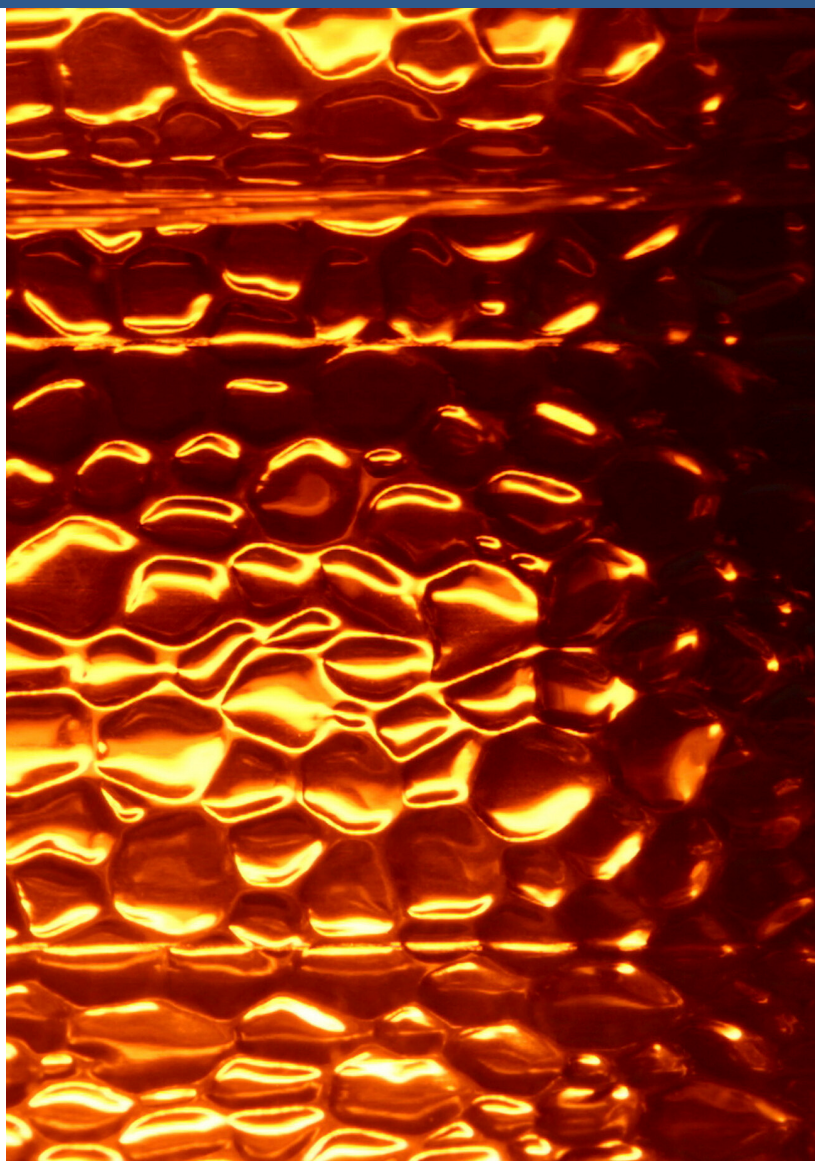
HOME-BAKED: HOUSING, HEAT, AND HEALTH



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Home-baked: housing, heat, and health
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Home-baked: housing, heat, and health

Better Renting, 2020

Executive summary

This paper examines the relationship between heat, health, and housing. From a literature review, our own analysis of the Australian Housing Conditions Dataset, and qualitative input from renters, we highlight that heatwaves pose a significant health threat, in terms of both disease and mortality. These risks are potentially concerning for older Australians, people with mental health conditions, and the socially isolated. Due to climate change, and an ageing population, these risks are projected to increase: dangerous events will happen more often, and the vulnerable population will be larger.

Housing, and tenure, are other important factors in how heat affects health. Vulnerable people are likely to be living in substandard housing, as are people who rent. This compounds vulnerability to deadly heat: inefficient homes get hot faster and can be harder to cool. Air-conditioning is a critical tool to reduce heatwave mortality, yet it is unavailable to many vulnerable people, either because it isn't present in their homes, or they cannot afford to operate it. Renters we heard from described homes that were virtually uninhabitable in summer, and a sense of powerlessness in the face of agents or landlords who are unresponsive to their requests.

