

Whole of House Verification – Stage 1

Department of the Environment and Energy
AECOM

Introduction

The objective of this project is to assist the Department of the Environment and Energy in gathering evidence for analysis with a purpose of progressing Measure 31.2 of the National Energy Productivity Plan (NEPP) by considering a 'whole of house' approach to achieving net zero energy buildings for new and existing dwellings.

The research will be undertaken to answer the following key questions:

1. What are the current residential building typologies in each jurisdiction (built form, appliances and energy use)?
2. In consideration of whole of building energy consumption and low cost design, what could the future residential building stock in each jurisdiction look like?
3. How can a residential building policy support holistic energy performance? And what should be considered in the scope of existing and new dwellings?
4. What are the barriers and risks associated with the above?

Project Stages

The project is broken down into two stages:

Stage 1: Establishing a baseline for housing across Australia in consideration of construction types, jurisdictional requirements and climate variances.

Stage 2: Quantitative and qualitative analysis of each baseline. This will include the assessment and optimisation of the thermal shell, inclusion and optimisation of baseline appliances (whole of house energy) and potential inclusion of generation (solar). Stage 2 works will also consider the ease of implementation and the risks, challenges and opportunities for the proposed initiatives.

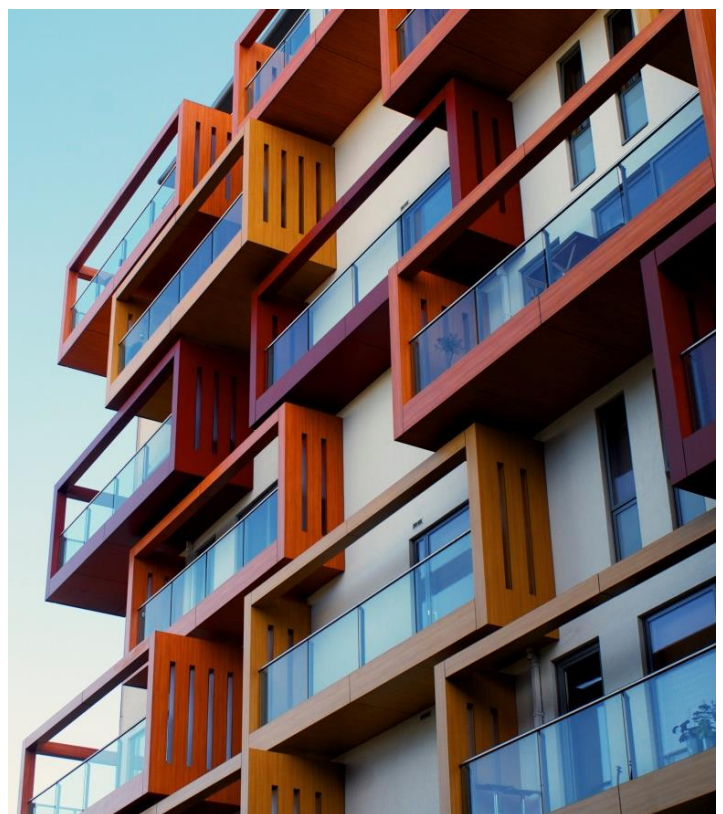
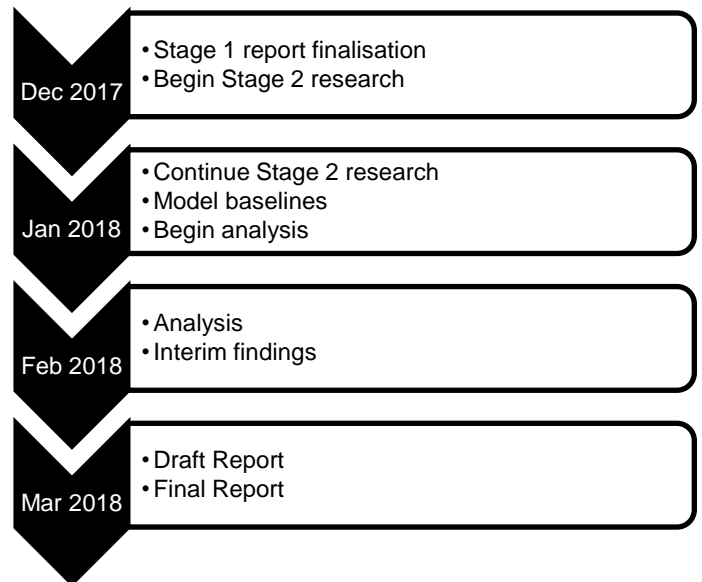
This paper provides an outline of the draft Stage 1 works for comment.

Stage 1 Baseline

The housing baselines span across both post NCC and pre NCC Class 1 and Class 2 developments. Although energy efficiency measures have been in place in the code since 2003; to understand a broader (and more current) range of potential upgrades; the baseline for post NCC performance will be on the current minimum requirements within each jurisdiction; with the baseline for pre NCC performance an aggregate of existing data and assumptions.

