

## SURVIVING HEAT

The clearest effect of climate change will be increased temperature. The hot days will be hotter, there will be more of them, and there will be more heatwaves. Even more importantly, when the sun goes down the nights will stay hot. When our bodies don't cool down at night we find it hard to recover from heat. Our bodies weaken and if we're vulnerable, old, ill or otherwise frail, we can die. What can you do?

### **How to keep your home cool**

Even if you can't or don't want to move to a cooler part of the world, you can keep your home cool and give yourself somewhere to retreat to.

Turning up the air-conditioning is the common response to hot weather. But as hot weather increases and power prices also go up, so will the cost of keeping your house cool this way. For some, that cost will become unaffordable. Reliability of power supply is also likely to get worse, particularly during extreme weather. What are the other options?

The first is to have your own renewable source of power so you can run your air-conditioner as often as you want, and there's more on this in the 'Power' chapter. But even if you do have your

own power, reducing your air-con use will mean more electricity left over for other uses.

***Orientation and through breezes***

Do you have money to buy a house or do you rent and can move? The good news is you have the chance to choose a house which is sensibly oriented. You want:

- No or few windows on the west side of the house: you really don't want the kitchen on the west side, because cooking on a summer evening with the hot sun glaring in your face is one of suburbia's least pleasant experiences, and you really don't want a west-facing balcony in an apartment.
- Decent windows on the north side to let in light and warmth in winter when the sun is low, but with an eave above them to shade the glass from sun in the summer when the sun is high.
- The rooms you want to keep cool (bedrooms, your office if you work at home) on the south side of the house.

Another option, and one which may be more plausible if you're a renter, is to look for an apartment which nestles between, above and below other units and has a north-facing balcony with a decent eave or an upstairs balcony above it. Other units do a great job of insulating.

Renting or buying, house or apartment, look for a place which can be opened up at both ends so you can get breezes through once the outside air cools down. Windows with flyscreens and security flyscreen doors give you more options for getting the house opened. Hot air rises, so if you can get a stream of cool air coming in down low and a vent out somewhere up high, you can lower the temperature quite efficiently through a process known

## REDUCING YOUR VULNERABILITY

as ‘natural buoyancy’. And during hot spells don’t use your exhaust fans or rangehood fans as they’ll pull in hot air from outside.

Houses which aren’t set up in a sensible way can be retrofitted to overcome some of their problems, but your life will be so much easier (and you’ll spend less time insulating and more time partying, harvesting kale or whatever) if you start with a good orientation. If you do need to retrofit, you’ll save yourself a lot of money and increase your self-reliance by learning some basic carpentry and DIY skills. It’s good to know you can build something if you need it, or fix it when it breaks.

### ***Retrofitting and cool retreats***

If you own a house, the most effective way to keep it cool without air-conditioning, particularly if you’re not planning to build a new house from scratch, is insulation. Have a look at the ‘Everything insulation’ section below for more detail on how to keep cool air in and hot air out.

Taking advantage of any thermal mass in the house will also help. For example, earth stays cool much longer than most buildings, so if you have the potential to dig down a little or even adapt your underfloor area, you may be able to build a cool retreat for use on the hottest days. Many early colonial Australian houses had basements or ‘summer drawing rooms’ used for just this purpose, but they have since fallen out of fashion.

Some innovative house designers<sup>76</sup> have been looking at introducing cool retreats or cool cells to new houses. These couple of rooms are on the south side of the house, heavily insulated and possibly air-conditioned while the rest of the house uses little or no insulation and isn’t artificially cooled, but is very well ventilated

with extensive passive cooling. The cells mean only a small part of the house needs to be kept cool during very hot weather, saving a great deal on energy use.

In a project for the National Climate Change Adaptation Research Facility<sup>77</sup>, researchers from the University of South Australia and others tested, in great detail, methods for retrofitting five different housing types, including apartments, in several different locations to determine which measures have the most effect.

Measures they took included external shading, adding insulation, improving glazing on windows and putting in ceiling fans. But throughout all the housing types in every location they found the best way to increase residents' comfort without increasing power use was to create a cool retreat, even though the houses had not initially been designed with one. If you're interested in setting up a cool retreat in your home it's worth reading the paper, called 'A framework for adaptation of Australian households to heat waves'. It includes plans and suggestions for different ways to tackle this project.

