Chapter 6

Residential and commercial building design

6.1 This chapter focuses on the challenges climate change presents for the resilience of residential and commercial buildings.

Issues with existing building design in the face of climate change

6.2 Evidence presented during this inquiry indicates that climate change is expected to affect the physical structure of houses and other buildings in at least three key ways:

- First, gradually and over time, changes to weather patterns such as increased temperature and rainfall, as well as increased solar radiation, could have a greater impact on the integrity of buildings than at present. For example, building materials could degrade or fail faster due to higher temperatures, and variations in rainfall could compromise building foundations.
- Secondly, other changes linked to climate change such as higher sea levels could lead to the loss or damage of property.
- Thirdly, expected increases in either the frequency or intensity of extreme events, such as storm surges, flooding, bushfires and cyclones, could significantly damage or destroy large numbers of properties.[1]

6.3 In addition to climate change affecting the physical structure of buildings, building occupants are also affected. In particular, temperature has a direct impact on the health, comfort and productivity of building occupants.

Overview of building standards

6.4 Minimum performance requirements for the design, construction and performance of building work are set by the National Construction Code (NCC), which is developed by the Australian Building Codes Board (ABCB).[2] Standards Australia also advised that the Australian Standards it develops provide guidance for

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1 Australian Sustainable Built Environment Council (ASBEC), *Submission 26*, pp. 2–3.

2 The NCC sets minimum requirements for safety, health, amenity, accessibility, and sustainability in the design and construction of new buildings and new building work in existing buildings. At present, the NCC covers building and plumbing (through the Building Code of Australia and the Plumbing Code of Australia); however, governments have agreed that all onsite building regulation will eventually be included in the NCC. The NCC is given effect by legislation in each state and territory, with each jurisdiction retaining responsibility for regulating building and plumbing. See Mr Neil Savery, Chief Executive Officer, Australian Building Codes Board (ABCB), *Committee Hansard*, 22 March 2018, p. 15; ABCB, 'About the National Construction Code, www.abcb.gov.au/ncc-online/About (accessed 16 April 2018).

the building and construction industry as many of its standards are reflected in the NCC and, therefore, state and territory building and planning regulations.[3]

6.5 The NCC is not, however, applied consistently nationwide:

- The Northern Territory Government advised that it departed from the latest energy efficiency provisions of the NCC due to the likely cost implications associated with bringing 'the Northern Territory into line' with those requirements.[4]
- In New South Wales, parts of the NCC regarding the energy efficiency of residential buildings are varied and assessment under the Building Sustainability Index (BASIX) is instead undertaken.[5]

6.6 Australian buildings are classified on a star-based scale for energy efficiency under the Nationwide House Energy Rating Scheme (NatHERS). NatHERS was added to the NCC in 2003. A recent research paper on heat stress-resistant building design provides the following explanation of the NatHERS star rating system:

> The NatHERS classifies buildings with stars from 0 to 10, based on the predicted annual thermal energy consumed for heating and cooling. The stars correlate to the nominally predicted annual thermal energy consumption, where more stars mean less energy used. The minimum requirements for new buildings were gradually raised to 6 stars, which became mandatory in 2011.[6]

6.7 For commercial buildings, the New South Wales' Young Lawyers Environment and Planning Law Committee explained that the '*Building Energy Efficiency Disclosure Act 2010* (Cth) requires commercial buildings above a certain floor space to meet energy efficiency requirements through National Australian Built Environment Rating System (NABERS) certification scheme'.[7]

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3 Standards Australia, *Submission 21*, p. 3.

4 Northern Territory Government, *Submission 17*, p. 10.

5 Under the BASIX regime, proposed development are assessed for sustainability against certain energy and water use targets that vary by region and for thermal comfort. For example, single dwellings in coastal areas are typically required to have a 40 per cent reduction in potable water consumption and 50 per cent reduction in greenhouse gas emissions compared to the benchmark set for the state. Caps in the annual amount of energy required to heat and cool the dwelling are also set, as a proxy for thermal performance and comfort of the dwelling. Department of Planning and Environment (NSW), 'BASIX targets', www.basix.nsw.gov.au/iframe/about-basix/basix-assessment/basix-targets.html (accessed 11 January 2018).

6 G Hatvani-Kovacs, M Belusko, J Pockett and J Boland, 'Heat stress-resistant building design in the Australian context', *Energy and Buildings*, vol. 158, 2018, p. 291.

7 New South Wales' Young Lawyers Environment and Planning Law Committee, *Submission 32*, p. 4.

Design requirements and practice in the face of climate change

6.8 As Australia has a history of extreme weather events, building standards have changed over time to strengthen building resilience. The changes introduced following Tropical Cyclone Tracy in 1974 were cited as examples.[8] With respect to Tropical Cyclone Yasi (2011), Standards Australia submitted the following evidence on how standards regarding wind loading developed in the 1980s have helped improve public safety:

> The powerful cyclone had extreme wind speeds and caused major destruction but did not directly result in any deaths. The damage to infrastructure in the area, although severe and the most costly throughout Australian history, was less than anticipated due to the implementation of post-1980s Australian Standards that specified the structure of housing in the cyclone-prone region. This is a story of Australian Standards working for the Australian community, ensuring competitiveness in the sector, while at the same time maintaining quality and promoting safety.[9]

6.9 Similarly, the Chief Executive Officer of the ABCB highlighted how data collected as a result of cyclones since Cyclone Larry in 2006 indicate that buildings constructed in accordance with the new standards 'are largely holding up'.[10] Furthermore, a representative of the Housing Industry Association (HIA) commented that during the 2011 Brisbane floods:

> …the buildings that were designed to stay dry during the one-in-100-year event based on 1974 calculations all stayed dry. It was only buildings that had been allowed to be built in areas that weren't safe from one-in-100-year floods that got wet.[11]

6.10 Other elements of building standards that are relevant when considering climate change are energy efficiency and water sensitive design. Various efforts to improve the sustainability and energy efficiency of buildings were referred to during this inquiry, such as the Green Building Council Australia's Green Star rating scheme. Since the Green Star scheme commenced in 2003, over 1400 projects have been Green Star-certified, including 37 per cent of office space in central business districts and apartments that house 40,000 people.[12]

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8 National Climate Change Adaptation Research Facility (NCCARF), *Submission 28*, p. 3; Standards Australia, *Submission 21*, p. 4.

9 Standards Australia, *Submission 21*, p. 4.

10 Mr Neil Savery, Chief Executive Officer, ABCB, *Committee Hansard*, 22 March 2018, p. 19.

11 Mr Michael Roberts, Executive Director, Planning and Environment, Housing Industry Association, *Committee Hansard*, 22 March 2018, p. 12.

