

AccuRate

energy simulation software
for residential buildings



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Challenges in Residential Building Energy Efficiency Rating

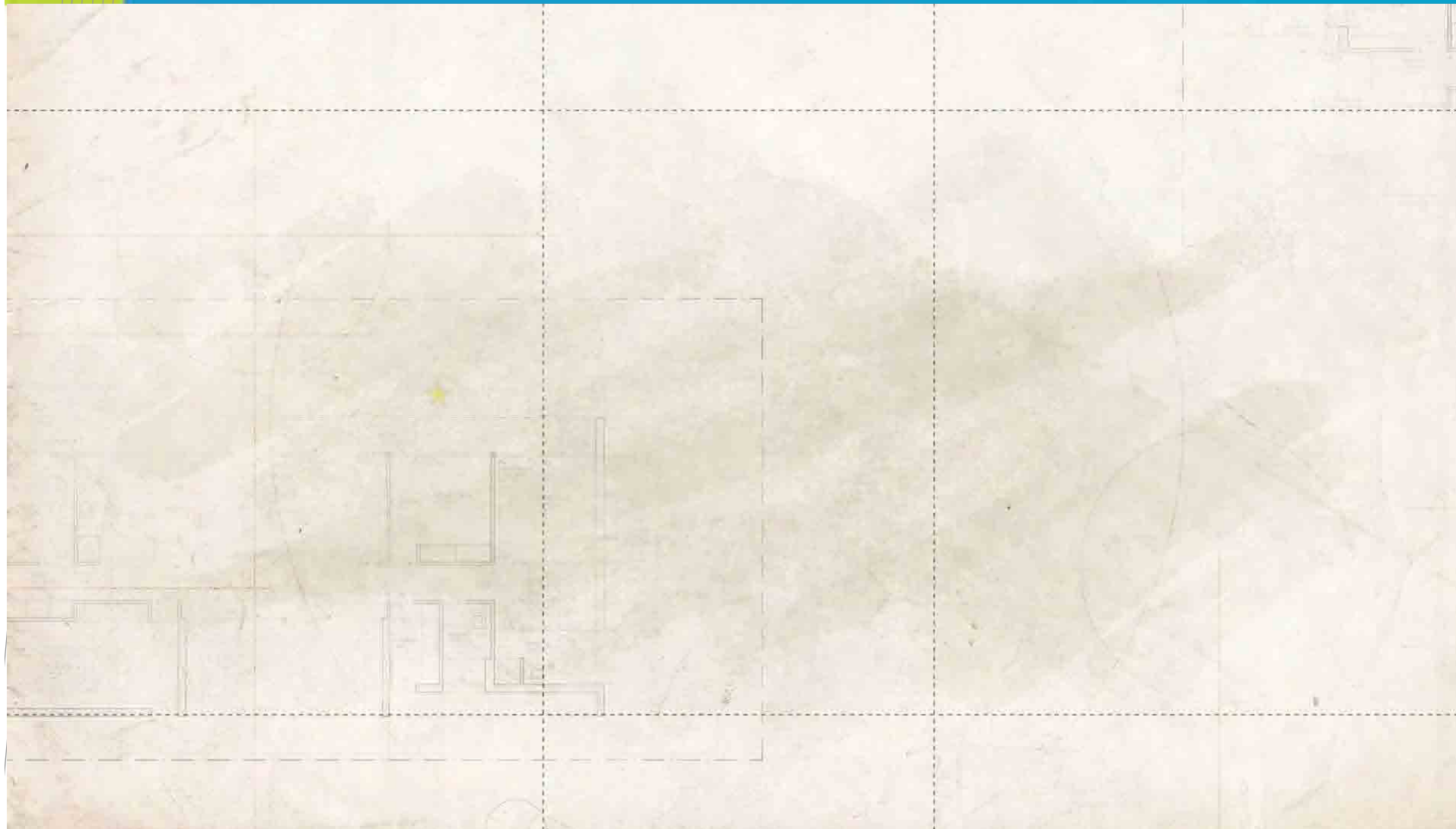
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Challenges in Residential Building Energy Efficiency Rating

- **A brief introduction of the NatHERS scheme**
- **Metrics, criteria and scopes**
- **Occupant behavioural settings**
- **Mechanically heated/cooled vs natural ventilated**
- **Extreme weather conditions and climate change**
- **Regulations and politics**

A brief introduction of the NatHERS scheme



A brief introduction of the NatHERS scheme

- 1984** 5 Star rating concept used
- 1991** Victorian introduced 3 Star requirement
- 1994** NatHERS introduced
- 1995** ACT introduced 4 Star requirement
- 2003** Nationwide energy requirement in BCA
- 2004** Victoria introduced 5 Star requirement
- 2006** Nationwide 5 Star requirement in BCA
- 2011** Nationwide 6 Star requirement in BCA
- 20??** 7, 8 stars ? Whole house ?

A brief introduction of the NatHERS scheme



NatHERS accredited software for house energy rating in Australia

- AccuRate Sustainability (CSIRO)
- BERS professional (CSIRO Chenath engine)
- FirstRate5 (CSIRO Chenath engine)

A brief introduction of the NatHERS scheme



Nationwide House Energy Rating Scheme (NatHERS) provides a framework that allows various computer software tools to rate the potential energy efficiency of Australian homes.

- **It is based on building design only**
- **The thermal envelope only**
- **It is used for compliance of building regulation for around 70 - 90% of the new residential houses.**

