastics from domestic production or imported resin were consumed in Australia in 2013–14. This was an increase of 4% from the previous year. In Australia about one fifth of plastics are recycled; in 2013–14 the overall plastics recycling rate was 20.4%, down slightly from 20.8% in 2012–13.

Plastic packaging refers to material used for the containment, protection, marketing and/or handling of a product, including primary, secondary or tertiary (freight) packaging in both commercial and industrial applications. 231,300 tonnes of plastic packaging (43.9%) was recycled in 2013–14.

Non-packaging plastic refers to plastic material used for a broad range of consumer and industrial products, with varying life-spans. This includes items such as medical consumables as well as pipes, cable casings, computer cases/enclosures, furniture and building products. 82,400 tonnes of non-packaging plastic (only 8.2%) was recycled in Australia in 2013–14.

*source: National Packaging Covenant Industry Association 2013-14 National Plastics Recycling Survey published by Sustainable Resource Use Pty Ltd

A PET project
Hothouse in Canberra

Environment teacher Deb Shaw found an innovative way to teach the principles of reduce, reuse, recycle to her students, at the same time as helping the school's vegie seedlings thrive in frosty Canberra.

"A PICTURE in a magazine of a greenhouse built from reused drink bottles planted the initial seed of the idea," says Deb Shaw, the environment teacher at Wanniassa Hills Primary School in Canberra.

Deb had been on the lookout for projects with a strong sustainability focus to fit in with the school's environmental education program. With a new kitchen garden at the school, a greenhouse built from reused materials fitted the bill perfectly.

"Students were able to do the building, which was great in itself, plus they also got to see a waste material like PET bottles getting used," says Deb. It helped the students to both think about the amount of waste in their own homes and to consider how waste could be used as a resource instead of being put in the bin.

An added bonus, of course, was that the result would be really useful in the kitchen garden. The hothouse enables the school to grow seedlings all year round, preserving plants through the school holidays and helping to compensate for Canberra's short growing season.

To design the hothouse, Deb found a website with instructions and measurements, which they then adapted to suit their needs.

The school's hothouse ended up using almost 2000 PET bottles. Students enthusiastically collected bottles over a period of months, with most coming from home and some from the "Aladdin's Cave of treasures" at the rubbish tip.

The school didn't specify particular bottle sizes as they realised that could dampen enthusiasm. "Bring in everything" was the message, and students then sorted the bottles into sizes and shapes that went together.

↑ Students threading the bottles onto the canes.

→ Fitting the completed strings of bottles into the frame to make the greenhouse walls.

The design is clever and simple, and the students were able to take part in almost every stage of the construction. A builder-parent donated the wood and built the frame, and Bunnings donated the bamboo stakes which hold the bottles in place.

The students cut the bottoms off the PET bottles, stacked them inside each other and threaded them on the bamboo stakes to make the wall and roof structures.

The students also slotted the bamboo stakes into the pre-drilled holes on the frame to make the walls. The pre-drilled holes meant they needed to be careful about which bottle sizes they used together to ensure a reasonably snug fit.

The result looks great and has been working really well since completion in 2012. The school hasn't taken temperature measurements yet, but the seedlings have a much higher success rate inside the greenhouse than out.

It prevents plants being affected by frost even on icy Canberra mornings in late winter and early spring. "We've had an aloe vera plant in there all this year," says Deb, "which just wouldn't have survived without the greenhouse."

The structure isn't airtight, with small gaps between the rows of bottles, and Deb would like to better seal the roof (and possibly also the walls) at some stage. There are advantages, though, to having gaps in the

New choices in lighting
An LED buyers guide

The move to LED lighting has become mainstream, with more options appearing constantly. Lance Turner takes a look at what's available.

FOR many homes, lighting is one of the most overlooked aspects. Incorrect lighting can make a room unpleasant to be in, or make it more difficult to perform tasks such as reading or cooking. Getting it right can take a bit of effort, and though this guide won't answer all your questions about lighting design, hopefully it will give you a headstart when thinking about the types of lighting to use and the questions to ask.

With almost all lighting technology moving towards LEDs, this guide focuses on LED bulbs. Even the reasonably efficient technologies such as fluorescent tubes and compact fluorescent lamps are rapidly being replaced by LED lighting. It's likely that within 10 years, most other light sources will have disappeared in favour of the robustness, longevity and energy efficiency of LEDs.

