Time to take charge? Electric vehicle buyers guide inside

DIY double glazing
Insulate your aluminium windows with this guide to easy, renter-friendly double glazing.

Sustainable transport special
Ready to go electric? Get the latest on EVs, e-bikes and long-distance e-transport, plus nine case studies from those who've made the move.

WIN
A TCK Solar sponsored Tesla Powerwall 2 valued at up to $15,000
Australian and NZ residents only
**Renew 148 is something of a milestone for me: my 100th issue.** It was 25 years ago that I first started working at the ATA, now Renew, on what was then Soft Technology magazine. It was issue 49, and I had a fast learning curve to get up to speed with production systems, which were quite basic—we used to laser print each page on high resolution paper and send those prints to the printer, who would transfer them to film to make printing plates. It was slow and tedious compared to today’s complete digital publishing process.

Over the last 25 years I’ve worked with no less than seven different editors (Claire, Michelle, Michael, Kulja, Donna, Jacinta and Robyn—and a special shout out to Anna Cumming, acting editor for this issue while Robyn is on leave). Each editor has brought to Renew their own unique ideas and style. Together we have developed the magazine into the high quality, full colour publication we have today.

When I first started at the ATA, the few electric vehicles that existed had short ranges and lead-acid batteries—not very practical for a reliable vehicle. Grid connected solar energy systems were in their infancy; the typical system was around 1kW and cost over $10 per watt installed. Climate change was also not well understood by the average person, if they had even heard of it. Indeed, the whole sustainability sector was just a baby, and one struggling to survive at that.

So, what’s changed after 100 issues of Renew? Well, we have amazing emission-free vehicle options now, as you will see in the EV buyers guide on page 45. The renewable energy industry has boomed, and we have much greater awareness of the environmental challenges we face. Indeed, climate change is now considered a climate emergency, as we examine in our article on page 23.

Renew was originally a very hands-on publication, with lots of DIY projects as renewable energy equipment was expensive or unavailable to buy. Nowadays solar and wind power has become mainstream—something I wasn’t sure I would actually see. This has meant fewer DIY projects, but has given us space to produce a wider range of articles covering all aspects of sustainability and renewables. We look forward to the day when sustainable systems and behaviours are truly the norm, not the exception; once that happens we may not be needed any more, but until then, we will keep pushing towards that ultimate goal of avoiding a climate disaster.

“"It’s fitting that this, Lance Turner’s 100th issue, is focused on sustainable transport—a topic very close to his heart. Lance is always ready to answer questions, big, small or embarrassing; we rely on him for that and so much more, as do our readers.”

— Robyn Deed, managing editor (Read more tributes to Lance in our member profile on page 94.)

**Cover image: Barton Taylor.** This Blue Mountains house, designed by Alexander Symes Architect, features a 3kW solar system and plenty of garage space for an electric vehicle when the time comes. (Read more about the house in Sanctuary 45.)
The hydrogen question
Renew’s Andrew Reddaway considers the pros and cons of hydrogen in our energy system.

Solar-powered building site
It’s common to think about solar powering a building, but what about the building site? Well, it is possible to run those big tools from a battery.

Don’t mention the emergency?
Climate change or climate emergency? The language we use is important.

Solar for an emergency
John Hermans suggests different ways to think about sizing your solar system to meet the needs of a climate emergency.

Working with contours
In this dry country garden, water is at a premium. So how does it look so good?

Going electric with hydronic heating
One family’s story of a shift from gas to heat pump hydronic heating, the issues along the way, and the results.

Emissions report: household electricity versus gas
Switching from gas to electricity for heating, hot water and cooking can favour your hip pocket. But which fuel gives the lowest emissions?

DIY double glazing for aluminium windows
A simple, renter-friendly way to improve the performance of aluminium-framed windows.
Hydrogen: help or hype?

Australia's government is currently developing a strategy for including hydrogen in a future low-carbon energy system. Renew's energy projects team has looked at where it has potential, and where it doesn’t.