Metrics, criteria and scopes

- **Design based or monitoring based**



Metrics, criteria and scopes

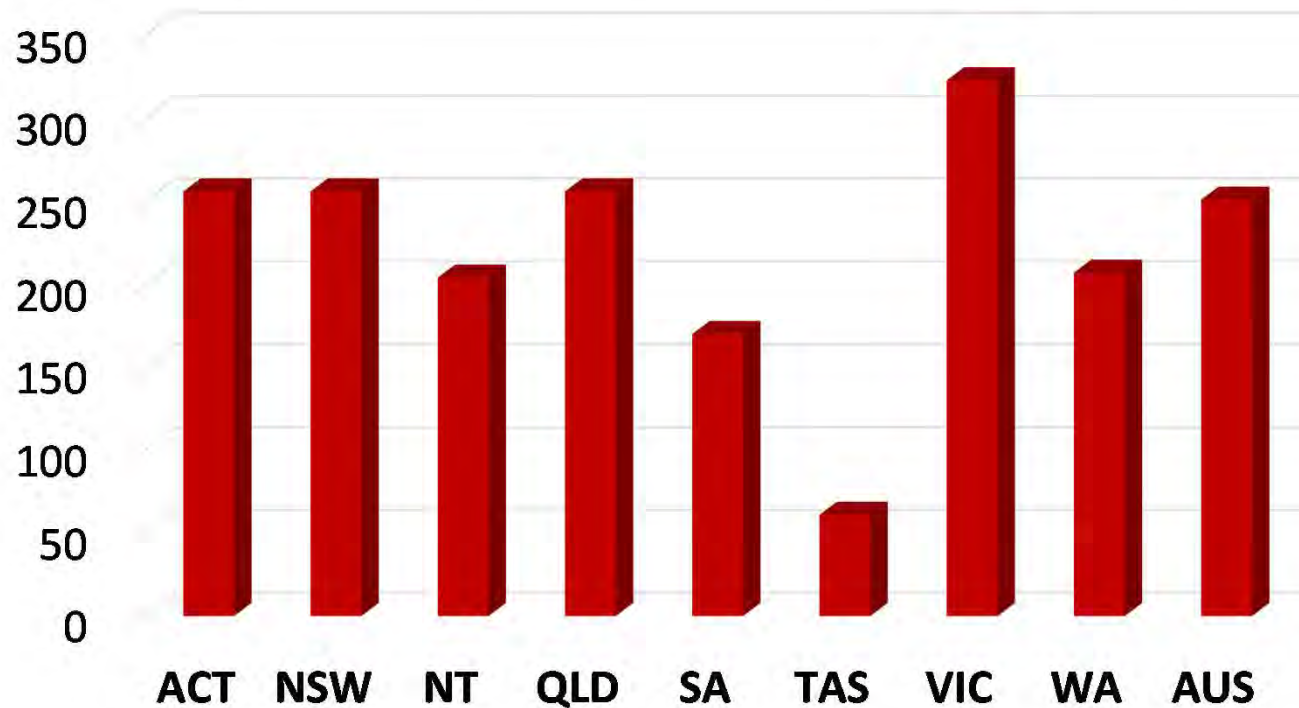
- **Energy or carbon emission ?**



Metrics, criteria and scopes

- Energy or carbon emission ?

CO₂ Emission Factor for Electricity (kg CO₂-e/GJ)



Metrics, criteria and scopes

- **Energy/m² or total energy (should we encourage small houses ?)**



Metrics, criteria and scopes

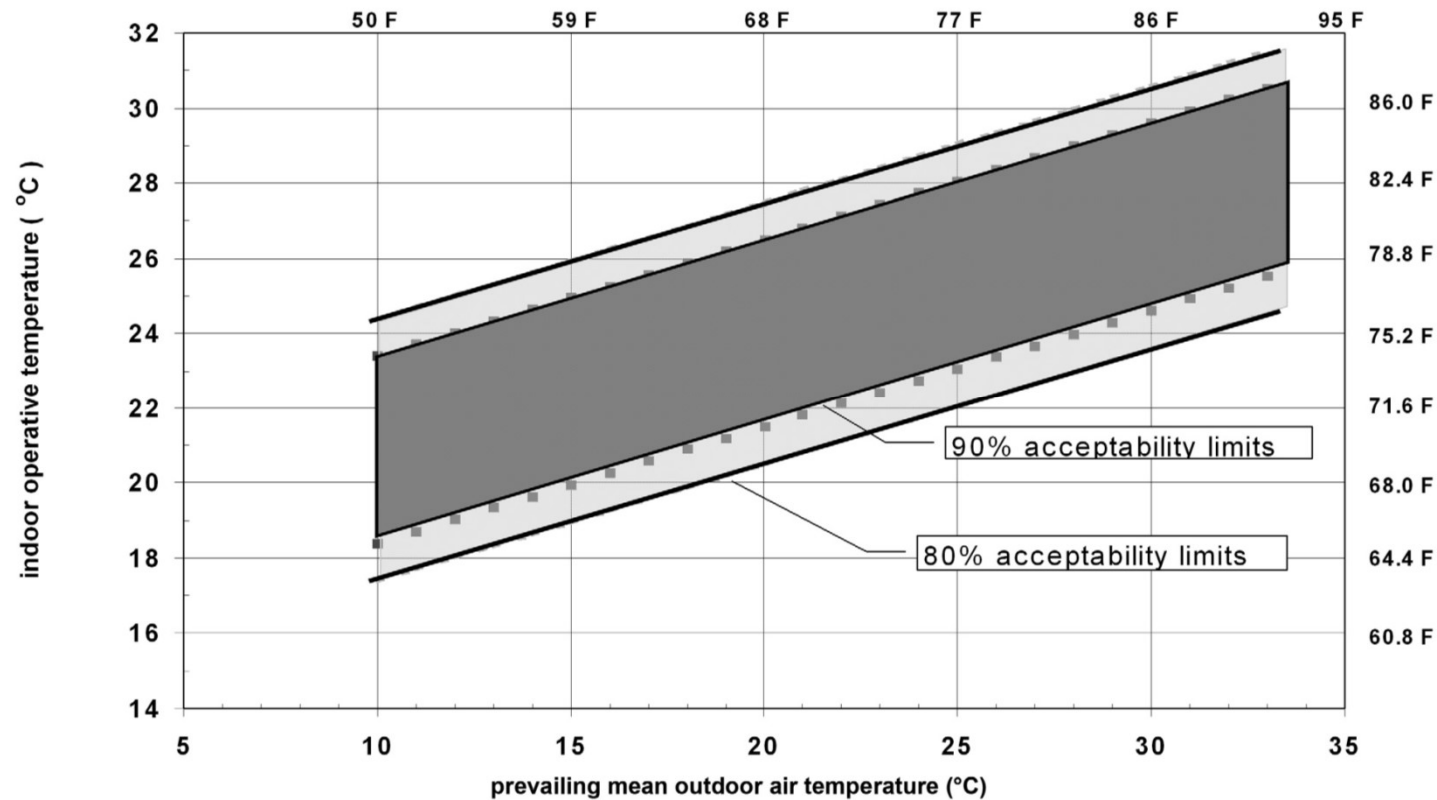
- **Building envelope**
 - **Ceiling fans**
 - **Roof ridge ventilation system**
 - **Room ventilation system and heat recovery system**
- **Fixed appliances**
- **Renewable**

Occupant behavioural settings

- **Occupancy profiles (currently 24/7 occupied)**
- **Appliance operation and thermal loads**
- **Thermostat settings (Heating and cooling, triggering and operation)**
- **Window/door operation**
- **Fan operation and thermal comfort benefit**
- **Indoor/outdoor shading/curtain device operation**

Thermal comfort criteria on star rating

Acceptable operative temperature ranges for naturally conditioned spaces – ASHRAE Standard 55-2013



