NSW Home Solar Battery Guide

NSW GOVERNMENT | Planning & Environment

Contributors

The NSW Home Solar Battery Guide was developed by the Total Environment Centre, in collaboration with the Alternative Technology Association and Zumio, for the NSW Department of Planning and Environment's Energy, Water and Portfolio Strategy Division.

The Department appreciates the valuable input provided by industry and other stakeholders in the development of this guide.

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The guide outlines things you may wish to consider when making financial decisions. However, the guide does not provide financial advice.

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Foreword

The Hon Don Harwin MLC
Minister for Resources, Minister for Energy and Utilities, Minister for the Arts

I am pleased to be releasing the **NSW Home Solar Battery Guide** as an important part of our NSW Renewable Energy Action Plan.

Rooftop solar panels are more affordable than ever and the people of NSW are making the most of this clean energy opportunity. More than 350,000 of our households are already harnessing the power of the sun.

Battery storage gives people the power to bank their solar supply and be able to use it any time—day or night. This means that those 350,000 households are now considering whether storage works for them.

Advances in the efficiency and affordability of batteries are speeding up. The Australian Energy Market Operator now anticipates more than 1,000 megawatts of batteries will be installed in NSW by 2035.

This guide seeks to help consumers answer two questions:

- Would battery storage save me money?
- How do I choose the right battery system?

The home solar battery market is evolving quickly. This guide provides general advice and every care has been taken to provide accurate and up to date information. You should seek expert advice to decide what option is right for you.

NSW has an aspirational objective of net-zero greenhouse gas emissions by 2050 and individual households and consumers will play a critical role in meeting this objective.

The government is working to accelerate the transition to emerging clean energy sources.

It isn't enough just to provide options, we want to ensure our people are empowered to access clean energy in the best way possible.

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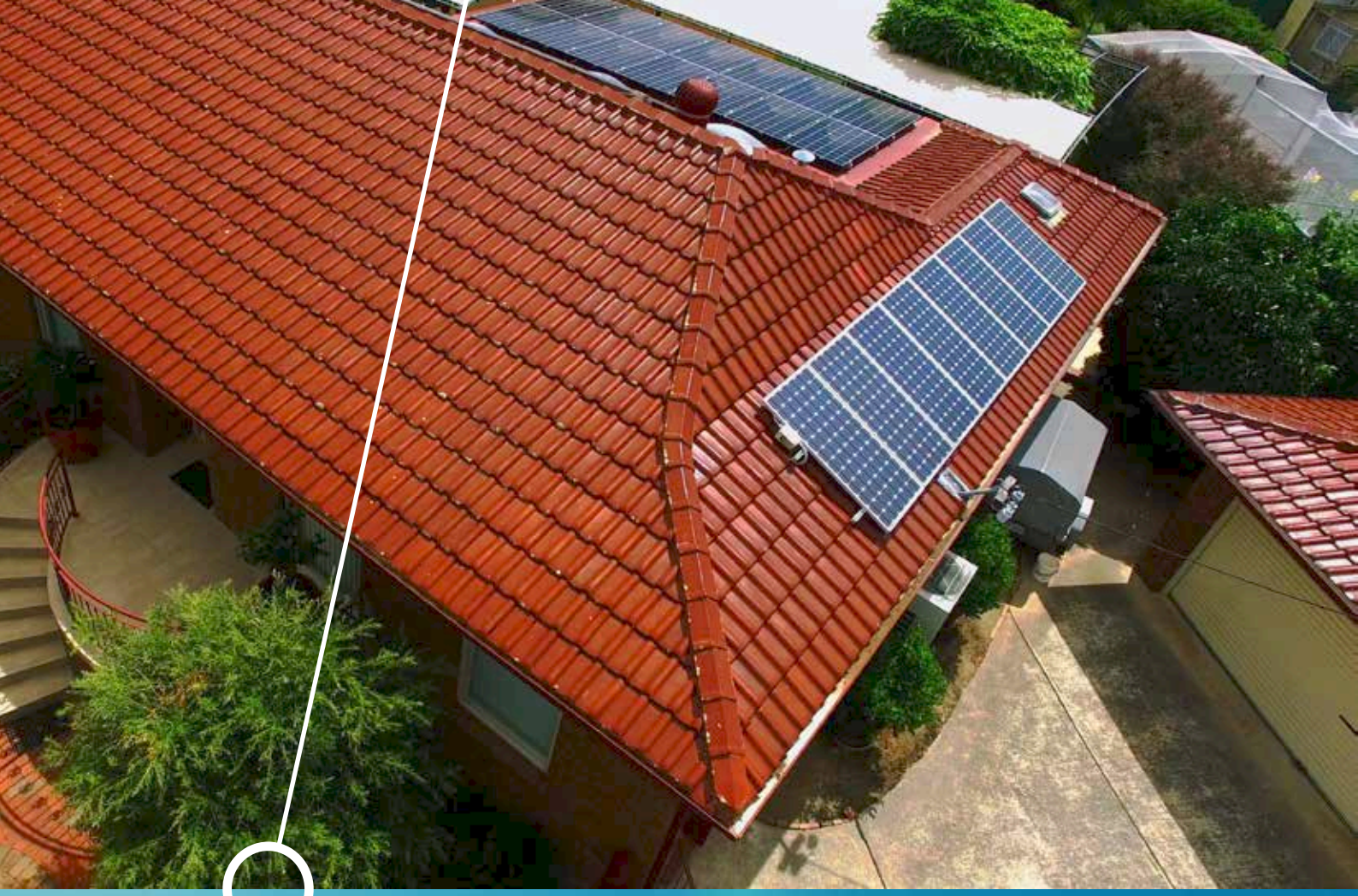

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Chapter 1
Your home solar battery guide

This chapter helps you to:

- Understand why the home solar battery market in Australia is booming
- Get a handle on the guide's key messages
- Recognise who this guide is for, the common motivations for buying batteries and how these might shape your decision
- Know how to use this guide

Solar battery systems and the changing energy market

Residential solar and battery systems will help ensure a clean, safe and affordable energy supply in NSW.

Australia's energy system is going through a transformation. More than 350,000 households in NSW have already installed rooftop solar systems[1], with many more expected to follow in coming years.

Home solar battery systems can store solar energy generated during the day and make it available when the sun isn't shining—potentially saving the household money.

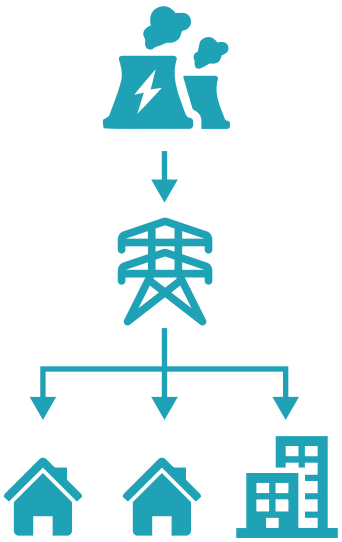
Battery storage systems for households are not new. For decades people have used them to support their use of the grid or to operate offgrid if they are in remote locations. These systems mainly relied on lead acid batteries. They were individually designed and often involved significant installation time and cost.

Batteries on offer today are virtually 'plug-in' (by a qualified installer). They are packaged as large single or small modular units, can be lead-acid, lithium-ion or several other chemistries, can store much greater amounts of energy in a smaller volume, and have integrated control and communications. Most importantly, their cost is rapidly reducing, making them more competitive with grid electricity.

Batteries are also an important link in the transformation of the grid. The old centralised model featuring the one-way flow of electricity from big generators to consumers is changing into a new model featuring two-way flows between 'prosumers' (producer-consumers) and the grid (see Figure 1 below).

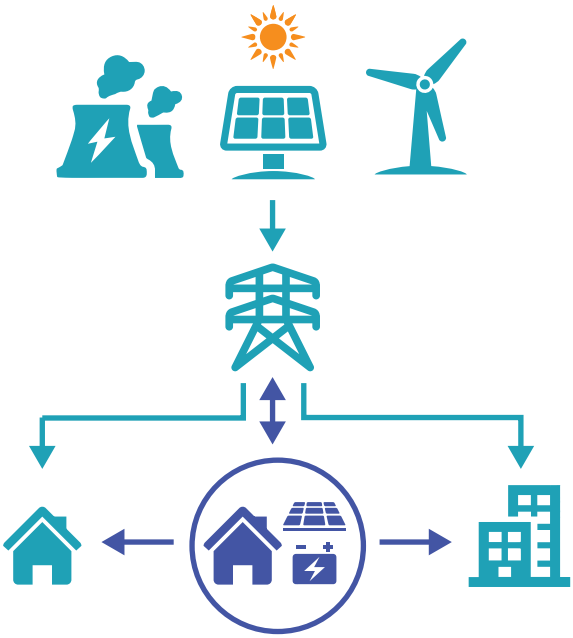
The changing energy market (Figure 1)

Recent past



In the old system, energy flowed in one direction only.

Into the future



Energy flows in two directions, and the customer is at the centre of the energy flow.

KEY MESSAGES

Battery storage systems are a major investment so it is important to look at what value they can deliver. Keep in mind all of the alternative options to save energy and money.

Is getting a battery a good idea?

1. Buying a battery is more complex than buying rooftop solar alone.
2. What you want a battery to do will determine whether you need one at all or what type of battery is right for you.
3. Understanding how you currently use energy in your household will help you to find the best battery to suit your needs.
4. There is a range of alternatives available to you, and depending on your circumstances, they can offer a better financial payback than batteries.

When do batteries make financial sense?

5. In most locations and household types in NSW, new solar battery systems are expected to pay for themselves within the typical warranty period of 10 years.
6. In most situations retrofitted batteries will not yet pay for themselves within 10 years, but within a few years they should as battery costs fall.
7. Batteries can also have practical, non-financial benefits such as powering your home in a power outage or supporting the grid by exporting energy at peak times.
8. Going offgrid only makes financial sense in a few select circumstances.

What are the critical things you need to know when buying a battery?

9. **Quality**—choose a quality product and an accessible and licensed installer with a good reputation.
10. **Size**—choosing an appropriately sized battery for your needs is critical to get the best economic return. The payback for smaller batteries is typically earlier than for large batteries (see page 30).
11. **Software**—the energy management system is key to making the whole system work (see page 22).

Australia will likely be one of the first places to experience a mass uptake of home solar batteries.

Who is this guide for?

The NSW Home Solar Battery Guide helps households make informed decisions when considering buying and owning a battery system.

We will look at subjects including:

- installing new rooftop solar together with a battery
- adding a battery to an existing rooftop solar system
- installing a battery without solar
- using a battery to disconnect from the grid.

This guide is designed for home owners, and is not intended for business owners or tenants.

The guide does not cover going offgrid in detail because in most cases this is not a financially viable option.

The guide outlines things you may wish to consider when making financial decisions. However, the guide does not provide financial advice.

The technical information and financial analysis in the guide are based on extensive modelling undertaken by the Alternative Technology Association (ATA), using current information as at May 2017.

EXTRA RESOURCES

On the **NSW Home Solar Battery Guide** website (resourcesandenergy.nsw.gov.au/battery-guide) you can find summaries and some additional information in the fact sheets published together with the guide.

There are also separate practical examples to give you an idea of how households in different situations go through the decision-making process.

HOW TO USE THIS GUIDE

Whether battery storage is right for you, and which kind to get, depends on what you want it to do. Your motivations will also affect how you navigate this guide and the supporting material on the guide website (resourcesandenergy.nsw.gov.au/battery-guide).

These are the main reasons people have given when asked why they want a battery.

'I want to save money by reducing the amount of power I import from the grid.'

With energy bills having risen significantly in recent years, it makes sense to look at ways to reduce them. While a battery may reduce your bills, it doesn't necessarily mean that it will pay for itself within the warranty period.

Focus on:

- Understanding your energy use —see page 12
- Designing a home power station —see page 28
- Will a battery save me money? —see page 34
- 'Isabella's story—a NSW home solar battery example' on the guide website

'I want to have more control over my power supply.'

Many people want to buy a battery as insurance against potential future energy price rises. You may also wish to rely less on your electricity retailer or network.

Focus on:

- Easy things to do first—see page 16
- Designing a home power station —see page 28
- Should I go offgrid?—see the 'NSW home solar battery offgrid fact sheet' on the guide website
- 'Wei's story—a NSW home solar battery example' on the guide website
- 'Leyla's story—a NSW home solar battery example' on the guide website

'I am concerned about climate change and want to support renewable energy.'

Any solar energy you generate will reduce emissions from fossil fuelled generation, whether you use it yourself or export it to the grid. Adding a battery will not necessarily further reduce emissions.

Focus on:

- Easy things to do first—see page 16
- How green is that battery?—see page 27
- 'Ali's story—a NSW home solar battery example' on the guide website

'I want to sell energy back to the grid.'

With a battery you expect to earn money by exporting energy to the grid during peak periods.

Focus on:

- Will a battery save me money?—see page 34
- Managing your battery—see page 47
- 'Wei's story—a NSW home solar battery example' on the guide website

'I want backup power in case of power outages.'

