City of Swan

Energy-efficient homes

Your guide to a more affordable, comfortable and sustainable home

Australians can do a lot better when it comes to how we manage energy at home.

The average Australian household has an energy efficiency rating as low as 1.8 out of 10 on the scale used by the Nationwide House Energy Rating Scheme.

Many of us simply increase our energy usage to live more comfortably at the expense of our savings and the environment.

This document has been created to help City of Swan residents design homes that are better for them and the environment.

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Designing your energy-efficient home

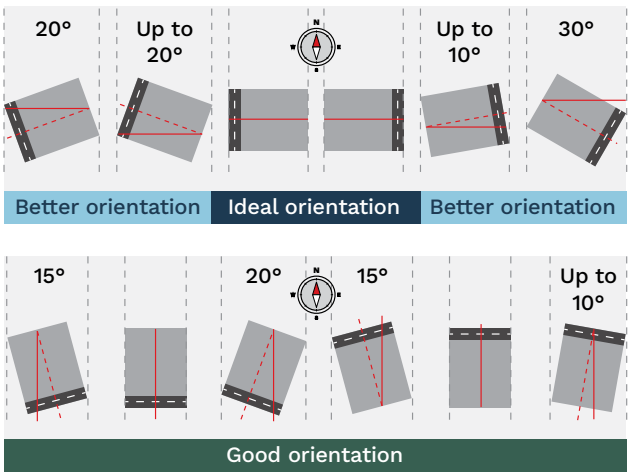
Design guideline

Orientation of the building site

One of your most important considerations when building a home is the orientation of your block of land. A good decision at this early stage of the process opens the door for positive design decisions when building. An ideal block is elongated along the east-west axis, giving it a larger north-facing boundary. This allows you to make the most of the home's northern outlook and exposure to winter sunlight.

Recommendation

Buy a building lot with an ideal orientation within 20 degrees of the east-west axis. If this is not possible, the next best option is to find a lot that aligns to the north-south axis as shown below.



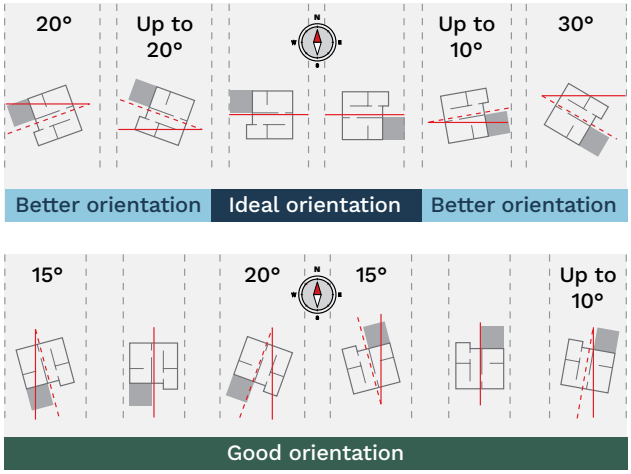
Design guideline

Orientation of the house

Ideally, your block of land will have an optimal orientation as outlined above. This will help you design a home with living spaces that allow light and heat to enter in winter but reject heat in summer. When it comes to the orientation of your home, a few degrees can make a big difference.

Recommendation

Try to orientate your building according to the diagram below, as space permits.



Heating and cooling costs based on orientation

Orientation	Heating	Cooling	Total	%
Living north	$68	$255	**$323**	Base
10° from north	$73	$262	**$335**	+4%
20° from north	$82	$301	**$383**	+16%
30° from north	$92	$342	**$434**	+25%
40° from north	$99	$386	**$485**	+33%
South	$125	$471	**$596**	+46%

Orienting living rooms south can increase heating by nearly 50 per cent. However, getting it within 10 degrees of north is still good and will only increase heating/cooling by four per cent.

Design guideline

Shading

Shading your home, particularly with windows and other forms of glazing, can have a significant impact on summer comfort and energy costs.

Appropriate shading designs and structures can help block unwanted sun in summer while allowing it inside your home in winter. Summer shading using eaves, trees and fences can save you money on cooling. Being able to welcome winter sun to the north cuts your heating bill and could leave you with even more savings in your pocket.

Shading can be fixed or adjustable, from a fixed fence to an adjustable shade cloth.