Much is being made of the announcement that at the Tokyo Olympic Games next year, hydrogen will burn in the Olympic torch and even power the athletes’ village. By some accounts, in the not-too-distant future we’ll all be using this high-energy, ‘clean’ fuel to run our cars, heat our homes, cook our food and power our electric appliances. But as we transition to a low-carbon energy system, how much of this posited ‘hydrogen economy’ is realistic, and how much is hype?

Australian federal and state governments are working on a hydrogen strategy document to be completed by the end of this year. Renew’s energy projects team has been involved in the roundtable discussions for the strategy, and has developed a discussion paper exploring the areas in which hydrogen for energy has potential, and where it is better avoided in favour of more efficient alternatives. In this article, we take a brief look at some of the team’s findings.

What is hydrogen?

Hydrogen is a gas which burns very cleanly, leaving behind only water vapour. It can be used to generate heat or electricity, including for use in transport, with no greenhouse gas emissions. It can act as energy storage and can also be transported, opening the door for energy export. However, thus far its use for energy purposes has been very limited. Currently, it is produced from fossil fuels and used in industries such as metalworking, glass and electronics.

The main barrier to more widespread use has been obtaining the hydrogen—unlike fossil fuels there are no geological deposits; instead renewable hydrogen must be created by splitting water, a process that requires energy. (In fact, more energy must be expended to create it than the hydrogen contains.) Thus, hydrogen is only a carrier of energy rather than an energy source.

When produced using renewably generated energy such as solar and wind, hydrogen is a renewable, emission-free fuel. Its main downside is inefficiency, because the required conversions waste a lot of the original energy in losses.

Renewable energy for transport: hydrogen vs batteries

A heavily promoted use of hydrogen is for transportation. In a fuel cell electric vehicle (FCEV), hydrogen from the car’s fuel tank is fed into a fuel cell which generates electricity. This is then stored temporarily in a small battery and used to power the car’s electric motor.

Because of the significant energy losses in the process of creating and supplying hydrogen, an FCEV is much less efficient than a battery electric vehicle (BEV) in which renewable electricity is used more directly via the car’s larger battery.

Figure 1 illustrates how energy losses accumulate for four scenarios all starting with newly generated renewable energy: an energy efficiency from generation to propelling the car of 53% to an impressive 77% for the battery vehicles, and just 15% to 34% for the fuel cell vehicles.

Although these numbers include many uncertainties, when comparing the range of results in these four scenarios it’s clear that renewable hydrogen is an inefficient option to propel a vehicle, compared to using renewable electricity via a battery. Figure 2 presents this in a different way, showing how many more solar panels would be required for a daily 30 km commute using hydrogen and an FCEV than using a BEV.

FCEVs also face a chicken-and-egg problem; manufacturers won’t export them to Australia until there’s a refuelling network.
Built with solar, runs on solar

Designing and building a more sustainable home is fertile ground for innovative ideas. Howard and Libby Elston explain how generators were largely avoided when building three new units.

What happens when everyone is ready to start a sustainable building project, but there’s a delay in getting a temporary connection to the electricity grid? For this suburban project, the solution was to try a bold experiment with a solar-powered off-grid worksite.

Electrical supply delay posed a problem
Removing the power pole from the footpath at the front of the Ringwood East property was a significant advantage for site access and future street appeal. However, the catch was the distributor couldn’t say for certain when the new underground cable would be connected to the grid.

Construction was ready to begin on the first of three units in our sustainable development which we’ve called Green Home Build Australia (greenhomebuildaustralia.com). Being unable to organise temporary power threatened to delay the start of the project.

So our builder David Coates from Sustainable Building and Design began to investigate alternative power supplies. The obvious solution of using a petrol-powered generator didn’t fit with the project’s sustainability philosophy. Apart from burning fossil fuel, it didn’t seem fair to the neighbours to have a generator chugging away all day.

David realised that a power system designed to be installed at the end of the project could provide a solution with a lower carbon footprint. We had planned to power unit 3’s garden shed by an off-grid system to avoid installing a lengthy electrical conduit run to the back of the property.

Could the off-grid system be installed at the start of the project and meet the power demand of a construction site? David discussed the concept with Gary Wilson from Sustainable Power Systems, the designer of the site’s electrical systems. The design brief was to provide a reliable electrical supply for a building crew using a variety of power tools.

