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Project Introduction

In the context of energy reforms to address peak electricity demand in Australia, this briefing paper provides a critical review of cost-reflective electricity pricing policy and the potential impacts of heatwaves and other extreme heat events in vulnerable households. It constitutes the first phase of the Heatwaves, Homes & Health research project, funded by Energy Consumers Australia.

In 2012, the Standing Council on Energy and Resources deemed it crucial that the introduction of cost-reflective retail pricing structures 'be accompanied by appropriate consumer engagement and education for all consumers, and protections for vulnerable consumers' (SCER, 2012, p.7). The Heatwaves, Homes & Health project will provide critical evidence about the health and financial risks for heat vulnerable households associated with:

- cost-reflective pricing
- public messaging about peak demand in hot weather

It is widely established that householder concerns about capacity to pay energy bills can lead to self-restriction of home heating during cold weather, and negative health, wellbeing, and social outcomes (e.g. Cornwell et al., 2016; Liddell and Morris, 2010). However, impacts of electricity costs on home cooling use and health in hot weather are less well understood. Understanding this issue is important for energy policy to deliver on commitments to protect vulnerable consumers, particularly given potentially disproportionate health and financial risks facing heat vulnerable householders such as the elderly, infants and those with chronic health conditions.

The Heatwaves, Homes & Health project involves three stages of research:

- Stage 1. Review of existing literature and policy (discussed in this briefing paper)
- Stage 2. An online survey and interviews with informants from the social services sector; and
- Stage 3. Interviews with potentially vulnerable households in Melbourne, Dubbo, and Cairns.

These activities aim to provide insights into:

- household experiences of extreme heat in three different regions and climatic zones;
- dependence on air conditioned cooling, fans and other strategies by vulnerable groups during periods of extreme heat; and
- how pricing, messaging, and programs may impact health and financial risks to heat vulnerable households.

This briefing paper identifies key empirical gaps for the Heatwaves, Homes & Health project to investigate. The paper is organised as follows:

- Section 2. Residential air conditioning and electricity sector impacts
- Section 3. Health and wellbeing impacts of heat in Australia
- Section 4. Consideration of household vulnerability in cost-reflective pricing policy
- Section 5. Impact of electricity pricing on heat health practices
- Section 6. Impacts of non-financial public messaging about peak demand
- Section 7. Conclusion

Residential air conditioning & electricity sector impacts

Key points

- Increased prevalence of residential air conditioning has increased peak demand, put strain on electricity infrastructure, and raised electricity bills
- Cost-reflective tariffs are central to current energy policy reform
- Cost-reflective tariffs aim to reduce household use of electricity at peak times

The prevalence of air conditioning in Australian homes has increased dramatically from around 10% 50 years ago to around 75% today (ABS, 2014; DEWHA, 2008). This growth has been attributed to changes in air conditioning affordability and efficiency; inadequate urban planning and housing design; cultural and building norms; and a changing climate (EES, 2006; Strengers, 2010; Wilkenfeld, 2004). Home cooling is the most significant contributor to demand for electricity at peak times ('peak demand'), particularly on hot afternoons and evenings. Increasing spikes in demand have required extensive upgrades of infrastructure to enable the electricity network to meet demand (Smith et al., 2013). Peak electricity infrastructure has been a major contributor to increased household bills which have approximately doubled in Australia over the last 8-10 years (Wood and Blowers, 2017). Due to the contribution of home cooling to peak demand, it is estimated that under 'flat-rate' electricity tariffs households who own and use air conditioners at peak times are cross-subsidised by other consumers by around $350 per year (Productivity Commission, 2013).

In response to challenges for the electricity sector and the potential role of demand management, the Council of Australian Governments (COAG) committee for energy directed the Australian Energy Market Commission (AEMC) to undertake a Review into Demand Side Participation in the National Electricity Market. The resulting 'Power of choice – giving consumers options in the way they use electricity' review was presented to COAG, which together with the Independent Pricing and Regulatory Tribunal of New South Wales, submitted a proposal to amend the existing National Electricity Rules governing demand management. A final rule change determination was made by AEMC in November 2014, with the new network pricing objective as follows: 'network prices that a distribution business charges each consumer should reflect the business' efficient costs of providing network services to that customer' (p. iii). As a result, distribution businesses are developing and implementing cost-reflective network tariffs (AEMC, 2014c).

