



Australian  
Energy  
Foundation



BOROONDARA  
*City of Harmony*



# A Guide to Creating an Energy-Efficient Home

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# Introduction

Creating a home that is efficient, affordable to run and comfortable year-round is easier than you think. By focusing on key areas of your home, you can make vast improvements in your home's efficiency, without it costing a fortune. In this guide, we'll walk you through what you need to know to make your home efficient.

## City of Boroondara and the Australian Energy Foundation

City of Boroondara has partnered with the Australian Energy Foundation to help you make your home energy-efficient. The energy advisors at the Australian Energy Foundation can:

Help you understand how to make your home energy-efficient

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Provide trusted, independent advice helping you make an informed decision

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Walk you through what you need to know

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## The Australian Energy Foundation

The Australian Energy Foundation is a for-purpose organisation leading the way to an equitable zero carbon society.

## Areas we help with:

Solar and Battery Storage

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Insulation

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Draught-Proofing

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Windows

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Lighting

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Heating & Cooling

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Hot Water

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## Get in touch

Contact one of our energy advisors on **1300 23 68 55** or **[advice@aef.com.au](mailto:advice@aef.com.au)**

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Visit **[aef.com.au](http://aef.com.au)** to learn about all the things you can do in your home

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# Draught Proofing



Ensuring your home is well-sealed is an important first step to creating an energy-efficient home.

## What are draughts?

Draughts are caused by gaps and cracks which allow cold air in winter and hot air in summer to leak in. Draughts can occur through every opening in walls, floors and ceilings, including power points, plumbing, wall vents, gaps between floor boards as well as around doors and windows. Blocking draughts will not only make your home warmer in winter and cooler in summer, but it will also reduce your energy bill. And best of all, it's one of the simplest and most affordable actions you can take.

## How can I tell if I have draughts?

Some draughts are easy to detect by using one of the following techniques:

- seeing daylight under doors or around window frames
- seeing curtains or blinds move when it's windy outside
- feeling air moving against your hand or on wet skin

Other draughts are more difficult to find and may require expert help. Using a thermal camera, a draught proofing professional can identify exactly where you have draughts in your home.

## What are the benefits of draught proofing?

Not only will draught proofing make your home warmer in winter and cooler in summer, but there are several other benefits of draught proofing too:

- Stops insects from entering your home
- Reduces traffic noise
- Stops windows rattling
- Saves you money
- Is the most cost-effective retrofit you can do

## Can blocking draughts be unhealthy?

It's important to make sure there's enough fresh air inside, however, the typical home has 4 times more fresh air than we need for health and oxygen supply. Even if you block all draughts, fresh air will still enter your home when you open the doors and windows. Generally speaking, a lack of ventilation in a home is usually noticed by damp or even mouldy conditions forming – if this happens in your home then we recommend seeking professional advice.



## Should I install draught proofing myself or get a professional?

If you're confident in your DIY abilities, installing draught proofing yourself is definitely possible. Most draught proofing products can be purchased in your local hardware store. See the below table for a few common draughts and how to fix them.

Getting a professional to inspect your home has several advantages. They can identify exactly where you have draughts in your home. This is particularly important for the ones that are hard to find. They will also recommend quality products that will last longer and will maintain your home's aesthetics. They can also install the products on your behalf, saving you the hassle.

<b>Draught Source</b>	<b>What can I do?</b>
Gaps around plumbing in kitchen and bathroom	Acrylic or silicon sealant or caulking foam fillers
Bathroom extraction fan	'Draught Stoppa' exhaust fan hat
Gaps around window and door frames	Weather strips and seals Acrylic or silicon caulking
Wall vents NOTE: First ensure there is no risk to carbon monoxide poisoning	Piece of plastic film or simple plastic cover
Gaps between floor boards	Timber filler Under-floor insulation Carpet with underlay Rugs or mats
Unused fire places	Chimney Balloon or Chimney Sheep
Around window architraves and skirting boards	Acrylic sealer or caulking

# Insulation



Good insulation is an essential element of every energy-efficient home. Insulation will make your home cosier in winter and cooler in summer, reduce condensation and your energy bill.