### ***Shading and vegetation***

Whether you rent or own, stopping the sun from falling on your walls, windows and more problematically the roof will pay coolness dividends. There are a lot of ways to shade a house. The most expensive are motorised outdoor blinds and awnings, or extensive shade sails. Some people install slanted louvres, but these are also expensive and unless oriented perfectly for your area they can be quite ineffective. External roller blinds, bamboo blinds or shade cloth are cheaper and less permanent, so better if you're renting.

## REDUCING YOUR VULNERABILITY

Attach the shade cloth to a bit of dowel at each end, put some hooks in the wall above the area you want to shade and chuck the dowel over the hooks. In cooler weather you can take it down.

If you're around for the long haul, why not plant some trees? Deciduous trees grown along a western wall will shade it in summer, and lose their leaves and allow sun through in winter. If you choose trees which fruit or grow nuts, even better. You can build a simple trellis or pergola quite cheaply along the west or north side of your house and plant it with a grapevine, wisteria, passionfruit or kiwi fruit, depending on whether you want bare branches in winter. Or if you're in a rented home and need something temporary, you can run wires up to your guttering from planters on the ground. Japanese homes and businesses have been using this method, called 'green curtains' since the shutdown of nuclear plants meant less energy availability. You can find instructions here <http://global.kyocera.com/ecology/greencurtains/sodateyou.html>. If your house is tall and thin and you're in an area which gets cold in winter, you can grow hops on wires up the walls as they grow incredibly quickly and very high each summer then die back in autumn. The hop flowers are used to flavour beer: if you're not a brewer you can probably swap them with a local hipster for something more edible. In a rented apartment, indoor plants or large pot plants on the balcony will make a difference.

Whether it's shading the house or not, the more vegetation you can grow on your little bit of ground, on your balcony or around your apartment, the cooler the area will stay. If you're in a bushfire prone area see the 'Surviving fire' chapter, as you'll need to choose your vegetation carefully. And depending on what you

plant you may also need water tanks or a method of recycling your waste water for garden use. See the 'Water' and 'Waste water and sewage' chapters for more information.

***Staying in tune with the temperature***

It's pretty common these days to use your house, car, office, gym, shopping mall, cinema, etc., to cut yourself off from whatever weather is happening outside. While we've largely abandoned controlling the global climate, we're very into controlling our own microclimate, generally by using large quantities of electricity. We scoot from air-conditioned house to air-conditioned car to air-conditioned office to air-conditioned car to air-conditioned gym to air-conditioned car...

It's not as reliably icy, but getting more in touch with what's going on in the climate around you can help you keep cooler without the use of air-conditioning. Be aware of when the sun hits the house in the morning, because that's time to lower all the blinds, shut the windows and doors and try to keep things sealed up. Once the sun is off the house you can think about opening some blinds if the air outside isn't too scorching. Then once the sun sets and the outdoor temperature drops below the indoor temperature, and this can take a while, open up everything you can and get a breeze through the place. If there are doors or windows you have to keep shut overnight for security, open those up as soon as you can when you get up in the cool of the morning to get some fresh air into the house. Then there are those blessed days when a cool change comes through. As soon as that happens you know it's time to open up absolutely everything and blow the hot air out of the house. It's possible to get a bit obsessive about

## REDUCING YOUR VULNERABILITY

indoor versus outdoor temperature (or is that just Jane?). Helpful tools include an indoor thermometer and a weather eye on the Bureau of Meteorology's current temperature website.

Having a flexible house design helps with shifting from room to room to stay cool. Rather than having specific rooms for specific functions, and having to move to the one that suits what you're doing, you can minimally furnish each room and move mattresses, cushions and rugs from one to another to follow the cooler temperatures. No one room has to be your bedroom, you just sleep wherever it's coolest at the end of the day, and that may even be outside.

