ReNew

Technology for a sustainable future

Issue 141

ENERGY SAVINGS SPECIAL

WIN a hot water heat pump valued at up to **$5500**

*Australian and NZ residents only; details p97

Store your solar

Latest battery systems for energy independence

PLUS

Energy monitoring essentials

Hydronic heating, no gas

Seal those gaps!

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Zero energy design: Aussies hit world stage
Efficient and comfortable: home truths
Battery reuse: solving an e-waste problem
DIY irrigation: how much water is needed?

Energy Storage Buyers Guide inside

Contents

Issue 141, October – December 2017

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Know your power

Energy efficiency, monitoring, energy storage guide + more

↑ Uni of Wollongong students ready to design, build and operate a net zero energy home. Page 52.

↑ Smart plugs are controllable and can even monitor energy use of your appliances. Page 36.

↑ Heat pump hydronic heating is being used in this super-sealed reno in Melbourne. Page 26.

↑ Insulating curtains are something that both renters and homeowners can install to improve energy efficiency. Page 32.

Special: energy efficiency and monitoring

↑ Warm head, cold feet: stratification of heat can happen with poorly installed air con. Page 22.

← Cover image by David Tooby.
Battery systems to store household-generated solar power are perhaps the 'barbecue-stopper' topic of the moment. We've updated our energy storage guide to cover the latest battery systems and present the pros and cons to help guide your approach. Read our case studies of homes that have recently installed batteries; we look at their varying motivations and how the installation has affected their grid imports and bills. Page 56.

↑ Saltwater batteries are coping with the tough conditions at this off-grid conservation site. Page 72.

↑ The new wave of batteries can be used off-grid to supplement existing systems. Page 78.

Regulars

Products

In this section we share info about products that sound interesting, sustainable and useful. Product listings are not an endorsement by *ReNew* or the ATA of any particular product—they are for reader information only. They are not product reviews and we have not tested the products.

01

Flexible solar panels for BIPV

Integrating solar panels into the skin of a building makes sense—it can eliminate part of the external cladding costs and make for a neater solar installation. However, until now, most solar panel products designed for building integrated photovoltaic (BIPV) applications could only be installed on flat surfaces.

The eArche solar panel from Energus is a solar panel laminate that is flexible and robust. It is designed to directly integrate into facades and roofs where rigid solar panels are unsuitable, such as surfaces with simple or even compound curves.

eArche panels can be customised to any size and can be made semi-transparent. They weigh 75% less than conventional solar panels, eliminating any installation restrictions due to weight.

eArche panels come with a 10-year product warranty and 25-year output warranty.

Currently the panels are only available to businesses for integration into commercial buildings, with installations done through Energus.

RRP: POA. For more information contact Energus, ph: 1300 090 187, www.energus.com.au

02

Water-based gap sealant with a twist

Sealants are usually either solvent-based or water-based. Although solvent-based sealants are available in transparent versions, it can be difficult to get a clean finish and they require volatile solvents for clean-up and finishing. Most water-based sealants produce far less fumes and require only a wet cloth for finishing and water for clean-up, but they usually dry opaque, so colour matching can be difficult.

HB Fuller's UltraClear is a water-based gap sealant that is white when applied and clear when dry, although not completely invisible. This allows substrate colours to show through, eliminating the need for colour matching while still providing the advantages of water-based sealants. Excess sealant can be easily cleaned up with a damp cloth when wet and the sealant is flexible enough to expand and contract with most movement of the building.

UltraClear is designed specifically for draught proofing and gap sealing areas such as floorboards, skirtings and similar places where small gaps can be difficult to seal neatly. It is paintable if desired, mould-resistant, UV stable, low odour and non-hazardous. It is suitable for outdoor use or in wet areas, but not for continuous immersion in water.

RRP: around $10 per standard cartridge. Available from selected hardware stores and from ecoMaster, www.ecomasterstore.com.au

03

Crossflow micro hydro

If you have a suitable site, a micro hydro turbine can be the most reliable, lowest cost form of renewable energy generation.