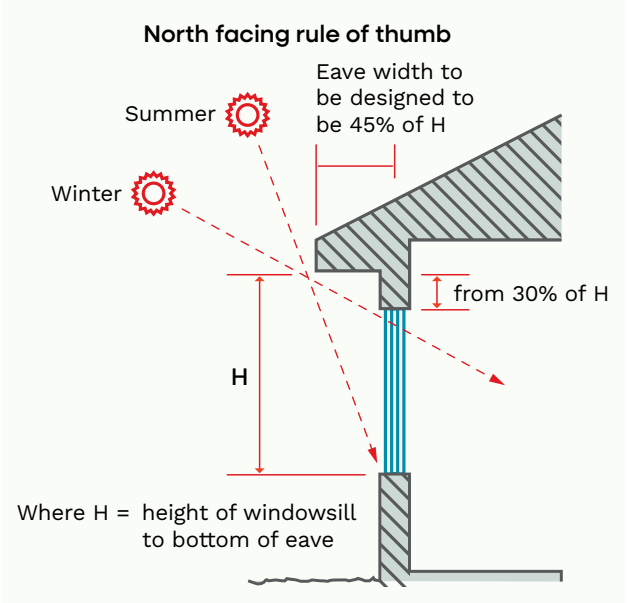
Typical shading scenarios:

- **Ideal shading** – good building design and any combination of structural or natural shading used to reject summer heat (east and west aspects) and to allow winter sunlight (north aspect) to enter your house. Examples include verandas, eaves, pergolas, shade cloth, block-out curtains, evergreen trees and deciduous trees for the northern aspect.
- **No shading** – Excess summer heat can enter the building and/or a lack of winter sunlight can happen when there is poor building design and structural or natural shading. In these examples, shading is not considered.
- **Overshadowed** – shading features either on the lot or on adjacent lots are poorly located to reject solar access in summer and allow solar access in winter. Shading may be considered but either poorly located or subject to factors beyond the owner's control, such as overshadowing.

Recommendation

As a rule of thumb, your eave width should be 45 per cent of the height from the bottom windowsill to the bottom of the eaves. This ensures north-facing glass is fully shaded for a month either side of the summer solstice or receives full solar access for a month either side of the winter solstice.

North-facing façades that follow this rule of thumb will provide optimum shading in summer and maximise winter sun. For east and west facing façades, vertical shade structures or deep pergolas are recommended.



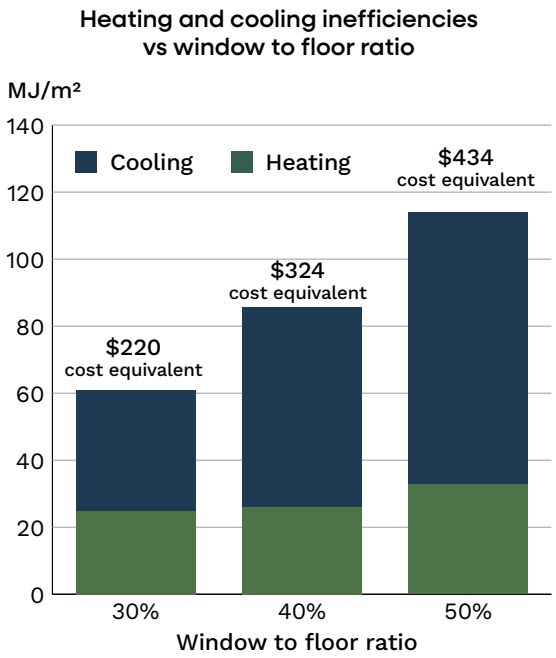
Design guideline

Window-to-floor ratio

Window-to-floor ratio is an important aspect of a sustainable home. Well-designed windows can provide natural ventilation and help you manage heat throughout the year. Getting the right ratio is key to good passive design.

Recommendation

Designing a new home or extension with a total window area of about 25 per cent of the total floor area could save you up to $300 a year.



New build Retrofitted Behaviour

Design guideline

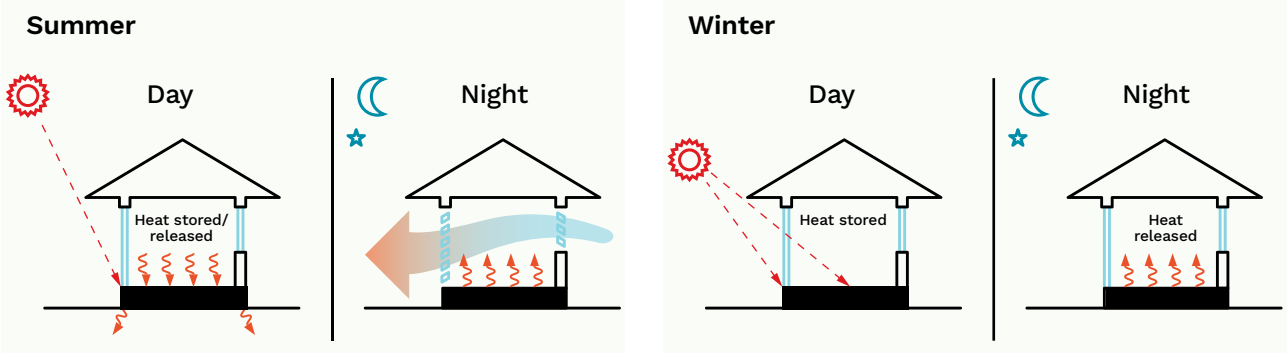
Thermal mass

Thermal mass is the ability of a material to absorb, store and release heat. In a building context, thermal mass refers to the use of materials to absorb and release heat at the right times of the year.