The off-grid theory
Gary concluded that, in theory, the shed’s off-grid system could be modified to suit the new purpose. Selecting components which met the site demand without blowing the limited budget was the tricky part. The two largest energy users would be the air compressor (1.8 kW) and drop saw (1.65 kW). Other tools included circular saws, grinders and a cordless tool battery charging station.

Choosing the panels was an easy place to start. The number of panels was limited to four, as that is the most that would fit on the garden shed roof. Gary chose 335 W Canadian Solar panels giving a total production of 1.34 kW. On a sunny day, the panels would produce most of the electricity required for continuous operation of one of the big energy-using tools.

An Outback Power FXR2024E inverter-charger is the heart of the design. Inverter sizing was a compromise between meeting site power demands and cost. The 2 kW inverter could certainly supply one large user (such as the 1.65 kW drop saw), along with smaller users (such as the cordless battery charger). An overload capacity of 5175 W (or more correctly, VA, the AC version of watts) was expected to cope with the starting current—motors usually draw more than their rated power when starting, called the startup power. Inverters can often provide a lot more than rated power for a short period (this unit is rated at over 5000 W for five seconds), which is often all you need to overcome start-up surge when a machine starts up, so you can often size an inverter smaller than you might expect and still have adequate capacity.

So why not a larger capacity inverter that could meet the startup and continuous operating demands of the two biggest users simultaneously? We couldn’t afford to spend the money on a system which would then be oversized for its final use in the garden shed workshop.
Don't mention the emergency?

Climate change or climate emergency? At a Renew Melbourne branch meeting, clinical psychologist and climate activist Jane Morton explained that the language we use is important.

When clinical psychologist Jane Morton attended a climate talk in 2007, she wasn't expecting a life-changing experience. But that's what she got. The graph that got her attention was one showing the extent of the summer Arctic sea ice (Figure 1). “The red line had fallen off the worst-case predictions and was now heading to what looked like an exponential curve.”

She found herself on the mailing list of David Spratt and Philip Sutton, who were writing a book called *Climate Code Red.* “They were saying even then that it was an emergency, and the scale and speed of changes that would be needed were like in a war.”

She became a spare-time climate activist in the years that followed, but her focus on values work in her practice as a psychologist guided her decision to make a more wholesale life change. She was using Acceptance and Commitment Therapy, an approach based on accepting difficult feelings while taking action guided by your values. So in 2012 she took long service leave and never returned. “I had come to the view by then, that we had ten years to act”—those ten years were 2010 to 2020.

**How to convey an emergency message?**

Jane is convinced that the severity of the existential threat we're facing is not widely understood: “The message is just not reaching the public.” She believes that this lack of understanding is partly caused by a combination of the understandable tendency of scientists to speak cautiously, and the strength of the ‘campaign of lies’. However, her particular interest is in a third problem: the widespread misconception that the public should not be told the full truth because “fear doesn’t work”.

Much of the discussion around the psychology of the climate emergency to date, says Jane, is written by people who don’t understand the urgency. Jane argues that in an emergency there’s only one form of messaging that has ever been used: tell people clearly and honestly about the danger, and tell them what to do to get to safety.

“If a fire is approaching your town, imagine a debate in the fire control room: ‘It’s a really dangerous fire, but we shouldn’t tell the public how bad it is because fear doesn’t work.’ You would never hear that.”

**Telling the scary truth**

According to Jane, it’s time to tell the truth about the climate and ecological emergency we’re now facing. Jane wrote a booklet called ‘Don’t mention the emergency’ to explain how to do this. The first step is to say ‘climate emergency’ instead of ‘climate change’. The opponents of climate action know that research shows that people are less likely to be concerned and less likely to take action when the term ‘climate change’ is used. Saying ‘global warming’ is better, but ‘climate emergency’ is stronger still. A shift into emergency mode is unlikely to happen if the language does not shift.