There are not many hydro turbines on the market nowadays and many require fairly high head pressures, but crossflow turbines can run at lower pressures and higher flows, making them suitable for sites that have less fall but higher water flows.

The Scott Cross-Flow Turbine is capable of producing 1500 watts or more (2000 watts maximum) of output with a head of around 11 metres (a 6-metre head is the minimum recommended). Water is supplied via a 6" (150 mm) pipe and output power is three-phase AC at up to 200 V or so, allowing for transmission over considerable distances.

Other features include a powder-coated aluminium housing; stainless steel runner (turbine), shaft and fasteners; and double-sealed permanently lubricated bearings. The alternator is directly coupled to the turbine to eliminate any gearing losses and the alternator is water-cooled for longevity.

The unit is suitable for off-grid or grid-interactive installations and is made in the USA.

RRP: $5950 plus GST and delivery from Brisbane. For more information, contact Essential Water and Energy Services, 477 Boundary St, Spring Hill Qld 4000, ph: (07) 3085 7458, geoff@essential-wes.com.au, www.essential-wes.com.au

Targeting energy efficiency
Halve consumption, double productivity

After 40 years of talking about the enormous savings (in both dollars and greenhouse gas) that could follow from energy efficiency, Alan Pears is still an enthusiastic, if not optimistic, champion. He reviews the current landscape.

↑ Smart data collection can help reduce home energy use by showing you which appliances are the biggest energy users. Energy monitors such as the Smappee, along with its mobile app, can tell you exactly where your electricity is being used.

THE POTENTIAL to improve efficiency of energy use in Australia is enormous. Several studies have shown we could halve our energy consumption per unit of economic activity by 2030—or, in the latest jargon, double our energy productivity (see www.bit.ly/2fJ69Ca and www.bit.ly/2xEPAEPO). I'm confident that we could do much better than that.

Emissions from the production and use of oil, gas and coal are responsible for over three-quarters of Australia's total climate impact. Recent modelling by CSIRO shows that the 'ambitious energy productivity improvement' scenario is the cheapest option to achieve a 27% reduction in energy-related emissions by 2030, the reduction level considered in the Finkel Review (www.bit.ly/FINKLETR).

The International Energy Agency (IEA) describes energy efficiency as the 'first fuel', because it is potentially the biggest contributor to cutting emissions while at the same time growing the economy and cutting energy bills—and it's the cheapest option. IEA studies show that energy efficiency must deliver as much emission reduction as renewable energy if we are to get anywhere near a 2°C climate target (see Figure 1). But we continue to undersell its value.

Enormous potential in refrigeration

Work I've been doing recently with the Australian Alliance for Energy Productivity (A2EP) has explored what we call the farm-to-plate value chain (Figure 2), with energy use from farm to plate accounting for almost 13% of Australian primary energy (over 10% from farm to shop checkout). Our study (www.bit.ly/2vCCyjp) shows that billions of dollars worth of food is lost (spoiled or has its shelf life shortened) because the correct temperature is not always maintained. This wastage of food equates to a lot of energy, emissions and cost embodied in its production and supply.

A study of Melbourne's food chain waste showed that, while 40% of waste was 'post consumer', 25% occurred on the farm and a third between the farm and home. This pre-consumer 'waste' involves a loss of tens of billions of dollars worth of potentially saleable food nationally.

Much of this food passes through the refrigerated cold chain. Improving insulation and optimising refrigeration efficiency is essential to reduce this waste—and would cut energy costs by hundreds of millions of dollars. This work has captured interest from several firms in the cold chain and A2EP is working with some of them to develop practical solutions. These involve using real-time temperature sensing and cloud-based data communication to identify when and where waste is being created, then acting to avoid it. Changes in practices, improved maintenance and investment in more energy-efficient, lower-emissions refrigeration equipment will be needed.

But a major problem our study identified is the 'split incentive'. Many of the businesses that will have to change practices and invest in upgrading or replacing equipment don't capture the financial benefits. One challenge will be to implement mechanisms so beneficiaries of savings help those who have to change. This is a major cultural change.

Indeed, in the cold chain, many suppliers such as dairy farmers feel that any saving they

Home truths
Notes from the assessor

After conducting home energy assessments for several years, Richard Keech shares some of the all-too-common problems he sees.