It is unclear at this stage to what extent network tariff changes will impact household retail tariff structures. Typical cost-reflective retail tariff types include time-of-use, critical peak pricing, dynamic peak pricing, and capacity pricing[1] - each of which involves higher charges for electricity used at peak times or high demand (such as running air conditioning at the same time as other appliances), offset by lower charges at other times. Price signals are expected to encourage most households to reduce electricity use at peak times (including periods of extreme heat) and are central to energy policy reform (AEMC, 2012).

1. See CUAC, 2015 for further detail about cost-reflective pricing and tariff types.

Health & wellbeing impacts of heat in Australia

Key points

- Duration, frequency, and intensity of hot weather in Australia is increasing
- Extreme eat can have significant negative impacts on health and wellbeing
- Elderly, infants, and chronically ill tend to be most affected by heat
- A range of risk factors increase vulnerability to heat in low-income households
- Health advice frequently encourages use of air conditioning in heat events[2]

The duration, frequency, and intensity of hot weather have increased in recent years. Before 1950 no more than half the years included extreme heat days[3], and in 2013 there were 28 extreme heat days (BoM, 2016). Prolonged and extreme heat was experienced in New South Wales, southern Queensland, South Australia and parts of Victoria over the recent 2016–17 summer. In January 2017, Sydney and Brisbane experienced the highest monthly mean temperatures on record and Canberra experienced the highest daytime temperatures on record (BoM, 2017). As a result of climate change, the numbers of days which reach temperatures over 35°C and 40°C are expected to increase substantially in many parts of Australia in future years (CSIRO, 2015).

Heatwaves[4] and extreme heat already have significant impacts on health and wellbeing (Victorian Auditor-General's Office, 2014). Extreme heat has caused the death of more people in Australia than all other natural hazards combined (Coates et al., 2014), with 374 excess deaths attributed to the 2009 heatwave in Victoria (Victorian Auditor-General's Office, 2014). Internationally heatwaves have also had severe impacts on human health. The 1995 Chicago heatwave led to 739 heat-related deaths over five days (Semenza et al., 1996) and in France 14802 heat-related deaths followed eight consecutive days of temperatures over 40 °C (Fouillet et al., 2006). A World Health Organization report (WHO, 2014) predicts that annual heatwave deaths could reach 260,000 by 2050 (without action to address climate change). In addition to lives lost, heatwaves cause significant impacts including exacerbation of medical conditions, long-term impairment and reduced quality of life (Astrom et al., 2011). The impact of heatwaves on human health can overwhelm medical, emergency and community services, and infrastructure (Queensland University of Technology, 2010).

2. Includes hot and humid weather often experienced in northern parts of Australia including the 'build up'
3. The Bureau of Meteorology (BoM) defines extreme events as those above the 99th percentile of each month from the years 1910–2015. The Victorian Department of Health and Human Services defines extreme heat as 'the minimum mean temperature that is likely to impact on the health of a community' (DHHS, 2015, p.3).
4. BoM defines heatwave as 'three days or more of high maximum and minimum temperatures that is unusual for that location'. Heatwaves may be 'low-intensity', 'severe' or 'extreme' (BoM, 2014).

Epidemiological studies of heatwaves have demonstrated the risk factors for heat-related deaths, including age (elderly and the very young), chronic health conditions, low socioeconomic status, poor quality housing, and social isolation (Coates et al., 2014). Older people are more likely to have health conditions (and take associated medications) that can reduce their ability to regulate body temperature and increase their susceptibility to extreme heat (Ibrahim and McInnes, 2008; Kovats and Hajat, 2008).

These conditions include: high blood pressure and cardiovascular disease; diabetes; lung disease; overweight and obesity; lymphoedema; Parkinson's disease; fibromyalgia; post-polio syndrome/poliomyelitis; and motor neurone disease (Kenny et al., 2010). Underestimation of own vulnerability to heat inhibits cooling practices such as increasing fluid intake or wearing light clothing and cognitive impairment (pre-existing or heat-induced) can exacerbate this risk. Many people underestimate their vulnerability to heat and cognitive impairment (including heat-induced) can also inhibit heat responses, such as increasing fluid intake or wearing light clothing (Adcock et al., 2000; Bi et al., 2011; Fouillet et al., 2006). Infants are also vulnerable to extreme heat as their bodies are less able to adjust to changes in temperature and they can easily become dehydrated (Hoffman, 2001). Inadequate cooling of the body and fluid intake can lead to renal failure, cardiovascular problems, vomiting, seizures, delirium, damage to the heart and other organs, and coma (DHHS, 2016; Parsons, 2003).