Considering these findings, we make the following recommendations to decision-makers:

- Improve the energy efficiency of housing stock,
- Increase vegetation and street shading,
- Facilitate access to public cool areas,
- Facilitate a transition from gas heating to RCAC, &
- Encourage rooftop solar PV.

In the words of Annie Bolitho and Fiona Miller, "prolonged periods of extreme heat reveal social injustices."[1] These measures will assist with adaptation and are likely to be of most benefit to more vulnerable households. They will improve public health and improve community resilience. In the face of a changing climate, they will contribute to protecting the health and wellbeing of those members of our community who would otherwise bear the greatest burden.

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The views expressed in this document do not necessarily reflect the views of Energy Consumers Australia nor the ACT Government.

[1] A Bolitho & F Miller, 'Heat as emergency, heat as chronic stress: policy and institutional responses to vulnerability to extreme heat', in *Local Environment*, vol. 22, 2017, 682–698.

Introduction

The effect of heat on human health is mediated by housing: high-quality housing offers shelter from potentially dangerous temperatures, while low-quality housing can increase risk, leaving inhabitants in temperatures hotter than the outdoors. Beyond the housing envelope itself, where and how people live determines their local microclimate and adaptation options available to them.

This paper examines factors in the relationship between heat and health, with emphasis on housing and tenure. With the frequency and severity of extreme heat events predicted to increase, and thus the risks to human health, we seek to better understand existing vulnerabilities and suggest possible responses.

Method

This paper is principally informed by a literature review of academic papers on heatwaves and health. Wherever possible, we have sought Australia-specific literature. In addition, we conducted our own analysis of the Australian Housings Conditions Dataset to look at the role of tenure with reference to these issues.

Further, we sought input from people who rent about their experiences of occupying rental properties in summer. Through our Facebook page (FBP) and "Canberra Renters" Facebook group (FBG), we heard from a convenience sample of twelve renters who shared anecdotes about their experiences. These are included in a dedicated section on the experiences of renters.

Key themes are summarised and discussed below.

Key themes

Heat is risky (and the risk is increasing)

Heat harms health. Extremely hot weather, particularly for extended periods without cool evenings, increases both mortality (deaths) and morbidity (disease). In Australia, the death toll from extreme heat events is greater than from all other natural hazards (such as floods or bushfires) combined.[2,3] Indeed, more people died from the heatwave that preceded Victoria's Black Saturday bushfires of 2009 than died from the bushfires themselves.[4] These deaths are linked to heat stroke and dehydration.[5] In addition, heat stress can worsen chronic conditions and affect existing mental disorders. Cardiovascular, respiratory, and renal conditions are

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[2] While many deaths are linked with cold weather, these deaths do not typically occur during extreme cold weather, and they would not be linked with a natural hazard as such.
[3] L Coates et al., 'Exploring 167 years of vulnerability: an examination of extreme heat events in Australia 1844–2010', in *Environmental Science & Policy*, vol. 42, 2014, 33–44.
[4] K Kruszelnicki, 'Heatwaves are more deadly than bushfires and they're going to get worse', in *The Sydney Morning Herald*, Sydney, 13 December 2016.

especially affected[6]; in warmer parts of Australia, higher temperatures predict increased rates of suicide.[7] Heat can also harm health by affecting moods and spurring dangerous behaviour such as overdrinking or violence.[8]

The health effects of heat are expected to get worse into the future. Climate change is part of this: the increasing frequency and severity of heatwaves and other extreme heat events is predicted to result in greater heat-related morbidity and mortality.[9] But other trends will compound the dangers of climate change: an ageing population will be less resilient on average to heat[10]; an urbanising population will be more vulnerable to the urban heat island effect (UHIE) and may have fewer options to escape the heat.[11]

Other trends may also be worth considering. Whether or not power prices continue to increase in real terms, if utility costs consume a growing proportion of household budgets (especially for lower-income households), this may result in reduced capacity to afford measures to adapt to heat extremes. Already, low-income households are mitigating against high power prices by reducing air-conditioner (AC) usage.[12] Changes in the housing market may also be relevant: a growing number of rental households with insecure tenancy may limit tenants' ability to negotiate improvements[13]; a growth in apartment living may result in homes that are ill-adapted to hot weather and dependent upon air conditioning in order to be habitable[14]; more single-member households may mean more risks from social isolation[15].