SINCE mid 2015 I've worked doing building energy assessments in Victoria, mainly for homes and mainly on behalf of ecoMaster. In that time I've visited about 290 clients to inspect their premises. In this article I'll try to convey insights about homes and energy based on my experiences. Some of this is specific to Victoria's housing stock and temperate climate and some applies to all homes.

THE ASSESSMENT PROCESS ITSELF

Winter thermal comfort is the biggest motivator in Victoria

I usually begin by asking clients what motivated their interested in an assessment. By far the most common response—probably three-quarters—is thermal comfort. Of that, most is winter thermal comfort. So whatever concerns people may have, it's thermal discomfort that turns their interest into action. Given the current media discussion about energy costs, it's interesting that cost is actually far behind thermal comfort in getting people engaged in the process.

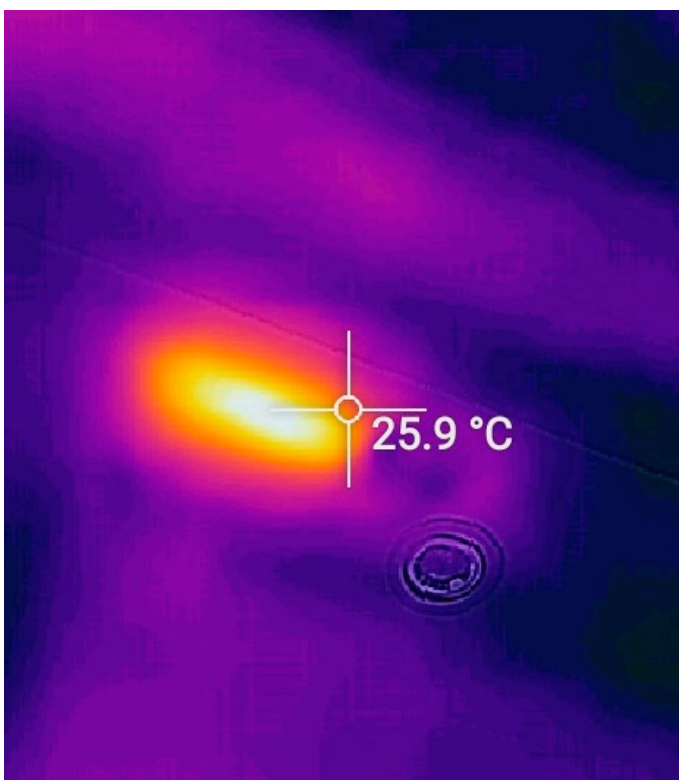
People like to talk about their house

There's an element of therapy about consulting on home efficiency that goes well beyond people simply receiving information about the state of their homes. It's very much a two-way process. So patiently listening to people talk about how their home does or does not work seems to help people engage in the issue of home energy and comfort.

People don't value professional advice highly enough

I'm very lucky to work for one of the few companies that consult on home energy efficiency. But even so, many people expect a lot for nothing, especially when it comes to draught proofing and general advice. Understanding a client's home, sufficient to specify the many things typically needed to draught proof a home, is time-consuming.

↑ Hot head, cold feet: stratification arising from incorrectly installed ducted heating.



↑ Downlight transformers are often inefficient, wasting energy as heat. A thermal camera illuminates this as a hot spot on the ceiling.

Case study: Shooting the breeze

Comprehensive draughtproofing was just the first recommendation that came out of Annie and Bob's home energy efficiency assessment, but it's already made a huge difference to the thermal comfort of their house, as they explain to Anna Cumming.

ANNIE Cvetkovic and her husband Bob live in a three-bedroom brick veneer unit in Burwood, in Melbourne's eastern suburbs. It's only around 30 years old, but according to Annie it's only comfortable to live in during autumn and spring. "In summertime it is unbearably hot, with no proper insulation designed to keep the heat out. We actually can't live in the back part of the unit—the spare room and study—during the summer."

And in winter the unit is very cold, despite gas ducted heating. Annie and Bob are getting close to retirement, but still both work and are otherwise active outside the house most days.