## How does insulation work?

Insulation works by slowing down the transfer of heat from inside to outside and vice-versa. It does this either by trapping air using bulk insulation, or by reflecting heat using foil insulation. By slowing down the transfer of heat you don't have to use heaters or air conditioners as much, and when you do, you can use them for a shorter time and with greater effect. It's just like a blanket for your house.

## What should I insulate?

You can insulate your home's ceiling, walls and underfloor space.

### Ceilings

Ceilings are insulated with bulk insulation in the form of batts or 'blankets' made from polyester, sheep's wool or fibreglass wool. Some bulk insulation also comes with reflective foil attached to one side, which reflects the sun's heat in summer, keeping your home cool.

### Wall Cavities

Your home's walls can be insulated in two main ways. If you're building new walls, or have a weatherboard home that needs to have some weatherboards replaced, you can

insulate the walls by placing batts directly into the wall cavity.

If you're not renovating, blow-in wall insulation is an alternative solution. Blow-in insulation involves drilling holes about the size of a 50 cent coin into the weatherboards or mortar between the bricks. A loose-fill insulation, such as rockwool, is then pumped into the wall. The hole is then filled, ensuring that they're concealed.

### Underfloor

Polyester batts or polysterene boards are used to insulate under your home's floor. This is usually only possible if you have adequate crawl space under your house.

## How do I know if I need more insulation?

### Ceiling insulation

If you can safely access your roof space, check to see if there are any gaps in your ceiling insulation. Many people find that there are gaps where insulation has been accidentally moved by tradespeople. It's important to cover these gaps, unless they are around halogen downlights, to ensure the insulation is effective.



It's also worth checking the thickness of your insulation, as most homes in Australia don't have enough insulation required for their climatic zone. If your insulation is less than 20cm thick you will benefit from additional ceiling insulation.

### Wall Insulation

If your home was built before the 1990s, it's likely to have no insulation in the walls at all. An insulation supplier can use a thermal imaging camera to help you see if this is the case in your home.

### Underfloor insulation

If you have draughty floorboards, a cold floor and a suitable accessible underfloor space, then you may benefit from installing underfloor insulation.

## How much insulation should I install?

The effectiveness of insulation is measured in 'R-values'. Generally, the thicker the insulation, the larger the R-value. The minimum amount of insulation you need is set by the Building Code of Australia and differs based on your location across the country. Recommended R-values differ depending on your climatic zone or region.

As a general rule of thumb:

- Ceilings require at least R4.1\* up to R6.3 for alpine regions.
- Walls require at least R2.8 up to R3.8 for alpine regions.
- Floors range from R1.5 for warmer climates up to R3.35 for alpine regions.

A professional insulation installer will be able to provide the best recommendations for your home.

## How much does insulation cost?

The exact cost will depend on the size of your home. But here are some estimates for a typical home.

- Ceiling insulation: \$1600 to \$2400
- Underfloor insulation: \$2800 to \$3500
- Wall insulation: \$3200 to \$4800

If you don't have the budget to address all of these areas at once, insulating your ceiling should be the number one priority.

## What insulation should I choose?

The following materials are typically used for each type of insulation.

- **Ceiling Insulation:** Polyester, Natural Wool, Glass Wool, Expandable or Extruded polystyrene batts
- **Wall Insulation:** Rockwool or cellulose fibre blown in
- **Underfloor Insulation:** Polyester, Expandable or Extruded polystyrene batts

# Windows



After insulation and draught-proofing, windows are the next important area of your home to address. There are many simple things you can do to improve the efficiency of your windows, without any major renovations.

## What curtains are most effective?

Curtains that are thick, touch the floor and have no gaps around the edges, are most effective.

Curtains are also more effective if they're paired with a pelmet. Without a pelmet, hot air rises to the top of the curtain, touches the cold glass of the window, causing the hot air to cool down. This cooled air then enters the room, making the room feel colder. Pelmet prevents hot air from touching the cold glass in the first place, making the curtains much more effective. See page 9 for a diagram of how pelmets work.

