This tool kit is designed to help you identify issues that are affecting the energy and water efficiency of your home. Each tool is designed to give information about some important aspects of your home's efficiency, which can help you to work out what steps you can take to reduce how much energy and water you use, reduce your greenhouse gas emissions and save money.

Energy efficiency refers to using less energy to perform the same task or achieve the same level of output. It involves reducing energy waste and optimizing the use of resources. Improved energy efficiency can lead to lower energy consumption, reduced greenhouse gas emissions, and lower costs for individuals, businesses, and governments.

Australian households generate about one fifth of Australia's greenhouse gas emissions, which are the emissions causing rapid climate change. Making our homes more efficient, and making the shift to renewable forms of energy, are important actions we can all take to reduce our carbon emissions and tackle climate change. Darebin Council was the first government in the world to declare a climate emergency and is committed to supporting residents to tackle the climate emergency in their homes, workplaces and communities. Offering these kits to residents via our libraries is part of this commitment.

We are grateful to Darebin Council for providing their support in the development of this set of instructional materials.

What's in the tool kit.

This kit contains the following tools:

1. FLIR TG – 267 Thermal camera
2. Energy Saving Thermometer
3. Water Flow Measuring cup
4. Power-Mate™ Lite energy meter
5. USB Cable
6. Carrying case

We would like to hear about your experience.

Wyndham City Council is providing this kit to support you in your efforts to make your home more energy efficient and climate resilient. Then you can save energy and money.

When you finish using the kit, please give us your feedback by completing the following survey.

Scan QR code or visit the following link.

Resources

This guide has been developed to help you understand exactly how to use all tools part of the kits. However, we recommend you do a bit of research first to understand how to use it correctly. There are some great resources available online if you want to learn more but ensure these apply to your situation and particularly your local climate.

If you would like to learn more, here are some resources for further reading:

- **Your Home** Technical Manual is a Federal Government resourced guide to environmentally sustainable homes. It provides advice relevant to Australia's climate typologies and building regulations.

  It is primarily aimed at new homes or renovations but the majority of the information can also be applied to an existing house. It is available for free online or you can purchase a printed book. https://www.yourhome.gov.au/

- **Sustainability's Victoria Energy Smart Housing Manual,** it's a local guide developed by Sustainability Victoria. This is a resource for prospective home builders, renovators, builders, local councils and students to use as a guide. https://www.sustainability.vic.gov.au/energy-efficiency-and-reducing-emissions/building-or-renovating/energy-smart-housing-manual

- **Renew** is an Australian not-for-profit organisation that has been providing expert, independent advice on sustainable solutions since 1980. Their website, forums and magazines are a goldmine of information about all aspects of living sustainably. You can also sign up for a membership or subscribe to their magazines to help support them to help support them. https://renew.org.au/

- **My Efficient Electric Home** is a popular group on Facebook dedicated to helping people get off gas and make their homes more efficient. At the time of writing they have around 45,000 members and there is a vast archive of questions and answers in the group. If you can't find the answer already there then you can ask and you'll likely get a range of expert opinions. https://www.facebook.com/groups/MyEfficientElectricHome/

- The **EnviroShop** is the company that has supplied this kit. They have a wide range of products and services to help you live more sustainably and as well as compiling this tool kit and instruction guide, have made available this great resource to help you identify and address wasted energy and resources in your home: https://enviroshop.com.au/pages/how-to-make-your-home-more-energy-efficient

  If you have further questions regarding the above information, please contact sustainability@wyndham.vic.gov.au