Thermal mass helps to stabilise internal temperatures in summer and winter. The amount of mass required is directly related to the orientation of your home and its windows. Thermal mass comes down to factors such as material choice, orientation, eaves, and window size and location. The concrete slab and walls of your house are examples of thermal mass.

Recommendation

Make best use of thermal mass in your house by arranging shading (window size, placement, treatments and external natural and structural shading) to allow winter solar access and deny summer solar access.



Heating and cooling costs based on the amount of thermal mass

Mass	Building Material	Heating	Cooling	Total	%
High	Brick – external and internal	$68	$255	**$323**	Base
Medium	Stud framed wall – burnished concrete floor	$46	$307	**$353**	+9.3%
Low	Stud frame – external and internal	$81	$371	**$452**	+39.9%

Design guideline

Roof colour

The difference between a light-coloured roof and a dark roof is negligible for a homeowner if their home has insulation. However, on a broader urban scale, light-coloured roofs can reduce the urban heat island effect – when suburban areas are significantly warmer than surrounding rural areas.

A light-coloured roof in combination with tree shade and other vegetation can benefit you and your neighbourhood.

Recommendation

Consider choosing a lighter roof colour with a solar absorbance of less than 0.45 to meet the deemed-to-satisfy compliance pathway.

Design guideline

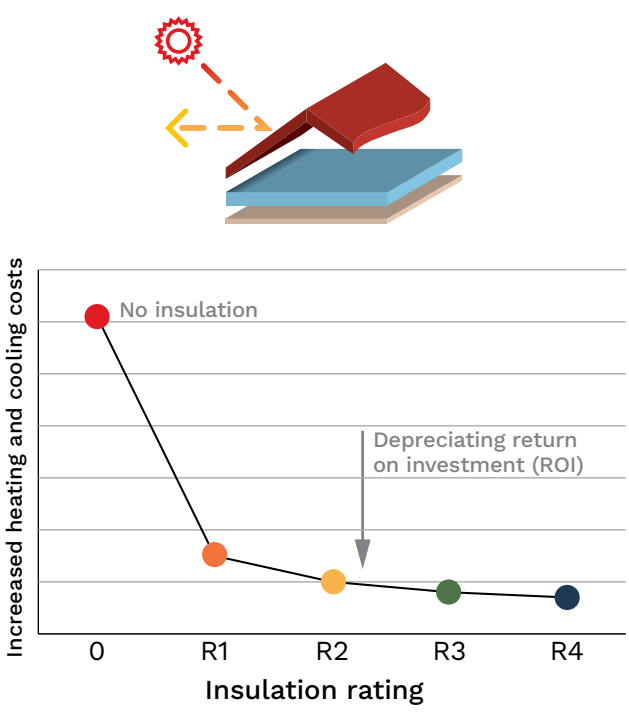
Ceiling insulation

The value of ceiling insulation is well recognised in Australia where it plays a critical role in home comfort. It is a common contributor to meeting the R-value performance requirements of the National Construction Code (NCC). However, there are other choices that contribute to this calculation, including roof material and colour, and the presence of a foil blanket.

The graph below suggests that "over-specifying" your insulation is unlikely to produce big improvements in comfort or give you a good return on your investment.

Recommendation

Use the appropriate level of ceiling insulation to achieve the required performance as prescribed in the NCC.



Annual energy costs – ceiling Insulation			
R1	R2	R3	R4
$462	$361	$324	$302

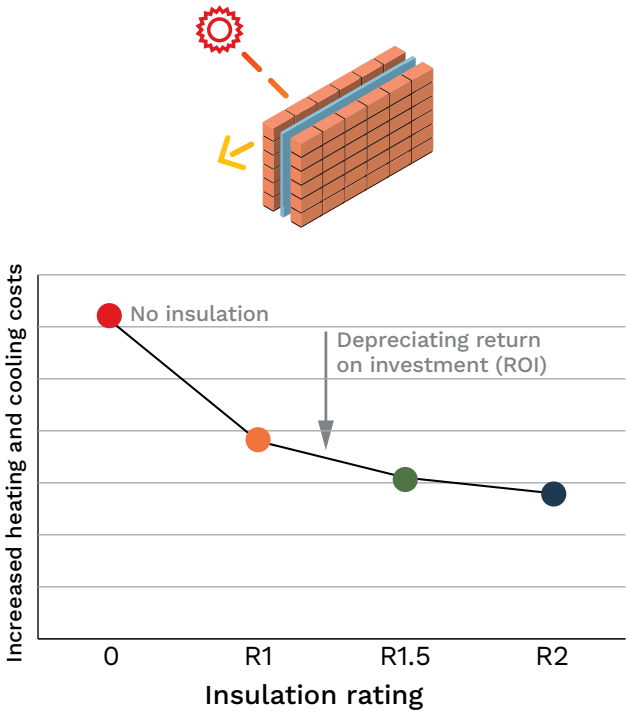
Design guideline

Wall insulation

Wall insulation can also play a key role in improving energy efficiency and thermal comfort in Australian homes.