Most parts of the network in NSW have been very reliable over a long period. Bear in mind, too, that not all batteries can operate independently if the network goes down.

Focus on:

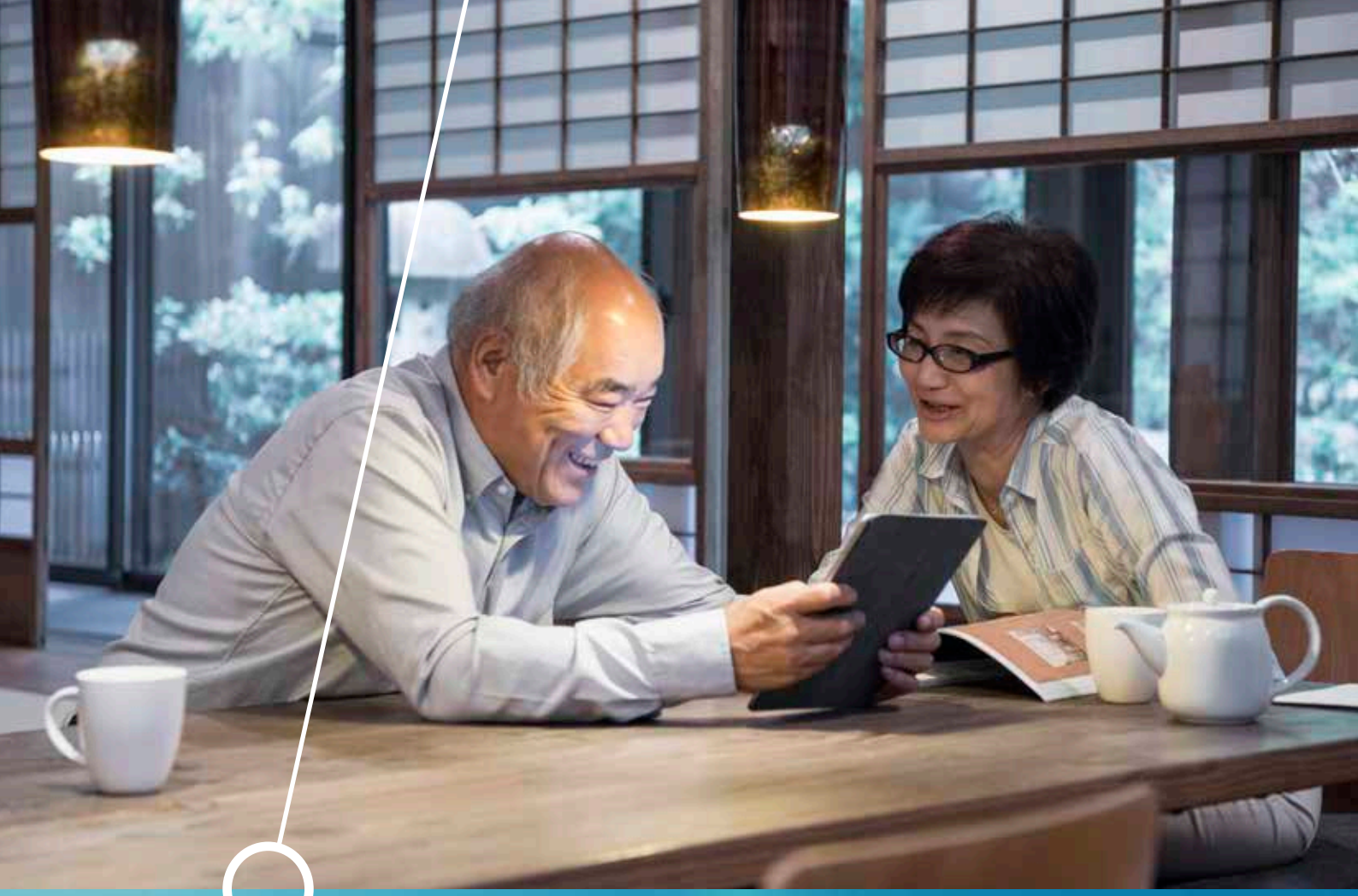
- Battery sizing—see page 30
- Will a battery save me money?—see page 34
- Should I go offgrid?—see the 'NSW home solar battery offgrid fact sheet' on the guide website
- 'Scott's story—a NSW home solar battery example' on the guide website

'I just want one!'

OK, so you're an early adopter or a tech enthusiast. But you still don't want to end up with egg on your face, a hole in your wallet, or a big lump of e-waste on your kerb next year.

Focus on:

- Battery basics—see page 23
- Designing a home power station —see page 28
- Buying a solar battery—see page 40



Chapter 2
Understanding your energy use

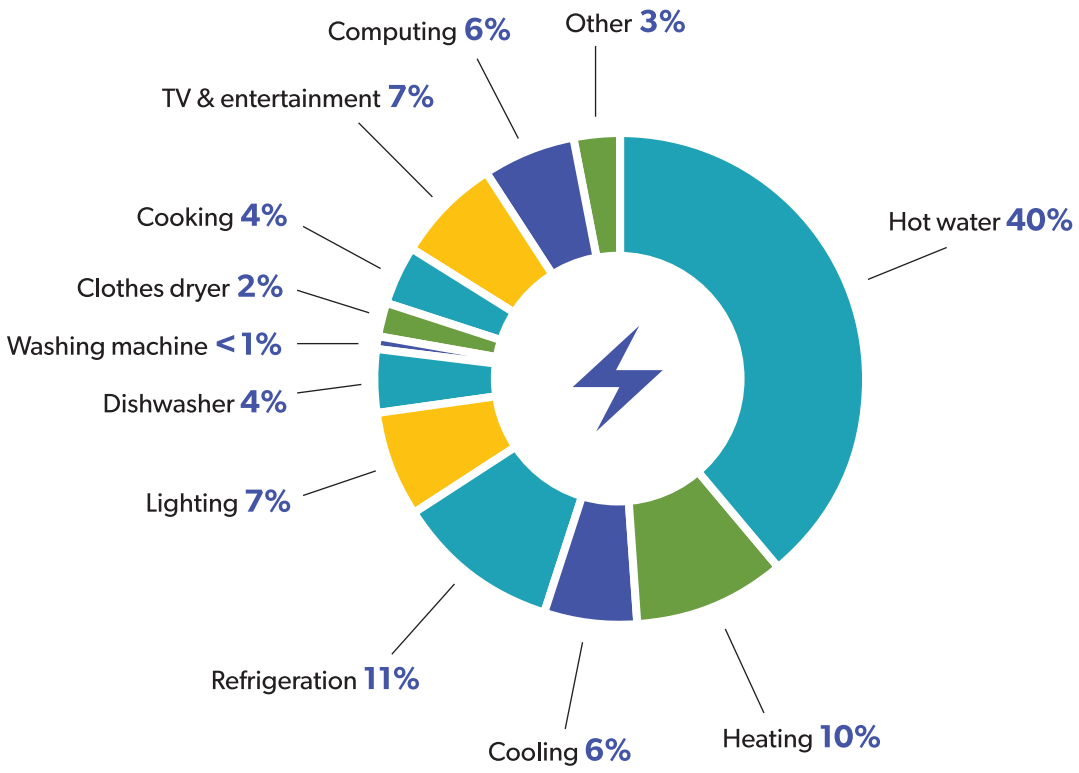
This chapter helps you to:

- Understand your current energy usage and how to access information about it
- Make sense of the different types of energy tariffs
- Learn some relatively cheap and easy ways to save money on electricity bills
- Make more use of your existing solar energy

Household energy use

We use energy for a range of services but not always during the hours of the day when solar produces it. The grid can absorb excess solar for use by others and retailers usually provide a feed-in tariff in return.

Typical energy consumption for a suburban household in NSW[2] (Figure 2)



The main uses of energy in NSW homes are hot water, space heating and refrigeration (see Figure 2 above). Most homes have their highest energy use in the early morning and late afternoon and evening.

When considering a battery, list which appliances the battery should power, and for how long.

Measuring energy

There are two units to measure energy. One is the power used at a given moment in kilowatts (kW). The other is the total energy used or produced in kilowatt hours (kWh). If your solar produces 5 kW of power for four hours then the total energy produced is 20 kWh.

It works the same way for consumption. If your air conditioner uses 1.5 kW of power and you leave it on for 13 hours it will have consumed about 20 kWh (1.5 kW multiplied by 13 hours) as shown in Figure 3 on the next page.

A solar household in the local grid

If you have a rooftop solar system with a typical 'net meter' the energy it generates is used by household appliances first.[3] Any excess is then exported to the grid and helps to supply nearby homes or businesses.

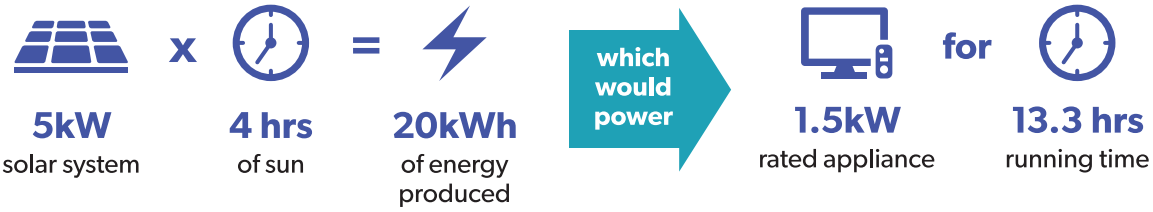
Any shortfall in supply—at night or on cloudy days—is met by importing electricity from the grid.

Solar feed-in tariffs

Exported energy usually earns a feed-in tariff from your electricity retailer. In NSW, the Independent Pricing and Regulatory Tribunal has recommended voluntary feed-in tariffs in the range of 11.9–15 cents per kWh for 2017/18.

Using power from the grid generally costs more than that, so it makes sense for you to use as much of your own rooftop solar energy as possible, rather than exporting it to the grid.

Guide for calculating usable power from solar power generation (Figure 3)



Find and understand energy information

Before buying a battery, understand your energy consumption and other costs as well as other ways to use less energy.

To correctly size and design your battery storage system, you need to understand how you are already using energy in your home.

This is useful for two reasons:

1. to avoid using power when it is most expensive,
2. to find the right battery size by knowing how much excess solar you have and when you use power.

There are several sources of information about how you are currently using energy.

Bills

Information in your electricity bill helps you understand how you are currently using energy. Comparing your average daily consumption for each of the billing periods throughout the past year will show you whether your consumption is increasing or decreasing, and how it varies with the seasons. If the bill is based on estimated usage, ask your retailer for accurate values.

Read the 'Tariffs' box on the next page for more information about what makes up your bill.

TARIFFS

A tariff is the rate you pay for grid electricity. It is usually composed of a fixed daily charge (in cents per day) and a usage charge (in cents per kWh) that increases the more energy you use. It can vary at different times of the day, days of the week or months or seasons of the year.

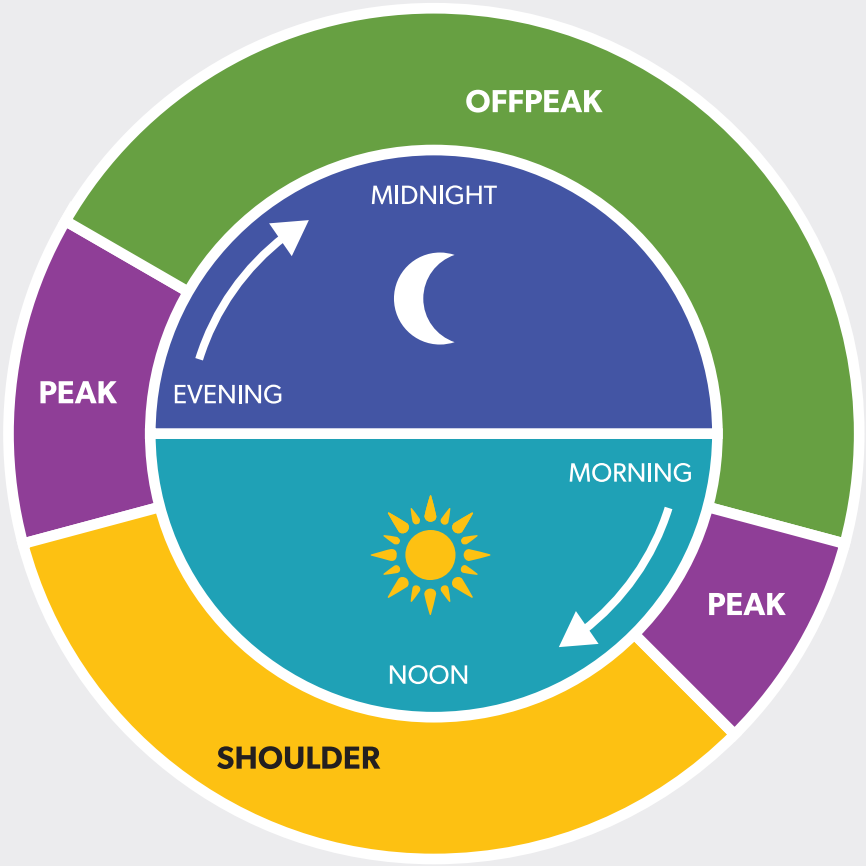
Most households in NSW are currently on flat (or nearly flat) tariffs. That is, you pay the same amount for electricity all day and night, plus the fixed daily charge.