12 See Green Building Council Australia, *Submission 50*, p. 4.

6.11 Other examples drawn to the committee's attention include:

- buildings at universities, such as the first six star Green Star education building in Australia opened at Bond University in 2008;[13]
- a housing estate managed by South East Water in Melbourne where, in addition to energy efficiency measures, houses are being developing with remote controlled rainwater tanks that enable water to be released before intense rainfall events, thus reducing the risk of urban flooding and damage to waterways;[14] and
- passive apartment design that can keep the internal temperatures of the apartments moderate without relying on air conditioning, such as the Nightingale apartments in Melbourne.[15]

6.12 Nevertheless, evidence received during this inquiry indicates that Australian buildings are generally not well suited to the existing climate, let alone a future further affected by climate change. It was also argued that the uptake of schemes to improve housing standards in the face of climate change such as the Green Star program is not occurring as rapidly as is required.[16]

6.13 Heat stress in existing housing stock is a particular concern. For example, the National Climate Change Adaptation Research Facility (NCCARF) submitted:

> In many parts of Australia, housing is poorly adapted to the current climate, and this is particularly the case for many modern developments, where lack of insulation and passive design elements mean that auxiliary heating or cooling, which accounts for about 40% (or much more in some climates) of energy use in the average Australian home, are the only way to maintain a comfortable environment for much of the year.[17]

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13 Professor Tor Hundloe, Chair, Climate Change Special Interest Section, Environment Institute of Australia and New Zealand (EIANZ), *Committee Hansard*, 15 March 2018, p. 10; Bond University, 'Bond Introduces Australia's Newest World-Leading Sustainable Building', *Media release*, https://bond.edu.au/news/44557/bond-introduces-australias-newest-world-leading-sustainable-building (accessed 12 April 2018).

14 Ms Dominique La Fontaine, Executive Officer, South East Councils Climate Change Alliance (SECCCA), *Committee Hansard*, 15 March 2018, p. 27.

15 Mr Brett Walters, Manager, Sustainability and Transport, City of Port Phillip, *Committee Hansard*, 15 March 2018, p. 31.

16 Professor Tor Hundloe stated that, in his view, the take up of the Green Star building scheme 'is moving slowly', considering that the problems it addresses have been clearly identified at least since the 2008 report of the Garnaut Climate Change Review. Professor Tor Hundloe, EIANZ, *Committee Hansard*, 15 March 2018, p. 10.

17 NCCARF, *Submission 28*, p. 3.

6.14 From a Western Australian perspective, Regional Development Australia – South West (RDA South West), noted that most houses are 'still constructed of double brick', which it submitted has a higher thermal conductivity (0.6–1.0 W/(m K)) than other building materials, such as 'timber (0.12), glass (0.96), gypsum board (0.17), rock wool (0.045) and other insulation materials (0.0035–0.16)'.[18]

6.15 As the introduction of mandatory energy efficiency requirements only apply to new buildings, most buildings have a much lower efficiency rating. Using Victoria as an example, the Centre for Sustainable Infrastructure at the Swinburne University of Technology highlighted how the majority of the housing stock is significantly below the new energy efficiency requirements:

> In Victoria, approximately 1.9 million (86%) of the existing houses were built before the introduction of mandatory energy efficiency requirements in 2005. Through an on-ground assessment of 60 sample houses, Sustainability Victoria reported that average NatHERS energy star rating of the existing houses constructed before 2005 is 1.81.[19]

6.16 Building design has clear implications for human health. For example, there is concern that building occupants are increasingly dependent on air conditioning during heat periods, and that this dependency exposes large numbers of people to health risks, including death, during heatwave events. The Centre for Sustainable Infrastructure at Swinburne University of Technology explained these concerns in its submission as follows:

> In Australia, heat events have killed more people than any other natural hazard experienced over the past 200 years. Humans spend most of their time indoors during heatwave period, as such assessment of indoor heat stress is an important issue for public health care. During [the] 2003 heatwave in Paris, 74% of excess deaths occurred among those who were staying at home. The situation in Australia is similar to that in Paris considering that the most vulnerable population is the elderly people group. In Australia, there is a growing dependence on mechanical air-conditioning to reduce the impact of heat stress. In March 2014, 74% of dwellings in Australia had coolers, up from 59% in 2005. However, this dependency on air-conditioning overloads the power grid and results in power outages during heatwaves as observed during 2009 and 2014 heatwaves in Melbourne and Adelaide. Therefore, it is crucial to ensure that the dwellings are thermally comfortable in the absence of air-conditioning during a heatwave period.[20]

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18 Regional Development Australia – South West, *Submission 15*, p. 8.

19 Centre for Sustainable Infrastructure, Swinburne University of Technology, *Submission 9*, p. 3 (citations omitted).

20 Centre for Sustainable Infrastructure, Swinburne University of Technology, *Submission 9*, p. 1 (citations omitted).

6.17 The implications of existing building design in the face of the warming climate are clear from studies that analysed and modelled previous warm weather events. This report briefly discusses the results of the following two research projects into heat stress:

- a simulation of how occupants of houses with different building energy efficiency would cope with the Melbourne heatwave event that occurred between 28–30 January 2009;[21] and
- a 2018 paper that assessed cooling consumption, peak cooling demand and the risk of indoor overheating for typical single-storey homes in Adelaide and Sydney.[22]

6.18 For the Melbourne study, the relationship between the ability of a building to mitigate heat stress in the absence of air-conditioning and heat-related mortality and morbidity was examined. Houses with different NatHERS energy ratings were assessed with reference to two indices for measuring heat stress: the WetBulb Globe Temperature (WBGT) index and the Discomfort Index (DI).[23] The study found that for a typical duplex house, the occupants of 0.9 star houses experienced extreme heat stress condition for almost 25 hours under the WBGT index and 17 hours according to the DI heat stress index. Occupants of 5.4 star houses were exposed to extreme conditions for only 6 hours (WBGT index) or 3 hours (DI).[24]

6.19 The heatwave event resulted in excess mortality of 374 deaths (that is, 374 deaths in addition to what would otherwise be expected at that time).[25] The study concluded, however, that upgrading building energy ratings would have a significant impact on related mortality and morbidity. Assuming that the occupants of 0.9 energy star houses were the victims of the 2009 heatwave event, the analysis determined that if all Melbourne homes had at least a 1.8 star energy rating, the number of excess

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21 During this heatwave, Melbourne experienced three consecutive days of temperatures above 43°C. Australian Bureau of Statistics (ABS), 'The exceptional heatwave of January–February 2009 in south-eastern Australia' in *Year Book Australia 2009–10*, cat. 1301.0, June 2010, www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/1301.0Chapter1042009%E2%80%9310 (accessed 3 January 2018). The research is published as M Alam et al, 'Modelling the correlation between building energy ratings and heat-related mortality and morbidity', *Sustainable Cities and Society*, vol. 22, 2016, pp. 29–39.