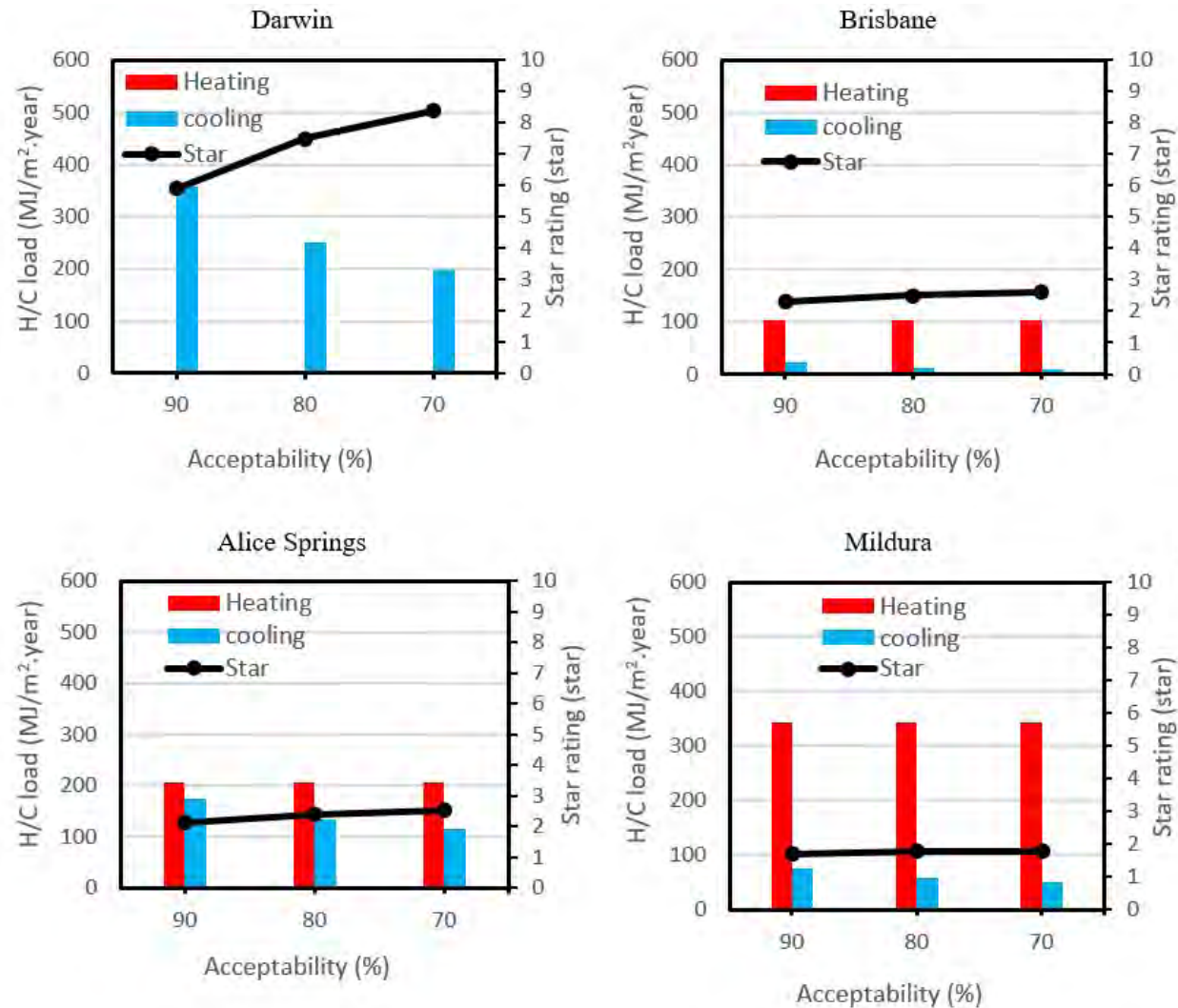
Thermal comfort criteria on star rating

Three acceptability limits were investigated: 70%, 80% and 90%

Table 2 The comfort zone upper/lower temperature bandwidth for each acceptability limit

Acceptability (%)	Upper/lower temperature bandwidth (K)	Source
90	2.5	ASHRAE Standard 55-2013
80	3.5	ASHRAE Standard 55-2013
70	4.0	European Standard 15251