If you don't like the look of pelmets, you can purchase 'invisible pelmets', where the pelmet is placed on top of the curtain rod and is not visible from the front.

## What blinds are most effective?

Honeycomb blinds (also known as cellular blinds) are the most effective options. These blinds are so effective because each 'honeycomb' in the blind is able to trap still air. Because air is

such a good insulator, this means less heat escapes from your home in winter. These blinds also come with aluminium foil backing, making them a good option for keeping your home cool in summer too.

Other blinds that are effective include roman and roller blinds. Though venetian blinds have become popular, they do very little to make your windows more energy-efficient.

## How about window films?

Window films are a great solution for improving the energy-efficiency of windows, particularly if you'd like to keep your views uninterrupted. Depending on the film you choose, window films can be designed for year-round use (retaining heat in winter and blocking heat in summer), or just summer time use.

Films that are designed for year-round use can prevent up to 50% of heat from escaping in winter. This is comparable to double glazing. Unlike double glazing, window film is able to reflect and absorb the heat that hits your windows in summer. This significantly reduces the amount of heat that gets





transmitted into your home. Year-round films can reduce the amount of summer radiant heat that enters your home by 50%, while summer only films can block up to 85% of the sun's heat.

## How much do window films cost?

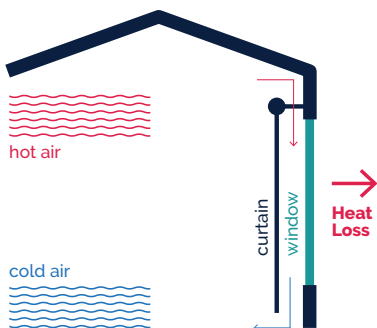
One of the biggest advantages of window films is their cost. For the typical home with 10-15m<sup>2</sup> of windows, upgrading all the windows with a year-round window film costs between \$1900 to \$3000. This is approximately a quarter of the cost of double glazing and half the cost of secondary glazing. Summer use only films cost between \$800 to \$1500 to upgrade an entire home.

## My home is very hot in summer - what can I do?

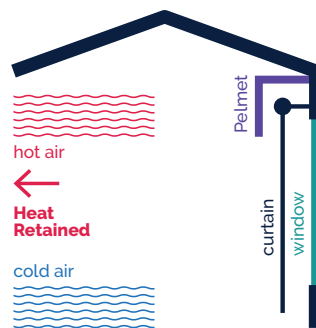
If your home overheats in summer and you've checked your insulation and sealed your home, it's likely that the extra heat is entering through your

windows. North and west-facing windows receive the most direct sun in summer, so it's important to address these first. The heat comes from sunlight hitting the window, so by shading the window from the outside, you can prevent the heat from entering your home. External blinds, awnings and deciduous plants are effective ways to do this. If you prefer not to interrupt your views, window films are an excellent option. Summer only films can block up to 84% of the sun's heat, while year-round films can block the sun's heat by 50%.

There are also simple aluminium foil products that can be applied from the inside, to reflect the light off a window that might be too difficult to shade from the outside. This is a good option if you're renting.



Without Pelmet



With Pelmet

# Heating & Cooling



Heating and cooling can comprise up to 40% of a home's energy usage, so it's important to use an efficient system. Thanks to advances in technology, it's now more affordable than ever to maintain a comfortable home year-round.

## What is the most energy efficient way to cool my home?

Other than natural ventilation, there are two main ways you can cool your home - fans and air conditioners.

### Fans

Fans can range from portable models such as pedestal or tower fans to fixed ceiling fans. No matter the type, fans are the most affordable way of cooling your home, as they only cost \$5 to \$10 to run per year. Though they don't reduce the room's temperature, a fan makes you feel cooler by increasing the evaporation of perspiration and removing a thin layer of hot air near your skin.

### Air Conditioners

Air conditioners can range from split systems to ducted units that cool your whole home. Of the two choices, split system air conditioners are more affordable to run, costing between 25c-40c per hour, while ducted air conditioners cost between \$1.45-\$2.12 per hour (depending on the size and efficiency of the unit).