22 G Hatvani-Kovacs, M Belusko, J Pockett and J Boland, 'Heat stress-resistant building design in the Australian context', *Energy and Buildings*, vol. 158, 2018, pp. 290–299.

23 See M Alam et al.,' Modelling the correlation between building energy ratings and heat-related mortality and morbidity', *Sustainable Cities and Society*, 2016, vol. 22, pp. 29–39.

24 Centre for Sustainable Infrastructure, Swinburne University of Technology, *Submission 9*, pp. 2–3.

25 Department of Human Services (Victoria), *January 2009 Heatwave in Victoria: an Assessment of Health Impacts*, 2009, www2.health.vic.gov.au/Api/downloadmedia/%7B959CCD3C-8285-4938-872E-62E15AA62C62%7D (accessed 3 January 2018), p. iv.

deaths from a 2009-type heatwave would be reduced to around 240. This would reduce further to 37 if all houses could be upgraded to a minimum of 5.4 stars.[26]

6.20 In addition to projected reductions in mortality, corresponding reductions in heat-related morbidity and pressure on the health system were also identified. The results of the analysis are summarised at Table 6.1.

Table 6.1: Predicted health impacts of a heatwave based on the 2009 Melbourne event in different energy rated houses

	0.9 star	*1.8 star*	*2.3 star*	*3.7 star*	*4.5 star*	*5.4 star*
Deaths	374	240	197	96	62	37
Ambulance calls	514	399	347	196	129	63
Emergency department presentations	1055	864	774	511	394	280
After hours doctor consultations	71	59	50	28	20	13

Source: Centre for Sustainable Infrastructure, Swinburne University of Technology, *Submission 9*, p. 4.

6.21 The 2018 paper analysing typical houses in Adelaide and Sydney focused on whether the NatHERS energy efficient design requirements increased heat stress resistance. House design options of 6–8 stars as well as two types of traditional, energy-inefficient homes were simulated.[27]

6.22 The results of the Adelaide analysis included the following observations:

> The cooling consumption of a home with 6 stars (49.1 MJ/m2/year) can be nearly the same as an energy-inefficient, double-brick home with 2.6 stars (50 MJ/m2/year). Meanwhile, a design option with 7.2 stars (41.4 MJ/m2/year) used significantly more energy for cooling than one with only 6.2 stars (25.1 MJ/m2/year). Similarly, a home with 8.0 stars

26 Centre for Sustainable Infrastructure, Swinburne University of Technology, *Submission 9*, pp. 3–4. These results were examined further at the committee's public hearing in Melbourne: see Dr Morshed Alam, Senior Research Fellow; and Professor Patrick Zou, Professor of Construction, Centre for Sustainable Infrastructure, Swinburne University of Technology, *Committee Hansard*, 15 March 2018, pp. 1–7; and the document 'Impact of Climate Change on Occupants' Health', tabled at the 15 March 2018 public hearing. Importantly, the researchers advised that they relied on assumptions to overcome data limitations. These limitations relate to the number of hours of heat stress a person can be subjected to (which differs between individuals) and that the available data on excess mortality does not indicate whether the people were inside their house when they suffered from heatstroke.

27 The analysis was simulated using typical meteorological year data, with mid-February used for Adelaide (with a maximum temperature of 43.7°C) and late October/early November for Sydney (with a maximum temperature of 42.2°C and daily maximum temperatures generally remaining under 30°C during the adjacent days. G Hatvani-Kovacs, M Belusko, J Pockett and J Boland, 'Heat stress-resistant building design in the Australian context', *Energy and Buildings*, vol. 158, 2018, p. 291.

(22.7 MJ/m2/year) used nearly twice as much energy for cooling as a home with 7.1 stars (11.6 MJ/m2/year).[28]

6.23 For Sydney, the analysis found that all homes with 5.6 stars and above were within the maximum heating and cooling thresholds, and that the two types of traditional homes were within the maximum cooling threshold. The study also found that a 6.9-star home had higher cooling energy consumption than a 2.3-star double-brick home, and that the 5.7 star and 7.9 homes examined used the same amount of cooling energy. The paper concluded that 'the star rating did not indicate the cooling energy consumption of a building either in Adelaide or Sydney'.[29]

Particular implications for vulnerable households

6.24 Submissions also noted that certain categories of households are more likely to experience climate change-related risks as they generally live in lower quality housing. Some of these categories include:

- low income homeowners who cannot afford to retrofit their existing house or purchase similar priced housing with better energy efficiency;
- renters who cannot influence their landlords to improve the efficiency of their building or are unable to move to more efficient accommodation; and
- residents in public housing.

Low socioeconomic status homeowners

6.25 As noted above, low income homeowners may not be able to afford to retrofit their existing house or move to similar priced housing that would have lower heating and cooling costs as a result of better energy efficiency. It was also suggested that appropriate retrofitting efforts to make a house more flood resilient or energy efficient might, in addition to cost, be beyond the knowledge of some homeowners.[30]

6.26 Government programs to address residential energy efficiency have directly targeted low-income households, such as the Low Income Energy Efficiency Program operated by the Australian Government between 2011 and 2016.[31]

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28 G Hatvani-Kovacs, M Belusko, J Pockett and J Boland, 'Heat stress-resistant building design in the Australian context', *Energy and Buildings*, vol. 158, 2018, p. 293.

29 G Hatvani-Kovacs et al, 'Heat stress-resistant building design in the Australian context', p. 293.

30 SECCCA, *Submission 30*, p. 5.

31 Department of the Environment and Energy, 'Energy programs – closed', www.energy.gov.au/government-priorities/energy-programs-closed#low-income-energy-efficiency-program (accessed 24 April 2018).