Thermal comfort criteria on star rating



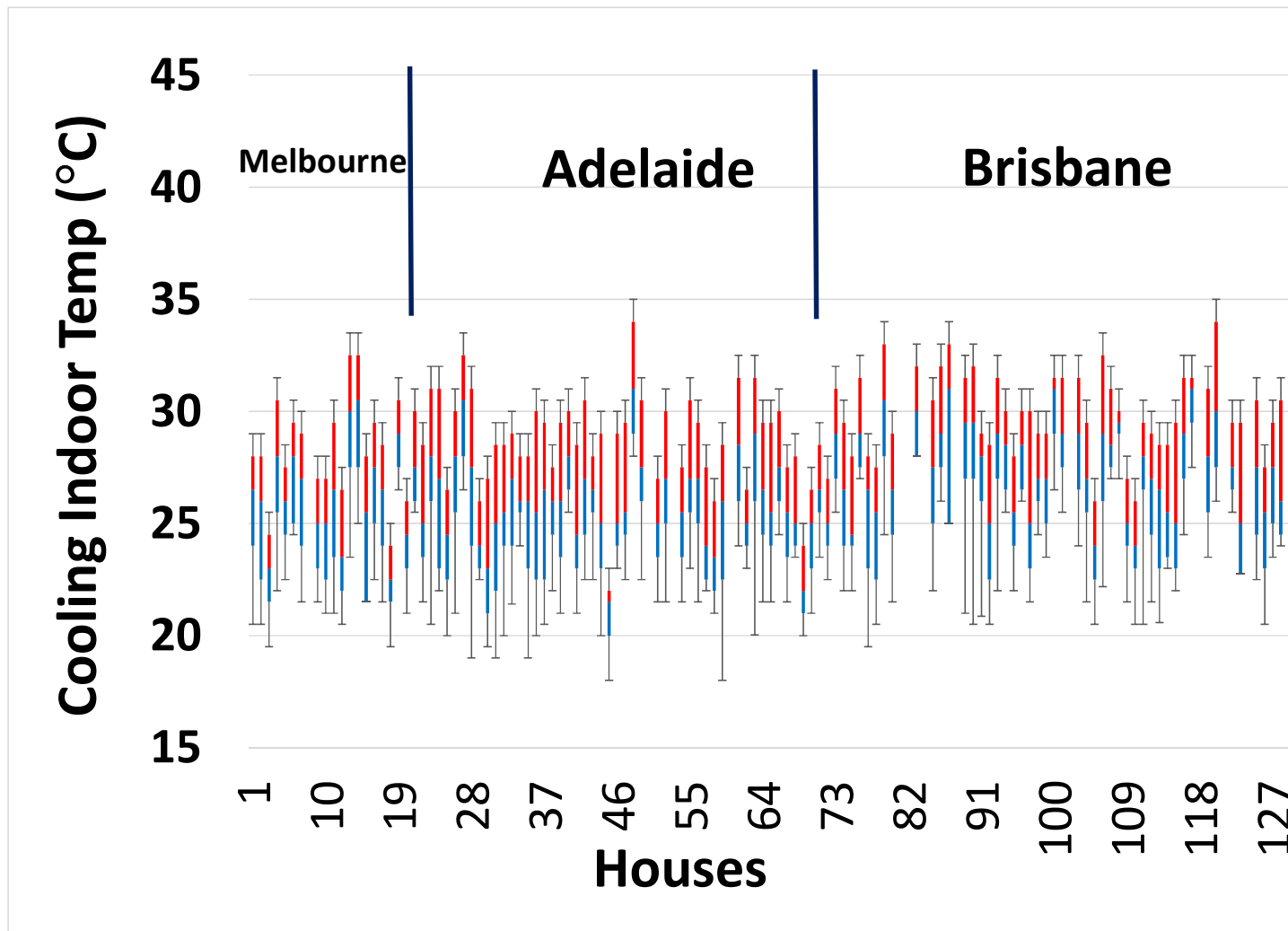
Highset
Lightweight
house

Thermal comfort criteria on star rating

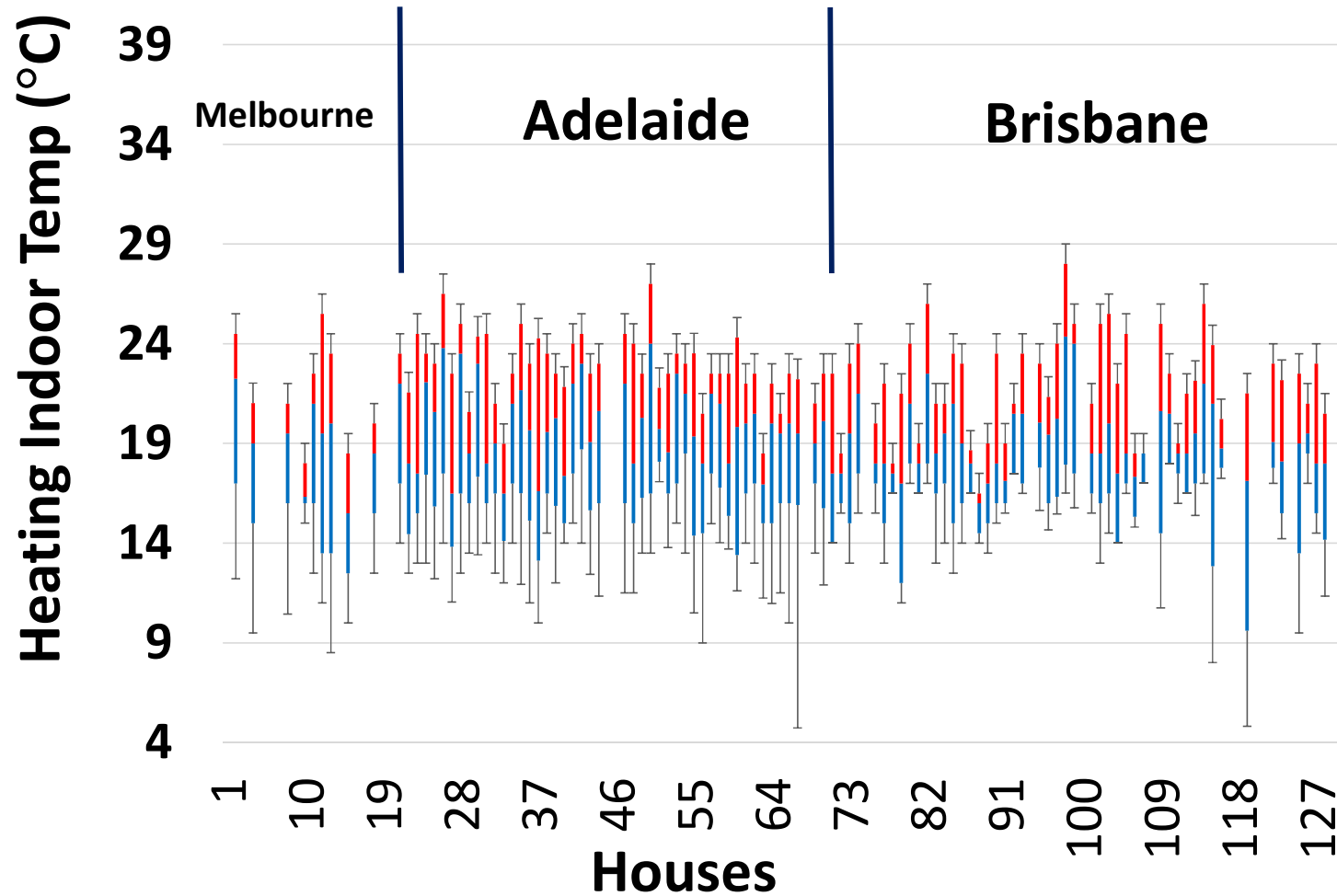
Relax the acceptability limit from 90% to 80%, high set light weight construction will be relatively much easier to achieve high star rating than heavy and medium constructions in Darwin.

The question is how occupants really operate air conditioning in houses in Australia.

