Policy recommendations to increase urban heat stress resilience

POLICY NOTE

LOW CARBON LIVING CRC

KEY POINTS

A range of policy recommendations are presented here across the four disciplines of public health, building and construction industry, and urban planning and infrastructure - emerging from CRC for Low Carbon Living (CRCLCL) project research findings related to heat stress in urban Australia:

- The excess heat factor was found to be a superior predictor of heat-related hospitalisation in Adelaide predicting up to 77% of the heat-related health issues compared to the 32% predicted by daily maximum temperatures [1].
- People increase their energy and water use by around 20%, and a similar percentage experience heat-related health issues [2].
- Roof insulation and double-glazing reduce heat-related health issues [3].
- The availability and the level of air- conditioning diminish other forms of adaptation and increase reliance on mechanical cooling [3].
- A high Nationwide House Energy Rating Scheme (NatHERS) star rating does not necessarily indicate a building with high heat stress resistance [4].

THE OPPORTUNITY / CHALLENGE

Heatwaves are not just the deadliest natural hazard [5], but they substantially decrease productivity and economic activity [6]; drive peak electricity demand caused by air-conditioning [7]; and are responsible for soaring electricity prices [8] and energy poverty [9]. Air-conditioning is not the ultimate solution because its use increases carbon emissions, contributes to urban heat island effects (UHIs) [10] and can increase dependence [11,12].

As the frequency and intensity of heatwaves are growing [13], strategies to improve our resilience are becoming more vital. Policies to increase heat stress resilience are mostly isolated across different disciplines and government departments. This policy note integrates multidisciplinary policy recommendations that could mitigate the numerous negative impacts of heatwaves on public health, urban infrastructure and services through adaptation to heatwaves.

CRC for Low Carbon Living

We are a national research and innovation hub supported by the Commonwealth Government's Cooperative Research Centres programme that seeks to enable a globally competitive low carbon built environment sector.

With a focus on collaborative innovation, we bring together practitioners from industry and government with leading Australian researchers to develop new social, technological and policy tools for facilitating the development of low carbon products and services to reduce greenhouse gas emissions in the built environment. For more information visit www. lowcarbonlivingcrc.com.au/

OUR RESEARCH

Between April and May 2018, 16 professional organisations from the built environment and city councils in New South Wales, Victoria and South Australia were consulted and policy recommendations emerged from a PhD research project on urban heat stress resilience, undertaken between September 2013 and March 2017. This was part of a research project on urban microclimates (RP2005) funded by the CRCLCL and the Australian Building Codes Board.

POLICY RECOMMENDATIONS

The recommended policy measures are discussed in order from the most readily implementable, to the ones requiring the most complex approval process under the four main disciplines of public health, building and construction, urban planning and infrastructure.

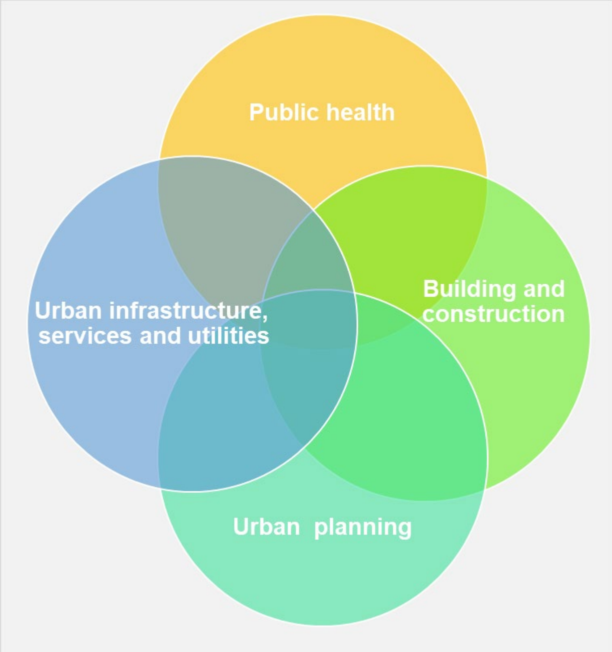

Figure 1 The four disciplines of policy making relevant to heat stress resilience