Many solar and some other households are on a time of use tariff. This tariff charges more for peak periods and less for shoulder and offpeak periods (see Figure 4 below).

In the future, more households may be encouraged to move to time of use and other new tariffs which better reflect the pressure on the network during peak periods.

A controlled load tariff refers to a separate tariff and meter with lower charges. This tariff can only be applied overnight by using special appliances such as hot water systems, some pool pumps and slab floor heating. Currently, home battery charging on controlled load tariffs is not available so if you charge your battery from the network it would be on a different tariff.

Example of time of use tariff periods (Figure 4)



Meter data

Data may be accessible via your meter depending on the kind of meter that you have. Older meters are only read quarterly. Newer meters generally provide more detail, for example hourly grid import and export data.

From December 2017 all new solar systems and new connections will involve the installation of 'smart' meters that send information about your energy usage back to the grid.

Your energy retailer and network provider keep smart meter data and are required to provide it to you within 10 business days upon request. More conveniently, many energy retailers now have web portals online where you can log in and access your data.

Solar inverters

A solar inverter collects data about energy generated by your solar panels and displays certain data on a small screen.

Many inverters are able to upload data in real time to a web portal or smartphone app.

In-home displays

You can get detailed data from in-home displays. Simple displays show data about one appliance while more sophisticated ones are wifi-connected and can tell you how the whole home is performing on your smartphone or computer. In-home displays can be bought from large hardware stores or borrowed from local libraries.

Easy things to do first

If you are mainly interested in a battery to save money on power bills, there are some other simpler and cheaper ways to achieve this before considering buying a battery. In terms of value for money, there is a simple hierarchy:

1. **Shop around for the best price** for your grid electricity, and make sure you ask for a discount on normal rates. Residential customers may save up to a few hundred dollars per year by switching to the best market offer. There may also be discounts available for direct debit or on-time payments. You should make sure you are on the most appropriate type of retail tariff that suits your needs.
2. **Reduce your household consumption by:**
   - using less energy where possible—e.g. by replacing old light bulbs with LEDs; turning off your television at the power point and not keeping it on stand-by; reducing the amount of time your pool filter runs in winter,
   - having good building insulation—gap sealing, window shading or ceiling batts, for instance, will likely have a shorter payback period than either solar or batteries,
   - buying energy efficient appliances—go for those with at least four stars on their Energy Rating label.[4]
3. **If you already have solar panels, make the most use of your existing solar energy.** You can do this by looking at:
   - running appliances such as dishwashers and washing machines when the sun is shining,
   - if your house is well insulated, pre-heating (in winter) or pre-cooling (in summer) while your solar system is producing energy to reduce evening consumption from the grid,
   - engaging an electrician to rewire your electric hot water tank so it uses your own solar power (see the box on the next page for more detail),
   - when replacing an existing gas or electric storage hot water system, consider replacing it with a heat pump hot water system (see the box on the next page for more detail).
4. **Install (more) rooftop solar power.**
5. **Only then, consider installing a household battery.**

THREE EASY ALTERNATIVES TO BATTERIES

Solar electric hot water

If you have an existing electric storage hot water system you can heat it directly (or as a priority) with electricity from your rooftop solar.

Doing this instead of using grid electricity could save around $300 per year (on a flat tariff). About half of the electricity for your hot water system would then come from your solar system, with the rest coming from the grid. However, if your existing hot water system heats overnight on a controlled load tariff an electrician will need to rewire it. If you have a large hot water usage and only a small solar system (e.g. 1.5 kW), this option may be no better than running the hot water system overnight on offpeak. In this case, you could select a time of use tariff and change the hot water unit to run overnight during the winter, when solar generation is lowest.

Heat pumps powered from solar

Heat pumps work like air-conditioners in reverse, extracting heat from the atmosphere and using it to heat the water in the tank.

If you set the timer to run when the sun is shining, it's a win-win outcome for renewable energy and low bills.

Modern heat pumps are highly efficient, producing up to five times the energy required to run them. You have to pay for the cost of the heat pump unit, but should save money in the long run.

Adding solar for early morning and evening

Adding more solar panels to an existing system or installing a larger new solar system may have a shorter payback period than buying a battery. This can be especially beneficial where the new panels' orientation and tilt helps produce energy later in the evening or in the early morning.

You will need to get professional advice about whether you can add more panels to your existing solar system or will need to install a whole new system and whether this is beneficial to match your existing or planned energy consumption.

Photo courtesy Fountaindale Project Marketing—Tullimbar Village

Chapter 3
Your home power station

This chapter helps you to:

- Understand how a home power station works—and how a battery can help
- Decipher the main tech specs you need to know
- Know the main battery chemistries on the market
- Be aware of the environmental benefits and impacts of home solar batteries

How a home power station works

Solar plus inverter, battery and software allows greater energy independence.

In a home with solar panels, your energy usage when the sun is shining is met by solar generation. Any excess solar energy is exported to the grid.

Exports are typically between 20% to 80% of the electricity generated and are highest for households which are not at home during the day.

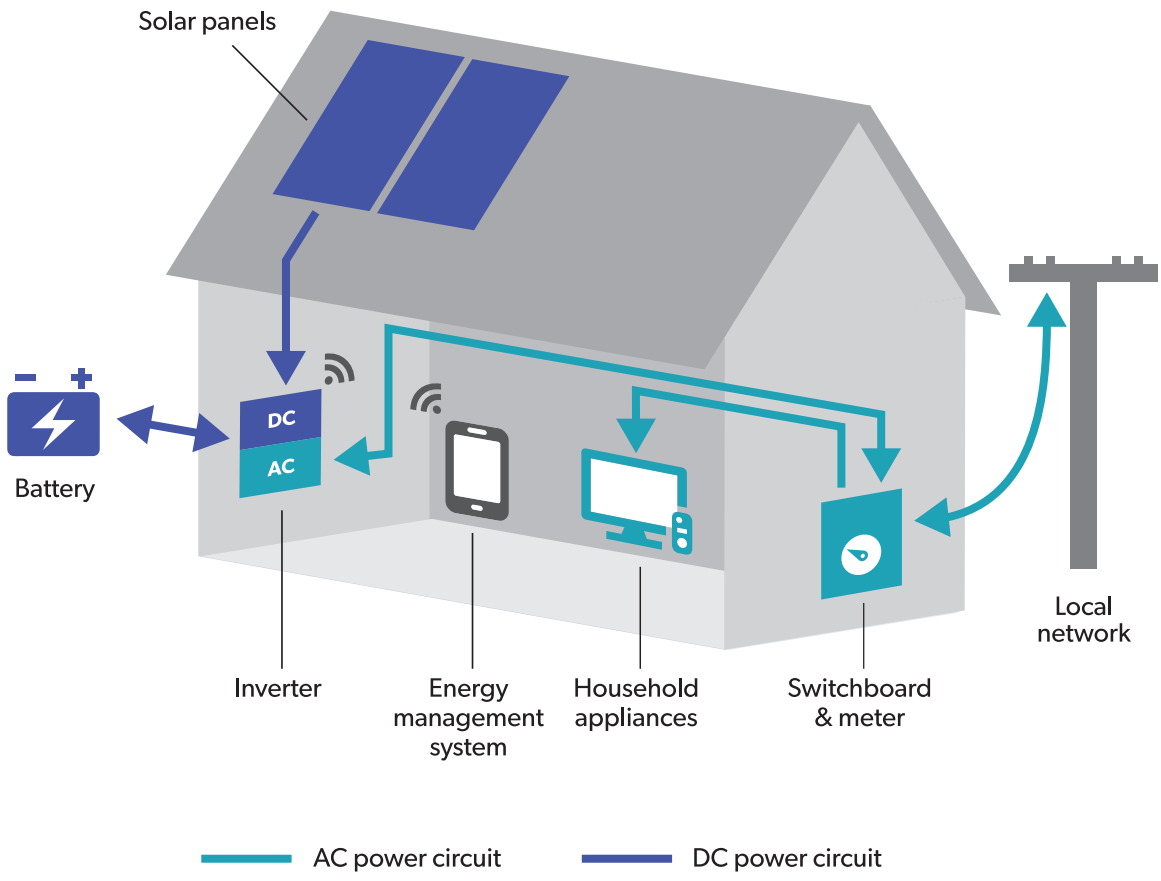
Shortfalls are met by importing grid electricity. This is where battery storage can really help to save money.

How a home solar battery works

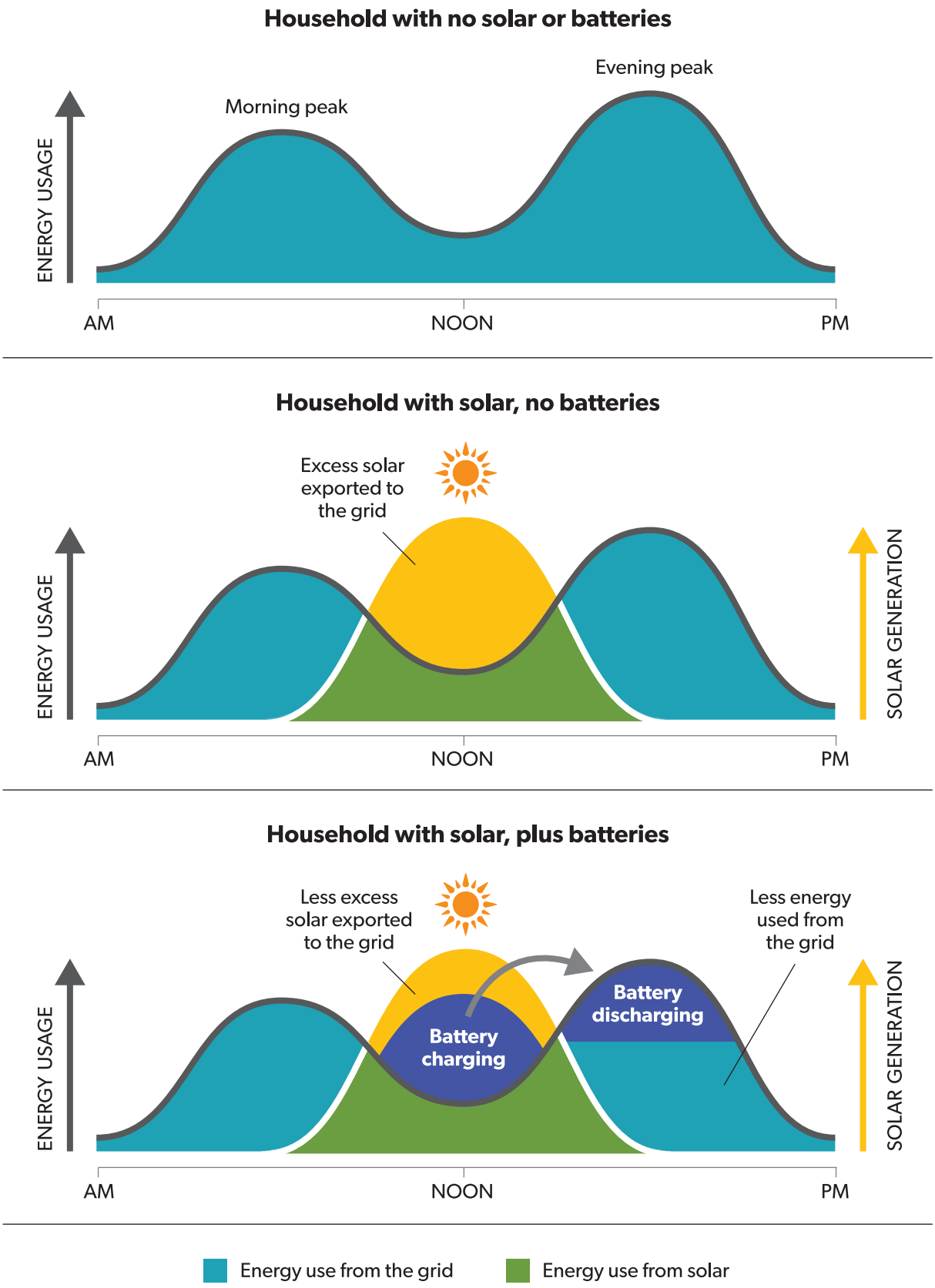
When you add a battery to a rooftop solar system (or install them together), the solar energy not used at home during the day is used to charge the battery. Figure 6 on the next page shows the typical daily energy consumption for a household without solar, with solar and with solar and batteries.

Some batteries can also be charged from grid electricity, for example during offpeak times on a time of use tariff when electricity is cheaper than during the day.

A home power station (Figure 5)



How solar power and a battery affect your home energy (Figure 6)



Solar panels

Solar photovoltaic (PV) panels convert energy in the form of light from the sun into electricity.

Because they have no moving parts, good quality solar panels are usually reliable and can last up to 30 years with only a minor loss of output during that timespan. You can find links to more information in 'Additional Information' on page 52.

Inverters

Inverters convert solar or stored power to alternating current for use in the home. They often don't last as long as other components so it can be worthwhile getting good quality.