The presence of other risk factors can also increase vulnerability to heat (Ibrahim and McInnes, 2008). Households with older, very young, and chronically-ill occupants often have lower incomes due to reduced employment opportunities or capacities. Low income households may have greater exposure to heat and fewer options to respond due to:

- increased likelihood of poor quality housing which heats up quickly, retains heat, and has less energy efficient appliances (Coates et al., 2014)
- restrictions on what changes private and public tenants can make to their homes, and the cost of improving the home's performance during hot weather or buying more energy efficient appliances (McMichael et al., 2003)
- likelihood of living in higher density areas experiencing higher indoor and outdoor temperatures than leafier suburbs, due to the urban heat island effect (Yardley et al., 2011).

In addition, heat vulnerable households may face difficulty seeking refuge from the heat in public places like libraries or shopping centres because of financial constraints, mobility issues and/or limited access to transport (Ibrahim and McInnes, 2008). Social isolation also increases vulnerability to adverse health negative outcomes from hot weather (Luber and McGeehin, 2008).

Studies of heatwave health outcomes have shown air conditioning to be a 'protective factor' (Klinenberg, 2002; O'Neill et al., 2005). Air conditioning is increasingly promoted by health authorities and governments as the most effective way to prevent heat illness during extreme heat (Hoffman, 2001; O'Neill et al., 2005). The NSW Health Department advice about 'how to stay healthy in the heat' advises people to 'use air-conditioning if you have it' (NSW Health Department, 2016). In 2010, the Australian Medical Association in Victoria called for subsidies for elderly households to install air conditioning and installation of air conditioning in public housing (Farbotko and Waitt, 2011).

Consideration of household vulnerability in cost-reflective pricing policy

This section presents an analysis of how energy sector cost-reflective pricing documents engage with issues of household vulnerability, particularly during and as a result of heat events. Over recent years a number of documents have directed and informed the transition towards cost reflective pricing in Australia. This section summarises a critical analysis of these documents to address the following three questions:

- How is vulnerability (including heat vulnerability) considered in cost-reflective pricing policy documents?
- How is cost-reflective pricing expected to impact vulnerable households?
- How will any impacts on vulnerable households under cost-reflective pricing be addressed?

Table 1 provides a summary of the relevant content from illustrative documents, including a graphic representation of the frequency which each report mentions topics related to household vulnerability. Documents included in Table 1 are based on two key criteria: 1) Energy sector documents which articulate key decisions or policy positions; and 2) Documents commissioned by the Australian energy sector to inform future tariff design. Other academic, advocacy, policy and consultancy documents were also reviewed and inform the discussion of the findings. Key findings are discussed below with reference to other relevant health and social research.

Key finding: Health risks facing heat vulnerable households are missing

None of the cost-reflective pricing policy documents acknowledge the intersection between air conditioning use and household vulnerability to heat. The scope of analysis of impacts on consumers is restricted to broad economic analyses. Other than the AEMC (2012) 'Power of Choice' review, there is little attention to the health and (non-financial) wellbeing of household consumers or the types of households who may be most at risk and reliant on air conditioning during heat events. Although AEMC (2014b) and (NERA, 2014) recognise air conditioning as the most significant contributor to peak demand and long run marginal costs, no consideration is given to household cooling needs during extreme heat, what different circumstances inform these needs, or how promotion of air conditioning use during peak periods competes with demand/charge management messaging.