Rental housing

6.27 Thirty-one per cent of Australian homes are rented.[32]

6.28 The committee was referred to a 2013 report which found that Australia's rental housing 'is poorly adapted to climate change, incorporates the lowest quality housing which is over represented by low income earners, and is the most vulnerable to climate change'.[33]

6.29 The City Futures Research Centre at UNSW advised that a research project into the barriers to low carbon living that low income individuals encounter found that the most significant of the housing-related barriers identified related to 'the prevalence of split incentives in the rental sector'. The Centre explained that landlords are often unwilling to implement efficiency upgrades as 'the benefits of their capital investments would be reaped mostly (if not solely) by the tenant'. The Centre continued:

> This issue especially disadvantages lower income households who are more likely renters than owner-occupiers and, without explicit cooperation from the landlord, are left with few recourses to protect themselves from climate change and extreme weather events even if they have the financial means to do so. One of our participants illustrates the situation: "*the landlord wasn't interested in insulation. We offered to put solar panels on but he wouldn't hear of it, and he wasn't interested in insulating the ceilings which is a pity*" (older couple in private rental, Tasmania).[34]

6.30 Hobsons Bay City Council noted that recently arrived migrants who are renting are also at a disadvantage, as they will need to learn about the need for efficiency measures in the Australian climate as well as their rights as tenants.[35]

Public housing

6.31 Concerns about public housing centred on older public housing stock that is poorly designed and maintained, and/or when public housing residents are unable to pay for air conditioning.[36] The South East Councils Climate Change Alliance (SECCCA), which represents several councils located south east of Melbourne, submitted that studies reveal '50,000 public housing properties in Victoria fail to meet

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32 ABS, 'Census of Population and Housing: Australia Revealed, 2016', cat. 2024.0, June 2017, www.abs.gov.au/ausstats/abs@.nsf/mf/2024.0 (accessed 17 April 2018).

33 Climate and Health Alliance, *Submission 16*, p. 5. The report cited is L Instone et al, *Climate change adaptation and the rental sector*, NCCARF, 2013.

34 City Futures Research Centre, UNSW, *Submission 24*, p. 1.

35 Hobsons Bay City Council, *Submission 7*, p. 12.

36 NCCARF, *Submission 28*, p. 5.

energy efficiency standards indicating that public housing tenants are less able to adapt to rising energy, water prices and contribute to climate change mitigation'.[37]

6.32 The NCCARF submitted that retrofitting, and the use of features such as cool refuges, could be pursued in response to these problems. The NCCARF explained:

> Retrofitting (e.g. to improve thermal performance) can be prioritised, and will provide value in reducing the climate risk. Particular care needs to be taken in the design and management of public housing for Indigenous Australians, to ensure it is appropriate with respect to cultural practices and to the often-extreme climatic conditions experienced by those living in regional and remote locations.
>
> External building features and landscapes can be an important contributor to improving resilience for public housing (e.g. cool refuges, flood protection) and should be considered in public housing design. External cool refuges, which may be swimming pools, are of particular importance in heatwaves, providing respite to residents unable to afford mechanical cooling or who are more vulnerable to heat stress.[38]

6.33 The committee was advised of projects underway to retrofit existing public and social housing to better withstand current climatic conditions. An example put forward is the Cooling Communities initiative undertaken by the City of Moreland with an $80,000 grant from the state government.[39]

6.34 The Northern Territory Government advised that guidelines and recommendations have been developed for public housing it supplies 'to promote site-responsive passive designs suitable for Northern Territory climate zones'. The Government submitted that it 'acknowledges that climatically appropriate design is integral to the liveability and sustainability of urban and remote public housing dwellings'.[40]

Suggestions for change

6.35 In response to the issues identified with the design of individual houses and other buildings, stakeholders put forward suggestions regarding changes to building standards and providing incentives for homeowners to improve the efficiency of their dwellings.

37 SECCCA, *Submission 30*, p. 5.

38 NCCARF, *Submission 28*, p. 5 (citation omitted).

39 Northern Alliance for Greenhouse Action, *Submission 19*, p. 4.

40 Northern Territory Government, *Submission 17*, p. 10.

Building standards and measuring energy efficiency

6.36 The benefits of a nationally consistent approach to construction regulation were recognised, with Green Building Council Australia characterising Australia as being 'fortunate' to have the NCC in place.[41] Similarly, the HIA advised that the NCC 'is seen as the benchmark by many overseas countries with respect to the technical construction standards it has established, particularly regarding building in bushfire- and cyclone-prone areas'.[42] Other recent improvements were also noted, such as the Victorian Government's Better Apartments Design Standards.[43]

6.37 Despite these positive comments about the NCC and building practices more generally, many stakeholders argued that strengthened or additional minimum building requirements are required to adapt to the effects of climate change. This evidence is discussed in the following paragraphs.

Need to reconsider minimum building requirements

6.38 Several submitters highlighted that existing building standards prescribed in the NCC are not suitable for extreme climate events associated with climate change. For example, the NCCARF submitted:

> Much of Australia's housing stock does not meet existing building standards and can be poorly designed for extreme climate events (e.g. heat, cyclones). Building guidelines currently use historic climate conditions to evaluate the energy demand and performance of a building, and these are unlikely to be adequate for future climate conditions. We do have a reasonable understanding of design features that can target heat reduction (e.g. orientation, shading, provision of appropriately sized eaves, light colours, reflective roofing, inclusion of a cool refuge, complimentary landscaping) but these are not formalised into the National Building Code.[44]

6.39 The NCCARF added that, despite the engineering-based standards introduced following Cyclone Tracy to improve the resilience of buildings to high wind speeds, there is '[s]ome evidence that modern housing may not be performing as expected under the Code'. The NCCARF suggested that ongoing review of the NCC 'is required to ensure that new buildings can withstand present-day and likely future high windspeed events'.[45]

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41 Green Building Council Australia, *Submission 50*, p. 14.

42 Mr Michael Roberts, Housing Industry Association, *Committee Hansard*, 22 March 2018, p. 9.

43 Mr Brett Walters, Manager, Sustainability and Transport; Mr Steven McKellar, Senior Project Manager, Climate Adaptation and Sustainability, City of Port Phillip, *Committee Hansard*, 15 March 2018, p. 31.