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[5] Moreland Energy Foundation & Moreland City Council, *Cooling Communities Final Report*, Melbourne, 2017.
[6] Moreland Energy Foundation and Moreland City Council.
[7] Y Zhang et al., 'The MJA-lancet countdown on health and climate change: Australian policy inaction threatens lives', in *Medical Journal of Australia*, vol. 209, 2018, 474.e1-474.e21.
[8] C Palazzo, 'Sydney's heatwave blamed for spike in violence as Australians drink more', in *The Telegraph*, Sydney, 14 March 2016; CA Anderson, 'Temperature and Aggression: Ubiquitous Effects of Heat on Occurrence of Human Violence', in *Psychological Bulletin*, vol. 106, 1989, 74–96.
[9] N Watts et al., 'Health and climate change: policy responses to protect public health', in *The Lancet*, vol. 386, 2015, 1861–1914.
[10] HJ Bambrick et al., 'Climate change and health in the Urban environment: Adaptation opportunities in Australian cities', in *Asia-Pacific Journal of Public Health*, vol. 23, 2011.
[11] CK Uejio et al., 'Intra-urban societal vulnerability to extreme heat: The role of heat exposure and the built environment, socioeconomics, and neighborhood stability', in *Health and Place*, vol. 17, 2011, 498–507; Chief Health Officer of Victoria, *January 2009 heatwave in Victoria: an assessment of health impacts*, Melbourne, 2009.
[12] Bankwest Curtin Economics Centre, *Energy Poverty in Western Australia: A Comparative Analysis of Drivers and Effects*, Perth, 2016.
[13] Bolitho and Miller, 682–698.
[14] University of Melbourne, *Living Well: Apartments, Comfort and Resilience in Climate Change*, in *Thrive Research*, Melbourne, 2017.
[15] Bolitho and Miller, 682–698.

While heatwaves have long been a health threat in Australia, the health risks are predicted to worsen into the future. This is caused by a confluence of factors including a changing climate, an ageing population, and increasing urbanisation.

Who is vulnerable?

The health risks of heatwaves are not distributed evenly across the population. Depending on the nature of the risk, certain sections of the community are particularly vulnerable. Below, some of these sections are discussed. Housing-related risk, including access to AC, is discussed in a subsequent section of this paper.

Age-related vulnerability

Both the very old and the very young are particularly at risk from hot weather.[16] Just as older Australians are particularly vulnerable to cold weather, they are also more at risk from the heat, due to both greater probability of having an existing health condition and a decreased capacity for thermoregulation.[17] Infants and young children are also more at risk of morbidity.[18] Older people are also more likely to have reduced cardiovascular capacity, to be using medications that may impair thermoregulation, or to have impaired mobility. These factors add to the vulnerability of elderly people.[19]

Mental illness

Hot weather worsens mental health. In addition, people with mental health conditions are more at risk of morbidity or mortality from extreme weather events. This relationship is not simple and is due to a number of factors: people with mental illness tend to experience disadvantages that may affect their ability to access air-conditioning[20]; they may be more socially isolated[21]; their mental illness may itself be linked with increased physical vulnerability[22]; and they may be unable to care for themselves or be unaware of risks or

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[16] Australian Academy of Science, *Climate change challenges to health: Risks and Opportunities. Recommendations from the 2014 Theo Murphy High Flyers Think Tank*, Canberra, 2015; Watts et al., 1861–1914.

[17] WL Kenney & TA Munce, 'Physiology of Aging Invited Review: Aging and human temperature regulation', in *Pandolf KB. Exp Aging Res Ageing Res Rev Exp Aging Res*, vol. 17, 1997, 41–76; RS Kovats & S Hajat, 'Heat Stress and Public Health: A Critical Review', in *Annual Review of Public Health*, vol. 29, 2008, 41–55.