1. FLIR TG-267 Thermal Camera Instruction Guide

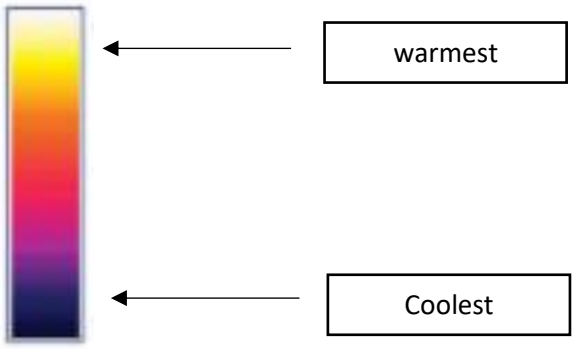
This FLIR camera is a very powerful tool for finding the gaps in your home's thermal envelope that are not so obvious. While it's usually easy to see or feel draughts or obvious hot or cold areas there are many parts of a house construction that you don't have easy access to, such as wall cavities and ceiling structures. This camera gives an indication of the relative temperature of objects, making it possible to see patches of wall or ceiling that may be missing insulation and therefore leaking heat in or out. They can also be a quick fun way of seeing what appliances in your house are consuming energy (and therefore emitting heat).

It is important to understand what the camera is showing you. It is not a direct measurement of the temperature of objects in its view but a measure of their 'thermal emissivity'. This means how much thermal or infra-red energy they are radiating. This is a very good way of looking at the changing temperatures across surfaces, but it does need some understanding to interpret correctly. Some objects such as glass or shiny metal surfaces don't emit much thermal radiation but can be good reflectors or allow it to pass right through. For this reason, don't put too much faith in the absolute temperature readings of different objects or contrasts between objects that are next to each other. This tool is best for seeing temperature differences across a continuous surface, such as a ceiling or wall.

It is best to do the testing on a hot day or cold night to be able to see the best contrasts in temperature. The higher the temperature difference between inside and outside, the easier it is to spot the thermal gaps in the building envelope of your home.

The basics of using the camera are quite simple. There are five buttons on the back of the unit below the screen and a trigger on the front. Press and hold the centre button for a second or two and the unit will power up. After a few seconds it will show a live image on the screen of whatever is in front of the camera. There will be a temperature reading indicated for the spot in the centre of the image. You can move this around to compare the temperature of different parts of an object.

This basic camera view is all you really need to diagnose thermal issues in your home. Point it at a wall, ceiling etc, give it a second or so to stabilise and you will clearly be able to see whether the surface is one continuous colour (and therefore temperature) or if there are obviously hotter or colder patches. An uninsulated ceiling on a hot day will look like an X-ray view of your ceiling structure where you can clearly see the ceiling joists and other framework as a different colour to the plaster between. The colours represent the temperature ranges in the image with blue as coolest through to white as the warmest as per the below figure.



There are a few more features of the camera that might be handy.

- If you pull the trigger on the front of the unit it will save a picture to the internal memory. You can then use the USB cable to connect it to a computer and download the pictures, the same as other digital cameras. The USB port is under the rubber flap on top of the unit. You can use these images to clearly indicate to a tradesperson the areas without adequate insulation.
- If you press the button to the left of the main button it will turn on a laser indicator so you can see exactly where the temperature indicator on the screen is measuring.
- If you press the centre button quickly it will bring up the menu system. You can navigate using the up and down buttons, the Back button to the right and using the centre button as Enter. Use the Back button to return to the live view screen. It's unlikely you'll need to use any of the menu functions. If you change any settings, please change them back to the defaults before returning the unit.
- There are quite a few advanced features of the camera. You are highly unlikely to need these for diagnosing home thermal efficiency issues. If you do need to use them please download and refer to a copy of the manual from the FLIR website.

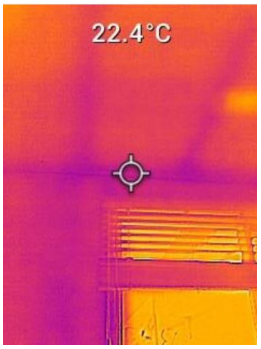
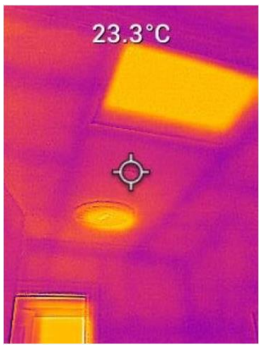
When You're Done