"A major issue for us is walking in the door at the end of the day, and the place is so freezing. It just didn't feel right," says Annie, explaining why they decided they needed to make some changes. "I found myself having to sit with my feet up on the couch because it was cold underfoot." They also wanted to make the house more comfortable so that they can feasibly stay in their home as they age.

They employed Richard Keech of ecoMaster to conduct an energy efficiency assessment, which resulted in a prioritised list of actions they could take to improve things.

"We originally thought we'd start with double glazing," says Annie, "but Richard convinced us that that's actually the last thing to do!" The advice was to start with draughtproofing, then underfloor insulation, followed by wall insulation pumped or blown into the wall cavity—particularly for the north-west facing back wall which makes the spare room and study so unusable in summer.

Upgrading the ceiling insulation would be next, "and only then should we consider double glazing, and possibly a small split-system air conditioner in the back room, if we find we need them."

So far, they have had draughtproofing installed where it was needed—mostly in the gaps between architraves and walls, and around doors and windows using a product called Draught Dodgers (supplied by ecoMaster). They have already noticed a big improvement.

"I didn't know how dramatically draughtproofing would change the comfort level of the house," says Annie. "It's not nearly so cold when we walk in at the end of the day. The ambient temperature is probably two or three degrees higher without any heating." They are having to use their heating less.

Annie and Bob are planning to work through the rest of the recommendations from the assessment as they find time to organise them and are looking forward to the even greater improvements in the thermal comfort of their house. ✱

← Annie and Bob's unit is only about 30 years old, but it wasn't built to perform well thermally. They are planning to upgrade it in order to live more comfortably in it as they get older.

↑ Following their home energy assessment, the first step for Annie and Bob was to install draughtproofing. Draught Dodgers stop airflow around the edges of doors and casement windows when they are closed; the product consists of a metal strip attached to the frame, with a flexible rubber seal against which the door or window closes.

All-electric and hydronic
A model of efficiency

There's a lot to learn from this highly insulated and well-sealed renovation in Melbourne, not least how a heat pump is providing both hydronic heating and hot water. Cameron Munro explains the house's modelling-led upgrades and the tweaks made along the way.

WHEN we bought our 1910 weatherboard home in inner suburban Melbourne, we were committed to making it as comfortable and energy efficient as we could. We'd partially renovated a previous home by installing double glazing and injecting foam into the wall cavity, but our new home presented the opportunity to do a far more extensive renovation.

Our approach was guided by the German Passivhaus movement (also known as Passive House in Australia), which requires extensive insulation and extreme attention to thermal bridging and airtightness. We really liked this approach as it's guided by building physics and requires extensive modelling and verification.

Moreover, we weren't comfortable with the usual practice of simply throwing energy into a building to keep it comfortable; whatever additional heat we needed, we wanted to ensure we could keep it within the building envelope for as long as possible.

First things first: going off gas

The previous owner used a conventional gas storage hot water system and gas heaters. Our strategy for heating and hot water was always going to be all-electric using an air-source heat pump and solar PV. We liked the simplicity of minimising our grid connections and had concerns about the carbon footprint from gas production and use. One of the first things we did was to have the local gas network utility remove the gas meter and cap the gas main in the street. This was surprisingly easy to do, and cost us nothing.

↑ The renovation in 2016 brought this 1910 home up to 7.8 Stars and almost Passive House standard, via extreme attention to airtightness, high levels of insulation and internal thermal mass. A 6.4 kW PV system coupled with all-electric appliances and an electric vehicle keeps energy use even lower. The building designer was Luke Middleton of EME Design and the builder was Ridge Developments.

Insulation, thermal mass

Extremely high levels of insulation were installed throughout the house as part of the renovation—the 1980s extension was demolished and replaced, and the original front section stripped out internally. This resulted in insulation levels equivalent to around R7 in the ceilings, R5 in the walls and R4 underfloor. The walls all use a double 90 mm stud construction, and the studs are offset to minimise thermal bridging. We also offset the studs at external corners to enable insulation to be installed in the corners to minimise geometric thermal bridges.