[18] Australian Academy of Science; Watts et al., 1861–1914; T Walter et al., *Impacts of climate change on public health in Australia : Recommendations for new policies and practices for adaptation within the public health sector*, in *Deeble institute issues brief*, Canberra, 2014.

[19] Chief Health Officer of Victoria.

[20] J Herbst et al., 'Heat-related deaths in Adelaide, South Australia: Review of the literature and case findings - An Australian perspective', in *Journal of Forensic and Legal Medicine*, vol. 22, 2014, 73–78.

[21] R Kaiser et al., 'Heat-related death and mental illness during the 1999 Cincinnati heat wave.', in *The American journal of forensic medicine and pathology*, vol. 22, 2001, 303–307.

[22] L Cusack, C de Crespigny & P Athanasos, 'Heatwaves and their impact on people with alcohol, drug and mental health conditions: A discussion paper on clinical practice

strategies for coping[23]. In all, pre-existing psychiatric illness has been found to more than triple the risk of death from heatwaves.[24]

In addition, many people with mental illness use psychotropic drugs. A meta-analysis of numerous case-control studies found this to increase the risk of dying in a heatwave by 90%.[25] This is because many such drugs affect the body's ability to regulate its own temperature, increasing vulnerability to heat.[26] Further, certain drugs can cause weight gain, which also increases the risk of heat-related death.[27] These risks are present even when the mental disorder doesn't compromise the capacity for behavioural adaptation.[28]

Social isolation

People who are socially isolated are more at risk of adverse health outcomes from heatwaves. These may be people who live alone, or who don't leave their home daily. People with increased social contact are 60% less likely to die during a heatwave.[29]

Efforts to address social isolation have demonstrated a marked reduction in heatwave mortality. One Italian program aimed to strengthen social capital for elderly Romans. The program contacted those over 75, aimed to involve members of their community in volunteer care actions, and educated the community about the needs of older adults. Using a controlled study, researchers estimate that the program reduced heatwave mortality by 13%.[30]

Hot property: heat and housing

A consistent theme in the literature on heat and health is the relevance of housing. Generally, more vulnerable people are more likely to live in substandard housing[31], and this housing compounds vulnerability: occupants have less capacity to adapt, and they are more likely to struggle with cooling costs. Renters are particularly at risk, partly because they are prevented from making structural improvements to their homes.[32]

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considerations', in *Journal of Advanced Nursing*, vol. 67, 2011, 915–922.

[23] Cusack, de Crespigny and Athanasos, 915–922.

[24] A Bouchama et al., 'Prognostic Factors in Heat Wave – Related Deaths', in *Archives of Internal Medicine*, vol. 167, 2012, 2170–2176.

[25] Bouchama et al., 2170–2176.

[26] Bouchama et al., 2170–2176.

[27] B CL, 'Heat stroke. Keeping your clients cool in the summer.', in *J Psychosoc Nurs Ment Health Serv*, vol. 35, 1997, 12–7.

[28] M Lõhmus, 'Possible biological mechanisms linking mental health and heat—a contemplative review', in *International Journal of Environmental Research and Public Health*, vol. 15, 2018.

[29] Bouchama et al., 2170–2176.

[30] G Liotta et al., 'Social interventions to prevent heat-related mortality in the older adult in Rome, Italy: A quasi-experimental study', in *International Journal of Environmental Research and Public Health*, vol. 15, 2018, 1–13.

[31] Coates et al., 33–44.

[32] L Nicholls et al., *Heatwaves, Homes & Health: Why household vulnerability to extreme heat is an electricity policy issue*, Melbourne, 2017.