44 NCCARF, *Submission 28*, p. 3.

45 NCCARF, *Submission 28*, p. 3.

6.40 The Climate and Health Alliance also noted that previous papers and public inquiries have highlighted gaps in the NCC, including that the Code does not include design measures for buildings to withstand hail, storm tide or heat stress.[46]

6.41 IAG also recognised that the current building code might 'not be adequate to meet the risks of future extreme weather events'. IAG submitted:

> It is important that research is conducted into both the drivers of damage to buildings as well as improved understanding of the potential changes to extreme weather events so that building codes are more effective in managing future community risk. Providing upfront protection of assets, buildings and infrastructure minimises the impact to community post disaster. This is an issue now and will only increase in its impact to communities as we see an increase in more extreme weather events.[47]

6.42 Apparent issues with the NCC relating to health attracted significant attention. The Climate and Health Alliance argued that the study of Melbourne housing based on the 2009 heatwave event (see paragraphs 6.17–6.19) indicates that the Building Code of Australia, which forms two volumes of the NCC, is deficient with respect to extreme heat.[48]

6.43 Similarly, the authors of the 2018 study of heat stress-resistant building design in Adelaide and Sydney homes (see paragraphs 6.17 and 6.21–6.23) concluded that overreliance on air conditioning can present a public health hazard and that integration of heat stress resistance in the NatHERS should occur. The researchers argued that, at present, energy efficiency schemes such as NatHERS 'can be potentially counterproductive to heat stress resistance'. A result that particularly supports this conclusion is the finding from the Sydney analysis that although all homes with 5.6 stars and above were within the maximum heating and cooling thresholds, the two types of traditional homes were also within the maximum cooling threshold. The researchers described this as an unexpected result that highlights that the cooling threshold requirement 'is lenient'.[49]

6.44 Overall, the authors of the study concluded:

> …NatHERS does not directly encourage heat stress resistance in new homes and can even deliver buildings with worse heat resistance than traditional, energy-inefficient buildings. Current building construction methods, compliant with the NatHERS, rely greatly on AC, thus increasing

46 Climate and Health Alliance, *Submission 16*, pp. 5–6.

47 IAG, *Submission 56*, p. 8.

48 Climate and Health Alliance, *Submission 16*, pp. 5–6.

49 G Hatvani-Kovacs, M Belusko, J Pockett and J Boland, 'Heat stress-resistant building design in the Australian context', *Energy and Buildings*, vol. 158, 2018, p. 293. Evidence received from the ABCB confirmed that the NatHERS software assumes 'that at a certain point, or over a certain temperature, there is going to be artificial climate control'. Mr Neil Savery, ABCB, *Committee Hansard*, 22 March 2018, p. 18.

> the population's dependence on it. New homes can potentially be more hazardous without AC during heatwaves than traditional, double-brick buildings. Consequently, the risk exists that the NatHERS, without modification, can adversely impact on human health during heatwaves. Energy efficiency and heat stress resistance can be both achieved in the design process. A design approach that considers both aspects is recommended, particularly considering future increases in the vulnerability of the population and climate change. [50]

6.45 The study recommended that heat stress-resistant measures should be implemented in NatHERS to 'decrease risks associated with the population's dependence on [air conditioning], ensure a thermally safe indoor environment and reduce pressure on electricity prices'.[51] Further research into Australian building practices and how the NatHERS affects heat stress resistance was also suggested.[52]

6.46 Evidence from the City of Melbourne supported the researchers' concerns about the relevance of NatHERS for heatwaves. Mr Gavin Ashley, who leads the City's climate resilience team, commented:

> Where the Building Code currently sits, the six-star minimum standard for NatHERS is not sufficient in its ability to address heatwaves in particular. It's based on year-round energy use and splits that between your cooling and heating requirements. That doesn't give a great indication of how your building is going to perform in a heatwave. Additional guidance, which essentially puts buildings through a model that allows us to understand what the internal thermal comfort conditions are going to be during a heatwave, is critical to understanding how the building is performing. That's not currently a metric that's included in the Building Code. In order for us to plan properly and for developers to get it, it needs to be.[53]

6.47 To address heat stress risks, Green Cross Australia argued that a heat stress building code needs to be developed and 'that available disparate knowledge about effective responses to heat is integrated and combined with guidance material to support users'.[54] The Australian Health Economics Society suggested that building design and building codes for housing and commercial premises should 'emphasise passive cooling and to minimise heat gain when air conditioning is not available (e.g. due to power supply disruption)'.[55]

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50 G Hatvani-Kovacs et al, 'Heat stress-resistant building design in the Australian context', p. 297.

51 G Hatvani-Kovacs et al, 'Heat stress-resistant building design in the Australian context', p. 297.

52 G Hatvani-Kovacs et al, 'Heat stress-resistant building design in the Australian context', p. 291.

53 Mr Gavin Ashley, Team Leader, Climate Resilience, City of Melbourne, *Committee Hansard*, 15 March 2018, p. 28.

54 Green Cross Australia, *Submission 38*, p. 5.

55 Australian Health Economics Society, *Submission 23*, p. 4.

6.48 Work that has been undertaken on bushfires and wind loading was noted, although it was acknowledged that further work could be undertaken in response to extreme weather conditions. Standards Australia submitted:

> As a result of extreme weather conditions and technological shifts, there is further scope for standards development in key areas, ensuring that the infrastructure we build remains future-focused and responsive to our environmental conditions.[56]

6.49 Other stakeholders supported reviewing and revising building standards, including the NCC, to improve the energy efficiency of buildings and resilience of housing design to climate change risks.[57] In particular, Green Building Council Australia argued that the minimum standards in the NCC regarding energy efficiency should be updated more frequently. The Green Building Council submitted:

> The gap between minimum practice outlined in the NCC and best practice grows wider by the year. Lifting minimum standards for energy efficiency in the NCC will ensure that new buildings in Australia do not miss opportunities for emissions reduction, as well as creating opportunities to reduce running costs over the life of buildings.[58]

6.50 The Green Building Council added that a 'goal of net zero emissions for the NCC supported by a trajectory of planned updates over time will encourage innovation and regular upskilling of industry, and deliver more high performing buildings'.[59] Similarly, the ASBEC called for a national plan to be established to move towards zero carbon buildings by 2050.[60]

6.51 The New South Wales' Young Lawyers Environment and Planning Law Committee argued that Australian Standards 'should include preventing property damage occasioned by climate change as part of their goals, to the extent that this would help to protect lives'. Furthermore, although it was acknowledged that there are difficulties in updating Australian Standards 'where future impacts of climate change are uncertain', it was argued that updates could be progressed based on a precautionary approach that considers worst-case scenarios using 'best practice scientific data'.[61]

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56 Standards Australia, *Submission 21*, p. 4.

57 See NCCARF, *Submission 28*, p. 4; Tasmanian Government, *Submission 4*, p. 4; Sustainable Business Australia, *Submission 52*, p. 16; City of Melbourne, *Submission 43*, p. 3; New South Wales' Young Lawyers Environment and Planning Law Committee, *Submission 32*, p. 7; Northern Territory Government, *Submission 17*, p. 4; Wesfarmers, *Submission 20*, p. 4; ASBEC, *Submission 26*, p. 6.