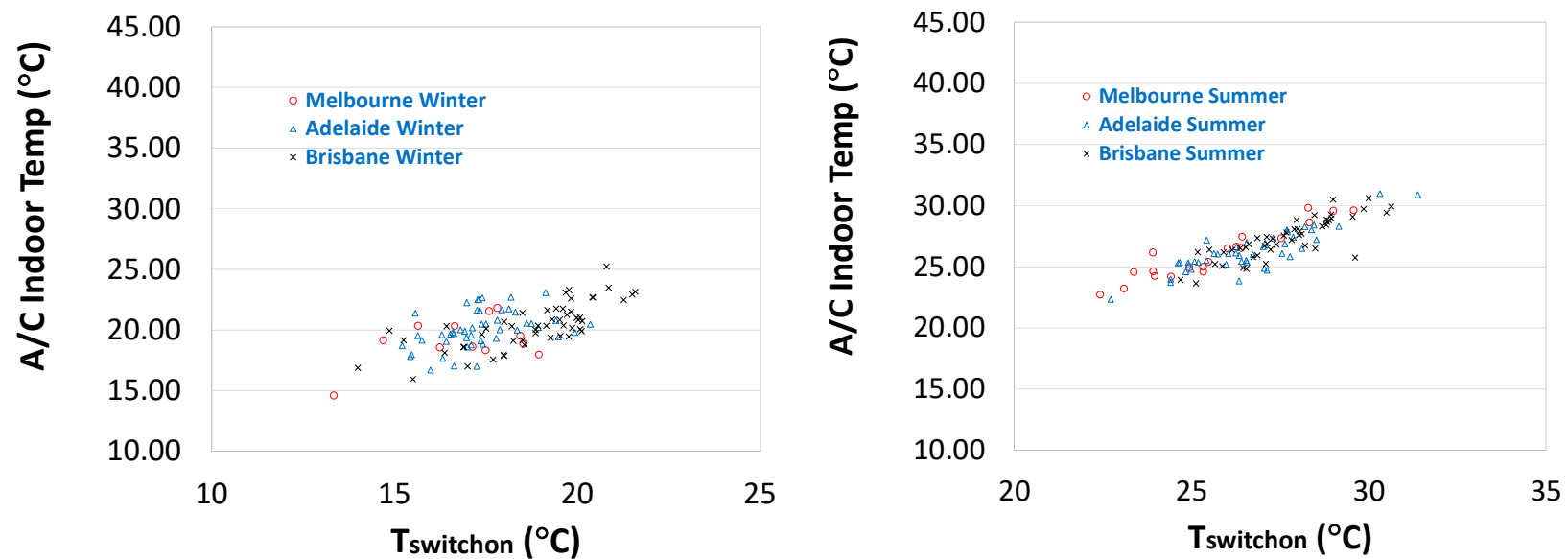
Occupant behavioural settings



Occupant behavioural settings



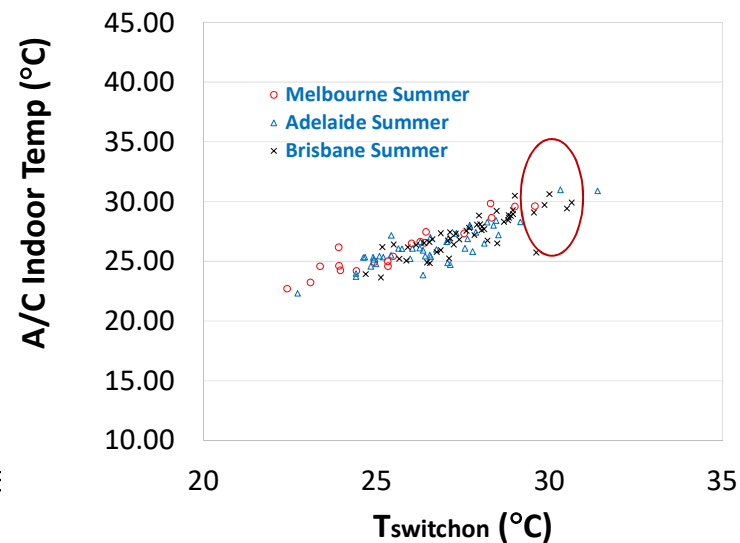
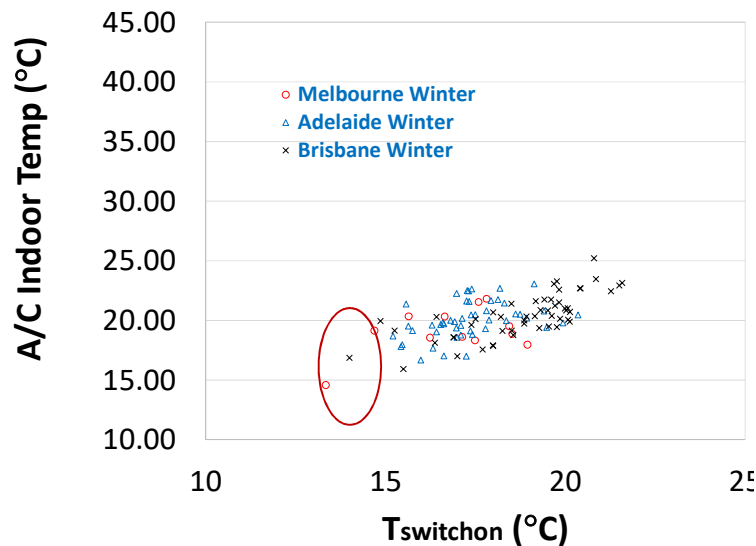
Occupant behavioural settings



Relationship between the average A/C switch on indoor temperature and the average A/C operation indoor air temperature for each house in winter and summer

Occupant behavioural settings

- If the designs based on average behavioural settings encourage energy efficient house design as well as energy efficient occupant behaviours, then, using average settings are appropriate.
- Otherwise, using average settings may not appropriate and alternative method may be needed.



Occupant behavioural settings



If extreme temperatures are allowed, then, in terms of thermal comfort, a simple shelter can be a house.

Occupant behavioural settings

- **Occupant behavioural settings affect house designs and determining to some extent what type of construction and designs can pass the building regulation requirements.**



(a)

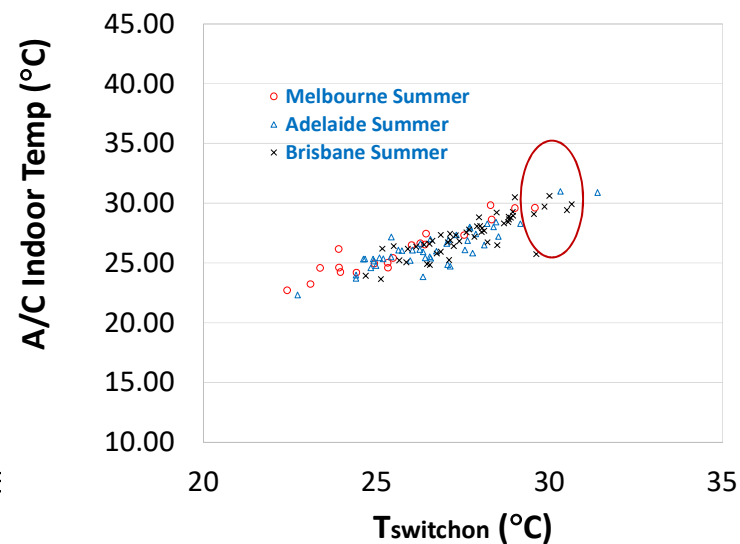
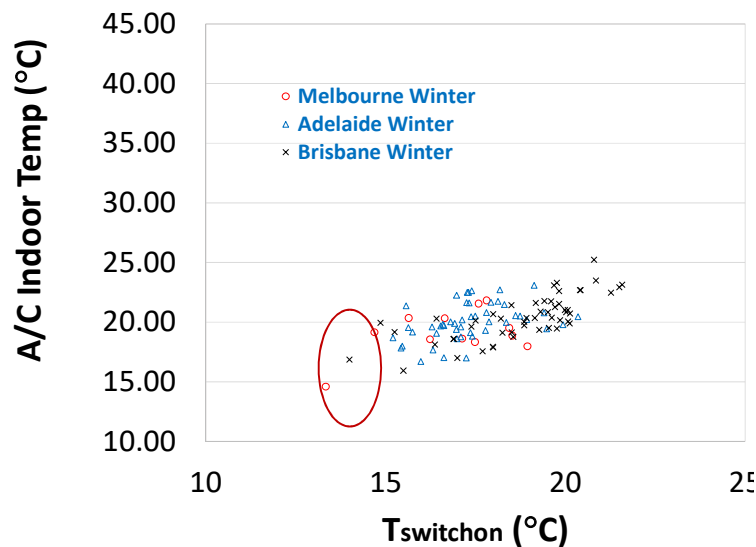


(b)

Figure 1: An Atlas for residential earth building thermal performance in Australia climates: (a) Heating thermostat reduced from 20 °C and 18 °C in living rooms and bedrooms to 17 °C; (b) Cooling thermostat increased 2°C.