Recommendation

Use appropriate wall insulation to boost liveability and save money.



Annual energy costs – wall insulation			
0	R1	R1.5	R2
$324	$287	$275	$271

Design guideline

Glass type

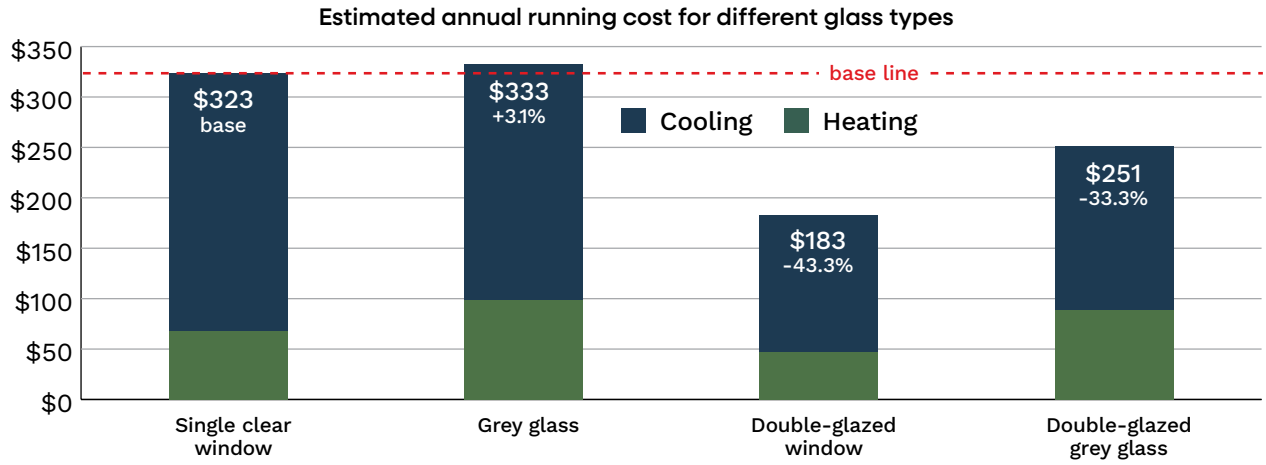
Understanding some of the key properties of glass can help you choose the best glazing for your home.

Conduction is how readily a material conducts heat. The U-value for windows describes the heat transfer of the whole window, including the glass and frame. The lower the U-value, the greater a window's resistance to heat flow and the better its insulating value.

The Solar Heat Gain Coefficient for windows measures how readily heat from direct sunlight flows through a whole window. SHGC is expressed as a number between 0 and 1. The lower a window's SHGC, the less solar heat it lets into the house.

Recommendation

- Choose double-glazed windows for your home to provide the lowest estimated annual cost
- Use window furnishings, blinds and curtains to improve the overall thermal performance of your windows
- Reduce convective heat transfer through windows with snugly fitted blinds and curtains with pelmets that trap a layer of still air next to the window. Eliminate air gaps around the curtain and pelmet to improve performance
- Use multiple layers of heavy fabrics to increase the insulation provided by curtains.



Design guideline

Go solar

Australia is an ideal location for photovoltaic cells. These systems generate electricity from sunlight. Solar photovoltaic cells that capture sunlight are placed in panels on a rooftop to deliver solar power to homes.

Recommendation

Install a photovoltaic system of sufficient size to meet your peak daytime energy use. Exceed this size if you intend to add a home battery to your system.

Changing your energy behaviour

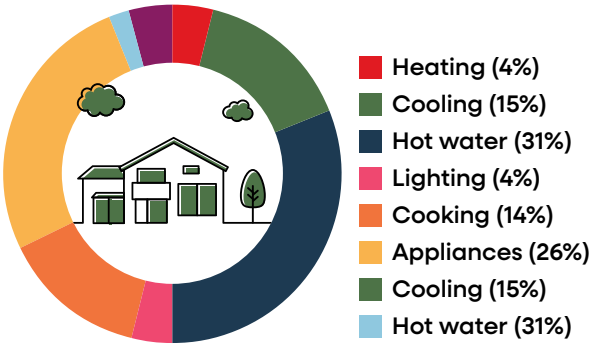
Your lifestyle and demographic factors have a big influence on your energy use at home. A family with young children may consume more energy because of higher demand. However, individual habits – from shower duration to appliance choice – can also have a significant impact on your energy bills.