The biggest risk with making your home too comfortable is that you'll never want to leave it. Try not to shut yourself away, as staying connected with friends, family and the wider community will help get you through some of the worst extreme weather or psychological crises. Evan Beaver, an energy efficiency consultant who's retrofitted more than one Canberra house to heat proof and cold proof it and who helped out with a lot of the information in this chapter, says it's important to make sure there's something you enjoy doing outside for every type of weather. He's taken up canyoning so he looks forward to going outdoors on even the hottest days. And if the heat is bringing you down, he says, remember that having solar power and solar hot water on the roof will make you feel better about those long sunny days...

### *Everything insulation*

If it hadn't been run so poorly, the Australian government's home insulation scheme, otherwise known as 'the pink batts debacle', might have done a great deal to keep Australians' electricity bills

down and their houses more comfortable. Unfortunately, the scheme was cut off and you now have to pay for your own pink batts. Still, insulation is one of the most worthwhile things you can do to keep your house comfortable without expending energy. And the good news is even if you only insulate your ceiling, you'll make the money back on power bills in around five years<sup>78</sup> and that figure assumes 2011 power prices and 2011 temperatures, neither of which is true anymore.

Insulation works best at keeping cold out and heat in, which isn't the best news for our future climate. But it can work well in hot climates if you follow a few simple rules. The first is to shade windows as windows let in a *lot* of heat if the sun falls directly on them. The second is to make sure your house can easily be opened up to breezes once the outside temperature drops. If you over insulate and don't shade windows or have adequate ventilation, you'll find it really hard to cool your house at night.

Your ceiling is the best place to start insulating as most of the sun's heat falls on your roof. You have the choice of bulk insulation or foil, but either way, look for the highest 'R value' you can find. Bulk insulation includes batts and pumped-in paper or foam. If you're using batts, try not to compress them, and don't leave gaps where air can get around them. You should cover any downlights with specially made caps that reduce airflow and stop the batts catching fire from a light's heat. You can use foil alone or with bulk insulation. In the roof the shiny side should face inwards. It's best to get a professional to install foil, as it's dangerous when done near electrical cabling, as anyone who watched the news during 'the pink batts debacle' would know.

Next, go for the walls, and particularly the west wall. The late-



## REDUCING YOUR VULNERABILITY

afternoon sun does the most to heat your house and the further away you can keep it from you, the better. If you're retrofitting rather than starting from scratch, your wall insulation will probably be one of the blow-in types, either loose fill or a foam that's free from volatile organic compounds as foams with VOC have been linked with bad health for house occupants. If you've got a way to get foil in there as well, point the shiny side towards the inside of the house and remember it's best to use a professional installer.

If you still have money left to spend, insulate under your floor. Installing underfloor insulation is particularly unpleasant and difficult as well as being the least effective for keeping cool, so don't worry too much if you can't get it on to your to-do list.

The effectiveness of any insulation relies on you sealing draughts around doors, windows and roof ducting, so seal, seal, seal.

Analysis by the Alternative Technology Association has found that if you want to minimise the environmental and adverse health impacts of insulation, recycled foil or recycled polyester batts or sheeting are the best choices.

If you're building a house from scratch, you can insulate everywhere as you build. You can even build your house *from* insulation. Straw bales are a great building and insulating material. Or for something more modern and high-tech, try hempcrete (a mix of hemp and lime), structural insulated panels (a sandwich of board-insulation-board) or Hebel (a lightweight, fire-proof, Australian made concrete replacement).

If you're buying somewhere new, think about what it will cost you to retrofit it. For example, insulating a roof with trusses costs around \$800. If it's a cathedral ceiling and you have to put a false ceiling in, you're looking at \$15,000. A house with brick veneer

will make your life easier when you're filling wall cavities but double brick or weatherboard will be a pain. Add those costs to the purchase cost and decide whether it's worth it or whether you should keep looking.

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**CASE STUDY: LIVING IN AN EARTHSHIP**

Design lecturer Marty Freney is building an Earthship in the Adelaide Hills as an experiment in the extremes of sustainable architecture.

Freney's Earthship is designed to be entirely off-grid for both energy and water. It is crazily thermally efficient, maintaining a comfortable temperature day and night, summer and winter, without powered heating or cooling, though it does have a wood stove, more for coziness than heat, and as a backup for the solar hot water should he want a warm shower after a string of overcast days.