## What's the most energy-efficient way to heat my home?

There are several options when it comes to heating your home. You can choose from systems that are designed to heat your entire home, such as hydronic, ducted gas, ducted air conditioner, electric under-floor, to systems that are designed to heat a single room. These include, split system air conditioners, portable electric heaters and gas heaters. Out of all these options the most energy efficient and cheapest to run are **split system air conditioners**.

## Why are reverse cycle air conditioners so efficient?

Reverse cycle air conditioners are so efficient because they use heat pump technology. This technology allows air conditioners to extract heat found in ambient air and move it either inside your home to keep it warm in winter, or outside to keep your home cool in summer.



Because moving ambient heat doesn't require a lot of energy, reverse cycle air conditioners use a lot less energy to heat your home. By comparison, electric or gas heaters use a lot more energy because they need to produce heat directly via an electric element or gas burner, instead of simply moving it from one place to another.

## **Should I get a ducted air conditioner or a split system?**

Even if you need to cool or heat your entire home, it's best to install several split system air conditioners rather than a ducted system for the following reasons:

### **Cost**

Ducted air conditioners cost more to run than split system air conditioners, even with zoning. They also cost much more to install (approximately \$5000 to \$15000).

### **Flexibility**

There's greater flexibility with having several split system air conditioners as you can set different temperatures in different rooms.

### **Energy-efficiency**

Ducted air conditioners can make your home more draughty, as heat loss or heat gain occurs throughout the year via the ducts. This can make your home more uncomfortable in summer and winter.

## **Gas is no longer the best option?**

You might be surprised to learn that gas is no longer the cheapest option for heating your home. Changes in the gas market mean that the majority of our gas resources are now exported overseas, making it much more expensive for us to buy for use in residential homes.

Gas also used to be seen as a cleaner source of energy (compared to burning coal). But, with diminishing gas supplies it is now increasingly extracted from coal seams and shale layers. Hydraulic fracturing or 'fracking' is a method used to extract hard to access fossil fuels. This gas extraction method can have significant environmental and agricultural impacts. Using electrically powered heating options, such as reverse cycle air conditioning, means you can heat your home with renewable power. Whatever source your renewable power comes from, it's a better choice for the environment.

## **But aren't air conditioners bad?**

Air conditioners, when used excessively, can be costly to run and a drain on the electricity grid. But the technology has improved significantly, which means that a split system air conditioner uses much less power than they used to. In fact, it might be worth replacing with a newer, more efficient model if your system is:

- Excessively noisy
- Costly to repair
- Costly to run
- Producing uneven cooling or heating
- Over seven years old

# Hot Water



Hot water can comprise up to 25% of a home's energy usage, so by choosing an efficient system you can make a significant difference to the efficiency of your home.

## What is the most energy-efficient hot water system?

Both solar hot water and hot water heat pumps are the most energy-efficient systems to run. So if your current system is more than 7 years old, prepare to upgrade it with a hot water heat pump or solar hot water instead of buying the same one you had before. This will save you considerably in the long run and make your home much more efficient.

## Which should I choose: solar hot water or a heat pump?

Both heat pumps and solar hot water systems have low running costs, but we recommend installing a heat pump for a number of reasons:

### Better use of your roof space

Solar hot water systems use up valuable roof space. Instead of using this space for just hot water, it could be used to install solar panels, which can then provide power to all of your home appliances.

### Heat pumps powered by solar panels have very low running costs

Hot water heat pumps come with built in timers, allowing them to be easily set to run during the day when your solar panels are generating electricity. By using freely generated solar electricity to power your hot water, your running costs can be even lower.

### Allows you to go off gas

Many households are moving away from using natural gas as it's a fossil fuel. Gas has associated greenhouse gas emissions and its cost continues to rise each year. By switching to a hot water heat pump, which is powered by electricity, you can reduce your gas usage and even disconnect from the gas grid. This could save you a further \$200 to \$300 per year.

### How does a heat pump work?

Hot water heat pumps are efficient electric storage tank systems that extract heat from the ambient air and use it to heat the water tank. See page 13 for a diagram of how they work.