Substandard housing is likely to be inefficient, offering less protection against extreme heat. Such homes heat up faster and can take longer to cool down. Occupants thus spend more time exposed to dangerous, unhealthy temperatures.[33]

Renters are more likely to be in substandard housing, and disproportionately likely to lack cooling measures such as fans[34]. According to a 2016 survey, renters, both private and public, are much more likely to be living in housing rated "poor" or "derelict": 18.65% of public renters, and 9.46% of private renters, compared with just 3.14% of owners.[35] Better Renting research has found that disclosed energy efficiency ratings in the ACT are 0 for rental properties 40% of the time, and only 5% of the time for properties advertised for sale.[36]

Another dimension to this issue is urbanisation and the loss of green space. Generally, built-up urban areas are hotter due to the UHIE, especially when there is limited green space. These environments are less comfortable and more dangerous during periods of extreme heat.[37] For example, analysis of heat deaths from a 1995 heatwave in Chicago found that decedents were more likely to have lived on the top floor of a building, or to have lived in an apartment.[38]

However, the experience may not be the same in Australia, as vulnerable populations may be less likely to live in dense urban areas, instead residing in free-standing dwellings in suburban areas.[39] Further, density itself is not necessarily a problem and may in fact enable adaptation. For example, an appropriate combination of density, mixed land use, and connectivity, can encourage active transport and a more resilient population.[40]

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[33] T Moore et al., 'Dwelling performance and adaptive summer comfort in low-income Australian households', in *Building Research and Information*, vol. 45, 2017, 443–456.
[34] Bolitho and Miller, 682–698.
[35] E Baker et al., 'Poor housing quality: Prevalence and health effects', in *Journal of Prevention & Intervention in the Community*, vol. 44, 2016, 219–232.
[36] Better Renting, *Baby it's Cold Inside: Energy Efficiency Ratings in the ACT*, Canberra, 2019.
[37] Bambrick et al.
[38] SJ C. et al., 'Heat-Related Deaths during the July 1995 Heat Wave in Chicago', in *New England Journal of Medicine*, vol. 335, 1996, 84–90.
[39] M Loughnan, N Nicholls & NJ Tapper, 'Mapping Heat Health Risks in Urban Areas', in *International Journal of Population Research*, vol. 2012, 2012, 1–12.
[40] Bambrick et al.

Air conditioners: an ambivalent adaptation

Another way that housing influences heat-related health risk is through access to air conditioning (AC). Consistently, access to AC is powerfully linked with reduced heatwave mortality.[41] As such, households without AC are more at risk, and the installation of air conditioning appliances may improve resilience.

However, caution is warranted before championing AC. Many low-income households are reluctant to use AC due to cost concerns[42]: a household that has AC but doesn't use it is no better off. Further, increased penetration of AC results in increased peak demand, which can lead to higher power prices overall and/or increase the risk of blackouts.[43] AC, when powered by fossil fuels, also contributes to climate change: an example of maladaptation.[44]

Blackouts are particularly concerning because many Australian apartments are designed such that they rely on AC in order to be habitable in summer. This contrasts with other jurisdictions, where apartments must be habitable while "free-running", i.e., without the use of AC.[45] Perversely, the greater availability of AC may result in the construction of dwellings that are less climate-resilient and depend upon AC to compensate.

As such, public health messages should be nuanced. Encouraging AC as an adaptation to extreme heat runs the risk of increasing stress on the electricity grid and promoting a perverse dependence on cooling appliances.[46] However, for certain households, AC usage is essential in order to maintain health in hot conditions. Ultimately, public health messages need to 'thread the needle'. This may look like prompting at-risk individuals to access AC, while alerting other households to the individual and community benefits of moderating their own usage.

Experiences of heat for people who rent

People who rent are particularly vulnerable to heat. This is because vulnerable people are more likely to be renting and because renting increases vulnerability. As such, renting is both an effect and a cause of vulnerability to heat.