What is an LED?

LEDs (light emitting diodes) are unlike any other lighting system. They contain no glass tubes or heating filaments, instead using a small piece of semiconductor material (as used in computer chips) that emits light directly when a current is passed through it.

LEDs produce light in a range of colours, without the need for coloured filters; thus, to get white light, a phosphor is used over a blue or UV LED chip, similar to what's used in a fluorescent tube.

Note that the LED is actually the small light producing element(s) in a light bulb or fitting, but most people now erroneously refer to LEDs as the entire bulb or fitting.

→ It looks like a regular oyster-style fitting, but the XL-LED 18 watt Circular Ceiling Light from Crompton Lighting produces 1100 lumens of 4000 K neutral white light or 1200 lumens of 5600 K daylight white light from a maximum of 18 watts.

LED specs

There are a number of specifications that are useful to consider when buying LED lights.

BULB WATTAGE

All light bulbs have a wattage rating, which measures how much power they consume. This is where LEDs have a shining advantage over older, more inefficient technologies. For domestic LED lights, the rating is usually between one and 20 watts, compared to a typical incandescent rating of 25 to 100 watts.

LIGHT OUTPUT:
LUMENS, LUX AND BEAM ANGLE

Many LED bulbs include an 'equivalent-to' wattage rating, showing the wattage of the incandescent bulb that the LED bulb is equivalent to in terms of light output. For example, a six watt LED bulb might be rated as putting out the same amount of light as a 50 watt incandescent.

This 'equivalent-to' rating is based on the light output in **lumens**. The lumen rating of an LED bulb, usually included on the packaging, measures the total light output, relative to the response of the human eye.

For bulbs that are suitable for general room lighting—those with wide beam angles, above 60 degrees, but preferably 90 degrees or more—matching lumens for lumens should give you the result you need. Thus, for these types of lights (these are generally found in the common Edison screw, bayonet or 'oyster' fittings), the 'equivalent-to' rating should be all you need to determine if the bulb is a suitable replacement.

For directional lights, often known as spot lights, it's a bit different. These are lights with a smaller beam angle, up to around 60 degrees. Such lights are generally used for task lighting, directed onto a desk or work area. Halogen downlights are an example of these—it's because of their small beam angle that so many of them were needed to light a room! For these spot lights, small differences in the beam angle can make a big difference in how bright the light appears. Many people have had the experience of buying an LED bulb which was meant to be equivalent to a 50 watt halogen, but found that it appears much less bright. The lumens may have been lower, but more likely the beam angle was narrower, creating a bright light directly under

DIFFICULTY RATING: ★★★☆☆

Downlight transformers
The good, the bad, and the very inefficient

Not all halogen downlight transformers are created equal when using them with retrofit LED globes. Alfred Howell explains how the wrong transformers can be costing you money.

WITH the retrofitting of LED downlight bulbs to MR16 halogen fittings, households have seen great efficiency gains and cost savings.

However, if you change your bulbs to low-power LEDs but don't check the transformers, you may be wasting energy. Many of the older downlight fittings use ferromagnetic (iron core) transformers. While simple, they are inefficient compared to modern electronic replacements. To determine the extent of losses in these transformers I performed some simple testing.

Testing and results

I tested a typical ferromagnetic transformer alongside an Osram Redback electronic transformer. Both transformers were tested, with and without a Brightgreen DR700 retrofit LED globe. A Power-Mate Lite energy meter was used to measure power draw.

As can be seen in Table 1, the electronic transformer performs well with or without the globe. While it seems a bit pointless to test a transformer without a globe fitted, it's actually a good indicator of the efficiency, or otherwise, of each transformer. Compare the electronic transformer's 0.38 W draw without a globe with the ferromagnetic transformer's draw of an extra five watts. Indeed, the ferromagnetic transformer uses an extra five watts more than the electronic transformer with or without the globe's load.

While that doesn't sound like much, it's not uncommon to find 20 or more downlights in a home. With all 20 lights on, that would be an extra 100 watts burning a hole in your wallet—or 0.5 kWh if they're on five hours a day.