They can be either integrated (with the tank and compressor together in one unit) or split where the tank and compressor are separate. Both types of



units need to be installed in a well-ventilated area. They are usually installed outdoors but can be installed indoors if there is adequate space.

## How much do heat pumps cost?

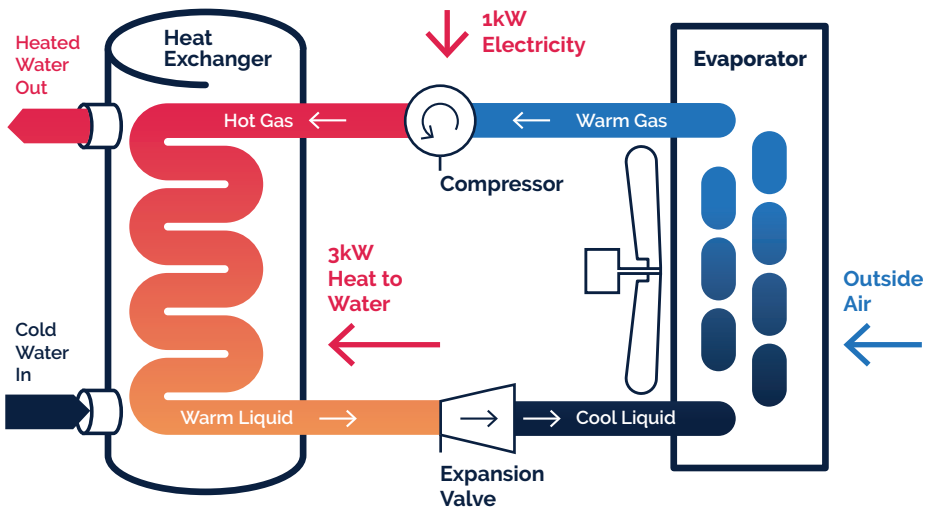
Heat pump hot water systems range in price from about \$2500 to \$4000 fully installed. Additional costs may be incurred if alterations to valves or pipes are needed. The above prices include the federal incentive that is provided through the small scale renewable energy scheme. Certain states also offer a rebate in addition to this.

Though a heat pump may cost more to begin with, they are cheaper to run than other hot water systems, saving you money over the long run.

## Are heat pumps noisy?

You've probably come across air-conditioners and have heard the 'fan-coil' unit whirring away on a hot day. Heat pump systems are similar and care should be taken when choosing where to locate a heat pump, for example, away from bedrooms or places where the noise might disturb others.

Some heat pumps also come with a noise reduction function where they can be programmed to reduce the speed of the ventilation fan between certain hours. In most instances, this function will not be necessary, but it's an option in case the unit is installed close to a bedroom window.



# Solar Power



With solar becoming more affordable, more Australians than ever before have embraced solar power for their homes.

## How much does solar cost?

Thanks to government rebates and falling solar prices, solar is now cheaper than ever. For a 5kW system (a commonly installed size in Australia), you can expect to pay:

- Between \$6500 to \$8000 for good quality solar panels with a string inverter
- Between \$8000 to \$9500 for good quality solar panels with microinverters

You may also be eligible for additional state government rebates.

The best way to determine the exact price for your home is to get a quote.

## Is solar worth it?

For most households, solar is worth the upfront cost. By installing solar you can expect to reduce your electricity bills by 30 to 60%. With these savings, a typical home will recoup the initial investment between 3 to 7 years. One of the factors which influences how quickly you will recoup the investment is how much of the system's power you're able to use throughout the day. If you're at home during the day, you'll be able to recoup the investment faster, closer to the 3 year mark. But if you're not at home during the day, you can expect the system to pay itself back closer to 7 years.

## Is my home suitable for solar?

Nearly every roof in Australia is suitable for solar panels, but there are certain conditions which can cause the panels to not work as well or can increase the installation cost. Here's what you should check:

### Roof Type

Every roof material is suitable for solar, except for slate. Because slate is so fragile, most installers aren't willing to work on it.