Timeline

Note that these works fit within the broader trajectory work being completed by the Department of the Environment and Energy on low energy homes.



Class 1: Typical 2018

The single storey four bedroom floor plan as developed in the “Development of Representative Dwelling Designs for Technical and Policy Purposes” prepared for the Energy Efficiency Division, Department of Resources, Energy and Tourism is still considered representative of the bulk of new Class 1 homes currently being built around Australia by volume builders.



Specification	Measure
Conditioned Floor Area	185m ²
Window Height	2100mm
Ceiling Height	2400mm
Window to Conditioned Floor ratio	18%

STATE	CLIMATE ZONE	THERMAL SPECIFICATIONS
ACT	Canberra	Roof: Metal deck- medium, R2.5 Wall : BV, R2.0, Floor: Waffle pod Glazing: Double glazing
NSW	Richmond, Moree	Roof: Metal deck-medium, R3.5 Wall: BV, R2.0, Floor: Waffle pod Glazing: Single glazing
	Wagga Wagga	Roof: Metal deck-medium, R2.0 Wall: BV, R2.0, Floor: Waffle pod Glazing: Single glazing
	Nowra	Roof: Metal deck-medium, R2.5 Wall: BV, R2.0, Floor: Waffle pod Glazing: Single glazing
	Sydney East	Roof: Metal deck-medium, R3.5 Wall: BV, R2.0, Floor: Waffle pod Glazing: Improved single glazing
	Sydney	Roof: Metal deck-medium, R2.0 Wall: BV, R2.0, Floor: Waffle pod Glazing: Improved single glazing toned
NT	Alice Springs	Roof: Metal deck- light, R2.5 Wall: Concrete block, R0.0 Floor: Slab on ground Glazing: Improved single glazing
	Darwin	Roof: Metal deck- light, R4.1 Wall: Concrete block, R0.0 Floor: Slab on ground Glazing: Single glazing super toned (Dwelling rotated 180 degrees)
QLD	Charleville, Brisbane,	Roof: Metal deck-light, R2.5 Wall: BV, foil insulation, Floor: Slab on ground Glazing: Single glazing
	Townsville	Roof: Metal deck-light, R2.5 Wall: Concrete block, foil insulation, Floor: Slab on ground Glazing: Single glazing (Dwelling rotated 180 degrees)
	Oakey	Roof : Metal deck-medium, R2.0 Wall: BV, foil insulation, Floor: Slab on ground Glazing: Single glazing
SA	Adelaide	Roof: Metal deck- medium, R3.0 Wall: BV, R2.0, Floor: Slab and ground Glazing: Single glazing
	Mt Lofty	Roof: Metal deck- medium, R5.0 Wall: BV, R2.0, Floor: Slab and ground Glazing: Improved single glazing
	Mt Gambier	Roof: Metal deck- medium, R5.0 Wall: BV, R2.0, Floor: Slab and ground Glazing: Single glazing
	Woomera	Roof: Metal deck- light, R5.0 Wall: BV, R2.0, Floor: Slab and ground Glazing: Improved single glazing super toned
TAS	Hobart	Roof: Metal deck- dark, R2.5 Wall: BV, R2.0, Floor: Timber, R2.5 Glazing: Double glazing
VIC	Melbourne	Roof: Tile-dark, R4.1 Wall: BV, R2.0, Floor: Slab on ground Glazing: Single glazing
	Ballarat	Roof: Tile-dark, R4.1 Wall: BV, R2.0, Floor: Waffle pod Glazing: Single glazing
	Mildura	Roof: Tile-medium, R4.1 Wall: BV, R2.0, Floor: Waffle pod Glazing: Single glazing
WA	Katanning, Albany, Perth	Roof: Metal deck- medium, R4.1 Wall: Double brick, R0.0 Floor: Slab on ground Glazing: Single glazing
	Manjimup	Roof: Metal deck- medium, R4.1 Wall: Double brick, R0.0 Floor: Slab on ground Glazing: Improved single glazing
	Newman	Roof: Metal deck- light, R4.1 Wall: Double brick, R0.0 Floor: Slab on ground Glazing: Double glazing
	Swanbourne	Roof: Metal deck- light, R4.1 Wall: Double brick, R0.0 Floor: Slab on ground Glazing: Improved single glazing super toned
	Broome	Roof: Metal deck- light, R4.1 Wall: Double brick, R0.0 Floor: Slab on ground Glazing: Double glazing (Dwelling rotated 180 degrees)
	Halls Creek	Roof: Metal deck- light R4.1 Wall: Concrete block, Foil Floor: Slab on ground Glazing: Double glazing (Dwelling rotated 180 degrees)

* Building materials were initially determined based on the list of references provided on page 6. Where dwelling was found to achieve a star rating >0.5 stars above the jurisdiction average when modelled, the thermal specification was reduced.