Solutions and options

To reduce this energy use, the cheapest option is to swap the ferromagnetic transformers for electronic ones when you retrofit. They are low cost, usually under $15, and available from electrical wholesalers and lighting stores. Alternatively, you could upgrade the halogen fittings to dedicated LED downlight fittings with an incorporated driver.

An even better option is to remove the downlights altogether in places where suitable. Downlights compromise ceiling insulation as they must be uninsulated to prevent the fitting from overheating. Also, many downlights, even LED ones, have a fairly narrow beam angle and so tend to produce pools of light. To get high ambient lighting levels requires a greater total wattage from downlights or a light fitting with a wider dispersion, such as an oyster fitting.

It's clear that changing the globe as part of an energy saving makeover is only part of the solution. For maximum efficiency and results, the whole lighting system, and how the system is used, needs to be evaluated. This includes behavioural changes such as turning lights off when not in use. With a bit of effort, you will be amazed at the savings that can be realised. ✱

↑ Electronic transformers (at left) waste far less power than the old ferromagnetic ones while being smaller, lighter and producing less heat. Even with no load, the ferromagnetic transformer is wasting over five watts!

Alfred Howell has years of experience managing complex machines, which he reckons puts him in a terrific position to understand how we can work as part of this complex machine we call Earth.

Type	No globe, or globe blown	10.5 W globe fitted
Ferromagnetic	5.34 W	18.23 W
Electronic	0.38 W	13.13 W
Savings	4.96 W	5.10 W

↑ Table 1. Energy consumption of electronic versus ferromagnetic transformers, with and without a load (globe) fitted.

Clean out the dust and save money
Simple fridge maintenance

Is your fridge running all the time? It may not be worn out, just dirty. Charlie Woolstencroft explains how easy it is to fix.

↑ After removing the grill/cover you will see the compressor (here mounted on the left), the cooling coils (middle) and possibly a controller box (right).

→ The cooling coils will probably be full of dust, which needs to be carefully removed with a soft brush and vacuum cleaner.

THE sound of my fridge seeming to run all night prompted me to find out why. Dust on the air intake and cooling fins was the problem, so I set about cleaning them. It was a simple one-hour job, which will hopefully save me both electricity and wear on my fridge, at zero cost. Here's how to go about it.

What to clean, and how

First, and most important, unplug the fridge from the power point before beginning.

Next, slide the fridge out until the rear is completely accessible. Now, be appalled at the cobwebs, dust and fluff clinging to the air intake grill/cover, usually located at the bottom rear of the fridge.

It's now time to undo the screws holding the grill on. In my fridge's case, there are six screws around the grill. You'll then be able to see why the fridge is having trouble. All that fluff and dust is blocking the airflow through the condenser coils and cooling fins.

To reach the fluff on the cooling fins, I undid the two screws securing the plastic white control box (on the right-hand side). I gently slid this out; the wires are secured inside this box so no disconnection of wiring is required. You may or may not need to do this, depending on your fridge's design.

With the control box out of the way, you will see the full extent of dust on the cooling fins. In my case (see photo), it makes me feel ashamed that it got to this stage. Use a soft plastic brush to clean the cooling fins and suck the dust away with a vacuum cleaner. Be gentle: the fins and pipes can easily be damaged.

There is a little cooling fan on the left-hand side which sucks the air through the cooling fins. Again, in my case, there was fluff stuck to the blades which was slowing them down and making the cooling less efficient. I used my fingers to remove this fluff.

After cleaning, it's time to reassemble. Slide the plastic control box back in, making sure the wires slide in easily, without forcing. You may need to relocate the wires if they are getting caught against the back of the control box.

Replace the rear grill, making sure the power lead sits in the slot so it is not crushed by the cover when the screws are done up.

Slide the fridge back, plug in the power and if your fridge is like mine, you will notice it runs about 50% less. Success!

When you slide your fridge out, you may find that it has old-style cooling coils on the rear of the fridge or that it doesn't have an air intake grill. In the latter case, your fridge radiates its heat via the side walls of the cabinet, and it's important that there's a clear air space on all sides to allow the heat to escape. You haven't wasted your time pulling the fridge out though: look at all the treasures you've found hiding under the fridge! ✱

Charlie is a semi-retired electrician in Canberra helping low-income households to reduce their energy consumption.