We need to shift the ‘Overton Window’ (see Figure 2) – the range of ideas that are seen as being in the ‘sensible centre’. Opponents of action have been successful in shifting the...
Working with contours
Sarah Coles speaks to Guildford local Louise Balaz-Brown about gardening in tough conditions, the importance of contours and the miracle of sheep manure.

I’m tucking into a plate of beans on toast at the Guildford General Store when a man in overalls stomps in and says to anyone within earshot, “When’s it gonna rain?”. It’s a common question in these parts, but you wouldn’t know it looking at Louise Balaz-Brown’s garden.

Guildford is a town of approximately 350 people on the Loddon River between Daylesford and Castlemaine, in Victoria. In 2013, Louise bought a bare one-acre block and, with the help of her son Lynden and builder Jean Lucchesi, set about building a passive solar house and garden.

Standing in the garden, I’m flanked by Indian bean trees, passionfruit, roses, persimmon, maple, crabapple, butterfly bush, winter honeysuckles, lilacs, euphorbias, Jerusalem artichokes, grapevines, lilies, japonicas, oaks, and the ever-changing foliage of the tamarisk. I have come here to find out how Louise manages to grow an abundant garden in an area of low rainfall.

The nearest weather station is 8.7 km away in Yandoit, where the average annual rainfall is 619.4 mm. Of Guildford’s annual rainfall, “We’ve only been getting around 250 mm,” Louise says. She goes on to explain that “Guildford is in a rain shadow between Mt Franklin, Mt Tarrengower and Mt Alexander.” A rain shadow is the dry area on the downwind side of a mountain.

On contour
Louise’s mind was on the garden before the foundations of the house were even laid. “The first thing we looked at was the water situation. There was nothing here except a sloping block facing north and we knew it was going to be important to collect all of the water.” Louise’s son Lynden is a farmer and has studied the water capture techniques of permaculture and holistic land management. Using a total station (a surveying instrument), he surveyed the contours of the block and they dug a system of swales. A swale is a ditch and a mound, aligned on a contour line to capture water and direct it to the plants.

During floods, the water level in the swales is banked up high enough to reach the tree trunks. “When we’ve had big rains, the swales have filled up past the trees,” says Louise.

Rainwater harvesting
On the rare occasions when it does rain, rainwater is captured from the roof of the house and carport into two water tanks—22,000 L and 16,000 L—with half diverted to a billabong, an unlined pond full of water lilies and frogs. The water level is low at the moment. Around the billabong are Manchurian pear trees, whose roots receive the water that seeps out of the billabong. The garden paths are lined with cardboard and straw, so are also water permeable.

The property is still connected to town water, which Louise partially relies on to water the garden in summer. Louise expects that as the shade trees grow larger, water usage will decrease. Louise does not use any irrigation systems, as she prefers to avoid the use of plastic in the garden: “I water everything by hand on an as-needs basis.”
Going electric with hydronic heating

One year after converting from gas to heat pump hydronic heating, Peter Hormann gives us a full account of the upgrades at his family’s Melbourne home and how they are staying comfy and zero carbon.

As an energy conscious family of three, we wanted to upgrade our 1908 Edwardian three-bedroom weatherboard home in Melbourne to be zero carbon for energy. We’ve achieved this by upgrading from gas to heat pumps for our heating and hot water, installing solar PV and buying 100% GreenPower. Here’s what we did and what we learnt.

Evaluating efficiency
The previous owner had renovated our house in the early 1990s. They added a flat-roofed rear extension, wall and ceiling insulation, gas hydronic heating, solar hot water with gas boost and a 7kW air conditioner. They also removed the old chimneys and fireplaces, restumped and rewired. And, as befit the times, halogen downlights were almost everywhere.

The Archicentre property report we got before we purchased the home in 2008 identified some minor structural issues, but made little reference to building energy performance. Once we moved in, we found quite a few such problems.

These issues included a lack of insulation on the below-floor hydronic heating pipes, limited draught sealing—found by listening for shaking closed doors on cold windy days, then using a ‘back of hand’ test to find the source—and poor cooling effectiveness from the 20-year-old air conditioner; inefficient to start with, it had lost much of its refrigerant gas.