Inverters are needed to convert direct current (DC) from solar panels and batteries to the 230 volt alternating current (AC) that households and the grid use.

There are two main types of inverters used in residential systems:

- **Stand-alone inverters** do not connect to the grid and are used in homes where there is no grid connection.
- **Grid-interactive or grid-connected inverters** operate only when the grid is working. These inverters may be solar-only, battery-only or hybrid. A hybrid grid-interactive inverter can change both solar and battery current from DC to AC. Some grid-interactive inverters can also run independently from the grid during power outages if they are designed for that. Inverters with this backup function are usually more expensive.

It is worth buying a good quality inverter because their typical lifespan is around 10–15 years—significantly shorter than solar panels. Ambient temperature, unstable grid voltage, dust, heat, ventilation and vermin such as ants can affect the lifespan of the inverter.

Most inverters currently being installed don't provide backup during a power outage.

Photo courtesy Enphase Australia

Software

Getting a good energy management system for your battery helps you make the most of it. It might be part of the product you buy or can be bought separately.

Software—often called an Energy Management System (EMS)—controls the different components of your home power station. This software will decide when to:

- charge from the solar system,
- discharge to power home appliances,
- discharge into the grid.

Some batteries come with an integrated EMS. If they don't, it is important to know how this functionality can be provided separately so that you make the best use of your battery. Generally speaking, the brands offering solar, batteries, inverters and software as an integrated system are likely to work best together, but you may pay more for this added functionality.

Note that EMS are not the same as battery management systems (BMS). The BMS control the internal safety of a battery while the EMS helps to integrate it with the other components of a home power station.

Some retailers have websites and apps that allow you to access your daily smart meter data.

Battery basics

Manufacturers often give specific information about their batteries that affect how they can and should be used. It is important to understand these basics, especially to make sense of what is covered in the warranty.

Put simply, a battery is a box of chemicals. One type of chemical reaction stores energy (the charging cycle), while the reverse reaction gives off energy (the discharging cycle). Different battery chemistries have different properties that affect how they perform.

The box below looks at a range of chemistries currently available in the market.

Here is an introduction to the most important technical specifications you need to know about if you are considering buying a battery.

CHEMISTRIES

Lead-acid

Until recently the most common chemistry used for home batteries—especially in offgrid locations—has been the 'flooded' lead-acid battery. It is similar to multiple car batteries strung together to provide more capacity. Their main advantages are proven reliability, safety and fairly low upfront cost. The main disadvantages are bulk and corrosion. They also require regular maintenance, need to be kept upright to prevent leakage and must be kept in a ventilated environment. There are new variants that overcome some of these disadvantages. However, these new versions are not as cheap as flooded lead-acid batteries.

Lithium-ion

Network-connected household batteries are increasingly focused on lithium-based chemistries, which have seen a steady decrease in cost in recent years. Lithium-ion batteries are also widely used in mobile devices such as mobile phones or tablet computers.

These batteries are small and light in comparison to their capacity. They can be efficiently charged and have relatively long lifespans.

Not all lithium-ion batteries are the same. The two main varieties currently being sold are lithium NMC and lithium iron phosphate. NMC batteries have high energy densities, but can overheat if discharged too quickly. Lithium iron phosphate batteries are a little larger but are considered safer.

Other chemistries

The other main chemistry is 'flow' batteries, which use liquids to store energy. Their main advantages are safety, ease of maintenance and the ability to store the charge for long periods. The main disadvantages are greater bulk per capacity compared to lithium-ion as well as being relatively more expensive.

A range of other chemistries is in various stages of development and commercialisation and could become available in the coming years.

Useable capacity

This is the amount of a battery's total or rated capacity that is available for regular use without overly affecting its lifespan.

For instance, a battery may have a rated capacity of 12 kWh, but its recommended useable capacity is only 10 kWh. If information is not available, you should assume that around 10% of the total capacity should not be used on a regular basis.

Lifespan and warranty

You want your battery to last as long as the warranty and hopefully well beyond it. A battery's lifespan will be influenced by a number of factors including the charge or discharge rate and the depth of discharge (DoD) employed in its everyday operation.

Some battery warranties are for a specific period (usually 10 years), but other warranties can refer to a specific number of cycles instead, where charging and then discharging the battery makes up one cycle. Batteries are also typically warranted for a certain number of cycles at a given depth of discharge (e.g. 3,000 cycles at 80% discharge). Discharging them beyond this point may affect the warranty or lifespan.

Other factors like high ambient temperature may also affect the warranty. It is important to check any assumed reduction in useable capacity over the warranty period.

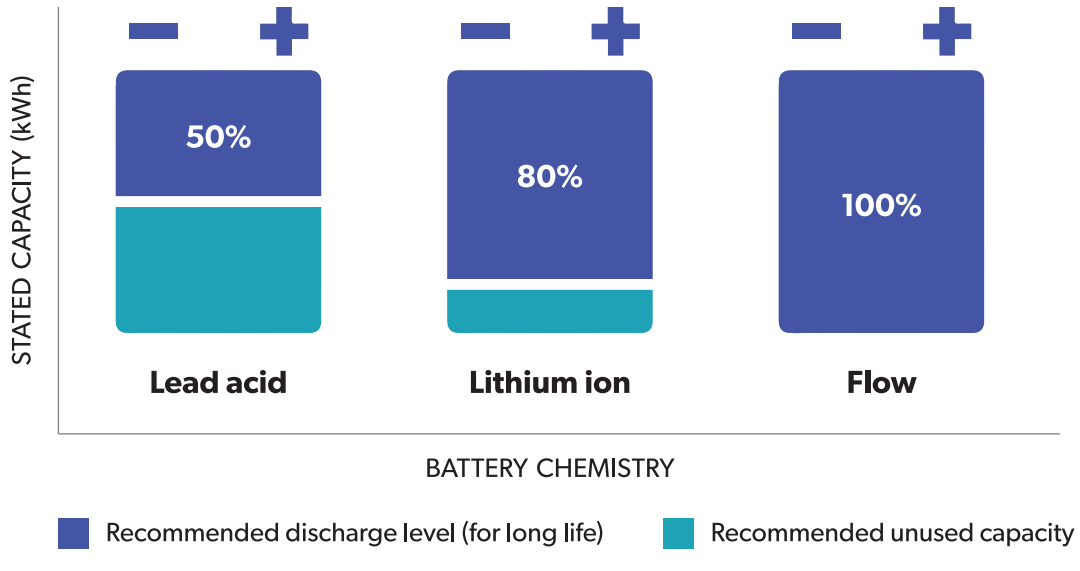
Depth of discharge

Some battery chemistries can handle being fully discharged on a regular basis; others can't and will degrade quickly if fully drained often. Generally, lithium-ion batteries of either main type (NMC and iron phosphate) may be discharged to a relatively low level. Rough estimates for the recommended discharge level for lead acid, lithium-ion and flow batteries are shown in Figure 7 below.

Charge and discharge rates

The maximum charge and discharge rates are the most power you can feed into a battery at once, or the most power you can get out of a battery at once. It is usually given in kilowatts (kW). Battery providers usually include it in the product specifications. The higher this rate, the more instantaneous power is available.

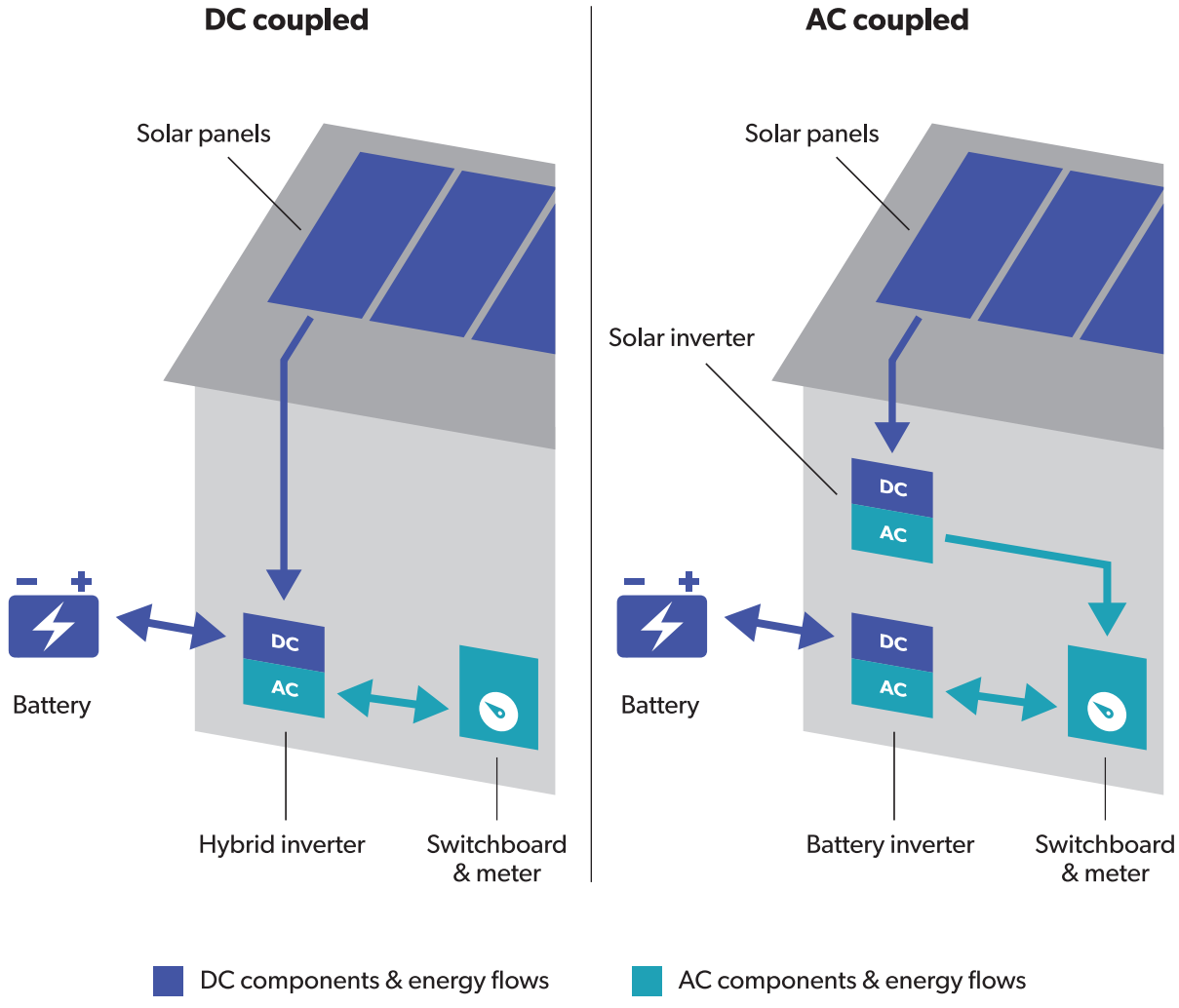
Recommended battery discharge levels (Figure 7)



Most batteries are more efficient if you don't charge or discharge at the maximum rate. The Energy Management System may allow you to control these rates. This is an important consideration for households that wish to use a lot of energy at once.

For instance, a battery with a usable capacity of 10 kWh may have a maximum discharge rate of 5 kW. If discharged at 2 kW power it can deliver the full 10 kWh of energy but if discharged at 5 kW power for a short time it may only deliver a total of 9 kWh of energy.

Comparing AC and DC coupled battery systems (Figure 8)



Choosing a lead acid, lithium or other chemistry affects how often and how completely you can empty the battery.

Coupling—should batteries share the inverter with solar?

'Coupling' refers to the way batteries and solar panels are connected to the switchboard. In a direct current (DC) setup a battery is connected to the same inverter as the solar system. In an alternating current (AC) coupled setup, a battery inverter connects the battery to the meter box, separate from the solar inverter. The setups are illustrated in Figure 8 on the previous page.

It's best to discuss options and costs with the installer. Here are a few reasons why you would choose one over the other:

DC coupled batteries are slightly more efficient and are easier to get network connection approval for because only one inverter is connected to the network. However, DC coupling can be tricky for existing solar systems, as it requires a hybrid inverter in place of the existing solar inverter.

If your existing solar inverter is relatively new and working well you may not wish to replace it.

AC coupled batteries are slightly less efficient, but AC-coupling allows power from the battery to be used at the same time as solar power, and usually allows you to charge the battery from the grid, which is not always the case for DC coupled systems. An AC coupled battery can be installed without any changes to an existing solar system.

DC coupling is more common for new solar and solar battery system installations, whereas AC coupling is more common for battery retrofits. However, this could change.

Both AC and DC coupled batteries can be designed to have backup functionality during a power outage, but check the specifications of the products.

Photo courtesy LG Chem

How green is that battery?

Will buying a home solar battery help or harm the planet? There are a number of things that you need to think about when considering the environmental sustainability of particular battery types and products.

Right now there are no independent sources of information or advice that rank different products for their environmental performance or impact. Nor is there an industry product stewardship scheme for the whole supply chain and product lifecycle that would put the onus on makers and sellers to provide this information. Both of these are likely to happen in the near future.