Eco-warrior – withstand higher temperature swing, 18-26C internal conditions, will put on jumper or fan, minimum shower time (5mins), shower once per day.

Inbetweener – withstand moderate temperature swing, 19-25C internal conditions, moderate AC usage, average showering time (10mins), showers once to twice per day.

Comfort is key – room temperature between 20-24C, longer showering time (15mins), showers twice or more per day, uses clothes dryer frequently.

Energy breakdown for a typical house

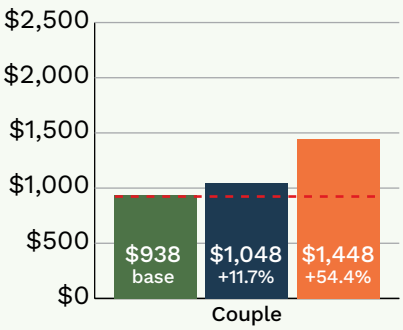


Calculation does not include appliances such as pool pumps, external lights and equipment associated with sheds.

Estimated annual energy cost for couples, families and retirees

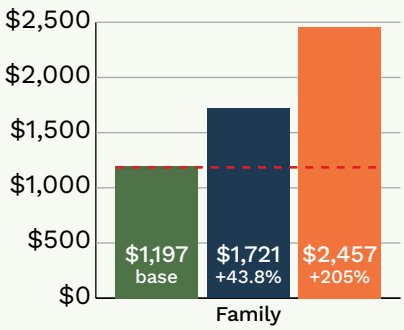
Couples

Out during the day
(7am – 6pm)
Minimal cooking



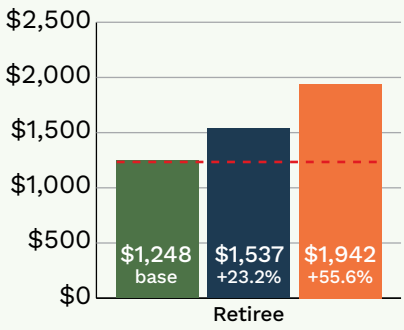
Families

Out during the day
(9am - 3.30pm)
Cooking most nights



Retirees

Home most days
Extended holiday periods
Moderate cooking



Behaviour change

Get comfortable

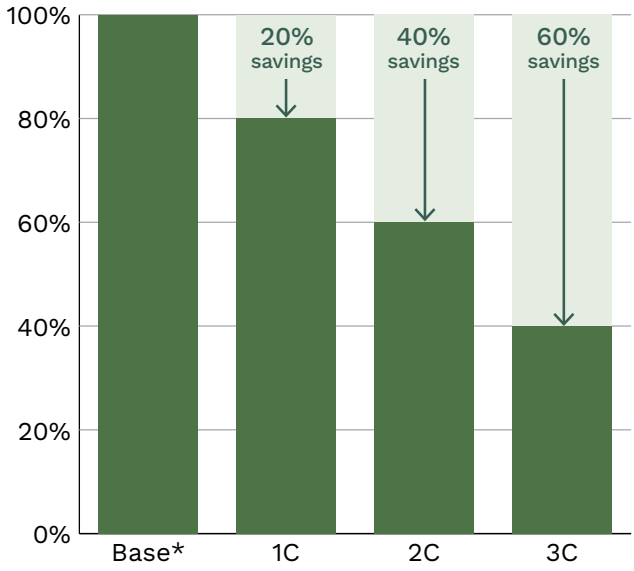
One of the simplest ways you can save money is by doing your best to adapt to the temperature before you touch the thermostat. Small changes in your home comfort range can reduce your heating and cooling bill anywhere from 20-60 per cent.

Recommendation

When cold – wear warm clothing that covers as much skin as possible; put rugs on cold floors; try to prevent draughts, using draught stoppers or heavy curtains if needed.

When hot – wear short-sleeved, loose-fitting and breathable clothing; using fans can be equivalent to reducing the temperature by about 3C.

Typical savings



Applicable for all social demographics, couples, families and retirees

*Base comfort is based on the assumption of heating when the temperature drops below 20C and cooling when the temperature rises above 25C. The degree difference is changing the thermostat by a degree.