58 Green Building Council Australia, *Submission 50*, p. 14.

59 Green Building Council Australia, *Submission 50*, p. 14.

60 ASBEC, *Submission 26*, p. 6.

61 New South Wales' Young Lawyers Environment and Planning Law Committee, *Submission 32*, p. 8.

6.52 The Australian Sustainable Built Environment Council (ASBEC) described the building regulation and standards development processes as 'slow and reactive'. It noted that this 'is perhaps understandable, considering that changes to these documents are required to be supported by evidence, cost-effective, and subject to regulatory impact assessment'. Nevertheless, the ASBEC argued that 'regular review processes are needed to enable building codes and standards to reflect, in a timely way, new climate change research and industry feedback'.[62]

6.53 Finally, it was suggested that, at least in some jurisdictions, it would be desirable to confirm that the energy ratings indicated at the outset of new developments are actually achieved. The Western Australian Local Government Association argued that occupancy certificates required for single residential properties should 'confirm that the Energy Rating prepared at the start of the project, has actually been achieved once the build is completed'.[63]

Work currently underway and need for further research

6.54 The appropriateness and effectiveness of current building standards from a climate change perspective has been the subject of policymakers' attention recently. Mr Michael Roberts from the HIA explained that there are currently three reviews considering the future benchmarks that should be set for housing. In addition, Mr Roberts noted that the NCC is due to be amended in 2019 and will be reviewed again in 2022. In summary, Mr Roberts noted that these reviews indicate there is 'a continuing discussion about how buildings need to improve'.[64]

6.55 The ABCB is also undertaking work and monitoring developments in this area. The Chief Executive Officer of the ABCB, Mr Neil Savery, explained that the Board 'continues to monitor events and the science of climate change to determine if any further changes to the NCC are warranted'.[65]

6.56 In support of this statement, Mr Savery referred to a 2014 paper produced by the ABCB which 'explores what natural hazards might be relevant to the NCC, the challenges that they present and the boundaries within which the ABCB has to operate'. On heat stress, the paper concluded that it is an area 'where further analysis was warranted, which resulted in its consideration as part of the board's current work in updating the NCC's energy efficiency provisions for 2019'. Mr Savery advised that the approach being taken by the ABCB:

> …draws a strong correlation between improving the performance of a building's energy efficiency with providing a more comfortable

62 ASBEC, *Submission 26*, Attachment 1, p. 31.

63 Western Australian Local Government Association, *Submission 57*, p. 8.

64 Mr Michael Roberts, Housing Industry Association, *Committee Hansard*, 22 March 2018, p. 12.

65 Mr Neil Savery, ABCB, *Committee Hansard*, 22 March 2018, p. 16.

> environment for occupants in extreme temperatures. This includes the introduction of split heating and cooling loads, as part of the proposed changes for NCC 2019, to improve the passive performance of buildings in extreme temperatures as well as reduce greenhouse gas emissions from artificial heating and cooling.[66]

6.57 Mr Savery added that further work on energy efficiency involving NatHERS and BASIX 'is anticipated to be undertaken for the NCC…which, subject to the modelling from the current work, may result in the consideration of additional cost-effective measures'. Mr Savery explained that the proposed change to the NatHERS software would shift the refocus of NatHERS from keeping homes warm to ensuring the home is suitable for all seasons; that is, a minimum performance requirement equivalent to six stars would need to be achieved in a house every day of the year.[67]

6.58 Although the ABCB is having regard to heat stress issues as part of its energy efficiency work, Mr Savery nonetheless emphasised that there is no project in the ABCB's work program at present 'that is specifically related to heat stress'. Mr Savery further added that if the energy efficiency project does not sufficiently address the issue of heat stress, then it would be proposed to the Board that additional work be undertaken; however, this would mean that any changes subsequently identified that met the COAG regulatory requirements could not commence until the 2022 revision of the NCC.[68]

6.59 It was also suggested that further research would assist policymakers in ensuring that measures to address heat stress are effective. For example, researchers from Swinburne University of Technology commented that research is needed into:

- how heat traps and overheating in high rated energy efficient dwellings can be created by inadequate ventilation; and
- the behaviour of building occupants during heatwave periods.[69]

Other considerations

6.60 Although most stakeholders that commented on the NCC suggested the Code needs reviewing to ensure houses are more resilient to climate change and safer for building occupants, some evidence was received that cautioned against changing the overall process for updating the NCC, or which raised other issues that should be considered.

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66 Mr Neil Savery, ABCB, *Committee Hansard*, 22 March 2018, p. 16.

67 Mr Neil Savery, ABCB, *Committee Hansard*, 22 March 2018, pp. 16–17.

68 Mr Neil Savery, ABCB, *Committee Hansard*, 22 March 2018, p. 19.

69 Dr Morshed Alam and Professor Patrick Zou, Swinburne University of Technology, *Committee Hansard*, 15 March 2018, p. 4.

6.61 The HIA warned against changes to how the NCC and relevant Australian Standards are developed. The HIA observed that ensuring 'residential and commercial buildings are resilient to natural hazards is not a new concern'.[70] In the HIA's view, the building industry and existing processes for updating the NCC and relevant Australian Standards are well placed to respond to any challenges climate change might present. In particular, the HIA emphasised that the current process requires any proposed changes to be 'evidence-based and be informed by Regulation Impact Analysis in accordance with COAG principles'.[71]

6.62 How changes to building standards could affect building users on a day-to-day basis also attracted comment. SECCCA noted that raising the standards of construction in relation to energy efficiency 'may adversely impact housing affordability'.[72] Mr Savery from the ABCB also made this point; he commented that the NCC needs to be developed with 'regard to what society can afford to pay'. Mr Savery observed:

> Whilst it is technically feasible to build a building that in the conditions of, say, seven consecutive days of plus-35—and possibly plus-40 in some parts of Australia—the cost of doing that for the average house would potentially be extremely high.[73]

6.63 Mr Karl Sullivan from the Insurance Council of Australia observed that extreme weather events are rare and, accordingly, policymakers need to consider not only the merits of enhanced building standards, but also their cost and whether any everyday benefits (or detriments) would be associated with them. To illustrate this point, Mr Sullivan commented:

> An example of that is how you wrestle with the potential of conflating sea level rise and storm surge and how buildings address the streets. From a simple urban design perspective, do we want to be raising buildings…above the pavement and have all the issues that are associated with disabled access for those sorts of buildings or are we investing in other solutions that can occasionally see water in the streets but can give us greater amenity throughout the 99 per cent of the year when that isn't going to be a problem?[74]

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70 Housing Industry Association, *Submission 47*, p. 1.