In the meantime, here are some of the things to look for:

- **The materials and energy used in manufacturing and transportation** ('embodied energy'). Some battery raw materials are relatively cheap and plentiful (like lithium or lead), while others are rare and expensive (like cobalt). A solar system that includes a battery should offset the energy used to manufacture it in around a year or two.[5]
- **The energy efficiency and lifespan of the system in use.** The longer a battery is warranted to last, and the more energy a battery is guaranteed to store within its warranty period, the better the use of resources to manufacture it.
- **Whether or not the battery helps to increase renewable and decrease fossil fuel generation.** Unlike solar, installing a battery doesn't automatically guarantee that you are creating more renewable energy. However, batteries may have a direct environmental benefit such as allowing you to install an oversized solar system or reducing the use of diesel generators in offgrid situations.
- **End of lifecycle reuse, recycling or disposal.** Batteries are likely to constitute a significant source of e-waste in future. However, organisations like the Australian Battery Recycling Initiative are already working on a solution for waste disposal and recycling. In the meantime, some batteries (such as lead acid) have ingredients that are easier to recycle than others. Batteries may also become reusable in new applications and installers could potentially offer used electric car batteries for your home power station.

BUYING GREENPOWER

You can make sure any grid electricity you use directly or to charge your battery has zero net emissions by purchasing 100% GreenPower through an electricity retailer. Most retailers offer a GreenPower product for all or part of your electricity consumption.

GreenPower is renewable energy sourced from accredited solar, wind, bioenergy and mini-hydro generators across the country.

GreenPower accredited electricity is additional to the national Renewable Energy Target and is strictly audited to verify that the retailers ensure that electricity generated from accredited renewable energy generators is feed it into the grid on your behalf.

By purchasing GreenPower, you will be able to lower your emissions and to contribute to the growth of Australian renewables at the same time, whether you decide to invest in a battery or not.

To find out more visit greenpower.gov.au.

GreenPower®
Accredited Renewable Energy

Chapter 4
Designing a home power station

This chapter helps you to:

- Understand the three main options for adding battery storage to your home
- Identify the right battery size for you and the implications of backup power capability
- Know how to 'future proof' your battery investment decision

Options for adding a battery

Unless you are thinking of buying a battery to operate on its own, you will be adding one to a new or existing rooftop solar system.

Buying a battery and solar at the same time

This option has both cost and practical advantages. You can have a single hybrid inverter instead of two. Also you can install a larger solar system in the knowledge that the extra power it generates can be stored and used later.

Adding a battery to existing solar

Many owners are wondering whether their solar system is 'battery ready.'

In general you will need to install a dedicated battery inverter with your new battery. Most battery products on the Australian market are now being sold with an inverter, which may be integrated into the battery unit or may be separate.

Some providers might offer to replace the existing solar inverter with a single hybrid inverter which connects to both the solar and battery, but this is not possible in all cases.

Providers may also offer to connect the battery to the existing solar inverter, without needing a battery inverter, by fitting a dedicated DC to DC converter between the solar panels and the battery. This option will mean that the battery can only be charged from solar, and not from the grid.

Installing a battery without solar

Households that want to charge a battery from the grid at offpeak rates and then use the energy in their home during peak periods might consider this option. However, the battery-only option is not expected to be financially effective using current prices (see 'Will a battery save me money?' on page 34) and it does not allow households to use their own renewable energy onsite.

Photo courtesy Reposit Power

Battery sizing

Choosing the right battery storage size for your needs will mostly depend on the size of your solar, how much energy you consume overnight and whether you want backup during a power outage.

Choosing a battery size

For bill-saving purposes, it is generally best to buy a battery that you will regularly charge and discharge to the recommended level.

You must be careful to not over-use a battery, for example by fully charging and discharging two or three times a day. Doing this might shorten its lifespan. You can usually set this up in the Energy Management System or app.

The best way to choose the right size battery for your needs and budget is to get an independent assessment from an accredited installer or supplier.

To help you when you talk to an independent assessor, we have included some tips for battery sizing in the box below, and some example sizing for different households on in Figure 9 on the next page.

TIPS FOR BATTERY SIZING

If you want to make the most of your solar:

- Calculate how much excess solar energy you will have during the day, for example by using your solar data and subtracting the energy consumption during sunny hours from the typical solar generation in a day.
- Decide whether you want to store all your excess solar or, for example if you are on a time of use tariff, just the energy you use during the evening peak. Smaller batteries usually pay back more quickly.

If you want your battery to power your house overnight:

- Calculate your excess solar energy (see above) and your overnight energy use, for example by using your solar data and subtracting the average solar output used at home from your total average daily consumption.
- Choose a battery that is big enough to store the excess solar energy, and then discharge it again overnight to power your house.

If you want your battery to power your house during a potential multi-day power outage:

- Your battery should be big enough to cover several days of energy use, and you may need an on-site diesel generator in addition to battery storage.
- Your home power station should be designed more like an off-grid setup, requiring special inverters and connections to allow charging from solar panels while the grid is down.
- You should plan for higher costs, an installer with specialist skills and a longer grid connection process.

Practical examples of solar and battery sizes (Figure 9)

On the **NSW Home Solar Battery Guide** website (resourcesandenergy.nsw.gov.au/battery-guide) you can find practical examples that illustrate what battery size and savings to expect. These are summarised in the table below.

The first three lines show the person's motivation, their power use and whether they already have solar. In the lower section you can see what their decision might be, including new or extended solar, battery capacity and what that means in terms of costs and savings.

	Isabella	Ali	Wei	Scott
SUMMARY	Having solar already, she and her husband want to save money but find the battery payback is too long. They do some energy efficiency instead.	For environmental reasons he wants to use mostly his own renewable power, but the price matters.	Because of bad experiences with his retailer he wants to rely less on the grid but going completely offgrid is too expensive.	He wants to become more self-sufficient, but also needs backup for his home office during power outages. Cost is secondary.
DAILY CONSUMPTION	10 kWh	10 kWh	25 kWh	20 kWh
EXISTING SOLAR	2 kW	–	5 kW	4 kW
	Their investment			
NEW SOLAR	None—energy efficiency instead	4 kW	5 kW	–
NEW BATTERY		2 kWh	14 kWh	14 kWh
SYSTEM COST	$2,800	$9,100	$24,000	$18,000
ANNUAL SAVINGS	$520	$840	$1,500	$480
PAYBACK	5 years	9 years	17 years	37 years

Emptying a battery past its recommended discharge level will affect its lifespan and long-term capacity. Take this into account when choosing a battery size.

Backup power capability

For backup power your system needs an isolation switch. During an outage the switch disconnects your whole house from the grid. This is necessary to protect anyone fixing the grid from getting an electric shock from your battery. There is usually an additional cost for the isolation switch and its installation.

For most NSW households, power outages are relatively rare so you may not need backup.

Sizing for backup and offgrid

The more independent from the grid you wish to be, the larger the battery system you will need.

If you want backup for multiple days or are considering going offgrid then all of your consumption will need to be covered either directly by a rooftop solar system or other generator, or indirectly by using power which is generated earlier and stored in a battery. This means your system cost could be multiple times that of a grid-connected system.

Photo courtesy Zen Energy

Standard solar and battery systems do not work when there is a power outage.

Future proofing

In the fast-changing home battery market there is a range of factors to consider when trying to 'future proof' your investment decision.

Wait

If bill savings are your main motivation, the best way to future proof your investment would be to only buy a battery when you are confident you will get a payback within the warranty period. With prices falling steadily, that could involve a wait of as little as one year (see 'Will a battery save me money?' on page 34).

Solar now, battery later

You may wish to install solar now and add a battery later, when prices fall further. In this situation, many customers wonder about how to ensure their system—particularly their inverter—is 'battery ready.'

You might simply install solar with a solar inverter. Later on, when you decide to add a battery, you may need to replace the original grid-interactive solar inverter partway through its usable life with a hybrid inverter that can accommodate the new battery. In general, a hybrid inverter is about $1,500 more costly than a solar inverter. Alternatively, you may wish to install solar with a hybrid inverter, ready for the battery later on. However, there is a risk that by the time you install the battery the inverter will be obsolete or unnecessary.

The ATA's advice is that the risk of technology obsolescence is too great if you don't install a battery in the next two years. Alternatively you can buy a low-cost solar inverter and replace it when you install a battery.

Consider future tariff changes

The more you pay for grid electricity, the more benefit a battery will create if you are using it to store excess rooftop solar energy.

Conversely, the higher the feed-in tariff a retailer will pay you for exporting excess solar to the grid, the lower the potential economic benefit from a battery.

You should shop around to understand tariff offerings from electricity retailers. Batteries can reduce electricity bills in situations where the tariff during peak times, such as weekday evenings, is higher than the standard tariff. They also mean that part of your energy use is independent of retail prices.

Sell your energy into the wholesale market

As an alternative to selling your excess solar or stored battery energy into the grid for a fixed tariff, you can also buy software that allows you to sell your excess energy into the grid at times when the wholesale spot market price is high.

Some retailers are currently offering up to $1 per kWh for this service. However, the software can cost up to $1,000, and the retailer may make this service available only infrequently. So, at the moment, this value stream should be considered supplementary.

In the future, new electricity business models may emerge which include a wider range of offerings to households that can sell their excess energy back to the grid or to other local households or businesses.

Start small

Some batteries are designed to be modular. Having more storage is then simply a matter of adding more units. Of course you and your installer will need to make sure that the inverter capacity matches your needs. Some modular batteries include an inverter in each module.

Chapter 5
Will a battery save me money?

This chapter helps you to:

- Calculate the 'payback period' for a battery
- Get a feel for the typical battery payback periods in NSW in 2017
- Read our general advice on whether batteries are a good investment right now

Calculating the 'payback period'

The time a battery takes to pay for itself depends on a few important factors.

It's important to know whether a battery will pay for itself before its output degrades significantly, and certainly before the end of its warranty. At this early stage in the evolution of the home solar battery market we don't know how long they will last.

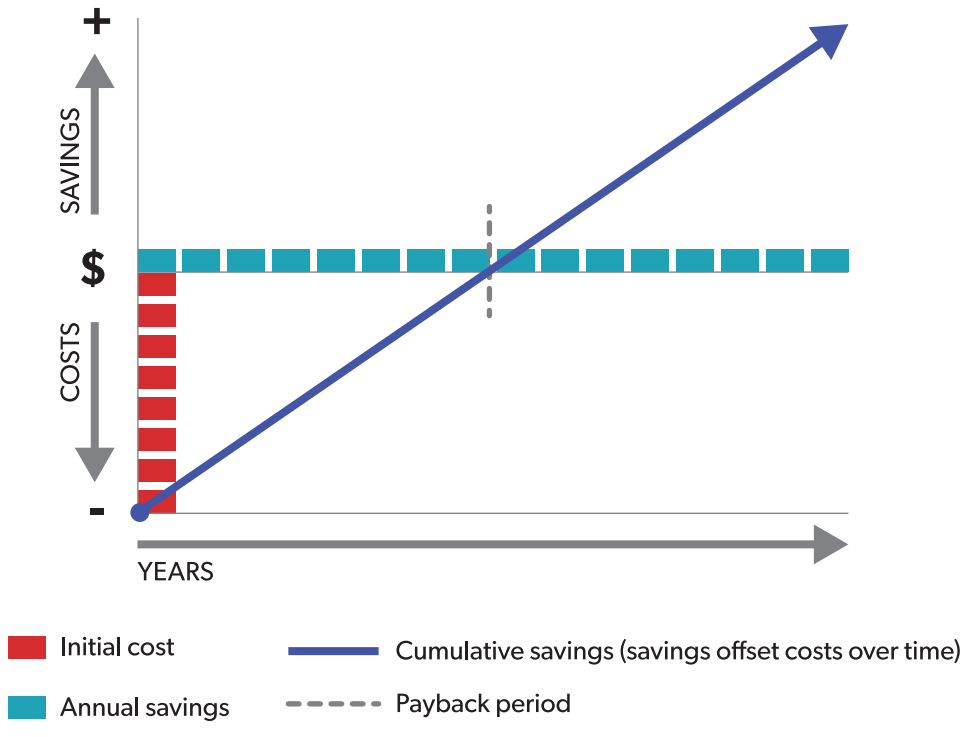
The payback period is the time it takes for a battery to pay for itself through reduced energy bills and is the simplest way to calculate whether it will save you money over its warranted lifespan.

For a simple estimate, the payback period in years is usually calculated by dividing the system cost by the annual savings. Figure 10 below shows an example with system cost in year one, and a rectangle for each year's savings. The blue line shows the balance of the two, reaching the payback period after eight years.

If the warranty period is 10 years, the example shown would suggest a relatively safe investment because the payback period is shorter than the warranty period. If the warranty is less than eight years you would be taking a risk by assuming the battery will be able to pay back its cost.

Figure 11 on page 37 provides a simplified example of how to work out the payback period once you have received one or more quotes. This is important because it can help you assess the different offers you will receive. For example, try to understand what your 'annual savings' would be depending on if you will use the full battery capacity every day, or what part of the savings are due to installing solar panels plus the battery.