Key finding: Energy policy understandings of vulnerability are limited

The energy policy documents reviewed were inherently concerned with vulnerabilities of energy infrastructure and security of supply during peak demand, assumed reductions in consumption under cost-reflective pricing, resolving pricing 'inequities', and household financial vulnerabilities. The AEMC states that in Australia there is 'no operational definition employed by governments to define vulnerable consumers' (AEMC, 2014a, p.7), nor are vulnerable customers defined in the National Energy Customer Framework. Where policy documents are concerned with household vulnerability, it is positioned financial condition. Cost-reflective pricing is seen as a generally positive reform for vulnerable households based on estimations that there will be more 'winners' than 'losers' within the groups identified as vulnerable, low-income households and households on hardship programs. For example, the federal government's Energy White Paper

(2015) anticipates 60% of households will pay less in the longer run under cost-reflective pricing based on calculations by AGL (Simshauser and Downer, 2014) and consultant reports (see Table 1). Households considered to be financially vulnerable are assumed to benefit in part because 'their energy use is typically spread more outside peak times' (Australian Government, 2015, p.16). While some low-income households spend more of the day at home (not at work) and have flatter load profiles, this also means they may experience greater exposure to heat in poor quality housing (possibly without access to or willingness to use air conditioning) than other household types. In addition, assumptions that low-income households spend the day at home and are therefore more able to respond to cost-reflective pricing do not recognise that many of these households have significant commitments outside the home such as caring responsibilities, volunteer work and low paid work. Known contributors to heat vulnerability such as age, health, cognitive capabilities or social factors – which are highly relevant for many of the 40% of households not identified as winners – are not considered.

Key finding: Cost-reflective tariff complexity is under-acknowledged

The documents reviewed also assess various forms of cost-reflective pricing, such as capacity tariffs, time-of-use tariffs and critical peak pricing tariffs, for their potential demand response outcomes. For example, the Deloitte review assessed a range of tariff structures in relation to four criteria – cost reflectivity, simplicity, stability and revenue variability (for network businesses) (Deloitte, 2014). It suggests that flat-rate tariffs are easier for households to understand and recommends that time-of-use tariffs be used as an intermediate step towards more sophisticated cost-reflective pricing tariff structures such as capacity charges.

Recent research with Australian households shows serious limitations in householder understandings of retail tariffs even in a relatively simple tariff environment. For example:

- Misunderstandings that electricity is already generally cheaper at night ('off-peak') contribute to households running dishwashers overnight (Nicholls and Strengers, 2015).
- Households on time-of-use tariffs in NSW are often unaware of their tariff type or the times which different prices for electricity apply (Strengers and Nicholls, 2013).
- Tariffs that include capacity charges are hard for householders to understand (Stenner et al., 2015; Strengers & Nicholls, 2012).
- Low-income consumers, and consumers with a lower level of education, are likely to prefer flat-rate pricing (Stenner et al., 2015a; Strengers and Nicholls, 2012).

The ability for consumers to interpret and respond to time-of-use tariffs is widely acknowledged as a fundamental success factor in reducing peak demand, yet peak and capacity tariffs are complex. Challenges for consumers interpreting complex tariffs are amplified within particular vulnerable groups. Although health risks receive little attention, CSIRO research concludes that cost-reflective pricing has potential to create significant, economic, social and political risks if uptake and usage are not jointly considered in policy design and implementation (Stenner et al., 2015b). Poorly understood cost-reflective pricing tariffs may result in bill increases for those already struggling to manage costs.

Key finding: Stronger financial signals suggested for unresponsive households

Under cost-reflective pricing households with low consumption overall but relatively high peak demand ('peaky' consumption) will face higher electricity bills under cost-reflective pricing. The NERA report recommends steeper increases in electricity costs at peak times or capacity based charges to encourage 'unresponsive' customers to reduce their electricity consumption at peak times. The reasons why some households may be unresponsive are not discussed. It is likely that one cohort of unresponsive households heat vulnerable occupants who rely on air conditioning to maintain health. Limited capacity to respond to price signals without experiencing detriment to health may result in unmanageable electricity bills for these households.

Key finding: Impacts on vulnerable consumers to be addressed by others

The AEMC's final rule determination acknowledges that 'some consumers will face high charges in cost-reflective network prices, and some of those consumers may be vulnerable consumers' but says that tariff design is not the appropriate intervention to consider these issues. The AEMC rule determination, and the Deloitte (2014) and KPMG and Energy Networks Association (2016) reports recommend state-based concession schemes and hardship programs as a means of addressing impacts of electricity prices on vulnerable consumers. The extent to which concession programs can protect and support vulnerable consumers is limited by consumer awareness and comprehension of concession programs (due to online information and literacy issues), eligibility requirements, ability to self-identify as eligible and complex and repetitive application processes (CALC, 2014). A concession program in the United States seeking to buffer vulnerable groups from cost reflective impacts had a penetration rate of less than 40% of eligible customers (Alexander, 2010). Currently in Australia, a limited range of customers with a limited range of medical conditions may access medical cooling concessions during hotter months. Yet as outlined above, a much wider range of consumers are vulnerable to extreme heat – such as the elderly, infants, and those with common chronic health conditions like cardiovascular disease, diabetes and respiratory diseases (Kenny et al., 2010).