We can see how renting causes vulnerability from the Australian Housing Conditions Dataset (AHCD). As discussed above, rental properties are much less likely to be energy efficient, compared to other properties. Rental housing is less adapted to climate change and is

[41] Bouchama et al., 2170–2176.
[42] Bankwest Curtin Economics Centre.
[43] S Buranyi, 'The air conditioning trap: how cold air is heating the world', in *The Guardian*, London, 29 August 2019.
[44] J Barnett & S O'Neill, 'Maladaptation', in *Global Environmental Change*, vol. 20, 2010, 211–213.
[45] University of Melbourne.
[46] Y Strengers & C Maller, 'Integrating health, housing and energy policies: Social practices of cooling', in *Building Research and Information*, vol. 39, 2011, 154–168.

vulnerable to heat extremes.[47] Consistent with this, 16% of renters report they are "not able to keep comfortably cool in summer", compared with 4% of owners.[48] This difference is not due to differences in income: renters on low incomes are almost six times more likely than mortgagor homeowners in the same income range to report difficulties keeping cool.[49]

> *"My husband has resorted to sleeping in the lounge room in summer as he cannot stand the heat in the room." (FBG)*
>
> *"Coupled with awful insulation it's pretty dangerous being inside some days, let alone trying to get restful sleep. I hate summer just because I rent." (FBG)*
>
> *"Our place is like an oven in summer upstairs in the bedrooms…being a townhouse estate it's a concrete heat sink." (FBG)*
>
> *"In summer we can get the inside temp down to 30 degrees minimum." (FBP)*
>
> *"Some nights in the peak of summer, the only way I could sleep was to wrap myself in a sheet and lie directly on the tiles in the kitchen, because they were the only cool place in the house." (FBG)*

Another dimension to the experience of people who rent is that of mental illness. As discussed above, mental illness is exacerbated by heatwaves, and mental illness also increases vulnerability to heatwaves. Further, poor-quality housing and rental stress can exacerbate mental illness.[50]

> *"The heat makes me extremely anxious and I'd have panic attacks daily because of how oppressive the heat was!" (FBG)*

The AHCD includes data on mental illness. Respondents were asked whether, in the last 12 months, they had been told by a doctor that they had anxiety, depression, a stress-related problem, or any other mental health problem. For each tenure, a higher household income was inversely correlated with poorer mental health. However, for the same income ranges, rental households were more likely to report a diagnosis of a mental health problem.[51] This suggests that rental households face an increased mental health burden during episodes of extreme heat.

	Very low income	Low income ($40-	Other households

[47] L Instone et al., *Climate change adaptation and the rental sector*, Gold Coast, 2014, .
[48] E Baker et al., 'The Australian Housing Conditions Dataset', ADA Dataverse, 2019. (Own analysis)
[49] E Liu, C Martin & H Easthope, *Poor-quality housing and low-income households*, Sydney, 2019.
[50] A Singh et al., 'Housing Disadvantage and Poor Mental Health: A Systematic Review', in *American Journal of Preventive Medicine*, vol. 57, 2019, 262–272.
[51] Baker et al. (Own analysis)

	(<$40k)	60k)	($60k<)
Owner (outright)	16%	17%	9%
Owner (mortgage)	28%	21%	16%
Renter	33%	36%	19%

Table 1: In the last 12 months, have you been told by a doctor that you have any of the following conditions: anxiety, depression, a stress related problem, any other mental health problem? (Percentage who responded yes)

These data corroborate the anecdotal experiences of people who rent who have been in touch with Better Renting. Many renters described homes that would become so hot in summer that they were virtually uninhabitable: some people would report abandoning their bedroom and even sleeping outside to try to escape the heat. While some renters do have access to AC, issues with draught-sealing and insulation can mean that AC offers limited relief, with the effect being lost within minutes of turning it off. People are also concerned about the health of their pets, given the extreme indoor temperatures.

An important psychological component to this experience is that of feeling impotent. In contrast with homeowners, renters have an experience of extreme heat that is compounded by a feeling of powerlessness. Renters can identify changes that would improve their situation (such as installing ceiling fans) but they are wary of asking for such changes due to a fear of retaliation in the form of a rent increase or an eviction notice. If a renter *does* ask for changes, they frequently receive no response, or a refusal.[52] This situation gives rise to a certain 'learned helplessness' where people who rent are conditioned not to even try to get an outcome from their lessor.