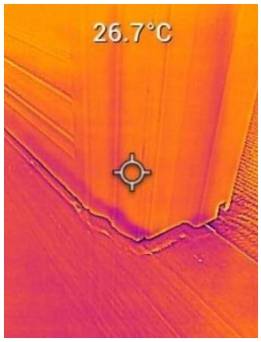
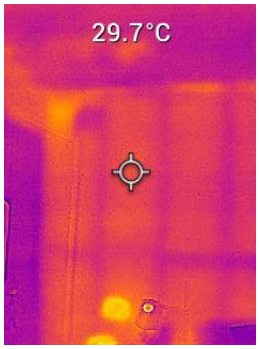
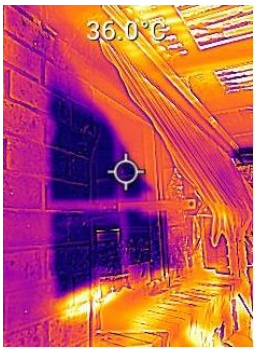
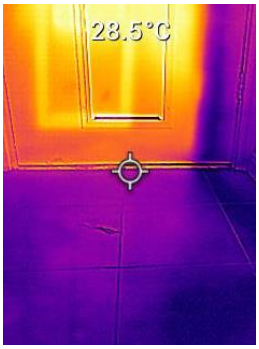
When you've finished with the camera there are a few things we'd appreciate you doing:

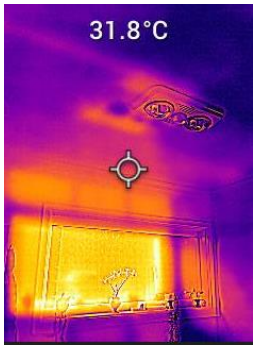
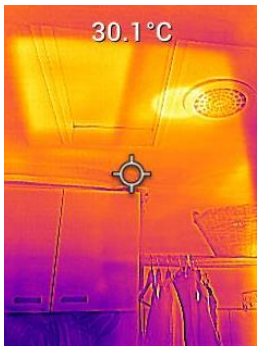
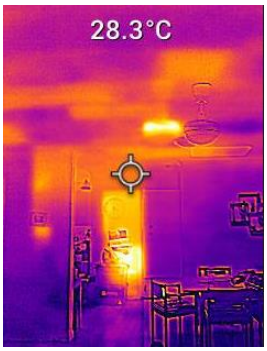
- Hold down the centre button for a few seconds to power off the camera.

- Please make sure you've deleted any images you saved onto the camera (after transferring them to your PC or phone). To delete images:
    - Tap power button to display menu
    - Tap power button to select 'Gallery'
    - Tap power button to select any image
    - Tap power button to display image menu
    - Use lower button to select 'delete all files' and tap power button again
    - Use lower button to select 'Yes' and tap power button again to confirm
- Please make sure the thermal camera is clean and ready for re-use. Leave it connected to a USB charger for a while to make sure the battery is full.
- Please make sure all included parts and accessories are present (e.g. USB cable)

Here are some examples (The spot temperatures are not always accurate due to thermal emissivity issues mentioned earlier.)

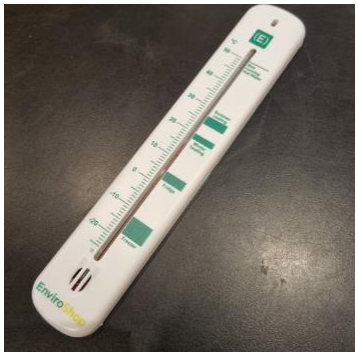
	**Description** This image shows that this building has the highest heat transfer at the window, then within the ceiling and the least heat transfer at the wall. This is fairly typical and why generally builders install two layers of insulation may be used in a ceiling and only one layer within a wall.
	This image shows breaks in the ceiling insulation around two downlights. If downlights are Insulation Contact (IC) rated, you can lay insulation around and over downlights.
	You can see high heat transfer at a ceiling fan and section of plaster that is missing an insulation layer. Exhaust fan sealing will help reduce heat transfer at exhaust fans, but will not eliminate it completely.