How vulnerable households are considered	Inclusion of heat vulnerability-related topics[i]	
Power of Choice Review: Giving consumers options in the way they use electricity (AEMC, 2012) • No reference to health or financial vulnerability associated with hot weather. • The needs of vulnerable groups are given significant consideration and are described as those who may have a reduced capacity to respond to price signals due to reliance on electricity. Also referenced are those who may spend a substantial proportion of their income on electricity bills. Explicit reference is made to the elderly, those with chronic medical conditions, those with a disability, shift workers, parents of young children, and the unemployed. • Recommends identifying and protecting vulnerable customers before implementation of CRP to prevent further disadvantage. Protective measures included tailored advice; support for efficient appliances and insulation; and evaluation of concession schemes in response to CRP. Recommends differentiated and gradual phase in of CRP[ii] depending on household consumption.	Heatwaves or heat events	**0 references**
	Health or wellbeing	1-5 references
	Elderly, young, other heat vulnerable occupants	20+ references
	Financially vulnerable households	10-20 references
Electricity Network Regulatory Frameworks: The costs and benefits of demand management for households (Productivity Commission, 2013) • No reference to health or financial vulnerability associated with hot weather. • Focuses on the potential benefits of CRP to address peak demand issues and notes the potential for greater demand response from very high critical peak charges. • No mention of how pricing might affect different household types.	Heatwaves or heat events	**0 references**
	Health or wellbeing	**0 references**
	Elderly, young, other heat vulnerable occupants	**0 references**
	Financially vulnerable households	**0 references**
Residential Electricity Tariff Review – prepared for Energy Supply Association of Australia (Deloitte, 2014) • No reference to health or financial vulnerability associated with hot weather. • References vulnerable customers (financial vulnerability) when highlighting the role of concession programs in addressing equity impacts from critical peak pricing).	Heatwaves or heat events	**0 references**
	Health or wellbeing	**0 references**
	Elderly, young, other heat vulnerable occupants	**0 references**
	Financially vulnerable households	10-20 references
Economic Concepts for Pricing Electricity Network Services - A Report for the AEMC (NERA, 2014) • No reference to health or financial vulnerability associated with hot weather. • Focuses on the numbers of customers' bills affected by various CRP structures but does not distinguish them by terms of income, hardship, health, age, etc.	Heatwaves or heat events	**0 references**
	Health or wellbeing	**0 references**
	Elderly, young, other heat vulnerable occupants	**0 references**
	Financially vulnerable households	**0 references**

i. Terminology categories, assessed on the basis of the frequency of reference and only counted when used in the context of health and/or vulnerability;
ii Cost-reflective pricing