PUBLIC HEALTH

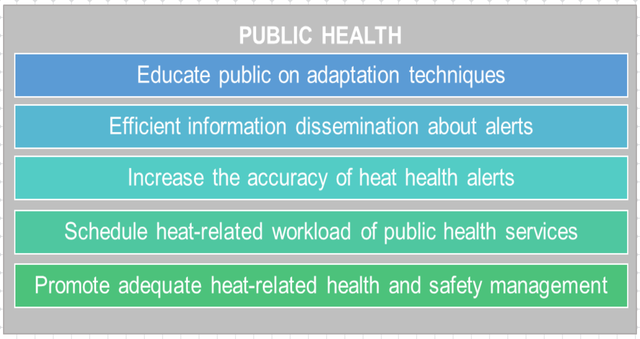

Figure 2 Policy recommendations for the public health

Educating people on adaptation techniques can increase their adaptive capacity and decrease their health issues during heatwaves [14], however, a significant knowledge gap exists [3,15]. For the benefit of efficient information dissemination, students could be targeted at schools, and patients with pre-existing health conditions by their medical service providers, before heatwave seasons. Adaptation techniques recommended in heat-related health messages should be customised for the different social groups [3] to maximise uptake. Spill-over effect and existing peer-to-peer connections could be utilised to educate people at workplaces and local community groups [3,16]. Information brochures on adaptation techniques could be published and distributed by the Department of Health.

Increase the efficiency of information dissemination about heat alerts using social media by the Department of Health. Such media coverage could be particularly useful to inform middle-aged people with families who were found to be unlikely to follow weather forecasts, presumably due to their busy lifestyles [3]. Additional real-time heat health information media may include pop-up windows on computer screens via internet-based location services and mobile applications [17].

The excess heat factor (EHF) is the first of its kind to evaluate heatwave intensity all across Australia in a consistent, still location-specific manner [18]. Recent studies have provided evidence that the EHF is a superior predictor of hospitalisation [1,19,20], though further research is warranted to test the application in humid climates considering the impact of humidity on health during heatwaves [21]. All health agencies and State Emergency Services should adopt and issue heat- health alerts in a uniform manner across all media and local health services following warnings of the Bureau of Meteorology based on the EHF to provide more accurate information about those days that are particularly dangerous to human health [1,17].

Adopting the EHF, a predictive model could be developed by hospitals and ambulance services to manage their workload during heatwaves.

‘Thermal comfort is a significant Occupational Health Safety issue for all Australians. Buildings and their responsibility to promote thermal comfort and reduce financial stress (due to energy use) should be raised to the greater level of Australian conscience.’

PROJECT STAKEHOLDER, ARCHITECT

Heatwaves cause a substantial productivity loss at work in Australia [6]. Even if heat-related health and safety policies are in place, they are not used sufficiently [11,22].The limited adoption of policies can be attributed to the lack of training and lack of commitment of management [22]. To mitigate the communication gap, public health agencies should reach and activate corporate health and safety managers before heatwave seasons.

BUILDING AND CONSTRUCTION INDUSTRY

BUILDING AND CONSTRUCTION

- Guidelines to heat stress resistant building design
- Showcase heat stress resistant public buildings
- Integrate heat resistance into the National Construction Code
- Educate public about heat stress resistant building tools
- Financially incentivise heat stress resistant design
- Address non-compliance issues
- Implement Building Energy Performance Certification (EPC)
- Encourage the uptake of NABERS for residential buildings

Create a publicly available guide and a series of the continuing professional development programmes for building designers, architects and builders on heat stress resistant building design considering the differences in climate zones across Australia.