	This image shows a wall where the floor has dropped, leaving a gap at the base of the wall, allowing cool air in and creating this darker, colder area at the base of the wall.
	This image shows a section of wall in a bedroom area. The wooden frame and battens are clearly visible. Unlikely the insulation levels installed during construction are sufficient.
	This image shows a kitchen window from outside of the home. By using external window shades, direct sunlight inside the home can be minimised. This reduces solar gain and keeps temperatures in the room cooler than outside on a hot day.
	This image shows a laundry door with a draft stopper installed at the bottom. There is no heat entering the home as a result of this upgrade. The door also has a doggy door installed. Hotter temperatures can be seen around the perimeter of the magnetic door flap.

	This image shows sections of wall and roof that have insufficient areas of insultation or sarking fitted. The majority of heat in the home is lost through the ceiling, top of walls and window areas.
	This image shows significant heat entering through an unshaded bathroom window. It can also be observed that the frame directly above the window has no insulation fitted at all. The room also has a heat lamp and extraction fan fitted to the ceiling. In this example insultation has been removed around the heat lamps.
	This image shows a roof hatch and extraction fan located in a laundry area. Roof hatches typically are easily removable to access roof spaces and cavities. Adding a layer of insultation to the top of the hatch would prevent heat from entering or escaping this area. Extraction fans can be fitted with top-hats to minimise heat loss from inside the home. These will automatically open via fan pressure when the fan is in operation.
	This image shows a lack of bulk insultation in sections of a living room roof cavity. A skylight above the table/dining area can also be observed. Heat gain or loss will occur in these zones leading to increased heating and cooling requirements and overall energy use.

And now for some appliances. Most of the energy consumed by modern appliances gets converted into heat, which is easy to see on a thermal camera. A good way to remind yourself about standby power.

2. Energy Saving Thermometer



This is just a simple old-fashioned thermometer but with the addition of marked temperature ranges for several different parts of your home. There are recommended zones for your hot water, fridge and freezer. Using it is very simple.

Checking heating appliances are not running too hot and cooling appliances are not running too cool could result in substantial reductions in your energy use. The *Energy Saving Thermometer* tells you the appropriate operating temperatures for your space heating, hot water, fridge, freezer and air conditioning (if you have it).

Hot Water

Energy is required to heat your water, but some of this heat can be lost through the pipes as the hot water travels from the water heater to the taps in your home. This heat loss results in using more energy and water.

Water that is too hot also wastes energy and causes additional strain on your hot water system, reducing its life. Water that isn't hot enough (less 60° C in the tank) has the potential to grow pathogens like legionella. There may be a drop of a few degrees over a long pipe run.

Steps to take:

- If the hot water temperature is outside the ideal maxima temperature, then you can usually adjust the thermostat on your hot water system up or down as required. If you have a storage system, it can take quite a while for the tank temperature to change so you may need to wait a few hours or even until the next day to check again. If you have an instantaneous system, it should change quickly.
- If your hot water system was installed in the last 10 years or so it may have a tempering valve fitted which mixes cold water with the hot water to prevent scalding, in which case the water temperature is unlikely to be more than 55° C.
- Insulating your hot water pipes with pipe lagging reduces heat loss and can raise water temperature 1°–2°C hotter than uninsulated pipes can deliver, allowing you to lower your water temperature setting. You also won't have to wait as long for hot water when you turn on a faucet or showerhead, which helps conserve water. Pipe insulation is not very difficult to install and although it will take some hours to get it done, the effects will be long lasting. Renters can also take the pipe lagging with them when they leave.
- If your hot water system includes a storage tank, you might consider installing insulating cover that is fitted on your hot water service PTR valve. Insulating your PTR valve could reduce your energy usage to up to 7% and is another improvement renters can take with them if they move.

Room Temperatures

There are ideal temperature ranges indicated for summer cooling and winter heating. The majority of people will be comfortable in these temperature ranges assuming there aren't other issues like draughts or radiant heat causing them to feel uncomfortable. Measure the temperature in your living spaces and adjust your heating and cooling if necessary. If you're not comfortable in these temperature ranges you'll need to do more research into why. (It could be as simple as dressing for the season).