How vulnerable households are considered	Inclusion of heat vulnerability-related topics	
National Electricity Amendment (Distribution Network Pricing Arrangements) Rule (AEMC, 2014b) • No reference to health or financial vulnerability associated with hot weather. • Acknowledges that some vulnerable consumers may face higher chargers under CRP and that state-based concession schemes are best placed to address this issue. • Does not define vulnerable consumers but often connects them to hardship programs and those consumers who have difficulty meeting energy payments (financial vulnerability). • Acknowledges that some high electricity use is due to medical needs when raising concerns with low user cross subsidies. • Low-income consumers are assumed to benefit from lower bills under CRP.	Heatwaves or heat events	**0 references**
	Health or wellbeing	**0 references**
	Elderly, young, other heat vulnerable occupants	**0 references**
	Financially vulnerable households	10-20 references
Estimation of Long Run Marginal Cost and Other Concepts Related to the Distribution Pricing Principles - prepared for Essential Energy (HoustonKemp Economists, 2015) • No reference to health or financial vulnerability associated with hot weather. • Acknowledges National Electricity Rule requirement to consider impacts to customers from changes in tariff structures including a customers' ability to mitigate the impact of changes in tariffs through their usage decisions. • The report primarily focuses on costs to consumers across different CRP	Heatwaves or heat events	**0 references**
	Health or wellbeing	**0 references**
	Elderly, young, other heat vulnerable occupants	**0 references**
	Financially vulnerable households	10-20 references
Energy White Paper (Australian Government, 2015) • No reference to health or financial vulnerability associated with hot weather. • Vulnerable customers are not defined but references are made to hardship programs (financial vulnerability). • Low-income (vulnerable) consumers generally expected to benefit from lower bills under CRP as their energy use is considered to be less 'peaky' than other households.	Heatwaves or heat events	**0 references**
	Health or wellbeing	**0 references**
	Elderly, young, other heat vulnerable occupants	**0 references**
	Financially vulnerable households	10-20 references
Electricity Network Transformation Roadmap: Key Concepts Report (CSIRO and Energy Networks Australia, 2016) • No reference to health or financial vulnerability associated with hot weather. • Recommends impacts to vulnerable groups (identified via their income or bill hardship status) be managed through concessions schemes which should be reviewed and unified nationally.	Heatwaves or heat events	**0 references**
	Health or wellbeing	**0 references**
	Elderly, young, other heat vulnerable occupants	**0 references**
	Financially vulnerable households	10-20 references
Electricity Network Tariff Reform Handbook (KPMG and Energy Networks Association, 2016) • No reference to health or financial vulnerability associated with hot weather. • States that government rather than the electricity sector should determine how impacts on vulnerable groups are managed. • Suggests a number of options for vulnerable (low-income) consumers including nationally unified concessions based on energy bills, support for energy efficiency, education programs and social tariffs.	Heatwaves or heat events	**0 references**
	Health or wellbeing	**0 references**
	Elderly, young, other heat vulnerable occupants	**0 references**
	Financially vulnerable households	10-20 references

Impact of electricity pricing on heat health practices

Key points

- Cost-reflective pricing is likely to heighten concerns about the cost of using home cooling during heat events, which may have negative health impacts
- Heat vulnerable, air conditioning-reliant households may face unmanageable electricity bills under cost-reflective pricing

There is currently no research to demonstrate the health and financial outcomes of cost-reflective pricing for heat vulnerable households in Australia. We therefore draw on other sources that point towards possible impacts.

Although cost-reflective pricing in Australia aims to reduce household demand during periods of extreme heat, the energy sector usually avoids suggesting households turn air conditioning off. Instead, raising the thermostat or pre-cooling the home before the peak tariff period are often recommended. However, with widespread understandings that running air conditioning is electricity-intensive (Nicholls and Strengers, 2015), it is likely that some households with concerns about electricity bills under cost-reflective pricing will restrict or try to avoid use of air conditioning.

Reduced use of air conditioning can have both positive and negative outcomes. Healthy households who are equipped and comfortable to shift to low/no-energy ways of keeping cool during hot weather may be able to manage the impacts of cost-reflective pricing for their bills (possibly with financial benefits) and assist with reducing their energy demand. However, heat vulnerable households may be at risk of negative impacts including financial (those who depend on air conditioning for health during hot weather), and health (those that switch off the air conditioner to avoid higher costs).

Evidence that vulnerable households already restrict air conditioning in extreme heat

While retrospective studies of heatwaves indicate that air conditioning reduces heat related illness by approximately 80% and a working fan by about 30% (Kenny et al., 2010), there is evidence that some heat vulnerable households avoid using them even during extreme heat. For example, during the 1995 Chicago heatwave that caused over 700 deaths, elderly residents revealed that they did not use air conditioners or fans due to concerns about electricity bills (Klinenberg, 2015). Other research on residential cooling practices during extreme heat across four North American cities found that one third of participants significantly limited their air conditioning use due to cost concerns, and some stated that their vulnerability would be increased as a result (Sheridan, 2007). The elderly often avoid air conditioning and fan use during extreme heat, perceiving themselves to be at less risk than others, such as those with a disability or infants (Khare et al., 2015; Wolf et al., 2010).