We began by replacing the halogen lights with LEDs, keeping the original fittings and transformers, and embarked on a spree of draught sealing around windows, doors, exhaust fans and more hidden locations such as behind cupboards and around the bath. We also serviced the hydronic gas boiler (which had a controller fault) and replaced the air conditioner with a Daikin multi-head 9kW cooling-only unit servicing the living area (7.1kW) and three bedrooms (2.5kW each). The multi-head outdoor unit fitted in the footprint of the old outdoor unit and saved us about $2000 compared to four separate split systems; buying ‘cooling-only’ saved another $500. In retrospect, a reverse-cycle unit would have been useful for individual room heating, especially during shoulder seasons.

We also replaced four windows with double-glazed Miglas wood-aluminium windows as the old frames had rotted due to hidden roof leaks in the newer rear extension.

Opportunities and challenges
With those changes in place, it was time to really address energy efficiency. For us, reducing household operating costs was important, but secondary to doing our part to tackle climate change. A key aim was to convert our gas hot water and heating systems to electric heat pumps, ideally achieving zero carbon emissions for energy.

We really like the warmth and comfort of hydronic heating, and also wanted to retain the system’s sunk costs in radiators and copper pipework. Our decision to continue to use hydronic heating was essentially made prior to this when we upgraded the air conditioner to a cooling-only system.

However, we were uncertain about the viability of using a heat pump instead of a gas boiler in our hydronic system. Would the existing radiators effectively heat room spaces at the lower operating temperatures...
**Emissions intensity of household electricity vs gas**

Switching from gas to electricity for heating, hot water and cooking can favour your hip pocket. But what about emissions? Rory Anderson presents the latest research by Renew.

Knowing whether electric or gas appliances are more or less emissions intensive for households is complex. In the past, ‘natural’ gas was considered the go-to option for cooking, water heating and space heating from both a cost and an environmental perspective. But with modern, higher efficiency electric appliances such as reverse-cycle air conditioners, heat pump hot water systems and induction cooktops, and with greater penetration of renewable energy in our electricity grid, what is the lowest emission fuel source for households today?

Currently, there is limited information for consumers on how to reduce their carbon footprint from household appliances. In response, Renew has undertaken an in-depth analysis comparing emissions from space heating, hot water and cooking when powered by gas or electricity. The results of this new study further strengthen the case for home appliance electrification, following on from previous work by Renew looking at the economics of gas versus electricity.

**From economics to emissions**

In 2018, Renew undertook a detailed analysis of the economics of household gas versus electricity use (www.bit.ly/EvsG_report), which demonstrated that in many cases households would be much better off financially with a switch to efficient electric appliances when replacing old appliances at the end of their life, or when building new.

This new analysis extends that economic study to consider emissions. It applies the relevant emission factors for gas and electricity in each state to the appliance energy loads developed in the economic study.

**The study’s methodology**

Modelling emissions in the Australian energy market is a challenging task. The electricity mix in the national electricity market (NEM) can change at any given time based on demand. Similarly, the natural gas network is interconnected and includes both traditional gas fields and coal seam gas (CSG) extractors.

To establish an estimate, a state-based greenhouse gas (GHG) emissions rate was determined using the National Greenhouse Gas Accounts Factors as at July 2018; this is the national reporting device for emissions rates across the economy.

This figure was then applied to modelled annual energy consumption for heating, hot water and cooking appliances in 16 different locations in the NEM. The energy consumption data came from Renew’s previous study on the economics of gas versus electricity for appliance replacement scenarios.

Table 1 shows the appliance types modelled for different household types. Appliances were selected to provide the same level of heating, hot water and cooking performance, whether from gas or electricity.

For example, a small household using gas for heating was modelled as using a wall furnace and one portable unit, except in Victoria and the ACT where a ducted 50MJ unit was used (as ducted gas heating is more common in these places). The same household type using electricity for heating was modelled as using two reverse-cycle air conditioners, a 7kW and a 3kW unit.

In line with the economic report, space heating was not modelled for Brisbane due to the low need for mechanical heating and the low take-up of gas heaters.