Earthships were invented by Mike Reynolds, an American architect who has been developing his design in the high deserts of New Mexico for decades. The classic Earthship design features a 'foundation' of recycled tyres, rammed earth floors and thick mud walls, often with part of the house built into a hill, or 'berm' to moderate temperature. Clever ventilation brings air into the house through the cool thermal mass of the thick walls. It has recycled bottle windows and a greenhouse on the sunny side of the house to provide food and to moderate temperature, bring nature and oxygen inside and provide a filter for waste water. There will usually be a reed bed outside the house to further filter waste water, large water tanks and solar cells or a wind turbine.

## REDUCING YOUR VULNERABILITY

Earthships are human built, with as much of the work as possible done by hand by teams of volunteers. The buildings use recycled materials and are low cost to build and very cheap to run.

Freney describes the Earthship as “the best passive house design I’ve seen. Better, in fact, than the *passivhaus*”, a European low-energy house which relies on an engine for thermal moderation. He expects his particular design, a small, rounded house with one main room, a bathroom and a greenhouse, known as the ‘simple survival model’, will have an energy efficiency rating of 9.5 to 10 stars. The mandated minimum for new houses is 6 stars. It stays brilliantly cool in summer and needs very little sunlight to provide for its power needs. It’s also bushfire resistant.

Samuel Alexander, who built an Earthship in rural Victoria in 2013, agrees with Freney, saying, “Heat congregates at the front of the Earthship and when it gets hot you open the window at the top front and open the cooling tube which goes back about 4m then 12m down to the right, and when you do that the cool air gets sucked in and the hot air gets sucked out. So you have this extraordinarily naturally adjustable house with no energy input. It doesn’t need cooling in the summer or heating in the winter. It’s been on the property for a year and I’m happy to say the theory is true in practice. I’ve been in there on a 42 degree day and it’s been pleasantly cool and I’ve been there in winter and it’s been pleasantly warm.”

Freney says he didn’t have that much trouble getting his house approved, despite its highly unconventional design. The lack of concrete footings did cause a bit of angst for the first planner he spoke to, but he says anyone keen to build their own Earthship should get a private certifier rather than going to the local council,

then look for an open-minded, flexible engineer who'll take your footings on their merits rather than being bureaucratic. You might also have to be prepared to abandon the purist Earthship design as very few jurisdictions will let you treat black water with a reed bed. Freney compromised by putting in a switch to divert flow to a septic tank if needed. His Earthship is costing him about \$120,000 to build, \$20,000 of which has gone on solar panels and batteries. The cost of panels and batteries comes down every year, so if you're considering this, budget for a bit less.

While he loves the Earthship idea, Freney says it isn't the be-all and end-all of sustainable house design. In fact, his everyday house is an off-grid straw bale house on the same property. What really matters, he reckons, is to start somewhere where the environment is optimally liveable if you can, build for your local conditions, minimise energy use as far as humanly possible, and then get off the grid. He thinks our lives could benefit from learning to live within our energy means, accepting that sometimes the power runs out before the day does and that a cold shower now and then won't kill you. And he loves the idea of a house that lets you be part of the natural world, where you can respond to changes in temperature and sunlight rather than sealing yourself off and creating a different environment.

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### **What happens in a heatwave**

Heatwaves are among the deadliest natural disasters. The Victorian heatwave preceding the Black Saturday bushfires killed over 370

## REDUCING YOUR VULNERABILITY

people (the fires killed 173) and heatwaves in January 2014 killed around 170 people in Victoria<sup>79</sup>. In heatwaves across Europe in the summer of 2003, 70,000 people died. In the U.S., more people die in heatwaves than in tornados, floods and earthquakes combined<sup>80</sup>.

Price Waterhouse Coopers have been studying the effects of future heatwaves<sup>81</sup>, and found that in Adelaide, Brisbane and Melbourne, deaths from heatwaves are likely to double by 2050, and in Melbourne double again during extreme events. High night time temperatures are usually the culprit as big jumps in mortality occur when there are more than two hot nights in a row. After the 2014 south east Australian heatwaves, medical bodies and opposition politicians expressed concern that very little was being done in Australia to develop comprehensive, strategic approaches to avoiding heatwave deaths<sup>82</sup>.