> ‘It could be a publication to illustrate and promote awareness to building owner/occupiers that buildings (all archetypes) have a responsibility to promote thermal comfort and reduce financial stress (due to energy use).’
> PROJECT STAKEHOLDER, ARCHITECT

The guide should include separate heating and cooling thresholds for each star above six (not assigned to the National Construction Code (NCC)) depending on the function of the building. The design guide should also recommend design strategies to decrease the risk of overheating, without compromising energy use during winter (such as the application of reflective foils, natural ventilation and lighter roof colours) and enable the operation of the building without air conditioning to reduce health and safety risks during a power blackout. In the long term, such a guideline could be extended with other climate adaptive design measures addressing the risks of floods, drought and bushfires.

> ‘Performance of free-running buildings in extreme heat wave events when power outages are more likely may be quite different to a building that can efficiently lower cooling loads.’ PROJECT STAKEHOLDER, BUILDING MATERIAL SUPPLIER

Local and state governments should build, showcase and advocate heat stress resistant public buildings, such as schools, public housing, with the reduced demand for air-conditioning to educate the public.

In the public draft proposal of the NCC 2019, new thresholds are proposed for separate heating and cooling loads. These thresholds eliminate only the most extreme designs, ruling out the 5% most cooling- dominant homes with 5.5, 5 and 6 stars. The thresholds should be strengthened.

Consider the introduction of a minimum indoor thermal performance of residential buildings during heatwaves in a free-running mode (without using air-conditioning) in the NCC. This is to ensure homes maintain safe environments, particularly since climate change increases the number and length of heatwaves [13].

> ‘The cost of energy to run a building together with climate change means great uncertainty for building users/owners.’
> PROJECT STAKEHOLDER, ARCHITECT

Replace the typical meteorological year data based on the weather data observed between 1990 and 2015 to the future predicted climate data in the Nationwide House Energy Rating Scheme (NatHERS), to consider climate change and that buildings built now will be in operation for around the next 25 years. The future predicted climate data should be calculated using medium predicted global climate change scenario.

A recent study found that a lighter roof colour can reduce the cooling load of a typical single-home, without compromising the annual energy use in all Australian capital cities, except for Hobart [15]. The introduction of a rebate is recommended on types and colours of roof cladding according to their total solar reflectance and heat emittance values. This will incentivise the purchase of better performing materials by the state governments, following the example of the USA [23]. Further studies should investigate the impact of roof colour on the annual energy use of commercial buildings and multi- storey residential homes.

Subsidies encouraging the installation of solar panels and water tanks resulted in a rapid uptake of these features by the residential sector, particularly for social housing. The use of solar panels and small-scale batteries can shift the timing of and reduce residential peak electricity demand [24]. The continuation of such programmes and extension to renovations would be beneficial in the jurisdictions funded by the local governments where the uptake is still slow.

Have local councils educate the public about the use of water tanks via online sources and brochures made available during the issue of building permits and installation of a new water tank, to encourage appropriate maintenance and operation.

‘Many homes do not use their water tank due to a variety of different reasons ranging from equipment failures and cost of repair to poor water quality.’ PROJECT STAKEHOLDER, WATER SERVICES

To address energy-efficiency related non-compliance issues with the NCC, random inspections should be carried out on the construction sites by building certifiers commissioned by state governments to create a credible threat against non-compliance. The inspection could be carried out in the form of a checklist generated from the building permit design.

State governments should extend mandatory disclosure of the NatHERS to the existing building stock for all buildings before sale or lease, as it has been in the Australian Capital Territory for two decades. A developed scheme could consider separate heating and cooling assessment, the efficiency of the home appliances and the inclusion of recommended retrofitting opportunities as in the Energy Performance Certificate in the European Union [11]. The final report should be easily accessible and interpretable to the customers.