We tried to minimise the use of steel in the construction, but there were a few locations where it was essential. Where this was required, we ensured the steel was wrapped in high-performance phenolic foam to keep it to the 'cool' side of the thermal envelope. The modelling suggested the steel would otherwise represent a very significant thermal bridge.

We replaced all windows with argon-filled triple glazing with low-emissivity film. As best as possible we tried to orient windows to face north to maximise passive solar gain, and used a small exposed concrete slab and rammed earth wall as thermal mass.

The result is that overnight temperatures inside the house drop by only around 2 °C during the coldest part of winter. For example, as shown in Figure 1, on the evening of 25 July the temperature outside dropped from a high of 13.6 °C at 4 pm to 4.5 °C at 7 am the next morning. The internal building temperature

Knowledge is power
Energy monitoring guide

Need help getting the upper hand on your electricity bills or checking that your solar system is working? You should consider an energy monitoring system, says James Martin from Solar Choice.

DO YOU have a clear picture of what's drawing electricity in your home right now? If you're like most Australians, you probably don't.

Historically, this hasn't been an issue because electricity bills weren't a major concern for most households and, in any case, the number of devices was probably small. But these days electricity prices are high and there are likely to be more electricity-consuming devices plugged into the walls of any given home than the occupants can think of off the top of their heads.

Many Australians have turned to solar panels to help them fight rising prices. Rooftop solar is now affordable and commonplace—the Hills Hoist of the 21st century. However, comparatively low solar feed-in tariffs in most places mean that solar homes have less incentive to send solar electricity into the grid and more incentive to use it directly. Despite this fact, many (if not most) solar system owners would be at a loss if you asked them how much energy their system produced yesterday, never mind the proportion that they managed to self-consume. Solar systems have even failed without the homeowner realising until they received their next bill. So monitoring is important!

Types of energy monitoring and management systems

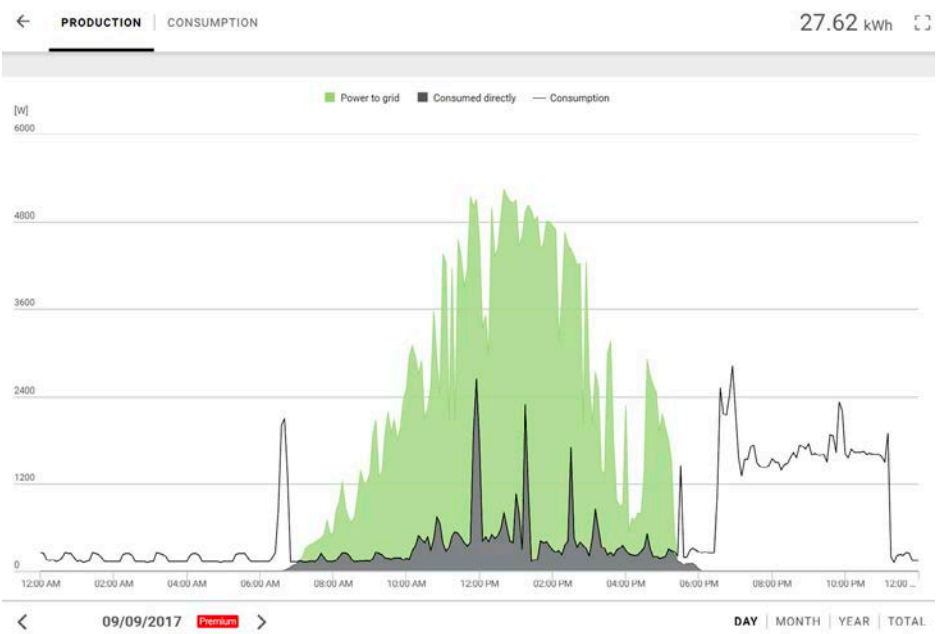
Thankfully, there's a growing number of products on the market that shed light on household energy consumption and solar generation. These devices take a range of approaches and offer a range of functions, but can generally be classed as either monitoring systems or management systems.