If future heatwaves are anything like those of the past, you can expect power outages, public transport delays and cancellations, water supply problems, too few ambulances to meet demand, overburdened hospitals and overfull morgues. In 2009, Adelaide had to set up a refrigerated storage container to cope with the spike in deaths from its six-day run of temperatures over 40°C<sup>83</sup>.

In studies of past heatwaves, researchers at the University of South Australia have found that to nobody's surprise, the well-off suffer least<sup>84</sup>. They can afford to have ducted air-conditioning and run it for longer, and have often built or modified their house to keep it cool. This is more difficult to do if you're renting or in public housing. But as power generation and transmission get flakier and blackouts more frequent, the unreliability of air-conditioning could close that gap.

### **What to do in a heatwave**

#### ***Stock up and get ready***

When you know a string of hot days is coming, get yourself prepared so you don't have to go out in the heat if you don't want to:

- Have a good supply of any medication you need, food for yourself and your pets and some bottled water just in case.
- Have a battery operated personal fan in case you lose power.
- Fill your bath with cold water – if you don't have a bath, fill some basins and buckets – before the heat hits so you can take a dip in it now and again even if the water goes off.
- Swap phone numbers with your near neighbours and make a plan to check on one another at a regular time.

It sounds awkward and you may feel alarmist asking your neighbour to call on you, but building good relationships in your community is one of the best ways of surviving extreme weather. In his study of the 1995 Chicago heatwave, Eric Klinenberg found that being socially isolated was a really significant risk factor for dying during hot weather<sup>85</sup>. In fact, he warned that as the gap between rich and poor grows, as governments hand off their responsibilities for providing social services and as poorer areas become less hospitable, social isolation will cause more heatwave deaths. That's because vibrant, walkable, safe communities provide a place for those who live alone to mix with others and make friends, and lively strips of shopping and community facilities provide air-conditioned retreats for those who can't afford to cool their own homes. In run-down neighbourhoods with high crime rates where people feel unsafe and cut-off, they shut their windows and doors, stay out of touch and bunkered down, and often end up dying alone in stinking hot, unventilated rooms.

## REDUCING YOUR VULNERABILITY

### **Set up a temporary cool retreat**

Keeping your whole house cool isn't necessarily the priority, what's most important is keeping yourself cool. This could be by dedicating part of your house to be a 'cool retreat', either permanently – see above for more information on how to do that – or if you don't have the means or ability, setting up a temporary cool retreat when a heatwave is coming. If you have a south or east facing room, particularly one on the ground floor or in a basement area if it has ventilation, try to isolate it from the rest of the house to keep it cool, then sleep in that room at night. Use a fan or air-con in the room too if possible.

### **Go somewhere cooler**

If there's nothing you can do to keep your house, or part of it, cool try to get out to somewhere cooler. If a heatwave is coming and you have a way to get out of the city and close to the ocean or somewhere cooler, take it. If your house is very hot it's worth trying to spend a few hours each day, assuming the power is on, in an air-conditioned place to let your system recover a bit, as it's the relentlessness of being hot which damages your body. If you have enough spare cash to spend a night or two in a local air-conditioned hostel, motel or hotel, consider doing that so you can get some sleep.

If you have pets they may also need to go somewhere cooler. Talk to your vet about whether your pet is susceptible to heat illness in extended periods of hot weather and about ways to keep that animal cool. If you can't be around to monitor your pet's health during a heatwave, put some money aside to send him or her to an air-conditioned kennel when the weather is really extreme.

### **Using fans**

If your house gets and stays very hot – over 35°C inside – be cautious with fans. The jury is still out, but a review of the health effects of fans in very hot air<sup>86</sup> found that on dry skin, they may make you hotter. Jane's personal, entirely unscientific experience is that it's best to drape yourself in something damp, or have wet skin, if you're using a fan when the room is very, very hot.

You can also put a bucket of water in front of the fan to cool the air current. Even without power, as long as there's a breeze you can wet a sheet and hang it in front of an open window to create some evaporative cooling.

### **Food safety**

Be careful with food during heatwaves, particularly if the power goes out. The warmer the weather, the quicker food goes off. And getting food poisoning will make you dehydrate more quickly and increase the effects of other heat-related illnesses.