### Space

Each solar panel is typically 1.6m tall x 1m wide. A 5 kW system (the most commonly installed sized system) consists of 15 to 20 panels. This requires an approximate area of 25 to 35m<sup>2</sup>. If you don't have this space available, you can install a smaller system instead.

### Roof Slope

Panels are typically installed flush to your roof. But if your roof is flat or very steep, tilt frames may be necessary. This would incur additional costs.

### Strength

Solar panels typically weigh 10-20 kg per square metre. Any roof in good condition can withstand this, but if you're unsure, an installer will be able to assess your roof for you. If your roof needs any repairs, it's important to get these done before installing solar.



### Orientation

Panels facing north, west or east are suitable locations for solar panels. South-facing panels are generally not recommended in Australia.

### Shade

Shade can significantly impact the amount of electricity produced by solar panels. Look for trees, chimneys, TV antennas or neighbouring buildings which can all cast shade on your roof.

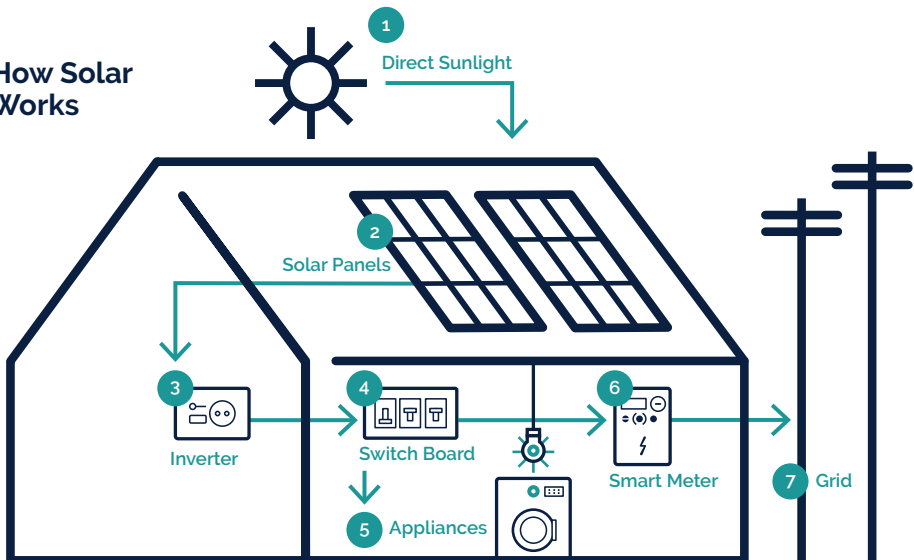
### Are there any rebates available?

Financial incentives are currently provided by the Federal Government and by the Victorian government. The STC scheme run by the Federal

Government currently provides a discount of approximately \$3000 off the cost of the system of a 5kW system.

The Victorian Government's Solar Homes program provides eligible Victorian households with a rebate of up to \$1,888 of the purchase cost to install solar PV panels. Eligible households can also claim an interest-free loan equivalent to the amount of the rebate. A rebate of up to \$1,888 is also available for rental properties.

### How Solar Works



# Battery Storage



With the price of batteries falling, the number of batteries installed across Australia has grown significantly over the last couple of years.

## How does battery storage work?

Battery storage allows you to store electricity generated by your solar panels for use in the evening. A typical home with solar sends any electricity that is not used by the home out to the grid. In return, the household gets paid a feed-in tariff from the electricity retailer. Once you add a battery system to the solar panels, instead of sending out the excess electricity to the grid, that energy is stored by the battery.

You can then use this power when your solar panels are not generating electricity, allowing you to buy much less electricity overall from the grid.

## How much does battery storage cost?

Batteries cost between \$1,000 to \$2,000 per kWh. A typical household can expect to pay anywhere between \$8,000 to \$16,000 depending on the size and model.

## Are there any battery rebates available?

The Victorian Government is providing a battery rebate of up to \$4838 for eligible households. These rebates are available to people in designated suburbs who've already installed solar panels, but have not accessed a solar rebate.