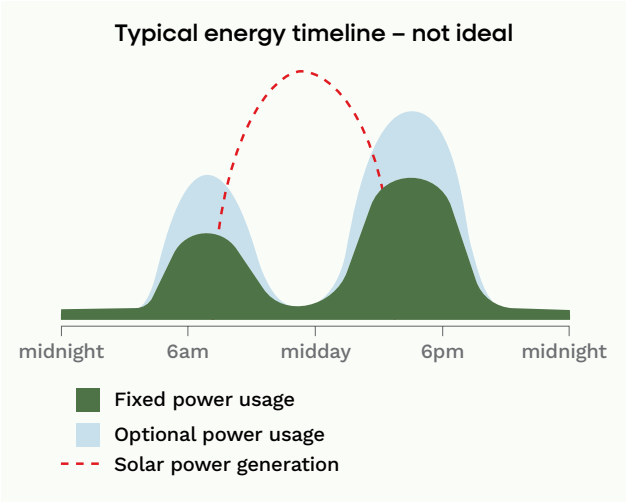
Behaviour change

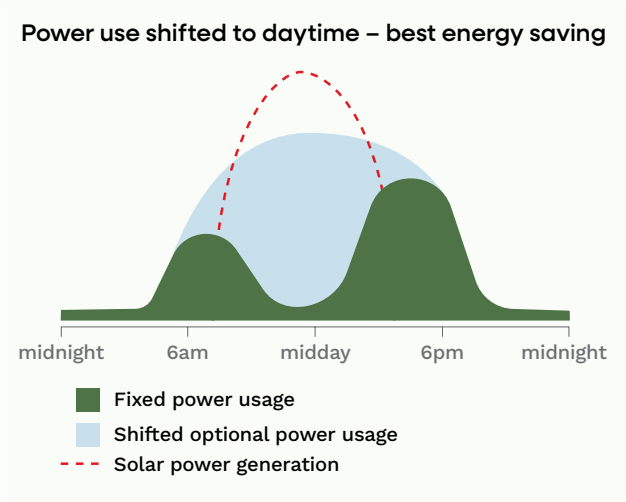
Shift the load

When it comes to electricity consumption, we often talk about how much we use or how we can use it more efficiently. Load shifting or demand management focuses on when energy is used, rather than how much. For many Australians, non-fixed or optional power use – for example, your dishwasher, hot water or temperature control – often occurs during peak use periods in the morning and evening.

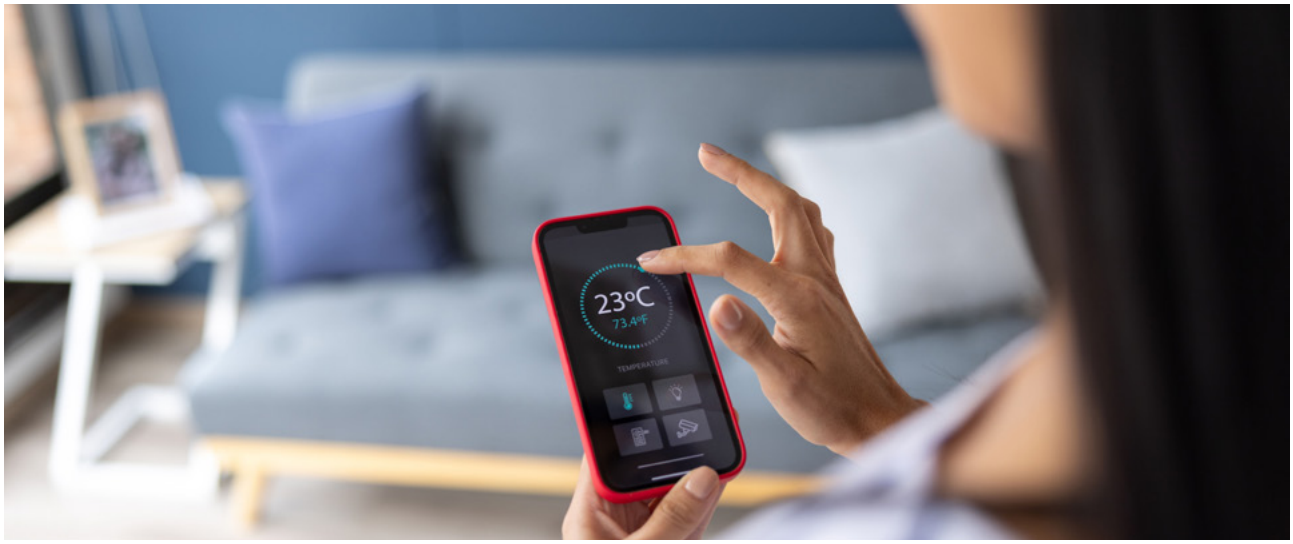
Recommendation

If you are not at home during the day, it is recommended that you shift all possible appliances to operate during peak solar production periods for your photovoltaic system.