As the name implies, a monitoring system enables the user to 'see' what's happening with their electricity, usually via an app or web-based portal, whereas a management system lets them not only observe but also 'reach in' and control which devices switch on at what times. In reality, the line between the two is becoming increasingly blurred as platforms that once offered only monitoring get upgraded to let them do more.

Monitoring and management systems can be lumped into roughly five categories based on how they are physically installed in the home.

1. APPLIANCE-LEVEL MONITORS AND CONTROLLERS

These include 'smart plugs' for general power outlets, hard-wired units that connect directly to appliances and smart appliances themselves. They sit between a power outlet and a device's plug, or are embedded within the device itself. Once connected to wi-fi, they let the user monitor energy consumption (via an app or web-based portal). They can be set on a timer or switched on and off manually from afar. Examples include Elgat and Aeotec smart plugs, Sonoff hard-wired



↑ Like most inverters installed with your solar system, Fronius has a web-based application and app that you can use to monitor solar generation and energy consumption. You'll need switches installed on your switchboard and wi-fi details set on the inverter.

Beyond the Stars
Energy ratings as a design tool

There's much more to be gained from an energy rating tool than the number of Stars. Sid Thoo and Alex Raynes-Goldie demonstrate how an energy rating tool can help tweak the building's orientation, materials, shading and more.

THE Nationwide House Energy Rating Scheme (NatHERS) ranks a home's potential thermal performance (heating and cooling needs) based on its proposed design and construction. NatHERS is often used to demonstrate that projects meet the mandatory energy efficiency requirements of the National Construction Code. In Australia, new residential projects are generally required to meet a minimum 6 Star NatHERS rating.

NatHERS is, however, more than just a certification tool. By estimating a home's potential heating and cooling needs based on different design and construction options, NatHERS can be a useful tool in identifying the best design strategies for your unique project.

Good design can reduce the amount of energy needed to keep a home comfortable, often with little or no additional cost. Many *ReNew* readers will know the fundamentals of designing a more energy-efficient home—NatHERS can help take this one step further, testing how to apply these principles to get the best value for money.

Using the example house design pictured below, we will look at some of the fundamentals of energy-efficient design and discuss how NatHERS can be used to inform the design process.

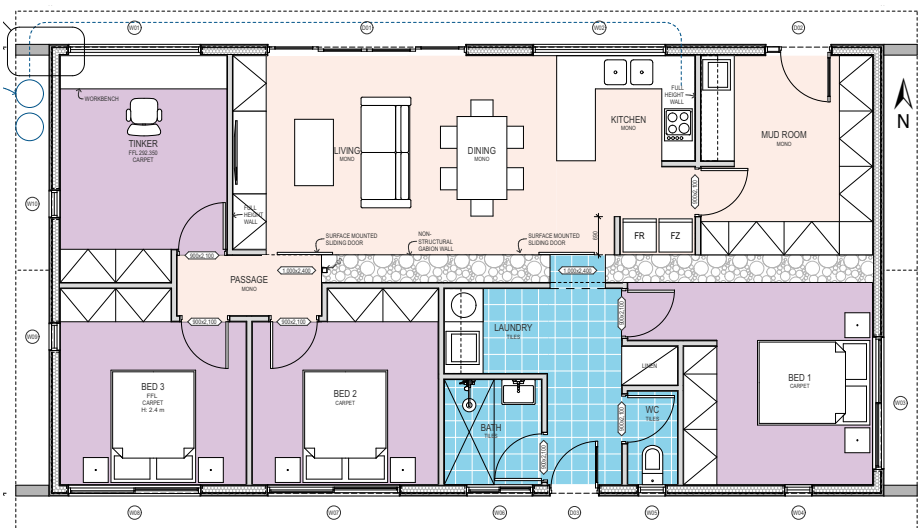
1. Climate

Understanding climate is the first crucial step in designing a more energy-efficient, eco-effective home. It's for this reason that passive solar design is sometimes more accurately referred to as climate-responsive design.

In Australia, the National Construction Code identifies eight distinct climates around the country, ranging from hot-humid to alpine conditions (see www.yourhome.gov.au/passive-design/design-climate). NatHERS breaks these down further into 69 climate zones, based on historical climate data which also takes into account solar radiation, wind speed/direction, temperature and humidity.