71 Housing Industry Association, *Submission 47*, p. 7. The Chief Executive Officer of the ABCB explained that amendments to the NCC are subject to regulatory impact assessment that considers 'the cost of compliance in comparison with the net benefits derived from compliance', including whether the benefits are 'likely to generate an outcome that is inconsistent with the NCC goal of imposing only minimum necessary regulation'. Mr Neil Savery, ABCB, *Committee Hansard*, 22 March 2018, p. 15.

72 SECCCA, *Submission 30*, p. 5.

73 Mr Neil Savery, ABCB, *Committee Hansard*, 22 March 2018, p. 17.

74 Mr Gavin Ashley, City of Melbourne, *Committee Hansard*, 15 March 2018, p. 27.

6.64 Evidence given by the ICA indicated, however, that additional costs could be offset by reductions in insurance premiums. To demonstrate how this can occur, Mr Sullivan from the ICA referred to the FORTIFIED Home program in the United States which, he explained, outline 'essentially a set of insurable characteristics that you build into your home and you get automatic discounts in your premium'.[75]

6.65 Discussion of these issues also revealed seemingly contrasting views about the purpose of the NCC. For example, Mr Sullivan advised that the Insurance Council's position is that a building constructed to the minimum standards under the NCC should be 'resilient or remain operational and functional given the predictable natural perils that it may face'.[76] The insurance company IAG similarly argued that the focus of the NCC on life safety is 'unquestionably vital'; nevertheless, it also considers there should be a focus on reducing the cost of damage from natural disasters to aid community resilience to such events.[77] However, the ABCB emphasised that the intention of the NCC is to protect the occupant of the building, not the building itself. Mr Savery commented that, following an extreme event:

> Ideally, the building stands and you can go back and occupy it. But if not, if it falls over, it's done its job. It's not about the durability of the building.[78]

6.66 Although several submitters consider the NCC needs to be reviewed to better address heat stress issues, it was recognised that there are other potential approaches. For example, rather than changing mandatory minimum building requirements, it was noted that higher quality buildings could be encouraged through incentives provided by insurance pricing or government programs.[79]

6.67 Finally, it was noted that better outcomes can be achieved by addressing myths about minimum building requirements.[80]

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75 Mr Karl Sullivan, General Manager, Policy Risk and Disaster, Insurance Council of Australia, *Committee Hansard*, 23 November 2017, p. 53.

76 Mr Karl Sullivan, Insurance Council of Australia, *Committee Hansard*, 23 November 2017, p. 53.

77 IAG, *Submission 56*, p. 8.

78 Mr Neil Savery, ABCB, *Committee Hansard*, 22 March 2018, p. 19.

79 Mr Karl Sullivan, Insurance Council of Australia, *Committee Hansard*, 23 November 2017, p. 53.

80 Mr Savery referred to a matter the ABCB addressed 'where designers were taking it that they had to essentially seal their buildings to meet the 6-star requirements of the code, which wasn't ever expected or required. In fact, it was the complete opposite; it was about promoting natural ventilation'. Mr Neil Savery, ABCB, *Committee Hansard*, 22 March 2018, p. 19.

Retrofitting existing buildings and ensuring homeowners are informed

6.68 In addition to strengthening building standards for new construction, it was argued that heat stress risks in existing buildings need to be addressed.[81] For example, the Climate and Health Alliance argued that the Australian, state and territory governments should 'identity retrofit opportunities for existing buildings to address climate risks, including extreme heat'. The Alliance suggested that retrofit works should 'include a particular focus on public housing, schools and early childhood centres, as well as health and social services infrastructure'.[82]

6.69 However, the costs associated with retrofitting are high. For example, the Northern Australia Insurance Premiums Taskforce estimated that a retrofit scheme for strengthening roofs for older properties in northern Queensland could cost around $1 billion.[83] In Melbourne, where researchers from the Swinburne University of Technology consider the majority of the 2.2 million homes are considered to have low energy ratings, the committee was advised that a preliminary estimate indicates that upgrading a dwelling from 0.9 star to 5.4 star through insulation and sealing could cost about $5000.[84]

6.70 It has been recognised in other jurisdictions that home and building owners may be reluctant to spend large sums on energy improvements if they expect to relocate in forthcoming years and the investment will not be recovered before they sell their property.[85]

Existing government policies regarding energy efficiency

6.71 State governments have considered energy efficiency issues. For example, the Victorian Government's *Climate Change Framework* commits to providing financial support for energy efficiency and resilience retrofitting.[86] Examples of specific programs or legislative requirements include the following:

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81 See Climate and Health Alliance, *Submission 16*, pp. 6–7; Dr Morshed Alam, Swinburne University of Technology, *Committee Hansard*, 15 March 2018, p. 3.

82 Climate and Health Alliance, *Submission 16*, pp. 6–7. As noted at paragraph 6.32, the NCCARF also argued that the suitability of public housing stock for retrofit measures should be assessed and investment in retrofit projects prioritised (NCCARF, *Submission 28*, p. 5).

83 The Treasury, *Northern Australia Insurance Premiums Taskforce: Final Report*, November 2015, p. 89.

84 Dr Morshed Alam, Swinburne University of Technology, *Committee Hansard*, 15 March 2018, pp. 3–4.

85 National Conference of State Legislatures (US), 'PACE Financing' www.ncsl.org/research/energy/pace-financing.aspx, 26 January 2016 (accessed 4 January 2018).

86 Victorian Government, *Victoria's Climate Change Framework*, 2016, p. 26.

- The Victorian Government's Energy Efficiency Target—under this scheme, accredited businesses can offer discounts to households and organisations to make energy efficiency improvements.[87]
- The Victorian Government's Residential Efficiency Scorecard—the star ratings obtained as part of the scorecard are intended to assist homeowners to make home improvements efficiently and cost effectively.[88]
- The South Australian Retailer Energy Efficiency Scheme—under this scheme, accredited operators can provide homeowners and tenants with a range of free or discounted services, including the installation of insulation, building sealing and the installation of thermally efficient windows.[89]
- In the Australian Capital Territory, since 2004 all homes for sale must have an energy rating. In addition, when advertising that a dwelling is for rent, the existing energy rating must be disclosed.[90]
- Long-term financing arrangements for building improvements known as Environmental Upgrade Agreements (EUAs, or Environmental Upgrade Finance in Victoria) are available in many parts of Australia. EUAs are a local government-based financing mechanism that help businesses access funding to improve building efficiency.

