Drivers and barriers to heat stress resilience in the urban context

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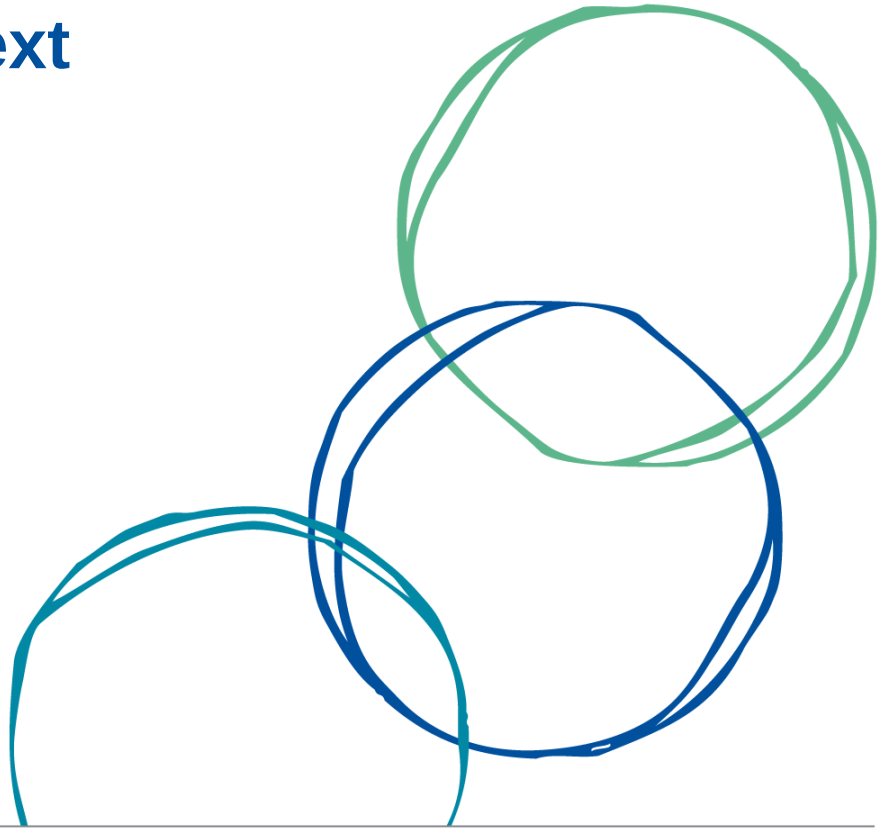


27 September, 2016

Heatwaves in Australia now

- Heatwaves are the most **deadly natural hazard** (Coates 2014)
- Cooling demand drives **peak electricity demand** (Australian Electricity Market Operator, 2011), contributing to soaring **electricity prices** and **energy poverty**
- **Air-conditioning (AC)** is one of the **most frequently used adaptation** techniques
- **Negative impacts** of AC:
  - Increased carbon emission
  - Increased dependence on it (Candido, 2010)
  - Warming up the outdoors

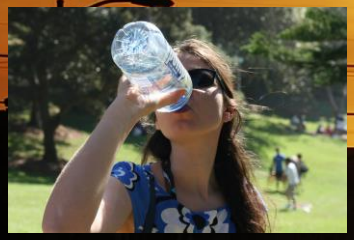
Heatwaves in Australia in the future

- Heatwaves are exacerbated by **Urban Heat Islands** with 89% of Australians living in **cities** (UN DESA 2011)
- The **frequency and intensity** of heatwaves are rising due to climate change (Nairn and Fawcett 2013)
- Population is **ageing**
- New buildings with high insulation and air-tightness rely even more on **AC**

>>>A wicked, interdisciplinary problem.

Framework for the population heat stress resilience

Adaptation



Electricity

RESILIENCE

IMPACTS

Vulnerability

Built environment

Water

Ambulance

Photos from https://unsplash.com/

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Methods

1. Impacts

Time-series and regression analyses in Adelaide and Sydney

Daily data of: electricity consumption, demand; water demand and morbidity

2. Population resilience

Online survey

Representative sample from Adelaide (N=393) and questions about: demography, built environment, retrofitting activity, adaptation, heat-related health problems.