Because different climates warrant different design responses, a six Star house in Melbourne is very different from a six Star house in Darwin. Melbourne is a heating load dominated climate (i.e. more warmth is needed to achieve thermal comfort), whereas cooling is the main issue in Darwin. Thus, it's vitally important to prioritise the most appropriate design strategies for the particular climate.

This means the six Star scale is calibrated



↑ Using this example house design, the authors examine how changes in location, orientation and building materials affect its heating and cooling loads, and hence NatHERS Star rating: a useful tool in the design process.

Beyond thermal efficiency

While NatHERS is a great design tool, it's important to acknowledge that thermal efficiency is only one component of making a home more sustainable. NatHERS focuses on thermal performance and the Star rating doesn't take into account things such as material embodied energy, energy-efficient window treatments and furnishings (though it does have a default assumption that Holland blinds are up to let sun in or down to prevent heat loss when beneficial), lighting, hot water systems, appliances, heating and cooling systems or how energy is generated. NatHERS is one of many tools that will get you closer to the sustainable home of your dreams.

Gaps in the building industry
Why test for air leakage?

Energy efficiency consultancy SuHo explains the hows and whys of testing for air leakage in your home.

AN INTERESTING subject presently under discussion and development in the home construction industry is air leakage from buildings. You may have heard of terms like air permeability, air infiltration, air change rate and air flow rates. All of these terms relate to building air leakage testing, or 'blower door' testing.

What air leakage is and how it relates to home energy efficiency is commonly misunderstood. Air leakage is the unintentional introduction of outside air into a building and can account for up to 25% of winter heat loss. It occurs via uncontrolled openings such as gaps and cracks. Note that this differs from ventilation, which occurs via controllable openings such as doors and windows.

Testing for air leakage

'Blower door' testing is a method of testing how and where a building leaks. It uses a high-powered fan mounted within an adjustable frame to control pressure levels within a building. The fan is mounted into an external door opening. All controlled external openings (doors, windows etc) are closed for the test, while all mechanical ventilation outlets (such as exhaust fans) are left unsealed and internal doors are left open. A blower door test is non-obtrusive and takes a couple of hours.

The rise in pressure elevates air flow through any uncontrolled leakage points such as gaps, cracks and poorly sealed door and window frames, as well as through non-baffled fans. These are photographed using a thermal camera, which differentiates surface temperature from cold (blue) to hot (red).

An added benefit is that the thermal imaging has the ability to identify such idiosyncrasies as missing or disturbed insulation batts, water ingress and electrical faults. Losing just 5% of the total insulation area of a ceiling effectively halves its performance (based on ceiling insulation calculations from the National Construction Code Volume 2 Section 3.12.1.1 Building Fabric Insulation; see also *ReNew 140*, p. 84).

The result is generally a building fabric audit report, provided to the homeowner and detailing all results, observations and recommendations, and quantifying potential savings.

Benefits of sealing

A well-sealed home can benefit your health, your energy bills and the environment. Humidity levels can be controlled, leading to lower instances of allergies. A constant temperature can be maintained with air

↑ Blower door testing takes a couple of hours and can help both new and existing homes find uncontrolled air leakage, which could be adding a lot to heating and cooling energy bills.

More flexible energy systems
Energy storage buyers guide

With rapidly increasing demand due to increasing energy prices, there has been an explosion in the number of ready-to-use energy storage systems available. We take a look at the options available.

WITH the steadily rising cost of grid electricity, more and more people are looking to make the best use of the solar electricity they generate to offset as much mains grid power as they can. While there are a number of ways to do this, including shifting loads to the middle of the day or diverting excess energy to heavy loads such as an electric water heater, if those options are not possible or desirable, or you have other needs, such as a degree of backup during grid failures, then an energy storage system is an option.

There has been a move in recent years towards storage systems that contain the batteries and other components in a pre-configured 'storage in a box' module for connection to a PV array. These sorts of pre-configured energy storage systems are the focus of this buyers guide. We do not cover individual batteries/cells in this guide, as they have their own buyers guide, the most recent in *ReNew 131*.