The modelling considers state-based emission estimates, energy consumption and efficiency of different types of appliances, local climate, household dwelling type and usage profiles. 352 scenarios were modelled and compared.

Attempting a study such as this comes with challenges, such as finding a balance between the need to maintain accuracy and the sheer complexity of modelling emissions on our energy network. Unfortunately, this meant that assumptions and averaging that occur in official reporting of emissions had to be carried over to our modelling.

For example, there is a considerable question mark over the accuracy of Australia’s officially reported GHG emissions from the gas industry. Indeed, finding a generally accepted accurate rate of emissions for gas extraction, transport and usage was one of the main challenges in this study.

For simplicity, this study does not attempt to calculate the GHG emissions of the household’s entire energy usage. Because it focuses on the relative emissions of specific appliances, we looked only at the energy usage of the appliances in question.

Finally, this research did not attempt to model the impact of rooftop solar on household appliance emissions. For a study such as this, it is more useful to estimate emissions without the use of rooftop solar, as solar lowers household GHG emissions independently of appliance usage.

**The findings**

The findings generally support the case for electrification across all household types in most locations. This is due in large part to the emissions savings that can be gained by
Ending the ICE age
An electric vehicle buyers guide

As the world slowly wakes up to the need to electrify personal transport, the range of electric vehicles is starting to ramp up. Lance Turner looks at how Australia is doing in the move away from fossil fuels, and which EVs you can buy now and in the near future.

Cars have evolved over the last 100 years or so, but one thing hasn’t changed much—they are predominantly powered by internal combustion engines (ICE) that burn fossil fuels. While engine technology has improved, you can’t avoid the fact that ICE vehicles emit CO2 and many other pollutants. They are one of the primary sources of greenhouse gases, with total transport emissions being around 18% of Australia’s total emissions. Electric vehicles (EVs) reduce these emissions considerably and have the potential to eliminate them entirely when run on an increasingly renewable electricity grid.

Why EVs
The world is hurtling towards electrification of cars, with many researchers expecting the complete replacement of the world’s private vehicle fleet with EVs in the next 20 to 30 years. Take, for example, Norway. Because of a number of government-backed incentives to buy an EV, more than 50% of all new cars in Norway are now sporting a plug. You could consider the ICE market in Norway to be dead already.

While EV sales in Australia are around 0.2% of new car sales, in other countries it is somewhat higher. At time of writing, in NZ it’s around 1.8%, in the USA it’s around 2.1%, 4.2% in China, and around 2.5% in the UK. And many other European countries are much higher, from 2.6% in Austria to a huge 59% in Norway, the majority ‘pure’ battery EVs (around 44% in Q4 of 2018 were plug-in hybrid EVs, more on these later)—this means Norway has almost 8% of all cars as zero emission vehicles. Globally, at the end of 2018, the world market share for plug-in vehicles was around 2.2%, and this has only accelerated in 2019. You can check out the world’s progress with EV sales at EV-volumes.com (Australia’s page currently has no data!).

In Australia, EV ownership has been constrained by lack of government support and lack of available models. When it comes to models, 2019 may well be the year that changes, with several new longer range and more affordable models hitting our shores. And when it comes to incentives, we have started to see political discussion on this in the most recent federal election—let’s hope this means more EV encouragement is on the way (see ‘EV buying incentives’ for more).

The Polestar 2 is touted as a Tesla competitor, with similar performance and specifications to a Tesla Model 3, although expected price will be higher. They are due in Australia in 2020-2021.

Image: Polestar

The primary advantage of a shift to EVs is lower greenhouse gas emissions, urgently needed in the current climate emergency. In almost all cases, EVs produce less greenhouse gas emissions than their ICE counterparts, even when the electricity that powers them is produced from coal—our regular EV writer, Bryce Gaton, analysed this in 2018 for Australia’s electricity grid (bit.ly/RenewUEVE), with only one exception in Victoria (if you buy an EV for all driving but take no other CO2 reduction measures). But even there, using GreenPower or rooftop solar reverses the equation. On top of that, Australia’s grid is getting greener every year, which means EVs are too, while ICE vehicles are approaching the limit of their efficiency already.