> *"I didn't ask the landlords to change it because I knew there'd be no point." (FBG)*
>
> *"[A request for an aircon] dragged out, as the real estate was "waiting to hear back" and after several follow ups we never got a conclusive answer." (FBG)*
>
> *"I had put in a request to have the blinds fixed when we moved in…. To no avail." (FBG)*
>
> *"We felt powerless at the time because there weren't many home owners willing to take us with a cat so we accepted this place [despite a lack of heating or cooling]." (FBG)*
>
> *"The air con died at the start of summer while I was pregnant - we requested it be repaired/ replaced and were threatened with eviction for being 'demanding and difficult'." (FBP)*

Overall, people who rent have an experience of heat and heatwaves that is particular to their form of tenure. Renters are more likely to occupy substandard housing and to experience mental illness. In addition, social practices and legislation conspire to create a situation where renters are highly unlikely to succeed in instigating changes in the quality of their homes,

[52] QCOSS, *Measuring choice and control*, Brisbane, 2017.

either because they are reluctant to approach their lessor, or because such an approach fails to bear fruit.

Options to reduce health risks from heat

Although the health burden of heat is expected to increase, there are steps that governments can take to improve community resilience. Our review has discerned a few principal recommendations. In addition to these, we offer our own recommendations, based upon the challenges we've identified.

Recommendations are:

- Improve the energy efficiency of housing stock,
- Increase vegetation and street shading,
- Facilitate access to public cool areas,
- Facilitate a transition from gas heating to RCAC, &
- Encourage rooftop solar PV.

Improve the energy efficiency of housing stock

As discussed above, inefficient housing stock leaves occupants more vulnerable to the harmful effects of extreme heat. In this sense, improving the energy efficiency of housing is an important step to improve climate resilience and assist adaptation. Not only would homes require less cooling, the cooling need could be met with less energy consumption, and reduced year-round energy bills could free up resources to use for summer cooling. In short, "passive design offers a way to ameliorate the vulnerability of low-income households to heat and financial stress."[53] Further, reduced energy consumption will contribute to climate mitigation.

This intervention would require:

- targeting new buildings, i.e., through the National Construction Code;
- targeting existing rental properties, i.e., through Residential Tenancies Acts; &
- targeting existing owner-occupier properties.

The COAG Energy Council, in line with the National Energy Productivity Plan, is currently investigating options in these areas.[54]

Increase vegetation and street shading

In addition to housing itself, another important component of the urban form is the quality of street shading: the quantity and quality of trees. Street shading is important to mitigate against the UHIE. This is especially significant when it comes to reducing overnight temperatures, which are a particular contributor to mortality.[55]

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[53] Moore et al., 443–456.

[54] Commonwealth of Australia, *Trajectory for Low Energy Buildings*, Canberra, 2018.

[55] CDW Rogers, AJE Gallant & NJ Tapper, 'Is the urban heat island exacerbated during heatwaves in southern Australian cities?', in *Theoretical and Applied Climatology*, vol. 137, 2019, 441–457.

As such, increasing "green infrastructure"[56] is another essential intervention to mitigate against the heat effects of climate change. Plants and trees provide shade, and the evaporation of water from their leaves creates a cooling effect. This has been demonstrated to make buildings and their surrounds more comfortable and to reduce energy demand.[57] As an example of a jurisdiction already adopting this approach, the Australian Capital Territory has recently published a climate change strategy which includes a 30% target for "urban canopy cover" and a 30% target for "surface permeability" as a way to "reduce urban heat."[58] In addition to residential sites, vegetation and shading could be rolled out around "open spaces, bus stops, and parking lots".[59]

Facilitate access to public cool areas

When it comes to heatwave mortality, a clear preventative factor is access to air-conditioned or cool spaces. By improving access to such spaces, governments may be able to reduce the death toll from heatwaves.

Common examples of such 'coolspots' are public libraries, public swimming pools, and air-conditioned shopping malls. Public libraries are particularly important, as they offer free entry and don't provoke expenditure — an important consideration for low-income households.[60] Options to facilitate access include extending opening hours so that people are able to access the air-conditioned space for longer. In addition, some people will face barriers even to getting to a cool space. One option for heatwave adaptation would be to provide special public transport services that may make it easier for vulnerable households, particularly those with older members, to get to cool spaces.

Facilitate a transition from gas heating to RCAC

Another option to assist with climate adaptation is for more households to disconnect from gas and become all-electric households, and for governments to facilitate this transition.