Understanding the payback period (Figure 10)



To be more accurate, this calculation would need to include a range of additional factors, including:

- the actual level of discharge of the battery over the course of the year—taking into account energy use patterns and solar generation (where solar exists). This will always be less than the usable capacity multiplied by 365 days,
- the reduction of battery capacity over its lifespan,
- potential future changes in retail electricity prices,
- efficiency losses between solar, the battery and your appliances.

There are online calculators that will give you a more accurate result. We have listed some in 'Where to go for more help' on page 58.

Photo courtesy Positronic Solar

A simple battery payback period calculator (Figure 11)

	Example:	Your system:
STEP 1	6 kWh Battery capacity x 365 x 80% = 292 days per year @ 80% daily discharge = 1,752 kWh Annual total grid energy displaced by battery	____ kWh Battery capacity x 365 x 80% = 292 days per year @ 80% daily discharge = ____ kWh Annual total grid energy displaced by battery
STEP 2	1,752 kWh Annual total grid energy displaced by battery x 39c – 8c = 31c/kWh Average cost of energy from the grid minus feed-in tariff for energy to the grid = $543 Estimated annual bill saving	____ kWh Annual total grid energy displaced by battery x ____c – ____c = ____c/kWh Average cost of energy from the grid minus feed-in tariff for energy to the grid = $ ____ Estimated annual bill saving
STEP 3	$7,360 Cost of battery system ÷ $543 Annual estimate bill saving =	$ ____ Cost of battery system ÷ $ ____ Annual estimate bill saving =
	~14 years Payback period	____ years Payback period

ASSUMPTIONS

- Battery costs based on $4,000 for the 6 kWh battery, $2,000 for battery inverter, $400 for other components and $960 for installation
- The battery discharges to 80% of its available capacity every day
- The household is on a time of use tariff with a peak tariff of 55c/kWh, shoulder 25c and offpeak 13c
- Battery discharge happens 50% during the peak, 40% during the shoulder and 10% during the offpeak period

Typical payback periods in 2017

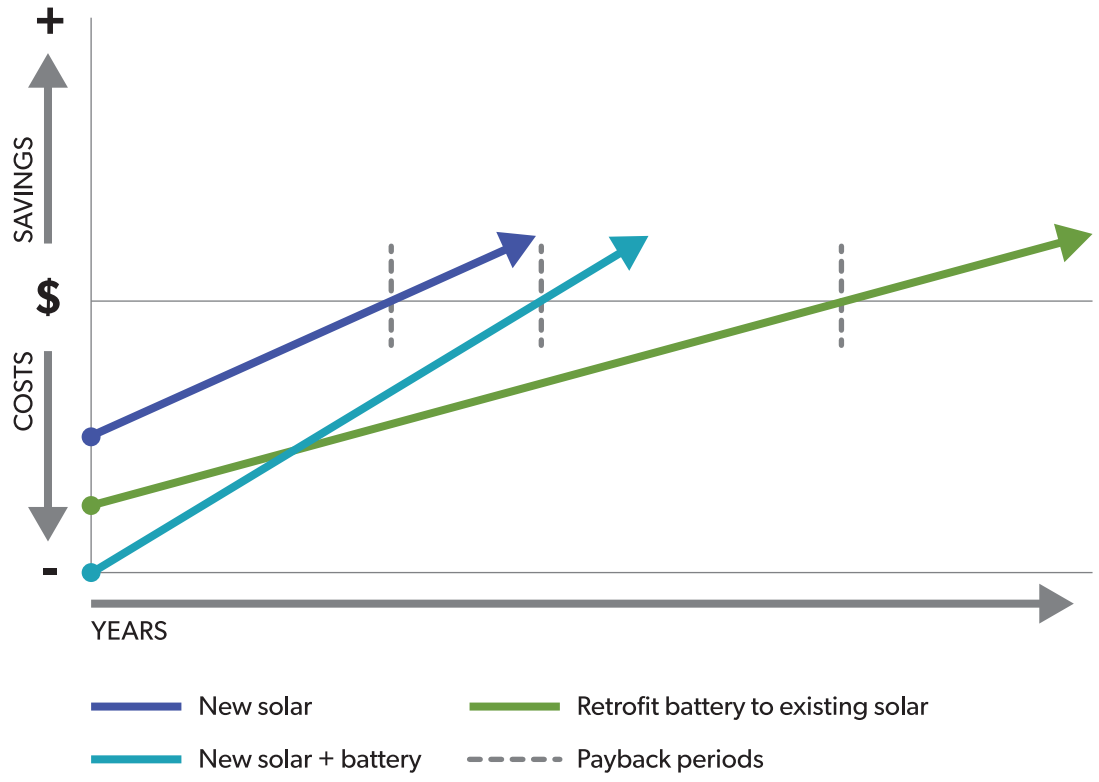
Payback periods for batteries are getting shorter.

As Figure 12 below shows, we expect that a solar-only system will likely pay for itself earlier than a solar battery system. A retrofitted battery currently has the longest payback period.

Whether or not you have a battery, a large solar system will generally pay for itself earlier than a smaller one. This is because a bigger system will provide more energy for use in the early morning and late afternoon.

In many cases a new solar system with a battery can already pay for itself within 10 years. This is particularly so for average to high consumption households (over 16 kWh per day) on time of use tariffs but this doesn't apply to below average consumption households.

Typical payback periods in 2017 for different battery system options (Figure 12)



Are batteries a good investment right now?

It's important to know whether battery storage bought today will give the financial benefit that you're after.

Some circumstances in which batteries could already make good financial sense are:[6]

1. You have higher than average consumption, are on a time of use tariff, and are planning on installing a new solar system with your battery.
2. You are in a rural area where a new grid connection would be expensive, so it can make sense to go offgrid. This would still have reliability, customer protection and other implications.
3. You have, or want to install, a large solar system but the local electricity network has imposed an export limit on your solar system, so some solar generation will go to waste without a battery.
4. A special program is available in your area, such as a Virtual Power Plant trial, including a battery subsidy. Carefully check installer certification, warranties and customer support and read this guide for other useful information.

This list might expand within a few years to include most grid-connected households that export solar power to the grid. However, the optimum battery size for most of these households is likely to be relatively small.

THE BOTTOM LINE

- **New solar**—a new rooftop solar system without a battery currently pays for itself sooner than one with a battery.
- **Existing solar**—retrofitting a battery to existing solar doesn't make much economic sense yet, but that may change in the next few years. The best cases for retrofits are for large-consumption houses with large solar systems.
- **Solar size**—bigger solar systems pay for themselves about one year quicker than smaller ones.
- **New solar and battery**—in many cases a new solar system with a battery can already pay for itself within 10 years.
- **Battery size**—the payback time is quicker for a small battery than a big one.
- **Location**—sunnier inland locations (e.g. Armidale, Broken Hill, Wagga Wagga) tend to pay back one year quicker than Sydney.
- **Financials**—payback times are likely to be better in 2021 than 2017, with payback periods likely to reduce by around three years for new solar and battery systems.
- **Tariff**—a time of use tariff is better than a flat tariff for solar with or without a battery, often speeding payback by one year.

These messages are based on cost modelling undertaken for this guide in May 2017 by the ATA.

Photo courtesy Reposit Power

Chapter 6
Buying a solar battery

This chapter helps you to:

- Know what to expect from a quote and from an installer
- Assess your options for buying a battery
- Understand the grid connection process

Getting a quote and choosing an installer

When you are ready to go ahead you should get at least two quotes, have your information ready, and choose a reputable, licensed installer.

Information to have ready for a prospective installer

Here is a list of things that may be useful for your installer to know in order to prepare a quote:

General

- Meter type, location and single or three-phase power supply type (an installer can tell from what's in the meter box). See 'Additional information' on page 52 for a link to more information
- Electricity bill information such as annual consumption, metering data, retailer name, tariff type and discounts.
- Appliances that use a lot of power and their age (e.g. air conditioning, space heating, pool pump, slab heating, freezers, industrial equipment, hot water).
- Usage patterns: do you use energy mostly during the daytime, or evening, or a mix of both?

Solar

- Approximate area of unshaded roof facing north, east and west.
- Roof height and construction (e.g. tile, colorbond).
- Approximate roof pitch.
- Existing solar system size.
- Preferred budget, system size, technology and/or brands.

Battery

- What you want a battery to do (e.g. maximising use of your solar or backup power).
- Preferred budget, system size, technology (chemistry) and/or brands.
- Whether you have interest in selling excess solar or battery energy into the wholesale market.

Photo courtesy Steven Davies

Choosing an installer

Here are some things to think about when choosing an installer:

- Is the installer accredited with the Clean Energy Council (CEC)?
- Is the solar retailer accredited with the CEC?
- Are they licensed to install this kind of system?
- What's their recent experience installing this particular product?
- What happens if the system needs to be fixed under warranty and their business is no longer operating?
- What maintenance is required? Who can do it?
- Are replacement parts readily available?
- Have a one-on-one consultation at your home—and be wary of anyone who claims to be able to give you a firm quote without a site visit.
- Try to get at least two quotes, and don't be rushed into making a decision. Ask for quotes for different system sizes or brands, so you can choose according to your budget.
- How long have the manufacturers been in the industry, and do they have a local office?
- Which warranties are their responsibility and which are the manufacturer's?

WHAT A QUOTE SHOULD CONTAIN

When you get quotes back from installers, here is the information they should contain:

- Battery specifications such as:
  - Battery size, and inverter size (if separate).
  - Maximum charge and discharge rate and recommended depth of discharge.
- A basic energy assessment of the premises, with recommendations for energy use reduction.
- A note of what, if any, electrical issues may need to be addressed before the system can be connected.
- A detailed list with individual prices of the system components you would be buying.
- An estimate of the energy output of the solar system, the expected self-sufficiency level and potential savings.
- An estimate of the CO_2 emissions reduction of the system.
- Installation information such as:
  - When will it be completed?
  - Is the price guaranteed until then?
  - Where will the battery be installed? Does that comply with the manufacturer's requirements?
  - Can the battery be relocated if you move house?
- Guarantees and warranties, including specific exclusions and conditions for them to stay valid (e.g. the battery location and temperature range) and what to do when something doesn't work.
- Customer references (if requested).
- Information about the energy management system and how it is accessible, for example via an app on your smartphone.
- Help with the network connection paperwork if required, and the small-scale technology certificates application if also installing solar.

An energy assessment of your home may be a worthwhile investment to size your battery properly.

Options for buying

Buying outright is the most cost effective way, but there are alternatives. Households must be careful to review offers that they receive, and to seek advice, if needed, before investing.

The most cost effective way to buy a solar battery system, or a battery system, is usually to buy it outright. This is because you don't have to pay a finance company to use their money. There are some alternatives listed here, but this guide does not provide investment or financial advice and customers must make their own decisions and consider the full details of any offer before making a decision.

Lease it—some solar suppliers have leasing programs which they are now extending to solar plus batteries. They own, install and maintain the system and you pay them a regular fee based on either a fixed monthly price or on the energy you use from the system. You should only go down this road if you are sure that the electricity bill savings will outweigh the lease repayments over time.

Finance it—some solar installers will offer finance, typically from an external funder. Separate finance is also available from financial institutions.

Watch out for apparently cheap finance attached to an inflated system price, or direct debit fees that continue after you have repaid the loan.

Bulk buy—from time to time companies or organisations promote solar and/or batteries at prices lower for buying in bulk than would be available for individual sales. By signing up large numbers of customers in the same area in advance, the promoters may be able to get better deals from manufacturers and suppliers, which they can pass on to you. When assessing a bulk buy program, customers may also choose to seek one or two quotes from other local installers so that they can compare offers.

EXTRA RESOURCES

The Clean Energy Council has a list of accredited installers.

https://www.solaraccreditation.com.au/

Photo courtesy Alternative Technology Association

Connecting to the grid

Your installer will manage the grid connection process for you. The process is often straightforward, although additional time or fees are sometimes needed for connecting larger systems. In some cases you may need to replace your electricity meter.

Network connection approval

To connect a solar or solar battery system to the grid, your installer first submits an application to your local electricity network. Upon approval, the installer installs the system and supplies both you and the electricity network provider with a Certificate of Compliance for Electrical Work (CCEW).

A rooftop solar system always requires application approval from the network provider. If you are installing a battery with solar, it will be managed by your installer as part of the same approval process. If a battery is retrofitted on an existing solar system then a connection application is generally only needed if the total connected inverter capacity changes.

Automatic connection approvals

All NSW network providers offer automatic connection approvals for smaller systems. Where the total system inverter capacity is larger than 5 kW, individual approval may be needed and additional fees may apply.

Network providers may offer automatic approvals for solar battery systems with combined inverter capacities over 5 kW as long as export to the grid is limited to 5 kW. Check with your installer or network provider what the exact requirement is.

As noted earlier, many older household electricity meters in NSW are not suitable for solar or batteries. Your installer could arrange the installation of a new smart meter. It may be free through your electricity retailer. If not, the cost should be included in your quote.

New meters and other costs

Any time an electrician is working on your house wiring, there is a chance they will discover existing deficiencies. For example, the switchboard may be too small to accommodate the new switches required for your battery or it may contain asbestos and be dangerous to work on, so it may need to be upgraded and re-wired. Such activities would incur additional costs.