Multiple Australian studies have also found that low-income households have restricted their use of air conditioning as a result of increasing (flat-rate) electricity prices. For example:

- Participants in a 2013 study (Chester, 2013) restricted air conditioning to the detriment of chronic physical and mental health conditions.

- The same study found younger people were concerned about their parents restricting air conditioning due to running cost fears and using shopping complexes on hot days because they could not afford to cool their own homes.
- Similar findings were reported in a Wollongong study of aged pensioners, including limiting use of a low power electric fans (Farbotko and Waitt, 2011)
- 60% of low-income survey respondents in a recent study in Western Australia reported curtailing use of heating or cooling despite discomfort (Cornwell et al., 2016).
- A Victorian Council of Social Service study identified that social service organisations were concerned about the impact of electricity costs on use of air conditioning in vulnerable households and limited access to cool spaces for social housing residents (VCOSS, 2013).

Some vulnerable households need more air conditioning than others

Different chronic health conditions require different levels of cooling to maintain health. For example, approximately 90% of people with multiple sclerosis (MS) in Australia are adversely affected by the heat, 15 times more often than other households resulting in energy costs 10 times higher than the average (Summers and Simmons, 2009). The severity of MS symptoms contributes to 80% of MS patients being unemployed within 10 years of diagnosis, which increases time spent at home and dependence on home air conditioning (Milo and Miller, 2014). Although a medical cooling concession is available to households with MS, there is a significant gap between the financial assistance provided and electricity costs (Summers et al., 2012). While MS is one example of vulnerability to heat, the difficulties faced by MS patients in accessing medical cooling concessions raises questions about the ability for existing concession schemes to adequately address potential cost-reflective pricing impacts on heat vulnerable households (Verikios et al., 2009).

CSIRO research reported concerns regarding the impact of cost-reflective pricing on householders' ability to use air conditioning for health conditions, and noted a dilemma for the energy sector 'that the more electricity prices do reflect consumer demand and the true costs of supply, the more unfair – even unscrupulous and exploitative – they seem to consumers' (Stenner et al., 2015a). This report stated that it is imperative that the introduction of new cost-reflective pricing tariffs include mechanisms to facilitate 'appropriate' demand response.

Low-income households are least able to accommodate electricity bill increases

Low-income households spend a higher proportion of their income on energy than other households, which makes energy price rises much harder to accommodate (ABS, 2012). Consumer Utilities Action Centre says:

> 'the fear of high bills during periods of high short run marginal costs could also prompt some households to inappropriately self-limit their consumption in a way that leads to negative welfare effects. For example, older consumers may limit their usage of air conditioning during heat waves and suffer or exacerbate health problems as a result' (CUAC, 2015).

High energy costs can result in low-income households going without other goods and services such as food or being involuntarily disconnected with adverse health and wellbeing consequences (Chester, 2013; Consumer Action Law Centre, 2015). Research by the U.S. Department of Agriculture and Economics found that low-income elderly residents in hotter states were 27% more likely to experience very low food security in summer than in the winter (Nord and Kantor, 2006).

Even households with similar or lower bills under cost-reflective pricing may still struggle to pay and seek to mitigate their energy costs by changing their air conditioning use in ways that do not support their health and wellbeing.

Impacts of non-financial public messaging about peak demand

Key point

- Public messaging about peak demand and cooling can exacerbate risks for heat vulnerable households

Public messaging is sometimes used during heatwaves to ask for reductions in electricity use when demand may exceed supply, such as during the eastern Australia heatwave in February 2017. The NSW energy minister said: 'we encourage the community to reduce their energy use where possible' and included the suggestion to turn air conditioner thermostats up to 26°C (Hannam et al., 2017). A later AEMO statement acknowledged the demand response: 'AEMO commends those who proactively reduced their consumption, from industrial customers, to residential consumers' which 'enabled the power system to provide uninterrupted electricity supply to the region'. Due to the continuing hot temperatures 'AEMO reiterate[d] the need to be mindful of individual electricity consumption' (AEMO, 2017). This messaging from government and the energy sector points towards household capacity to reduce peak consumption – without financial incentive to do so – and contribute to energy and community issues.