Occupant behavioural settings

So, should we use average settings ? Have we got a good understanding on this ?



Mechanically heated/cooled vs natural ventilated

- High energy efficient rated houses based on heating and cooling energy requirements do not guarantee better thermal performance during natural ventilation operations.

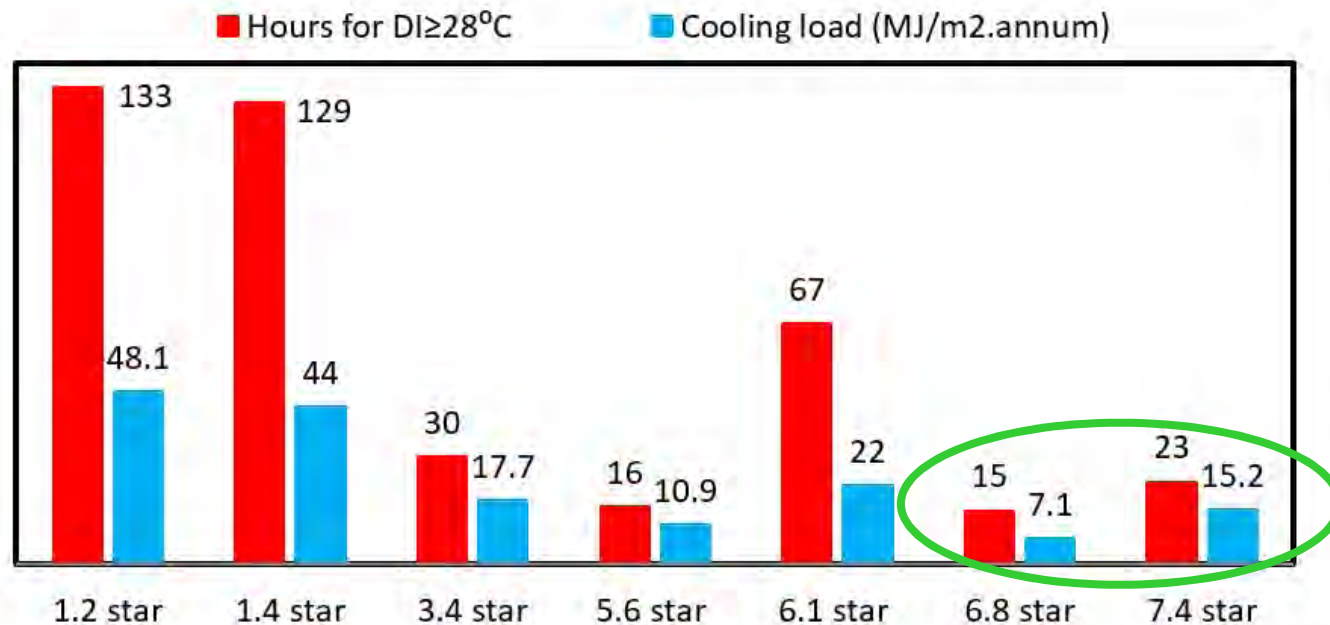


Figure 8 Hours for the houses with various energy star levels at heat risk of $DI \geq 28^{\circ}\text{C}$ for 2009

Melbourne heatwaves

Mechanically heated/cooled vs natural ventilated

- Vice verse, better thermal performance during natural ventilation operations do not guarantee energy efficient houses based on heating and cooling energy requirements

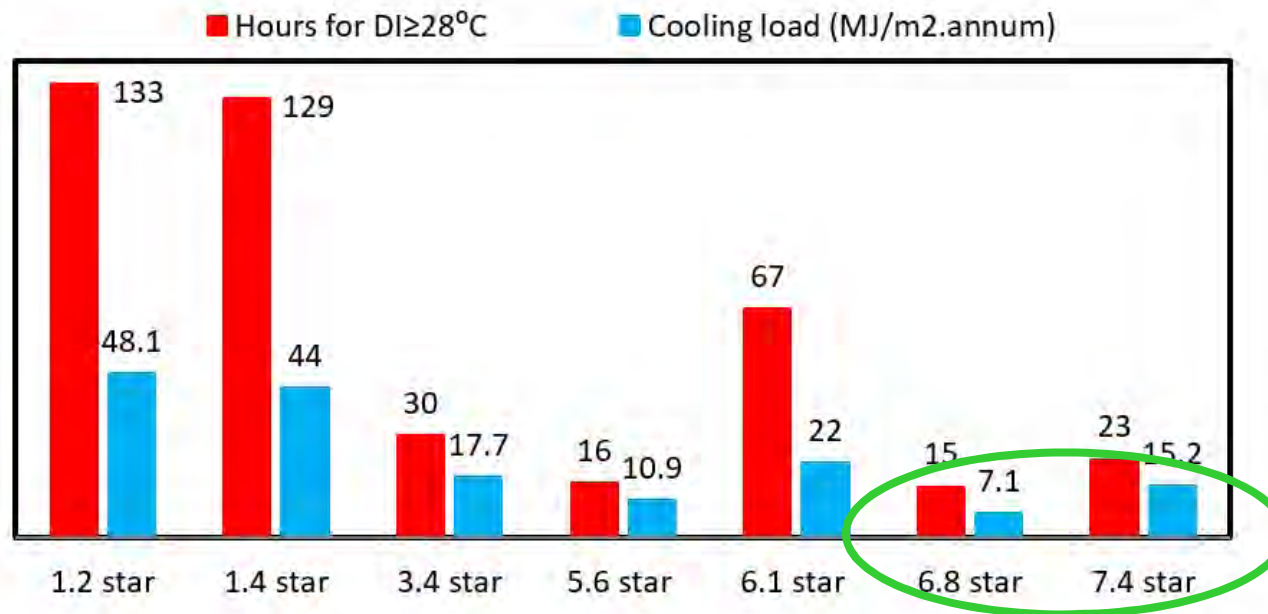


Figure 8 Hours for the houses with various energy star levels at heat risk of $DI \geq 28^\circ\text{C}$ for 2009