Steps to take: Draught-proofing stops warm air from escaping your home in winter and hot air from entering in summer, saving you money and making your home more comfortable. There are many inexpensive ways to draught-proof your home, including self-adhesive draught seal tape and draught snakes.

You can also minimise your heating and cooling costs by closing doors to areas of your home that you're not using, or 'zoning' your home. Some central systems will allow you to zone off areas from the control panel. If you have a ducted system, check the instruction manual to see how many ducts can be closed.

If your heating and cooling systems are ducted, or include reverse cycle air conditioners, don't forget to clean the vents and filters every 3-6 months to keep them working efficiently.

Fridge and Freezer
According to CSIRO, the best setting for a fridge is 3°C. The best setting for freezers is -18°C to -20°C. Keeping your fridge and freezer within these ranges will keep your food safe and your energy bills low.

Leave the thermometer in your (closed) fridge or freezer for a few minutes and then read the temperature. If it's warmer than the indicated range then your food is in danger of spoiling earlier than it should. If it's cooler, then you're using more energy than you need to.

Steps to take: Adjust the thermostat in your fridge and freezer up or down until it's in the recommended zone. It may take a few hours to stabilise to the new temperature. Check the seals on doors to make sure they close properly. If the temperatures won't go high or low enough then it's due for a visit from a service person to investigate why.

3. Power-Mate™ Lite Energy Meter

Important Safety Information

- The Power-Mate is an electrical device and should not be opened or tampered with. If you have any concerns about its operation or believe there may be a fault please return it to the library and inform staff.
- Please read the instructions carefully.
- Do not use the Power-Mate in wet areas or outdoors.
- The Power-Mate should only be used with mains power appliances up to a maximum of 10 amps (2400 watts). The majority of small home appliances will not exceed 10 amps. The appliance power or current rating will usually be written on the label or body of the appliance. Do not test multiple devices connected with a power board or double adaptor.

The Power-Mate Lite is an energy meter that measures how much electrical power is being used by a device that is plugged into it. It is very handy for educating yourself about how much energy different appliances are using and possibly identifying the culprit behind high energy bills.

It can't measure the energy use of hard-wired devices like lighting, electric hot water systems etc, but it can measure appliances such as your wall heater, stereo system or clothes dryer (any appliance with a plug). By educating yourself about energy use of these kinds of appliances you are better placed to be able to understand how much these devices are using and where you can conserve.

How to use it

The basics are quite simple, you just switch off and unplug the device you want to measure, plug the Power-Mate into the socket and then plug the device into the back of the Power-Mate plug and switch it on. The Power-Mate will then show the Watts being used by the appliance.

How to understand the Power-Mate reading

- Watts (W) are a measure of power, or how quickly electricity is being used. Power is probably the most important aspect to understand in energy efficiency.
- The total amount of energy actually used is the power multiplied by the length of time it is used.
- A small item run 24 hours a day (e.g. internet router) can consume quite a lot of energy, while a very high-power item only run for a few minutes (e.g. kettle) won't use much energy.

Did you know?
Electrical energy is usually measured in kWh, or kilo--hours and this is usually what appears on your electricity bill. One kWh is simply 1,000 watts being used for one hour. The maths is not hard to work out, you just need to convert power to kW and time to hours.
10 Watts = 0.01kW
100 Watts = 0.1kW
1000 Watts = 1kW
Multiple the kW by how many hours it is used for (e.g. a computer used 8 hours a day)
Eg. 0.1kW x 8 hours = 0.8kWh

For example, an internet router that consumes 10 Watts (0.01kW) and is switched on 24 hours a day will use 0.01 x 24 = 0.24kWh per day. A kettle that uses 2400W and is on for 5 min (5/60 minutes in an hour = 0.08333) will use 2.4 * 0.08 = 0.2kWh (nearly the same as the modem being on all day).

Multiply this by all the large and small appliances around your house and you have your power bill.