While cost-reflective pricing is the main Australian energy sector strategy to reduce household electricity demand at peak times, other forms of messaging can also impact household practices. Trials in Australia and internationally have shown that 'peak alerts' elicit reductions in household energy use. For example:

- In a dynamic peak pricing trial conducted by EnergyAustralia, households informed about a peak demand event but who received no financial incentive to respond reduced electricity use by 11-13% on average (Collins, 2009).
- Response to dynamic peak pricing trials involves a sense of 'social responsibility'. Even without being explicitly asked to switch off air conditioning, households can identify their own cooling (or heating) use to be part of the problem (Strengers, 2010).
- Australian research has shown that households express a willingness to act for the 'common good' in periods of peak demand (including turn off the air conditioner), particularly to protect the health of vulnerable community members who may need cooling in hot weather (Nicholls and Strengers, 2014, 2015).

Alongside beneficial responses to appeals for assistance with peak demand, there is also a risk of negative impacts for heat vulnerable households from public messaging. The Victorian Auditor-General's investigation into the health outcomes of the 2014 heatwave in Victoria reports that 'elderly Victorians, who are among the most vulnerable to extreme heat, were restricting the use of air conditioners because of advice to conserve power' (Victorian Auditor-General's Office, 2014, p. 39). As examples from the 2017 summer heatwave have shown, public messaging about electricity supply issues often does not expressly acknowledge:

- different types of households, e.g. those

including the elderly
- different levels and types of vulnerability to heat; or
- different levels of ‘need’ for cooling.

Generic public energy messaging relies on heat vulnerable households self-identifying as being vulnerable and maintaining the level of cooling they need for health. However, such households often underestimate their own vulnerability (Wolf et al., 2010) and may go ‘beyond the call of duty’ to assist others perceived as more vulnerable than themselves. Exacerbating this issue, periods of hot weather also coincide with media articles about costs of running air conditioning. Whether accurate or not for typical households, claims such as ‘Australian families could save more than $700 on their energy bills by reducing their air conditioning habits this summer’ (Ticha, 2016), are promoted to the public. Elderly people may be more at risk from this type of messaging as they tend to engage in energy conservation practices and respond to public messaging more than some other household types (Gibbons and Singler, 2008; Victorian Auditor-General’s Office, 2014).

Existing confusion and concern about electricity costs under flat-rate tariff structures (Nicholls and Strengers, 2015) is likely to escalate in an environment where the energy sector, media, and other messaging produces inconsistent messages about the cost and impact of using cooling, and what to do in extreme heat. Introduction of cost-reflective pricing, alongside messaging that encourages households to limit home cooling to save money or help reduce peak demand on extreme heat days, may exacerbate unhealthy self-rationing of cooling in heat-vulnerable households.

Conclusion

Key points

- Current cost-reflective pricing policy and research does not engage sufficiently with the health and wellbeing risks to heat vulnerable households
- Vulnerable households may be at financial and/or health risk during extreme heat under cost-reflective pricing

The energy sector is seeking to manage peak demand through the introduction of household electricity tariffs which are more cost-reflective, alongside public messaging encouraging demand reductions during hot weather. Both these financial and non-financial initiatives could contribute to unintended negative impacts for heat-vulnerable households. In particular:

- The elderly, very young, and chronically ill who are particularly reliant on cooling to maintain their health, and so are at risk of negative impacts from heat – especially those who live in poor quality housing and have limited options to seek cool spaces beyond their own home.
- Households who need to use air conditioning during peak times and may experience greater difficulties paying electricity bills.
- Households who respond by limiting their air conditioning use and may have negative health outcomes.

The potential outcomes of cost-reflective pricing for heat vulnerable households have received little attention in key policy research and reports, despite the Standing Council on Energy and Resources identifying in 2012 that 'protections for vulnerable consumers' (SCER, 2012, p.7) were crucial. Policy focus on average financial outcomes for particular household groups (that are expected to be favourable in some cases) draws attention away from the disproportionately negative outcomes for smaller numbers of vulnerable households. Recommendations to deal with the potential impacts of cost-reflective pricing on vulnerable households via energy companies (e.g. through hardship schemes) or concession schemes may not adequately address important risks for heat vulnerable households, including the likelihood of more prolonged and extreme heat events in the future.

The next stages of the Heatwaves, Homes & Health project will build further knowledge and awareness of these issues through fieldwork with vulnerable households and their service providers. This research will inform effective, efficient, and equitable approaches to reduce risks facing heat vulnerable households.

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