But it’s not just about emissions. EVs have lower ‘fuelling’ costs (around a quarter to a half of an equivalent ICE vehicle) and are
A winning formula: high-performance house plus EV

Despite the upfront cost premium, opting for a highly efficient, all-electric home with an EV can offer significant economic and environmental benefits. We analyse one example.

Near Cape Paterson on Victoria’s south-east coast, Joe and Jo Spano live at an eco-development known as The Cape. They recently built a highly efficient, all-electric home with 6kW of solar PV and 4.8 kWh of energy storage. And they are about to take possession of one of the next generation of long-range electric vehicles.

To understand the economic and environmental value of the Spanos’ home and car choices, the energy analysts at Renew compared them with two alternative scenarios: an average existing (2 Star) or minimum-standard (6 Star) new build, “dual-fuel” Victorian home, along with the purchase of a comparable internal combustion engine (ICE) vehicle.

For this analysis, we asked the following questions:

• What if the Spanos had built a typical 6 Star, dual-fuel Victorian home and bought an ICE vehicle?

• How does the Spanos’ all-electric solar home compare to a typical existing, 2 Star Victorian dual-fuel home?

• What are the costs, savings and environmental benefits of each approach?

The home
The Spanos’ new home is a three-bedroom, 153 m² dwelling that has been rated at 8.3 Stars. It uses a combination of direct solar electricity, stored solar electricity and mains grid electricity. The home isn’t connected to the mains gas network and doesn’t use bottled gas or wood for fuel.

The home consumes an average of 2 kWh of electricity from the grid per day—or around 700 kWh per year. This is about 1/20th of the energy grid usage of an average Victorian home, which consumes around 4400 kWh per year along with 40 gigajoules (approx 11,100 kWh) of mains gas (bit.ly/vuchs).

Based on their current retail tariff (including 100% GreenPower and the current Victorian feed-in tariff for solar), the Cape Paterson home will incur electricity bills of approximately $123 per year (excluding EV charging), with no gas bills.

The car
The Spanos have recently purchased a Hyundai Kona Hylander electric vehicle (EV), a model that is offered in both EV and ICE formats. See Figure 1 for their specifications.

As former residents of Melbourne, the Spanos plan to make twice weekly trips to the city (300 km round trip) to see friends and family. As new residents of the Bass Coast, they are keen to explore the region and estimate travelling approximately 400 km per month.

Aside from that, local trips are likely to incur another 150 km per week of driving. It has been assumed that the couple will take four weeks of holidays per year, where EV driving won’t be required.

Based on this, the Spanos’ total driving distance per year has been estimated at 40,400 km.

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<th>Kona Hylander ICE</th>
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Figure 1. Key specifications of the Kona Hylander EV and ICE versions.
I love to ride my (electric) bicycle

**E-bike as part of a no-car toolkit**

Laurie Miller bought herself an e-bike as a retirement present, and finds she chooses riding for many trips she'd otherwise use a bus or a taxi for.

My first experience with an e-bike was in the very hilly region of Sintra, Portugal, while on vacation in 2017. On that day, my husband and I rented e-bikes and found the ease with which we conquered the hills there miraculous! Home in Sydney, I bought a Velectrix Urban 2Plus e-bike (which cost $1995) in January 2018, as a retirement gift to myself. Previously, I used a regular bike or depended on walking, public transport or taxis, as we don't own a car; I've always lived in cities and have never felt the need for one.

I got to test ride several e-bikes for a few blocks around the shop (Sydney Electric Bikes in Pyrmont) and even borrowed two overnight to test ride longer distances. This was very easily organised and the shop was very helpful. I chose the Velectrix because of the ease of removing the battery and the comfort of the ride. I was not completely pleased with its overall size, as I wanted a slightly smaller frame, but they did not have a smaller frame bicycle that I liked as well.

I chose from the bottom of the range (cost wise) and this means that I might have sacrificed a bit on the initial pick-up ‘umph’ of the bike (it requires a pedalling revolution or two for the electrics to kick in—this can make it hard if starting on an up slope) and also on how well it manages the steepest of hills.