If you lose power, keep the fridge door shut and the food inside should stay cool for about four hours. A switched-off freezer will keep food safe for 24 hours if it's unopened. If food is still cool to touch, it's safe to eat. If it gets warm, cook it thoroughly and you can eat it within the next four hours. If frozen food has stayed solid you can safely refreeze it<sup>87</sup>.

### **Get used to summer**

Research has shown that people who spend most of their time in a narrow temperature band, controlled by air-conditioning, feel the heat more. People who are used to fluctuating, more natural climates are comfortable across a greater range of temperatures<sup>88</sup>.



## REDUCING YOUR VULNERABILITY

Try to get used to summer temperatures so when heatwaves hit they're not such a shock. But do remember that particularly if you're elderly, you may be able to psychologically tolerate temperatures which will still physically damage you. You need to be aware of the symptoms of heat illness, and take steps to cool down if you notice them. Getting dehydrated or too hungry can reduce your cognitive ability and make it harder for you to react to illness, so make sure you know before a heatwave comes what to look out for and have a plan for when it happens.

### **Symptoms and solutions for heat illness**

You are more likely to suffer heatstroke if you are:

- Elderly.
- A baby.
- Pregnant.
- Feverish from an illness or infection.
- Stuck in bed.
- Ill with a chronic illness such as multiple sclerosis, diabetes, dementia, Alzheimer's, a heart or lung condition, or serious mental illness.
- Overweight.
- Taking a medication which affects your ability to sweat or regulate temperature.
- Isolated from others.
- An outdoor or warehouse worker.

If you are in any of these situations, you need to take extra care of yourself during heatwaves. If you're a baby you will probably be relying on someone else to do this for you, so relax.

The early warning signs you're getting too hot are:

- Thirstiness.

## THE HANDBOOK

- Irritability.
- Profuse sweating.
- Tiredness.
- Loss of appetite.

Obviously, pretty much any time you get hot you are going to feel this way, but you shouldn't ignore those feelings. They're telling you to slow down: if you press on, you could go to the next, more serious stage. So find a cool place, relax, drink lots of cool drinks but not alcohol, energy drinks or caffeine, and spray yourself with water if you can. If your muscles are aching, massage them or apply an ice pack if you have one. If you start to feel dizzy or faint, you need to stop what you're doing, lie down in a cool place with your legs elevated, or get yourself into some cool water.

Not taking these steps could push you into heat exhaustion.

The symptoms are:

- Headaches.
- Cold and clammy skin.
- Fatigue and restlessness.
- Nausea and vomiting.
- Weak and fast pulse.
- Poor coordination.

The next step is heatstroke, and heatstroke can kill you. If none of the above strategies work, put ice packs in your armpits and groin, and then get to a doctor.

If your symptoms get worse get medical help. Get medical help immediately if:

- Your skin gets hot, flushed and dry.
- You're intensely thirsty.
- Your tongue swells.

## REDUCING YOUR VULNERABILITY

- Your temperature increases.
- You get disoriented or sleepy or start behaving bizarrely.

Without intervention you could easily begin convulsing or fall unconscious. If you are with someone suffering these symptoms, call an ambulance and, if they're conscious, give small sips of liquid. Do not give aspirin or paracetamol.

The problem with heatwaves, particularly as they become more frequent, is that many of the strategies for avoiding heat illness become more difficult. It's harder to find a cool place to relax, water supplies may be limited, ice packs may be entirely out of the question and doctors and ambulances are likely to be overburdened already.

If your resources are limited and the public health system isn't keeping up, the best thing you can do is avoid getting too hot in the first place. Slow down. Relax. Procrastinate about getting things done and lie around in a wet sarong instead. Put your pillowcase in the freezer until bedtime. Keep a stash of wet washcloths in the fridge to wipe yourself down with or to drape dramatically across your forehead while you lie inert on the couch.

Once the heatwave has passed, spend some time thinking about what worked and what didn't. Talk to anyone you share your home with and think about if there are changes you can make before the next hot spell arrives. Because the one sure thing about climate change is that another hot spell is always on the way.