EXTRA RESOURCES

Installing a smart meter often makes sense and may be required for a solar-battery installation.

More information about smart meters is available from the NSW Government. See the 'Additional information' section on page 52.

Photo courtesy Off-Grid Energy Australia

Chapter 7
Owning a battery

This chapter helps you to:

- Know how to manage your battery's operation
- Understand how to monitor and maintain your battery
- Be aware of safety and consumer rights and protections

Managing your battery

To get the most value from your battery, decide on the best software settings for charging and discharging.

'Solar buffer' and 'tariff optimisation' are the two main battery management strategies currently in use. Your battery supplier should help you to decide which is best for your needs, and help you with setup.

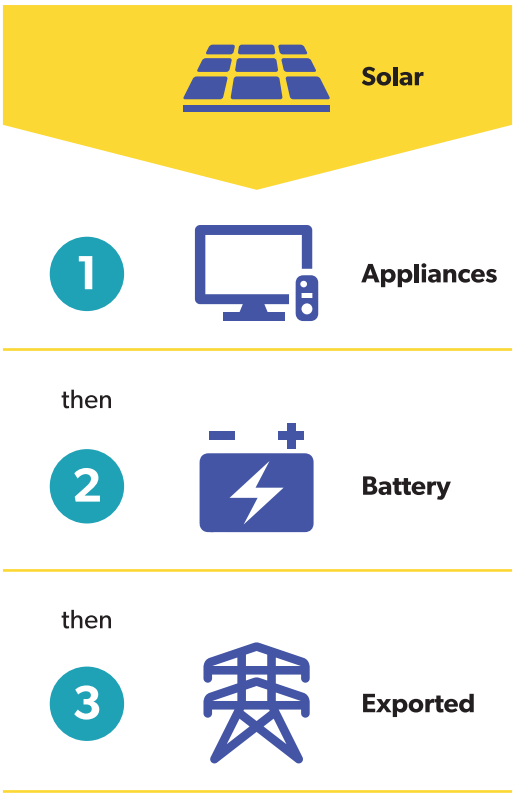
You may be offered an Energy Management System (EMS) to apply your battery management strategy, and will need to carefully weigh up the costs and benefits of the EMS over time.

Solar buffer

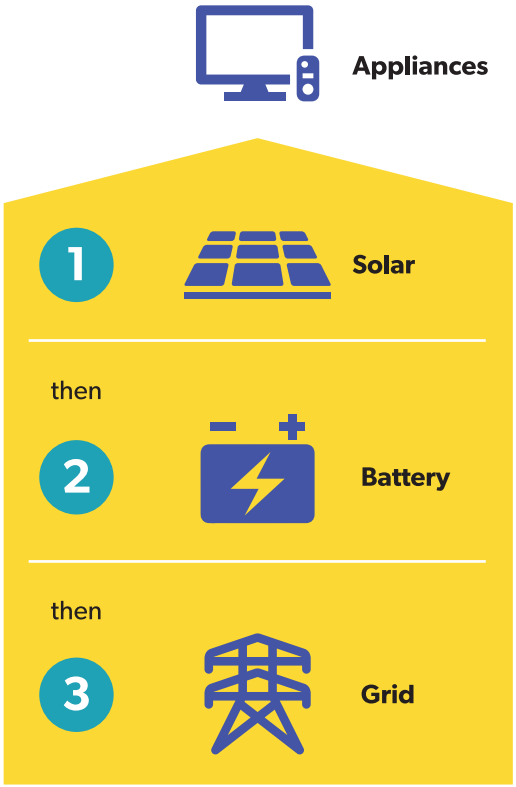
Using a 'solar buffer' is the most common battery management strategy (see Figure 13). Under this strategy, your solar generation is first used to supply your household appliances, just like a solar system without a battery. Any excess solar is then used to charge the battery. Finally, exports to the grid will only occur when the battery can't absorb the excess solar.

How a solar buffer battery management strategy works (Figure 13)

When you generate solar power, a solar buffer prioritises the order in which it is used.



When you use energy, a solar buffer prioritises where it comes from.



When your energy consumption is greater than what is being generated by solar, energy is discharged from your battery to avoid import from the grid.

Under this strategy, the battery is charged from your solar panel rather than the grid.

Tariff optimisation

This management strategy operates like the solar buffer, but has additional features that are useful when a time of use tariff applies.

When applying 'tariff optimisation,' the EMS normally uses weather forecasting to estimate the day's solar generation and consumption. It then decides how much to charge the battery to minimise the amount of grid import that will be required during the peak period. It also tries to avoid charging the battery more than necessary, as this may result in excess solar exports to the grid during the day.

Under this strategy the battery may sometimes charge from the grid overnight during the offpeak period.

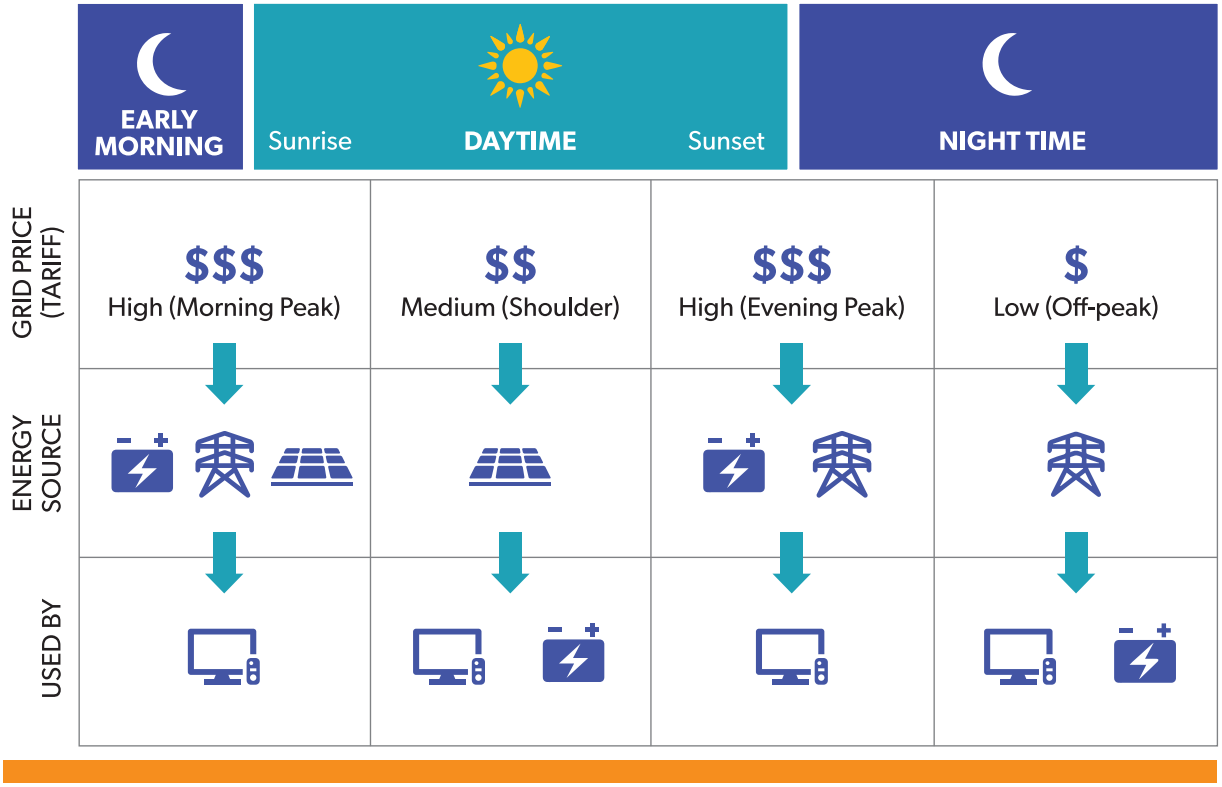
Under this strategy:

- **Morning use** is met from the partly charged battery when grid electricity is expensive.
- **During the day** rooftop solar powers home appliances and charges the battery when there is excess solar energy.
- **In the evening** when grid prices are also high the battery discharges to power home appliances.
- **Overnight** the battery may charge from cheaper offpeak grid power.

With specialised EMS software, this strategy can also be used to prioritise the export of energy from your solar battery system to the grid to take advantage of high prices in the wholesale market.

See page 15 for a reminder about how time of use tariffs work.

How a tariff optimisation battery management strategy works (Figure 14)



Monitoring and maintenance

You generally don't need to do much to maintain your battery and your installer should be able to help you with any support you need.

Most new batteries require minimal or no maintenance by owners.[7] They should come with instructions on any checks that need to be done, such as keeping them clean and free from insect and animal infestation.

An annual service by an accredited installer or other professional is usually recommended. They can provide you with feedback on the system's performance and help you understand if there is anything more you can do to help get the most out of it.

They should also provide you with manufacturers' manuals to help you spot when your system may be having problems.

If your system has failed or seems to be performing below expectations, your first port of call is the installer. If they are not available your next option is the manufacturer. In cases where your installer or manufacturer cannot deliver the expected service within the warranty period you should contact NSW Fair Trading.

YOUR RIGHTS AND PROTECTIONS

As with other consumer products sold in Australia, you are entitled to the full protection of the Australian Consumer Law. In NSW this law is administered and enforced by NSW Fair Trading. You should contact them if you have concerns about:

- not getting what you expected from the quote,
- overcharging,
- defective installation,
- excessive delays in installation and grid connection,
- the system not performing according to the quote and warranty,
- ongoing communication problems with the supplier or installer.

If you have concerns about your electricity retailer these can be directed to the Energy & Water Ombudsman NSW.

The consumer protections provided by the law may exceed those specified in the manufacturer's written warranty.

Once the warranty period has expired, your best option is to contact a local electrician with solar and battery experience and accreditation and, if expensive work is required, get at least two quotes.

When you buy a battery, make sure you keep the sales invoice and warranty document.

Safety

Some simple and logical tips for peace of mind.

Battery location

Most home batteries can be installed outdoors.[8] However, their lifespans will be improved by a stable, cool temperature, so try not to locate them in direct sun or in an uninsulated, unshaded metal shed. It's also important to make sure that any enclosure is vermin-proofed, cannot be accessed by children and displays appropriate signs relating to safety, warnings and shutdown procedures.

Tips for the space around your battery:

- Do not store heavy household equipment on top of a battery.
- Keep the area clear of obstacles.
- Don't put flammable objects or those that could conduct electricity in or on the battery enclosure.

While most batteries are extra-low voltage, they still have the potential to cause serious, sometimes fatal accidents. Safety signs are a requirement and care should be taken at all times.

In the unlikely event of a fault, some batteries can catch fire, and others can release flammable hydrogen gas, so they need proper ventilation.[9] These risks, while unlikely, may affect your home insurance, so you should check with your insurer before installation.

Lithium batteries are generally fully sealed and during normal use do not vent any gases so they do not need ventilation, but the battery enclosure should include ventilation for temperature control (particularly, in the event of a fire).

STANDARDS AND REGULATIONS

There are several Australian standards relating to battery design and installation within buildings. Most relate to traditional lead acid technology and currently do not address lithium-based chemistries and network-connected solar battery installations.

Standards Australia is currently working to finalise new standards to support the safe and efficient uptake of new battery technology in Australia.

In any event, householders should satisfy themselves of any battery installation's safety by asking sellers and installers about how their products and installation conform to the interim guidelines and any international standards.

Currently there is no registry of home batteries, however this could change in the future.

For any major incident call 000 immediately. If there is a fire or flood, let emergency services know about the battery and its exact location.

Photo courtesy Solar Hub

Photo courtesy Reposit Power

Chapter 8
Additional information

This chapter provides:

- Frequently asked questions
- A glossary of key battery-related terms
- Links for more information
- Assumptions for the technical and financial modelling done for this guide
- References used in this guide

Frequently asked questions

Can I get a government rebate to install a home battery?

Unlike rooftop solar systems, there is no federal government scheme to encourage the mass uptake of home solar batteries. There are currently no state government rebates for home solar batteries in NSW.

Can I recharge overnight from the grid on my offpeak tariff?

Overnight 'controlled load' offpeak power is installed in many properties on a separate circuit with a dedicated second meter. It is used to provide cheap power to hot water systems and some pool pumps and slab floor heating. None of the three electricity network providers in NSW currently allow overnight home battery charging on an offpeak controlled load circuit and tariff.

However, home batteries connected to the main circuit can be charged at offpeak rates for households on a time of use tariff. When this is done, households can partly offset the cost of their battery purchase by charging the battery at the offpeak rate and discharging it to meet consumption during the peak period.

I'm in an apartment with no solar; is a battery any use to me?

You can install a battery (with strata approval where needed) to offset peak period consumption on a time of use tariff. However, currently, this is unlikely to be an economic proposition, even if you are on a time of use tariff. As an alternative, buying GreenPower is a very easy way for apartment owners to access renewable energy (see 'GreenPower' on page 27).

I'm a landlord; what's in it for me?