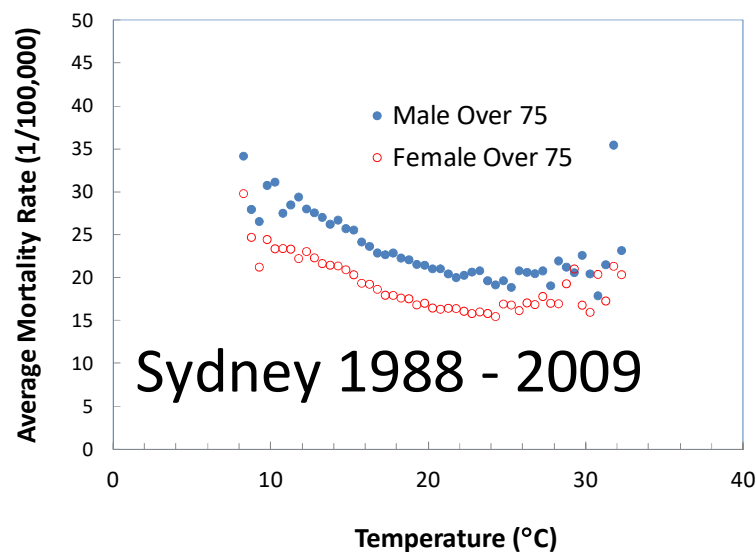
Melbourne heatwaves

Mechanically heated/cooled vs natural ventilated

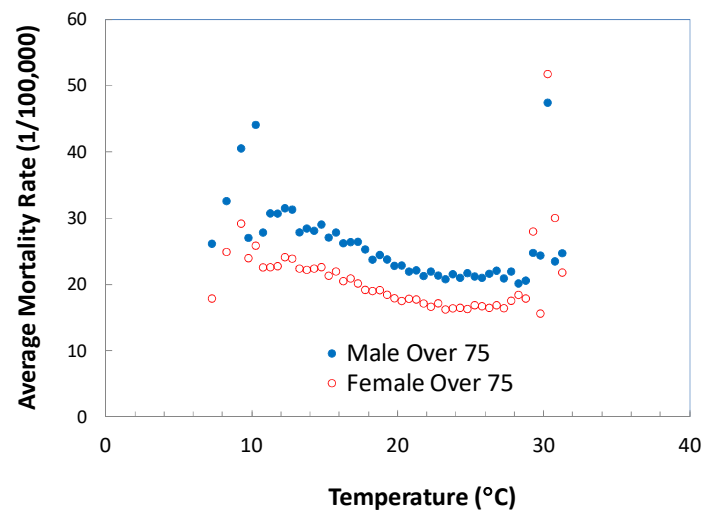
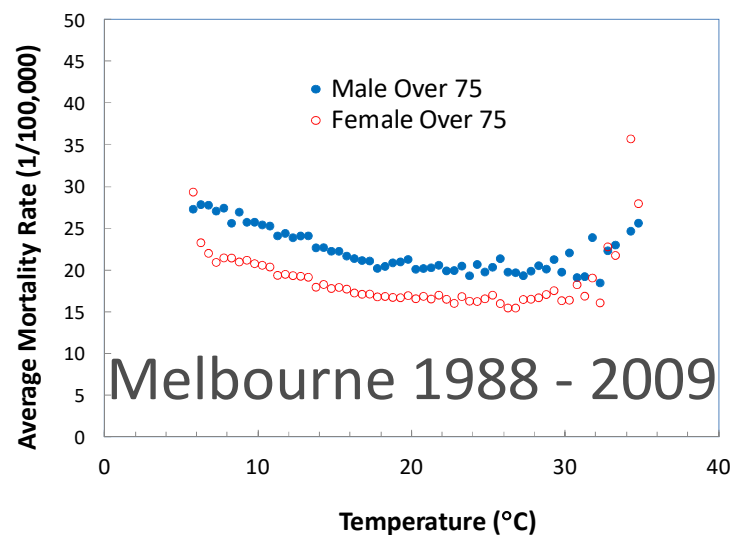
- **A separate system or a combined system may be required.**
- **What is the balance between these two rating systems**
- **If the house is rated with naturally ventilated, should the house or part of the house to be enforced regulatorily to maintain as naturally ventilated in its service life ?**

Extreme weather conditions and climate change

- Performance in extreme weather conditions (heat stress, cold stress)