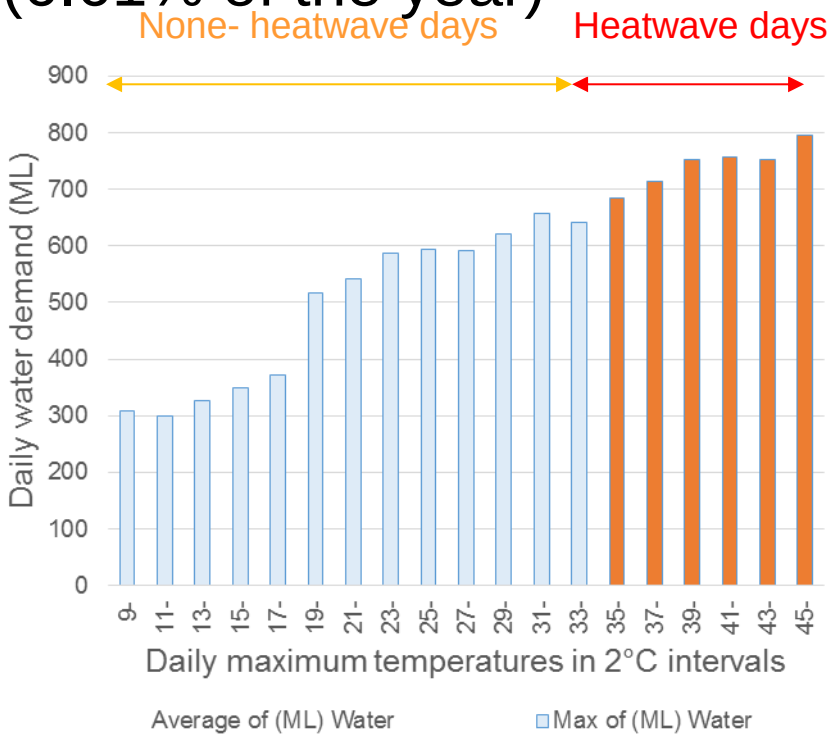
3. Heat stress resistance of buildings

AccuRate building energy simulation of a typical residential floor plan with different design scenarios

Results, impacts threshold temperatures

Temperature threshold	Impact
32 °C	electricity consumption
30 °C	electricity peak demand
28-30 °C	water supply
28 °C	morbidity

- One fifth of water and electricity supply occur during heatwave days (6.61% of the year)



Water demand duration and temperature graph

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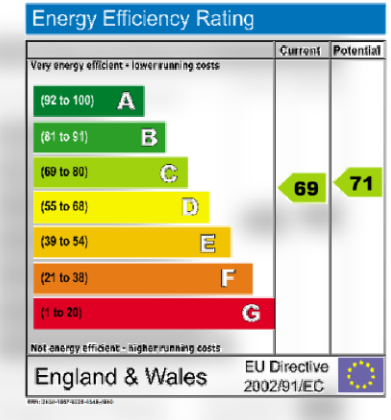
Results, online survey on heat stress resilience

- The **health of one fifth** of the population was impacted by a medium heatwave.
- **Three quarters of dwellings** were reported having insufficient heat stress resistance.
- **Tenants** tended to have more health issues and live in less heat stress resistant homes
- Homes with roof insulation had less health issues
- >>>
  Implement
  the Energy Performance Certificate