This will offer two benefits. Firstly, dual-fuel households are more likely to experience fuel poverty, likely due to the imposition of additional supply charges.[61] As such, households that meet all their energy needs from electricity will face lower overall energy bills. This may give households greater means to meet their need for cooling in summer.

Secondly, while gas is limited to heating (i.e., through combustion), electricity can be used for both heating and cooling. A household that uses gas for heating would require a separate appliance for cooling. But a household with a reverse-cycle AC can use the one electrical appliance for both heating and cooling. Thus, a shift from gas appliances could give more

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[56] Watts et al., 1861–1914.

[57] EP Del Barrio, 'Analysis of the green roofs cooling potential in buildings', in *Energy and Buildings*, vol. 27, 1998, 179–193.

[58] Australian Capital Territory, *ACT Climate Change Strategy 2019-25*, Canberra, 2019.

[59] Bolitho and Miller, 682–698.

[60] Nicholls et al.

[61] A Nance, *Relative Energy Poverty in Australia*, Adelaide, 2013.

households access to the benefits of AC. Reduced usage of gas, a fossil fuel, could also assist with climate mitigation.

Note that if this shift happened on any scale, it would have implications for peak demand in summer. This could affect retail electricity prices, as well as grid stability, which could create perverse outcomes. However, it may be the case that vulnerable households would be better off regardless due to savings on supply charges and greater access to AC. On this issue, more investigation may be warranted to better understand this trade-off.

Support small-scale solar PV

Generally, small-scale solar PV has benefits that are well understood by households, and its uptake is supported by governments. However, a less-considered benefit is the potential health benefits from promoting resilience during extreme heat events.

As noted above, some households ration their usage of energy for cooling due to concerns about affordability. Greater uptake of solar PV has the potential to address these concerns and enable more households to maintain a healthy indoor temperature in a changing climate. Households with their own solar PV systems will experience these benefits directly, and governments should explore options to facilitate direct access to solar PV for more 'locked out' energy users, such as renters and inhabitants of multi-unit complexes.[62]

But even households without their own solar PV system still benefit from increasing penetration of solar PV in the grid. Increased household solar PV reduces grid demand, which results in lower wholesale energy prices. Energy Synapse analysed this effect in the NSW region of the National Electricity Market: over one twelve-month period, they estimate that wholesale prices were lower by 33-50%, collectively saving NSW energy consumers $2.2-3.3 billion.[63]

Small-scale solar PV also mitigates against the risk of blackouts. Certain apartments are designed such that they are dependent upon AC to remain habitable and healthy during a heatwave. Occupants of such an apartment would be at risk in the event of a blackout. However, rooftop solar reduces the likelihood of certain blackouts as it reduces the magnitude of the grid peak and shortens the duration of the grid peak.[64] This makes it less likely that there would be unserved energy demand, reducing the chance of hazardous blackouts.

Conclusion

On current trajectories, the health consequences of heat in Australia are going to get worse. Longer and hotter heatwaves, an ageing population, increasing urbanisation: these trends portend a rising death toll from extreme heat events. The risk is particularly severe for certain

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[62] For example, through solar gardens.

[63] Energy Synapse, *Impact of small solar PV on the NSW wholesale electricity market*, Sydney, 2017.

[64] Energy Synapse.

vulnerable groups, particularly elderly Australians, people with mental illness, and the socially isolated.

Housing intersects with all these issues. Certain vulnerable groups are more likely to occupy low-quality housing, and such housing offers inadequate shelter from the health effects of heat. Renters are particularly likely to be in inefficient homes that get hotter faster and stay hotter longer. Many of them lack the means to cool their homes.

However, there are many options to improve this situation. Improving the energy efficiency and climate resilience of the residential housing stock is essential, as is increasing street shading and access to ‘coolspots’. In addition, a transition from gas to electricity and greater uptake of rooftop PV can both assist. In general, these measures will reduce health risks by improving adaptation, building resilience, and contributing to climate mitigation. They will also ensure that an adaptive response to climate change is possible for all members of the community, not just those with the most resources.

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