Recommendation	Load shifting	Couple	Family	Retiree
Install a 5kW solar PV system (solar panels)	No	$227	$330	$561
Use dishwasher and washing machine during daylight hours	Yes	$83	$146	$104
Put hot water on a timer for heating during the day	Yes	$156	$313	$150
Precondition your home by heating and cooling during the day when required, even when you are not home	Yes	$103	$137	$128
Estimated total annual saving		**$596**	**$962**	**$976**



Behaviour change

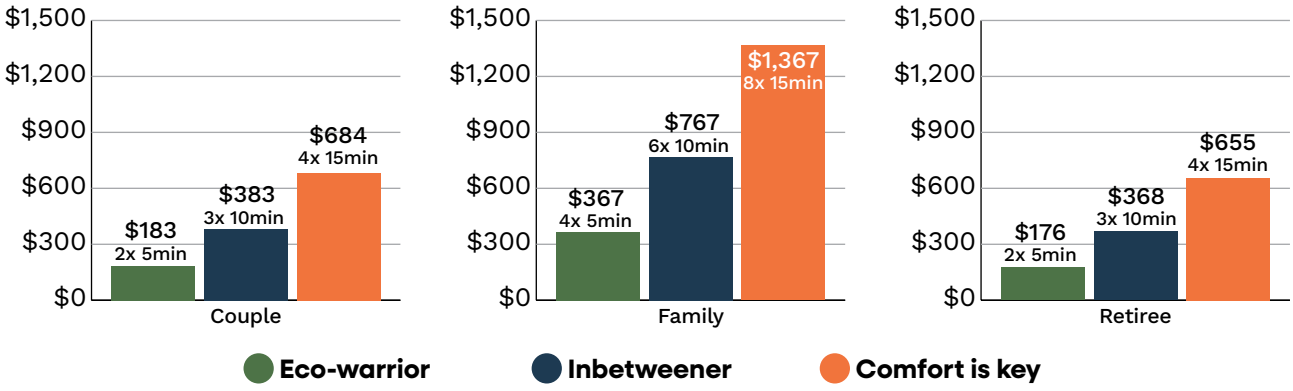
Shorter showers

Adjusting the duration of your showers can save you a lot of money, whether you're living by yourself or have a family. For example, limiting showers to five minutes could save a family $1,000 a year.

Recommendation

Reduce your shower time to reduce your costs. Have fewer baths. The average bathtub size is 80L, while a five-minute shower with an efficient shower head uses only 30L – a significant water and energy saving.

Estimated annual cost based on the number of daily showers and duration for couples, families and retirees based on their lifestyle



Behaviour change

Choose your appliances wisely

When it comes to choosing the right appliance for your energy-efficient home, it comes down to two main factors – capacity and efficiency.

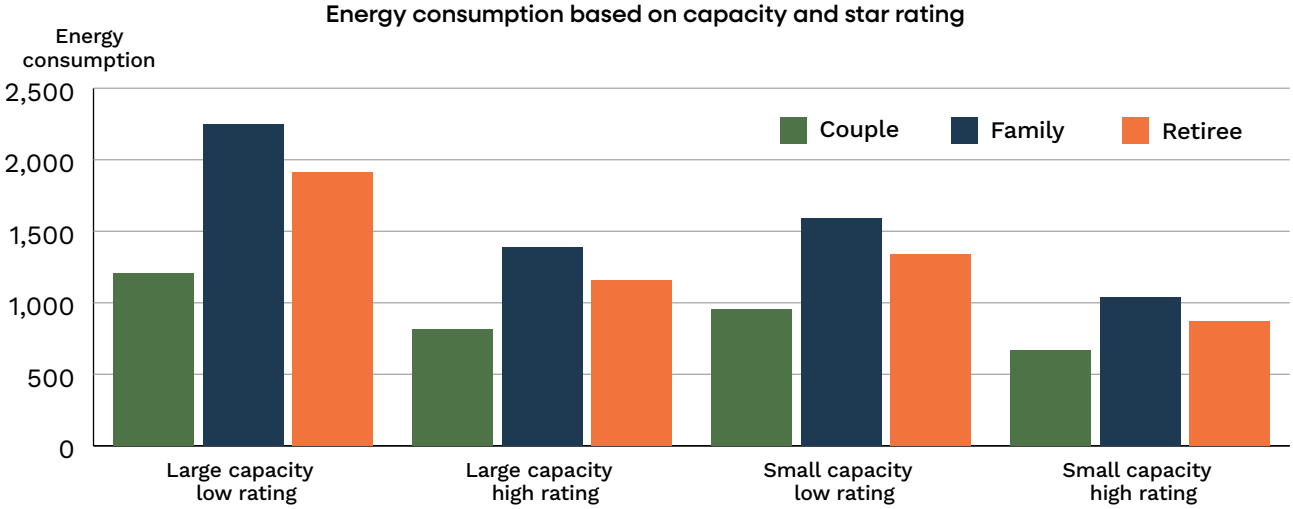
The well-known star ratings show the energy efficiency of an appliance. Energy consumption is the estimated amount of electricity the appliance will use in a year. This information can help you predict running costs and compare the energy efficiency of products with similar capacity and features.

However, it is worth noting that choosing an appliance with smaller dimensions or capacity can save you more than choosing a bigger product with a better energy rating. For example, an 80-inch television could cost you $400 a year more to run than a 55-inch television. Conversely choosing the right size refrigerator for your home (with a good energy rating) will be better than buying an undersize fridge and having to consider a second fridge.