If you already have solar, or are thinking of installing it, and are also considering a battery, you have options to ensure that both you and your tenants get a financial benefit.[10] There are no direct financial benefits that are specific to installing batteries alone. However, adding a solar or solar battery system may make your property more attractive to tenants and increase its resale value.

Which batteries are Australian-made?

At present there are no battery storage manufacturers in Australia. There are batteries developed by, and branded with the names of, Australian companies, but the batteries themselves are manufactured overseas. The country of origin is not a reliable indicator of a battery's quality.

Will I have to go on a time of use tariff if I install solar or a battery?

This depends on what tariffs your retailer offers for your configuration, so be sure to check with them first. If you don't think the tariff you are currently on suits your needs, shop around. You can find a link to Energy Made Easy in 'Where to go for more help' on page 58.

If I disconnect from the grid, will I still have to pay a daily service charge to the local grid?

There is currently no fixed network charge for households that are disconnected from the grid. However, disconnecting from the grid can incur fees and in most cases disconnecting is unlikely to save you money even without a daily service charge. If you or a future owner want to reconnect the property to the grid this will also incur a cost.

Can I use my rooftop solar energy to charge an electric car?

In theory, battery electric vehicles can be charged solely from your rooftop solar energy, but with the battery packs of electric cars ranging from 16 to 85 kWh or more, you would need a relatively large solar system with lots of spare capacity to supply a full charge.

I want to get an electric car eventually; can I use it to power my home too?

Depending on the charger type used in the vehicle, some electric vehicle batteries can be used to supply power to the house when they are not being used or recharged. However, there are major obstacles:

- The time when battery power is most likely to be needed is in the evening, which is when many electric cars will be at their lowest level of battery charge after being used in the daytime.
- Since electric car batteries are Lithium-ions with limited lifespans, using them to power your home may mean your expensive car battery pack needs replacing sooner.

Glossary

AC	Alternating current—the form of electricity used in household circuits and on the grid
AS4777	The Australian Standard relating to solar and battery inverters
ATA	Alternative Technology Association
BMS	Battery management system—software that regulates a battery's charging and discharging cycle and other functions
CEC	Clean Energy Council
Charge controller	Device that limits the rate at which electric current is added to or drawn from electric batteries. It prevents overcharging and may protect against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk. It may also prevent completely draining ('deep discharging') a battery, or perform controlled discharges, depending on the battery technology, to protect battery life.
Controlled load	Overnight 'controlled load' power is installed in many properties on a separate circuit with a dedicated second meter. It is used to provide cheap power to hot water systems and some pool pumps and slab floor heating. Often called offpeak power, it should not be confused with the offpeak rate on a time of use tariff, which is provided via the main circuit.
Cycle life	Number of cycles a battery cell can operate through, under specified conditions, before becoming non-functional
DC	Direct current—the form of electricity produced by solar panels and used in battery systems
DC to DC converter	Steps the battery voltage back up to a nominal voltage that meets the requirements of the existing grid-interactive inverter
DOD	Depth of discharge—the percentage of a battery's usable capacity that can be removed from a battery without causing damage
EMS	Energy management system—software that interacts with the solar system, inverter, home appliances and the grid to optimise a battery's performance and value
Feed-in tariff	Payment (usually in cents per kilowatt-hour) for your excess solar generation exported to the grid
Grid	The electricity system, with poles and wires in your street.
Hybrid	(In relation to inverters)—in this guide means a solar plus battery inverter (not an inverter that is both ongrid and offgrid capable, as some people use it)

Inverter	Device connecting your solar and/or battery system which converts DC (solar or battery) to AC (household) electricity. A hybrid or multimode inverter connects to both the DC solar panels and the DC battery.
IP rating	Ingress protection rating—determines whether battery is suitable for indoor or outdoor installation; the higher the rating, the more weather resistant it is[11]
kW	Kilowatts—the instantaneous power output available to discharge
kWh	Kilowatt hours—the total energy available to discharge
Lithium-ion	The most common battery chemistry. The most common varieties are LNCM (lithium nickel cobalt manganese) and LiFePO4 (lithium ferrous phosphate)
Load profile	What time of the day or night you use the most energy—e.g. 'peaky' (up and down) or 'flat' (relatively consistent throughout the day)
Meter	The device in your switchboard or meter box that measures the amount of electricity being imported to or exported from your house. The main types are accumulation versus interval; gross versus net; and smart versus dumb. The optimum for a solar battery system is a smart meter, which will also be an interval and a net meter.
Network	Your local distribution network service provider: In NSW this is either Ausgrid, Endeavour Energy or Essential Energy.
Nominal capacity	The standard capacity designated by a battery manufacturer to identify a particular battery cell model—may be 10–20% greater than the usable capacity
Payback period	The number of years it takes for the capital cost to be recovered through lower energy bills
PV	Photovoltaic solar panels
Retailer	The company responsible for selling you electricity (and perhaps gas); also responsible for paying any feed-in tariff for excess solar energy exported to the grid
Retrofitting	Installation of a battery where there is already an installed solar system. The term is generally used where something is added after the initial manufacturing or construction is complete.
Roundtrip efficiency	The ratio of a battery cell's output during discharge to its input during charge.

Solar electric hot water	Electric hot water system heated by rooftop PV via the main household circuit—as distinct from solar thermal or heat pump hot water
Switchboard	A box or board containing switches, fuses or circuit breakers for each electrical circuit in the home. This may be co-located with the network billing meter in the meter box, or it may be separate, for example inside the home.
Smart meter	Net meter (i.e. one that records the difference between electricity imports and exports on a half-hourly or hourly basis) that communicates daily with the electricity network via a mobile phone modem
STCs	Small-scale Technology Certificates—rebates available under the federal Small-scale Renewable Energy Scheme for rooftop solar systems (but not for batteries)
Three phase power	Alternating current power supply using three instead of the usual single waveform, used to supply three times as much power (useful for heavy loads such as ducted airconditioning, electric vehicle fast charging and use of large power tools or industrial equipment)
Tariff	The way you are charged for electricity—usually flat (the same rate at any time) or time of use (with different rates for peak, shoulder and offpeak use) for households.
UPS	Uninterruptable power supply, which has no lag time between a grid power outage and the battery starting up (unlike other backup power systems, which may have a short time lag).

Where to go for more help

Australian battery comparison websites	**Canstar Blue customer satisfaction research** http://www.canstarblue.com.au/energy/alternative/solar-power/a-list-of-solar-battery-retailers **GlobalRoam collaboration with Energy Storage Council** http://www.batterystorage.info/explanations/other-resources/batteryfinder **Solar Quotes** https://www.solarquotes.com.au/battery-storage/comparison-table
Battery technology information	**Educational website on all things battery** http://batteryuniversity.com **Battery chemistries** http://www.ecogeneration.com.au/the-bluffers-guide-to-battery-storage
Business and industrial customers	**Office of Environment and Heritage** http://www.environment.nsw.gov.au/business/battery-storage.htm
Connecting to the grid	**Endeavour Energy** www.endeavourenergy.com.au > residential and business > connecting to our network **Ausgrid** www.ausgrid.com.au > customer services > connecting to the network **Essential Energy** www.essentialenergy.com.au > our network > electricity > connecting to the network
Consumer complaints	**NSW Fair Trading** www.fairtrading.nsw.gov.au **Energy & Water Ombudsman NSW** www.ewon.com.au
Installer accreditation	**Clean Energy Council accredited installer list** http://www.solaraccreditation.com.au/consumers/find-an-installer.html
Meters	**NSW Government website and fact sheets** http://www.resourcesandenergy.nsw.gov.au/energy-consumers/energy-providers/smart-meters-in-nsw http://www.resourcesandenergy.nsw.gov.au/__data/assets/pdf_file/0010/683506/sbs-metering-factsheet.PDF

NSW Home Solar Battery Guide	http://resourcesandenergy.nsw.gov.au/battery-guide
Recycling and disposal	**Australian Battery Recycling Initiative** http://www.batteryrecycling.org.au/recycling/energy-storage-batteries
Safety	**Clean Energy Council** http://www.cleanenergycouncil.org.au/fpdi/reports/guide-for-energy-storage-safety.html
Sizing and pricing calculators	**ATA Basic Solar Advice form** (available from late July 2017) http://www.ata.org.au/ata-solar-advice **ATA Sunulator solar feasibility calculator** in MS Excel http://www.ata.org.au/ata-research/sunulator **Solar Choice online battery calculator** https://www.solarchoice.net.au/blog/solar-pv-battery-storage-sizing-payback-calculator
Solar panels	**NSW Government website about installation and connection of solar panels** http://www.resourcesandenergy.nsw.gov.au/energy-consumers/solar/installing-solar **NSW Office of Environment and Heritage website on solar energy** http://www.environment.nsw.gov.au/households/solar-energy.htm
Sustainable energy	**NSW Government website** http://www.resourcesandenergy.nsw.gov.au/energy-consumers/sustainable-energy
Tariff comparison	**Energy Made Easy** https://www.energymadeeasy.gov.au/ **IPART NSW solar feed-in tariff information** https://www.ipart.nsw.gov.au/Home/Industries/Energy/Reviews/Electricity/Solar-feed-in-tariffs-201718

Modelling assumptions

The Alternative Technology Association (ATA) carried out computer modelling scenarios to calculate when batteries do or don't save NSW households money, and what solar and battery system size is best for a number of practical examples. This work was done in May 2017 using current market pricing and with a number of assumptions as listed below.

- The Alternative Technology Association (ATA) carried out computer modelling scenarios to calculate when batteries do or don't save NSW households money and what solar and battery system size is best for a number of practical examples. This work was done in May 2017 using current market pricing and with a number of assumptions as listed below.
- Electricity consumption data is sourced from the ATA's data library, varying in half-hourly intervals over a whole year.
- Network electricity tariffs are standard mid-range offers for the selected location, not the cheapest or most optimal, and future price increases are moderate.
- Analysis uses the ATA's free Sunulator tool for a full-year simulation in half-hourly intervals, available at http://www.ata.org.au/ata-research/sunulator.
- Solar panels are north-facing on a 20-degree tilt.
- Solar generation is calculated for each interval, based on the sunbeam angle to the solar panels and Bureau of Meteorology sunshine data for the selected location over a Typical Meteorological Year.
- Batteries charge only from solar and operate to minimise grid import and export. State of charge is tracked over the whole year.
- Bill impacts are calculated for each interval by netting off generation and consumption and battery charge or discharge, and applying the tariffs.
- Solar system costs are sourced from residential price benchmarks published by Solar Choice, after STCs and GST.
- Additional costs to add a battery are based on ATA's assessment of typical current prices, drawing on Solar Quotes' comparison table.
- Minimal costs are allowed for a system check every 2–3 years ($40 per year each for solar and battery system).
- Batteries and inverters theoretically fail after 10 years of operation (the end of most warranties), with replacement costs estimated on ATA research.
- Batteries assumed to have 90% roundtrip efficiency, but the usable capacity does not degrade over its lifespan.
- Solar panel power degrades 0.5% per year, and panels fail after 25 years.
- 'Cars off the road' estimates the equivalent CO_2 emissions reduction benefit, assuming a typical driving pattern.
- The annual return on investment is a calculated Internal Rate of Return (IRR) over 20 years of costs and benefits.
- Future benefits and costs are discounted at a cumulative rate of 2.5% per year, equating to a typical mortgage rate minus Consumer Price Index.

Notes and references

1. Clean Energy Regulator via http://www.cleanenergyregulator.gov.au.
2. Energy consumption breakdown based on June 2017 analysis by the NSW Office of Environment and Heritage for a Western Sydney household using electricity for hot water heating and space heating.
3. Except for NSW solar homes which still have gross meters.
4. See http://www.energyrating.gov.au.
5. See http://renew.org.au/articles/energy-flows-how-green-is-my-solar/ for more detail.
6. That is, the battery will pay for itself within the warranty period and will save money compared to network imports over the same period. However, solar-only may still provide a superior return on investment.
7. There are battery chemistries requiring regular maintenance such as weekly discharging, but this is often done automatically, and lithium-ion is not among them.
8. You can tell by checking the IP or ingress protection rating, which combines measurements for resistance to dust and moisture. It should be 55 or above, and preferably 67, for external installation. See http://www.batteryjunction.com/ip-rating-guide.html for more detail.
9. For more details, refer to manufacturers' recommendations and the Clean Energy Council battery installation guide.
10. Usually you can provide the energy to your tenants in return for a slightly higher weekly rent without a change in the metering. However, if you have more than one tenant the wiring and metering will need to be set up to ensure than all tenants receive the solar and battery energy. Or you may be able to sell the energy to them by changing the wiring and meters so there is a main or 'parent' meter for the entire premises and create an embedded network. If you look at this option you should contact the Australian Energy Regulator as you may need to obtain approval to operate as an 'exempt retailer': https://www.aer.gov.au/retail-markets/retail-exemptions. There may be taxation benefits, as solar and batteries are capital improvements that can be offset against rental income.
11. See http://www.batteryjunction.com/ip-rating-guide.html for more detail.

Photo courtesy Alternative Technology Association


REMOTE HOME CONTROL
ONLINE HOME AUTOMATION
ECO MODE
22°C