Alternatively, encourage the uptake of the National Australian Built Environment Rating System (NABERS) for single and multi-residential buildings with a discount on energy bills offered by the electricity suppliers and subsidised by the state government.

‘Should a scheme exist the data is likely to be made available electronically and could be made more relevant by comparing on the basis of total energy consumed on the basis of household and neighbourhood data, as already occurs in some utility bills.’

PROJECT STAKEHOLDER, BUILDING MATERIAL SUPPLIER

URBAN PLANNING

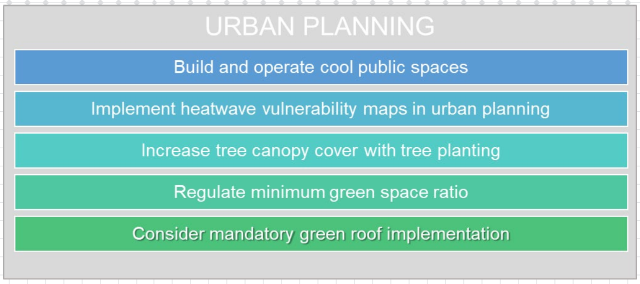

Figure 4 Policy recommendations for urban planning

Build and operate cool public refuges, such as public libraries, swimming pools and community centres by the local councils. The availability of such cool refuges, preferably with extended opening hours, should be communicated in local and social media. To encourage its use, community-operated shuttle buses could provide access for the most vulnerable people. These actions should be incorporated in the heatwave response plans created by the collaboration of the local councils and the state governments.

Develop heatwave vulnerability maps which consider demographic characteristics and local microclimates, with the cooperation of the local councils and metropolitan level governance where available. Implement the maps developed into urban planning and building design through local regulations.

‘Developments should be required to show how they do not contribute to HOT and COOL spots.’ PROJECT STAKEHOLDER, ARCHITECT

Increasing tree canopy cover by the local councils, with a special consideration of water sensitive design, is imperative to harvest the cooling effect of vegetation on the local microclimate and the UHI [25].

A mandatory minimum green space ratio and intensity should be introduced in local development plans for private properties beyond the existing open space ratios. For a wider uptake, the intensity of the greenery calculated for the different vegetated surfaces used could be stipulated in the NCC. For example, a surface covered with an intensive green roof would account for 50% intensity compared to the landscaped ground with hedges and trees accounting for 100% intensity.

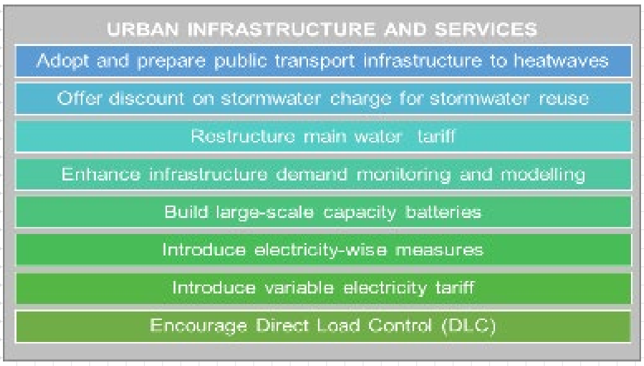

Figure 5 Urban infrastructure and services

‘Planners have an important role to help build inclusive communities and the development of our urban form can facilitate or make this more difficult to achieve. (For example) creating neighbourhoods and a sense of belonging.’

PROJECT STAKEHOLDER, URBAN PLANNER

The implementation of green roofs can provide cool islands in CBDs. Local councils can make the construction of cool roofs and green roofs and walls mandatory [26].

URBAN INFRASTRUCTURE, SERVICES AND UTILITIES

Adopt and prepare public transport infrastructure to heatwaves to avoid leaving daily commuters stranded outdoors as happened in Adelaide and Melbourne in 2009 [27]. Preparation could include cooling the rails with cold water following heatwave alarms, replacement of wooden rail sleepers to the more heat stress resistant concrete sleepers, where it is an appropriate choice, timely communication about the non- operating train lines and the provision of alternative transportations.