Recommendation

Think carefully about the size or capacity of your appliance and look for higher star ratings.

Energy consumption based on capacity and star rating



Couples

Choosing appliances with high star ratings could decrease energy use by **26.3 - 27.5%**.

Families

Choosing appliances with high star ratings could decrease energy use by **27.9 - 29.8%**.

Retirees

Choosing appliances with high star ratings could decrease energy use by **28.1 - 29.3%**.

Appliance change	One-off cost	Annual saving
Use a low-flow shower head (four-star WELS rating)	$170	$80 - $160
Buy a 55-inch television instead of an 80-inch television	-	$100 - $300
Use a heat pump dryer instead of a condenser dryer	$700	$100 - $200
Remove your second fridge/freezer	-	$160
Total	**$870**	**$440 - $660**

Putting it all together

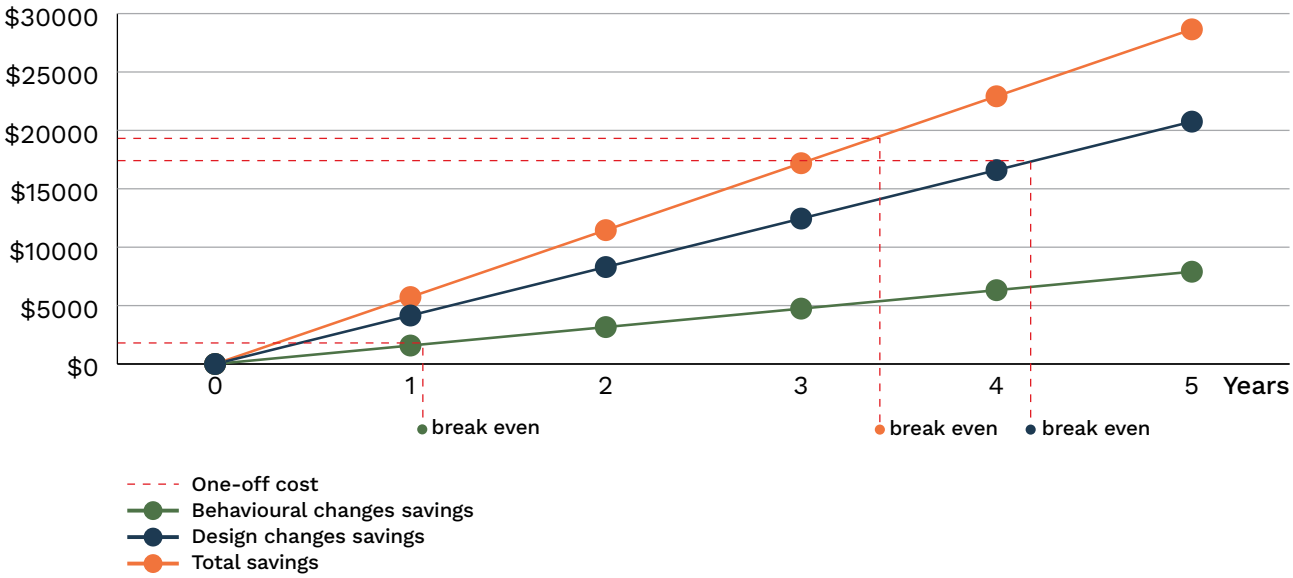
Design your energy-efficient home		One-off cost	Annual saving
☐	Orientate living room within 10 degrees of north	-	$272
☐	Use design guidelines for shading, such as the rule of thumb for north-facing shading	-	$104
☐	Maintain a window-to-floor ratio of 25 per cent	None	$104
☐	Add thermal mass to the building, such as a rammed earth wall or exposed slab	$4,000	$130
☐	Maintain an insulated envelope – ceiling R4, walls R2	$1,922	$900
☐	Upgrade to double-glazed windows	$7,000	$140
☐	Install solar panels (5kW priced)	$4,500	$1,500 - $2,500
Total		**$17,422**	**$4,150**

Change your energy behaviour		One-off cost	Annual saving
☐	Turn on a fan and dress for the weather	$1000	$150 - $250
☐	Implement load shifting to gain further value from your PV system	-	dependant on the number of appliances
☐	Have shorter showers and fewer baths	-	$500 - $1000
☐	Choose your appliances wisely	$870	$440 - $820
Total		**$1870**	**$1,090 - $2,070**

Overall Total	**$19,292**	**$5,240 - $6220**

Savings over five years based on behavioural and design changes

The upfront cost of an energy efficient house may seem large but as the graph below indicates, it will not take long for your investment to be paid back to you in avoided energy costs. Once this point is reached, you will reap the benefit of reduced energy costs for as long as you live in the house; and you will be helping our environment and increasing your resale value at the same time.



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