6.72 The Australian Government has previously implemented measures designed to encourage improved energy efficiency, such as the Green Building Fund for commercial office buildings introduced in 2008. As noted at paragraph 6.7, energy efficiency information is also required to be provided when commercial office space of 1000 square metres or more is offered for sale or lease.[91] The Clean Energy Finance Corporation also provides finance to support the utilisation of energy efficient technology solutions in commercial buildings and in new and existing community housing.[92]

87 Essential Services Commission, 'VEET scheme', www.veet.vic.gov.au/Public/Public.aspx?id=Home (accessed 13 April 2018).

88 Ms Dominique La Fontaine, SECCCA, *Committee Hansard*, 15 March 2018, p. 29.

89 Government of South Australia, 'Energy efficiency assistance', www.sa.gov.au/topics/energy-and-environment/using-saving-energy/retailer-energy-efficiency-scheme (accessed 13 April 2018).

90 Environment, Planning and Sustainable Development Directorate (ACT Government), 'Energy Efficiency Standards, Ratings and Disclosure', www.environment.act.gov.au/energy/smarter-use-of-energy/energy-efficiency-standards,-ratings-and-disclosure (accessed 13 April 2018).

91 Australian Government, 'Commercial Building Disclosure Program', http://cbd.gov.au/ (accessed 13 April 2018).

92 Clean Energy Finance Corporation, 'Sustainable Cities Investment Program', www.cefc.com.au/where-we-invest/sustainable-cities (accessed 24 May 2018).

Proposals to encourage retrofitting

6.73 One possible approach for improving the efficiency of older dwellings is through the imposition of mandatory requirements. Dr Morshed Alam suggested that greater energy efficiency outcomes could be achieved through a requirement that houses must reach an identified star rating by a certain year.[93] Wesfarmers also expressed support for 'the potential establishment of minimum energy performance standards for existing buildings'.[94]

6.74 In particular, it was suggested that prospective buyers and tenants could benefit if the provision of information about energy efficiency was required for property sales and leases. The energy efficiency disclosure requirements in place in the Australian Capital Territory (see paragraph 6.71) was highlighted as an example that could be followed in other jurisdictions.[95] The precedent of requirements for the disclosure of energy efficiency information for commercial buildings was also noted (see paragraph 6.72).[96]

6.75 Another potential approach is through the provision of incentives and information to encourage retrofitting and greater consideration of energy efficiency. Submitters noted that individuals building new homes are increasingly 'looking to build with a view to what it will cost to run homes'.[97] Existing homeowners may also decide to make alternations, although a range of factors can influence such decisions. The NCCARF explained:

> For private house owners, ability to respond to climate change risks is often related to financial capacity, support networks, and knowledge and understanding of risk. Once well-informed, private homeowners may undertake building alterations. Past experience of an extreme event can be motivating. Barriers to action include cost, design and construction of the existing home, insurance limitations, and government restrictions.[98]

6.76 The NCCARF argued that there is a need to consider 'mechanisms and incentives to support retrofit of private housing to improve resilience'.[99] For new homes, RDA South West similarly argued that there is a need to develop incentives to

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93 Dr Morshed Alam, Swinburne University of Technology, *Committee Hansard*, 15 March 2018, p. 3.

94 Wesfarmers, *Submission 20*, p. 4.

95 Ms Kristin Brookfield, Chief Executive, Industry Policy, Housing Industry Association, *Committee Hansard*, 22 March 2018, p. 12; Mr Brett Walters and Mr Steven McKellar, City of Port Phillip, *Committee Hansard*, 15 March 2018, p. 32.

96 Mr Brett Walters and Mr Steven McKellar, City of Port Phillip, *Committee Hansard*, 15 March 2018, p. 32.

97 Regional Development Australia – South West, *Submission 15*, p. 8.

98 NCCARF, *Submission 28*, p. 5.

99 NCCARF, *Submission 28*, p. 5.

encourage the use of more efficient materials in new houses. In particular, RDA South West suggested that:

- incentives could be offered to first home owners to encourage them to build in timber;
- incentives, tax concessions and farming programs relating to the plantation industry and for reforesting catchments to encourage 'further home cost savings in timber or light frame homes'; and
- governments could promote the use of timber frames, double glazing, insulation and solar water in public housing projects.[100]

6.77 Sustainable Business Australia argued that, to promote business and civil society actions on climate risks, the Australian Government should focus on developing financial incentives and innovative instruments that would 'continue and accelerate subsidization of energy auditing of buildings'. In addition, it argued that taxes applied to renovation, insulation work, and heating and cooling generally should be reduced to support improved energy efficiency in buildings. Sustainable Business Australia further suggested that the Australian Government could facilitate access to low interest loans, referring to the Property Assessed Clean Energy (PACE) programs available in the United States.[101]

6.78 The continued use, promotion or extension of existing schemes was suggested. The New South Wales' Young Lawyers Environment and Planning Law Committee observed that retrofitting could be supported by promoting greater uptake of EUAs.[102] The HIA argued that governments need to provide financial incentives—it endorsed rebate schemes for energy efficiency measures in place in Victoria and South Australia as models for providing 'a way for homeowners to tap into a little bit of support'.[103]

6.79 Other ideas put forward during this inquiry included:

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100 Regional Development Australia – South West, *Submission 15*, p. 8.

101 Sustainable Business Australia, *Submission 52*, p. 16. Financing provided under the PACE program enables local governments, state governments, or other inter-jurisdictional authorities to fund the up-front cost of energy improvements on commercial and residential properties, which are paid back over time by the property owners. See US Department of Energy, 'Property Assessed Clean Energy Programs', https://energy.gov/eere/slsc/property-assessed-clean-energy-programs (accessed 4 Janaury 2018) and National Conference of State Legislatures (US), 'PACE Financing' www.ncsl.org/research/energy/pace-financing.aspx, 26 January 2016 (accessed 4 January 2018).

102 New South Wales' Young Lawyers Environment and Planning Law Committee, *Submission 32*, pp. 4, 8.

103 Ms Kristin Brookfield, Housing Industry Association, *Committee Hansard*, 22 March 2018, p. 14.

- the development of an app to allow users to calculate the expected cost associated with installing insulation in their house as well as the expected savings over several years; and
- that electricity retailers include information on customer bills that enables a simple assessment about energy use and efficiency compared to similar households (some retailers already provide this information).[104]

6.80 As the committee was advised that owners of heritage buildings are often surprised that retrofitting work can be undertaken,[105] tailored guidance could be developed for owners of such properties.

104 Ms Megan Motto, Chief Executive Officer, Consult Australia, *Committee Hansard*, 23 November 2017, p. 27.

105 Mr William Millard, Director, Strategic Development, Hobsons Bay City Council, *Committee Hansard*, 15 March 2018, p. 30.