How to estimate your appliances' energy use

For simple devices that have fairly consistent energy use you can simply measure the watts and estimate how many hours a day it is used to work out total energy consumption.

- Some appliances such as a fridge or plug-in heater will switch on and off (to ensure they stay at the correct temperature). To get an accurate idea of their energy use you need to monitor them over several hours or days. The Power-Mate is capable of logging energy use over time. If you want to do this it's best

to refer to the manual (included in the kit). If it's not in the kit it is easily found online, just search for Power-Mate Lite manual.

- Make sure you measure as many appliances as you can. Sometimes the biggest energy user is a fridge or freezer kept in the garage. It's often an older model that's been moved out there when you've upgraded in the kitchen and can be subject to extremes of heat in summer.

- Some appliances still use energy when they are switched off, such as TVs and smart speakers. Measure these appliances while both on and off to get a full picture of their energy usage.

Many appliances these days come with an energy star rating which should have estimates of typical energy use. If the label has been removed from yours you may be able to find it on the official database here: https://www.energyrating.gov.au/.

Next steps

You can now use the information you have learned about your appliances to use them less and to switch them off at the wall when not in use.

When you need to purchase a new appliance, remember: the more stars it has, the less energy it will use, and the more money it will save you over time. It is a good idea to plan ahead and research appliances, as often you need to replace appliances quickly. Use the Power-Mate Lite to compare the energy use (kWh) of your current appliance and the energy rating label of new products to make sure you buy something more efficient to run.

Also, the more water efficient an appliance is (e.g. for a washing machine) the less energy it will need to heat the water when you are doing a warm wash (although many new washing machines and dishwashers heat the water themselves). Remember however, that the best way to save energy when washing clothes is to wash in cold water.

4. Water Flow Measuring Cup

The water flow measuring cup is a very simple device for measuring how much water your taps, shower etc are using in litres per minute (l/m).

Fitting a flow restrictor to a tap or a low-flow shower head can save lots of water and energy. It can also save you from running out of hot water by using less water for the same length of shower.

How to use it

It's very simple to use for measuring tap flow rates.

- Just turn the tap onto full, hold the cup under it with the handles pushed together and slowly pull the handles apart. There will be a point where the water level stops going up and overflowing and stays fairly level. If it's dropping, then push the handles back together a little.

- Once the cup is full to the top, and staying level, turn off the tap and look at the number on the side of the cup where the handle is pointing. This number will give you the litres per minute of flow.
- An efficient tap should have a flow rate of less than 9 l/m and it can be as low as 2 l/m with a very efficient tap. Kitchen and laundry sinks may require flows at the higher end of the scale, while bathroom basins etc. should be towards the lower end.

Measuring the flow rate of a shower can be a bit trickier because of the wider water flow.

- You might be able to improvise a wide funnel with a sheet of plastic (get someone to help hold everything!) to channel the water into the cup.
- Otherwise you can use a big bucket and turn the shower on for 30 seconds, measure the water colleted using a litre container, and then double the amount of water measured to get the result in l/m. (tip: get someone else to use the stopwatch on their phone while you hold everything)

Water-using appliances such as washing machines, dishwashers etc. should have a star-rating label indicating how much water is used per load in addition to their energy rating label. If the label has been removed you can look up the model on the official databases here: https://www.waterrating.gov.au/ and https://www.energyrating.gov.au/.

Next steps

You can retrofit most newer taps with flow restrictors or aerators. With older taps that can't be retrofitted, you can change your behaviour by not opening the tap fully when using hot water. When renovating or building make sure you compare flow rates on products.

If your showerhead uses more than 9 l/m you may be eligible for a rebate on the price of a new low-flow showerhead from the Victorian Energy Upgrades program. Find out more here: https://www.victorianenergysaver.vic.gov.au/save-energy-and-money/victorian-energy-upgrades/save-with-these-energy-efficient-products/water-saving-shower-heads

When you need to purchase a new appliance, remember: the more stars it has, the less water and energy it will use, and the more money it will save you over time.