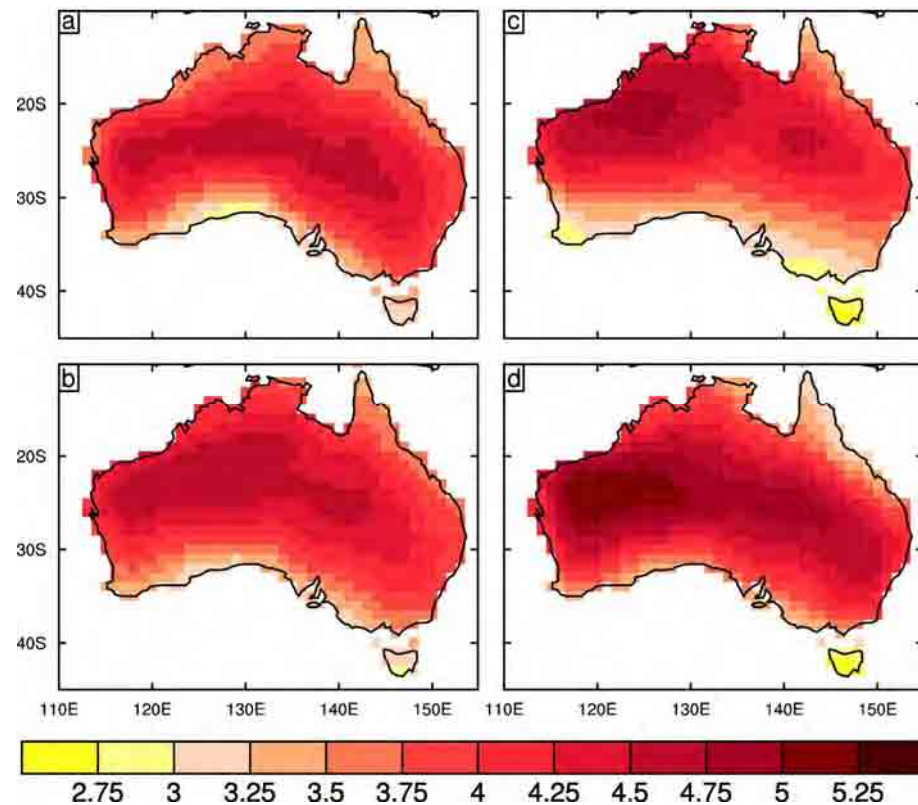


Brisbane 1988 - 2009



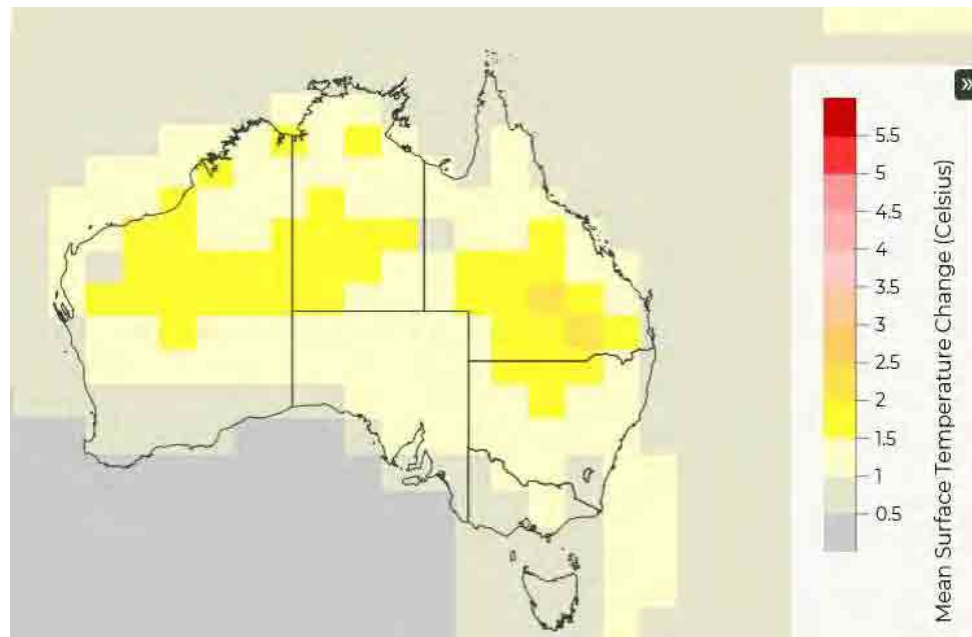
Extreme weather conditions and climate change

- **Climate changes (Median projected changes in temperature in each season for 2080-2099 relative to 1986-2005.**

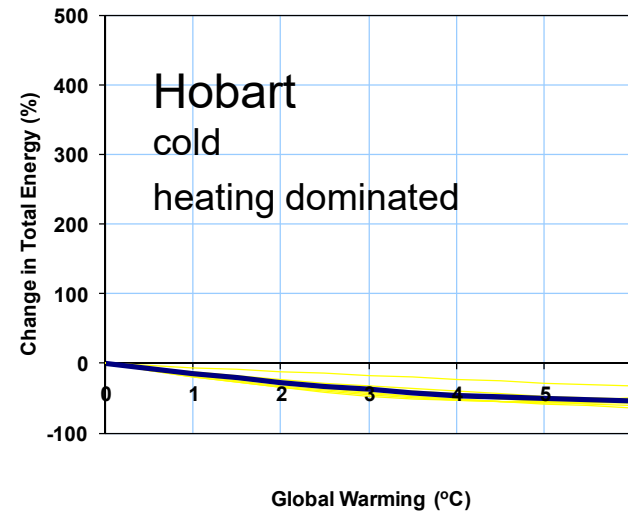
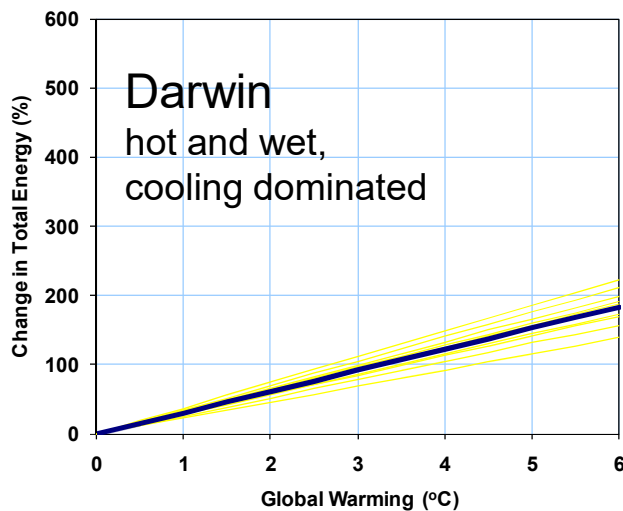
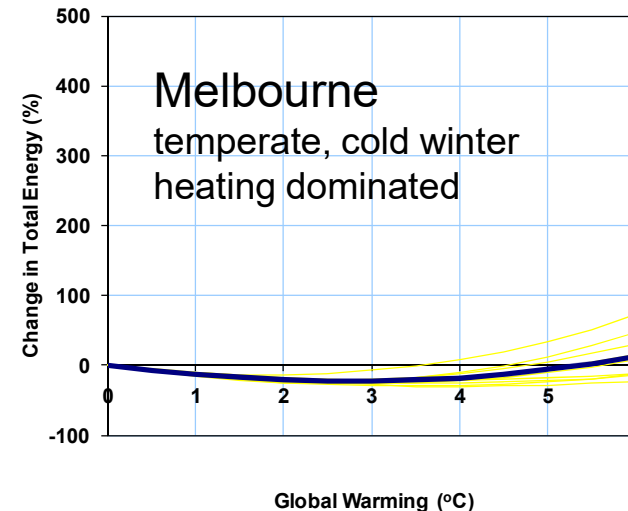
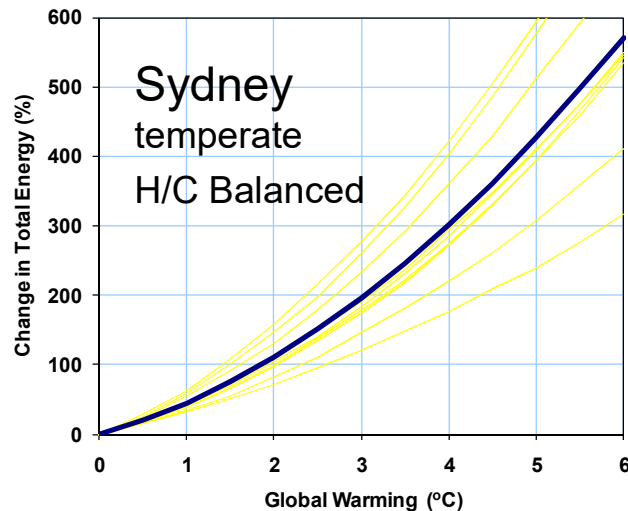


Extreme weather conditions and climate change

- **Climate changes (projected temperature changed for 2050 in relative to 1986-2005, RCP4.5 using GFDL model annual averaged)**



Extreme weather conditions and climate change



Gross floor area: 314.7 m²
Net air-conditioned floor area: 207.4 m²,
Four bedrooms,
A kitchen/family area,
A living room,
A laundry,
A separate bathroom and toilet,
A rumpus room
A double garage

Extreme weather conditions and climate change

- The current RMY weather data was constructed using weather data between 1970's-2004
- The new RMY weather data has been in developing and in assessment over a decade and may be adopted in 2022
- How about projected future weather files ?

Regulations and Politics

- **The frequency of building regulation update and duration for public consultation**
- **Other politics**
- **Can the industry wait ?**

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Thank you

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