## Are batteries worth it?

By installing battery storage you can expect to reduce your electricity bills anywhere between 60 to 90%.

With these savings, a typical home will recoup the initial investment in approximately 10 years. This is close to the warranted life of batteries which is 10 years. Please note, if you're able to access a battery rebate, this payback period may be shorter.

In addition to the financial savings, there are many other reasons why people are installing batteries.

### Energy independence

Installing a battery will mean that you won't need to buy as much power from your electricity retailer. Batteries also allow you to use the electricity that your solar panels generate in the evenings, helping you make the most of your solar.





### **Back up power**

Some batteries allow your home to still have power during a black out. Please note this is not a standard feature. If you would like this option, please advise your installer.

### **Grid-support**

Batteries have an important role to play in helping stabilise and support the grid during high pressure periods. They also cut down the need for bigger networks and more generation assets.

### **I already have solar - can I just add a battery?**

You can add a battery to any existing solar power system. Batteries that are retrofitted are typically AC coupled. This means they're connected directly into the 240V AC in the switchboard using an AC battery inverter.

If you installed your solar system several years ago, it's likely that you will need to expand it. This is to ensure it generates enough power to charge the battery during the day. Most homes will need a solar panel system of at least 5kW, though the exact size will depend on your usage.

### **I don't have solar yet - should I get a battery now or later?**

There are many advantages for installing a battery with your solar power. You can reduce your bills, get more energy independence and be part of Australia's sustainable future.

But if you can't afford the cost at the moment, instead of waiting, we recommend installing solar as soon as you can. You will start saving on your bills straight away, and you can always add a battery to your system later.

If you install solar now with the idea of adding a battery later, make sure to install a large enough system that will generate enough excess energy to charge your battery.

# LEDs



Switching over to LEDs is a simple yet effective way to reduce your energy costs.

## What are LEDs?

Light emitting diodes, known as LEDs are very energy-efficient light bulbs. Because they're able to convert 60% of electricity into light, compared to only 5-10% for compact fluorescents, these lights use much less energy.

Compared to halogen bulbs, LEDs use 75% less energy and last 5 to 10 times longer. Though they can cost slightly more in the beginning, the upfront cost of LEDs generally has a payback time of less than 1 year.

## What types of LEDs are available?

There is a whole range available for nearly all types of light fittings. You can choose varying levels of brightness and colour temperatures depending on how you'd like to use the light.

### Brightness

LEDs need much less electricity to produce the same amount of light. So to choose the right brightness, look for lumens, instead of watts. As a rough guide, 420 lumens is suitable for a table or floor lamp, 800 lumens is suitable for a small room while 1300 lumens is suitable for a large room.

### Colour

LEDs are available in a range of colour temperatures. Warm White is a soft, warm light similar to incandescent and halogen bulbs. It produces a calming and relaxing light that is great for bedrooms, living rooms, and dining rooms. Cool White is a neutral light which is good for any situation where you want to foster alertness, such as kitchen benches, garages and workshops.

## How much do LEDs cost?

LEDs typically cost between \$5 to \$20. You may be eligible to upgrade your halogen downlights to LEDs at a subsidised rate (or even for free in some instances). Typically, you will need to have a minimum number of halogen downlights in your home (approximately 10 to 20) to qualify.

## I have downlights, is there anything I need to consider?

If you have halogen downlights, it's best to remove both the transformer and the globe, and replace them with an integrated downlight. Removing the transformer means you can then top up your ceiling insulation to fill any gaps, making the insulation much more effective. Please note, only IC (insulation contact) rated downlights can be safely covered by insulation.

# My Action Plan



Here's a quick checklist to help you prioritise energy efficiency actions in your home.

Today's date: .....

## My Energy saving actions:

Done	To Do	
		Check home for draughts
		Draught-proof my home
		Check ceiling and under-floor insulation
		Install insulation
		Install honeycomb blinds or curtains with pelmets
		Install external shading
		Install window film
		Install or replace reverse cycle air conditioners
		Install a heat pump hot water system
		Install solar panels
		Install battery storage
		Install LED lighting



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