Provide a discount on stormwater run-off by the local councils or the water suppliers (whichever charges locally for stormwater), if appropriate measures to store and reuse stormwater are installed and in use on the site.

Water bills are comprised of water use, and fixed supply charge and sewage disposal. Increasing the water use component of the water bill could be a further incentive for the community to decrease their excess water consumption. The introduction of tiered water charges (as in place in South Australia) [28] would be an alternative solution in all states. Nonetheless, either initiative should be implemented with caution to avoid the potential negative impact of decreased water use on vegetation.

The consistent location-specific monitoring of the negative impacts of heatwaves on electricity and water use, public health and urban infrastructure would be essential to learn from past events and establish the best routine in preparation for and management of heatwaves [29]. Such a project could be funded and operated by the state governments.

The government of South Australia has recently built the world’s largest lithium-ion battery in cooperation with Tesla [30]. Such a battery can increase the stability of the electricity grid via charging the batteries from the adjacent wind farms before the electricity demand peaks during heatwaves and discharging them during the peak. The right timing can not only save electricity blackouts but decrease the maximum wholesale price of electricity occurring during heatwaves.

Electricity-wise measures, introduced by the electricity suppliers, could provide instructions to the community about how to avoid the operation of non-life-threatening white goods, such as a dishwasher, during the peak hours of electricity demand. It should be noted that monitoring the population’s compliance with such a regulation would be manageable only after a state-wide roll-out of smart meters regulated by the local states as was undertaken in Victoria.

Introduce dynamic pricing into the residential sector to limit the peak electricity demand caused by air conditioning along the wide-scale implementation of smart metering Australia wide.

> Dynamic pricing refers to different price ranges used for the various periods of the day depending on the demand [29].

To avoid a negative impact of dynamic pricing on the most vulnerable ones, the additional revenue collected from peak electricity demand tariffs could fund the costs of subsidising building retrofitting, including the installation of solar panels with household batteries of low-income householders and those with multiple or severe pre-existing health conditions. **Such long-term planning could help to avoid costs of future extensions of the electricity grid. This system would require collaboration between the power generator, distributors and retailers, given that they are separate business entities in Australia.**

Alternatively, a cooperation between small-scale battery and solar panel suppliers, and the electricity distributors and retailers can pave the way for the rollout in social housing, at no cost to the occupants, in exchange for the revenue generated from the excess electricity, as planned in a recent trial in South Australia [31].

> Direct load control enables the electricity supplier to remotely manage the operation of specific appliances located within private properties, such as solar panels and air-conditioning.

Air conditioners and swimming pool pumps are potential subjects for direct load control (DLC) as the largest electricity consumers during summer [32]. Such a cyclic control decreases the residential and commercial peak demand driven by air conditioners by up to 35% [32]. Under certain conditions, DLC of air conditioners does not influence the perception of indoor thermal comfort [33,34], though its application would warrant future empirical research. DLC can also be applied to match loads and distributed energy resources, such as solar panels.

'Switch on appliances (with Direct Load Control) in response to surplus PV capacity within the home minimising the costs of air conditioning for example and maximising the return on the PV installation with avoidance of high priced energy. ' PROJECT STAKEHOLDER, ELECTRICITY PROVIDER

CONCLUSION

Combining the policy instruments recommended in this paper would address many aspects of heat stress risk and resilience. These policy proposals could collectively increase the population's heat stress resilience through improved adaptation and heat stress resistance of the built environment, including infrastructure, as well as provide increased care for the most vulnerable population groups. The measures targeting the peak demands in electricity, water and public health would minimise the risk of the collapse of the urban services during heatwaves.

PROJECT TEAM AND PARTNERS

Dr Gertrud Hatvani-Kovacs, Professor John Boland

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FURTHER INFORMATION

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