↑ Energy storage systems come in a wide variety of capacities and designs, and several cell chemistries. Here we have, from top-left, the Tesla Powerwall 2, LG Chem RESU, Enphase AC battery, GridEdge Quantum and the RedFlow Z-Cell zinc-bromide flow cell battery.

Pros and cons of 'storage in a box'

There are several advantages to this sort of 'storage in a box' system. Firstly, installation is usually quick as much of the wiring between components has been done. Secondly, it often makes for a neater system as many components and their associated wiring are enclosed in a single cabinet.

There are some disadvantages too, including less flexible system sizing—most suppliers have a few standard battery bank sizes that they offer. However, storage units may be modular so that multiple units can be used to make up the required capacity, and some are designed to have extra battery modules slotted into the case to increase capacity.

For off-grid systems, it's critical to have enough energy generation and storage to meet your needs, so these are more likely to be of the traditional type with a separate battery bank and other components, unless your needs fall within the specifications of one of the pre-configured boxed systems. One situation where a prepackaged system may be useful in an off-grid system is for adding extra storage to an existing system by AC coupling storage to the system.

Economics on the grid

For on-grid solar systems, energy storage may or may not be economically viable when you factor in the cost difference between off-peak and on-peak power, feed-in tariffs versus cost of electricity, the cost of replacement batteries and the system maintenance required. The

Conservation of resources
Saltwater batteries in use

When the old battery bank gave out, it was back to diesel for a time at this significant conservation site in the Mallee. But an innovative off-grid upgrade has changed that and led to a significant improvement over the old system, as Trust for Nature's Chris Lindorff and Tiffany Inglis explain.

UP IN the Mallee, along the River Murray in far north-west Victoria, lies Neds Corner Station, a former sheep property now being restored as a significant natural habitat by the not-for-profit Trust for Nature. With an extreme climate—temperatures soar close to 50 °C in summer and frosts occur in winter—and no grid connection, this 30,000 hectare (300 km²) property presents challenges not only for habitat restoration, but also for the off-grid energy system needed to support the on-site rangers and visitors.

Purchased by conservation organisation Trust for Nature in 2002, the site is now home to two rangers and up to 30 visitors at a time: researchers and students studying the flora and fauna; bird groups conducting site surveys; works crews working on neighbouring public land; volunteers assisting with site restoration tasks such as reducing rabbit numbers, replanting local species and installing fences to keep out foxes; and the occasional corporate days and camping trips.

The site includes a homestead, shearer's huts (used as accommodation), kitchens and conference/workshop rooms, with associated energy needs for heating/cooling, lighting, water pumping, refrigeration and gas cooking.

↑ Half of the new 13 kW solar array. The other half, another 25 panels, is on a similar shelter nearby.

Energy system, take 1

When the property was first bought by Trust for Nature, the site ran solely on a diesel generator. Then, in 2012, philanthropic donations enabled the installation of a solar power system with a lead-acid battery bank. The system was designed to cater for an average of 25 kWh/day energy use, with a 25 kVA diesel generator as backup.

Over the following years, however, more people came to Neds Corner and energy demand increased, which led to the generator running more often than not. Frequent, heavy cycling of the flooded lead-acid battery bank meant it performed poorly and reduced its lifespan. Following the failure of multiple battery cells in 2016, the battery bank was disconnected and the diesel generator again became the sole source of electricity.

Upgrade needed

It was clear that an upgrade to the off-grid system was needed to make it viable, including a larger battery bank and solar array. This is where the Alternative Technology Association (ATA, *ReNew*'s publisher) came in. Not wanting to 'dive in without checking the water depth', Trust for Nature engaged Andrew Reddaway of the ATA to provide guidance on the system design.

A detailed loads analysis was the first task, including calculating energy usage figures for both general and peak periods. This exercise also helped to identify lighting and appliances that could be upgraded for energy efficiency, so the first tasks completed were a changeover to LED lighting and more energy-efficient refrigeration.

The loads analysis revealed an average energy use of 25 kWh/day across the full

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STIEBEL ELTRON

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