For me, the e-bike replaces some trips using my regular bike, buses and taxis, though is not a complete replacement for any of them. It’s mainly used for journeys that involve longer distances, hills or multiple destinations. I have also used it for hauling fairly heavy boxes. I like to use it for pleasure riding on the weekends once in a while.

Using the e-bike has been revolutionary for me. Biking is more fun and much less effortful. I can enjoy my surrounds and also watch out for traffic better because the pedalling is not taking all my concentration and effort. I arrive at my destination much more relaxed and not covered in sweat. The bike has five levels of assistance, so when I come to a hill I use them and need put no more effort into the pedalling than I would on the flat. It turns Sydney into the Netherlands! It certainly makes me choose biking to places that I would have otherwise taken a bus or taxi to, and I only use my regular bike about half a dozen times a month now, for short trips.

The e-bike is generally excellent on hills, though I have had it sort of stall once or twice on the very steepest of grades. It has taken me a bit of time to understand how to pedal and use the gears to avoid this. It also took me a bit of time to work out how to turn on the lights (which come with the bike) and work the speedometer, because I was not given any instructions on those things.

As for charging, I find I only need to charge it about once a month (after using it for about eight rides). It takes several hours. It is easy to remove the battery from the bike I have, bring it inside and plug it into the charger. I haven’t ever run out of charge on a ride. It is easy to see how much charge you have remaining, to avoid this. The bike is heavier than my regular bike and is definitely harder to pedal if not switched on.

Because of its weight, especially with the battery in place, my e-bike is more difficult to carry up or down stairs than a normal bike. Initially, I thought I’d carry it up two flights of stairs to my apartment, but that only lasted about two days! Luckily I was given some...
DIY: Insulating aluminium windows

Many Australian houses feature aluminium-framed windows, which perform poorly thermally. But performance can be greatly improved with a simple DIY project. Glenn Newman explains how his friend Lisa Rime came up with an easy system for DIY double glazing.

Single-pane aluminium windows are great for low maintenance, but they’re absolutely terrible for letting heat in and out of the home, with both the frames and glass being very thermally conductive. In winter, the warm air inside meets the cold window and the result is usually streams of condensation which can damage the window frames and encourage mould growth.

**DIY insulating films**

One solution is to apply a DIY double-glazing film to the window to create an air gap that provides good insulation.

DIY double-glazing film is a clear plastic film, similar to cling wrap, which you can attach to the window frame using double-sided tape. But this approach works best for windows with timber frames—timber has a reasonable insulation value and the roughly 10 mm thickness of the frame allows an optimal layer of air to be trapped.

With aluminium windows, the frames are too thin, allowing only around 2 mm to 3 mm of air to be trapped. This is not enough to provide effective insulation, and also doesn’t do anything about the frames conducting heat. Some double-sided tape used in these kits also doesn’t adhere well to some types of aluminium finish.

**A more solid solution**

So what can you do about it, especially if you’re in a rental house and can’t make any permanent modifications? You can easily build your own frames to fit inside the window sill which seal off the entire glass and frame!

You could make timber frames and finish them to your requirements (e.g. profile with a router, paint, stain, varnish). This will improve the appearance of old aluminium frames and provide great insulation value.

But making frames from scratch takes time and skill. A much cheaper and simpler way is to use an off-the-shelf material like flyscreen framing. This is easy to cut, join and ‘glaze’, and is quite cheap to buy.

The flyscreen frame is made of heat-conductive aluminium, but there’s a gap between the new frame and the original window, and the flyscreen frame is held in place with a foam strip, which acts as a thermal break, so there’s no thermal bridging.

My friend Lisa Rime has had great DIY success using these frames with clear tablecloth sheeting to insulate the windows of her rental house in Hobart. You can apply the same concept using window film, even applying a layer to each side of the frame to triple glaze your windows. The tablecloth material is stronger than the window film, but isn’t as clear or wrinkle-free.

This approach is also rental friendly by not applying any adhesives or fasteners to the dwelling, and the frames can be easily and quickly removed or modified if necessary.
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