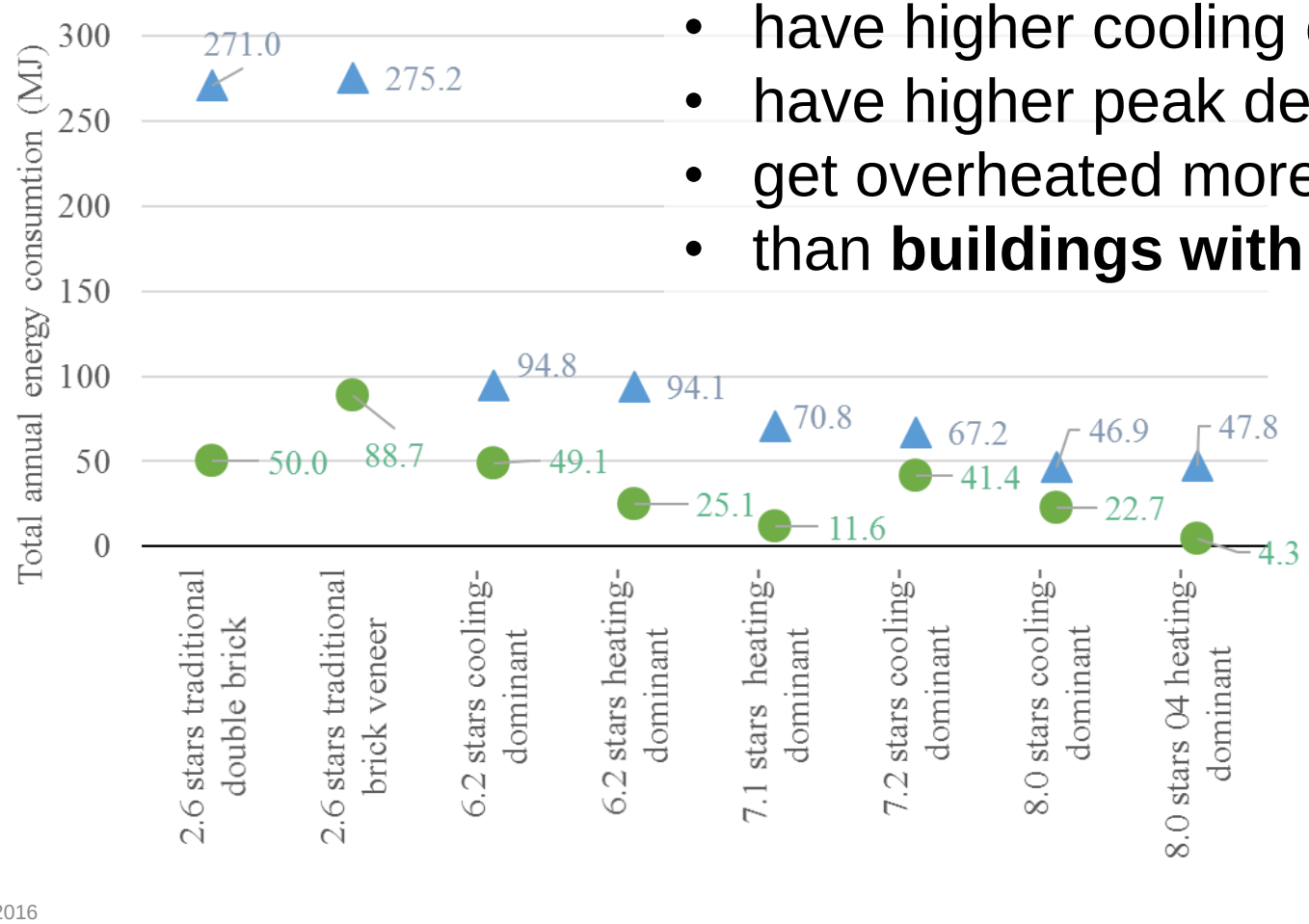
Results, online survey on heat stress resilience

- **Pre-existing health conditions** predicted higher vulnerability and they were oblivious of their vulnerability

- In contrast, **older people adapt more** and live in more resistant homes

- 6-9% of the population lives among poor housing conditions and suffers from **energy poverty**

Results: AccuRate simulation



Homes with more stars can

- have higher cooling consumption
- have higher peak demand
- get overheated more
- than **buildings with fewer stars**

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Conclusion

- **To asses vulnerability** we have to consider energy poverty, adaptation capacity and the built environment

- **AC is not a final solution** >> impact of electricity and morbidity have to be managed together

- Built environment has a **triple positive impact** on resilience
  - Save energy
  - Increase adaptation
  - Decrease health issues

- **Holistic building design** is important to create energy efficient AND heat stress resistant homes

Thank you for your attention!

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CRC LCL research project webpage

http://www.lowcarbonlivingcrc.com.au/research/program-2-low-carbon-precincts/rp2005-urban-micro-climates

PhD talk in the Science Show on the ABC RN, 2nd April, 2016,
http://www.abc.net.au/radionational/programs/scienceshow/coping-with-heatwaves/7291978