Class 1: Typical 1990's

As per the plan for the post NCC Class 1 dwelling, the single storey three bedroom floor plan as developed in the "Development of Representative Dwelling Designs for Technical and Policy Purposes" prepared for the Energy Efficiency Division, Department of Resources, Energy and Tourism can be considered representative of existing Class 1 stock.



Specification	Measure
Conditioned Floor Area	150m ²
Window Height	2100mm
Ceiling Height	2400mm
Window to Conditioned Floor ratio	20%

STATE	CLIMATE ZONE	THERMAL SPECIFICATIONS
NSW	Richmond, Wagga Wagga, Nowra	Roof ^{3,5,9} : Tile-medium, R2.0 Wall ^{8,9} : BV, foil insulation, Floor ^{3,9} : Slab on ground Glazing ^{3,9} : Single clear glazing
	Moree	Roof ^{3,5,9} : Metal deck- light, R2.0 Wall ^{8,9} : BV, foil insulation, Floor ^{3,9} : Slab on ground Glazing ^{3,9} : Single clear glazing
	Sydney East, Sydney	Roof ^{3,5,9} : Tile-medium, R2.0 Wall ^{8,9} : BV/ Double brick, foil insulation, Floor ^{3,9} : Slab on ground Glazing ^{3,9} : Single clear glazing
QLD	Townsville	Roof ³ : Metal deck-light, R0.0 Wall ³ : Timber, R0.0 Floor ³ : Timber Glazing ³ : Single clear glazing
	Charleville	Roof ³ : Metal deck-light, R0.0 Wall ³ : Timber, R0.0 Floor ³ : Timber Glazing ³ : Single clear glazing
	Brisbane	Roof ³ : Metal deck-medium, R0.0 Wall ³ : BV/Timber, R0.0, Floor: Slab on ground/Timber Glazing ³ : Single clear glazing
	Oakey	Roof ³ : Tile-medium, R0.0 Wall ³ : Double brick, R0.0, Floor ³ : Slab on ground Glazing ³ : Single clear glazing
SA	Adelaide	Roof ³ : Tile-medium, R2.0 Wall ^{3,9} : Double brick, foil insulation Floor ^{3,9} : Slab on ground Glazing ³ : Single clear glazing
	Mt Lofty	Roof ^{3,4,9} : Tile-medium, R2.0 Wall ^{8,9} : BV, foil insulation Floor ^{3,9} : Slab on ground Glazing ^{3,9} : Single clear glazing
	Mt Gambier	Roof ^{3,4,9} : Metal deck- medium, R2.0 Wall ^{3,9} : Timber, foil insulation Floor ^{3,9} : Timber Glazing ^{3,9} : Single clear glazing
	Woomera	Roof ^{3,4,9} : Metal deck- light, R2.0 Wall ^{3,9} : Timber, foil insulation Floor ^{3,9} : Timber Glazing ^{3,9} : Single clear glazing
ACT	Canberra	Roof ³ : Tile- medium, R2.0 Wall ^{8,9} : BV, foil insulation, Floor ¹⁴ : Slab on ground Glazing ^{4,9} : Single clear glazing
NT	Alice Springs, Darwin	Roof ^{3,4,9} : Metal deck- light, R2.0 Wall ^{3,8,9} : Double brick, foil insulation Floor ^{3,9} : Slab on ground Glazing ^{3,9} : Single clear glazing
TAS	Hobart	Roof ^{3,5,9} : Tile- medium, R2.0 Wall ^{8,9} : BV, foil insulation, Floor ^{3,9} : Timber Glazing ³ : Single clear glazing
VIC	Melbourne, Ballarat, Mildura	Roof ^{4,7} : Tile-medium, R2.0 Wall ^{3,9} : BV, foil insulation Floor ^{3,9} : Slab on ground Glazing ⁹ : Single clear glazing
WA	Katanning, Perth, Swanbourne	Roof ^{3,4,5,9} : Tile- medium, R2.0 Wall ^{8,9} : Double brick, foil insulation Floor ^{3,9} : Slab on ground Glazing ^{3,9} : Single clear glazing
	Newman, Carnarvon, Broome, Halls Creek	Roof ^{3,4,5,9} : Metal deck – light, R2.0 Wall ^{8,9} : Double brick, foil insulation Floor ^{3,9} : Slab on ground Glazing ^{3,9} : Single clear glazing
	Manjimup, Albany	Roof ^{3,4,9} : Metal deck- medium, R2.0 Wall ^{8,9} : Double brick, foil insulation Floor ^{3,9} : Slab on ground Glazing ^{3,9} : Single clear glazing

Class 2: Typical 2018

Two bedroom Class 2 residences in Australia represent over 50% of the market (52%); with the majority of the remainder made up of one bedroom apartments (21%) and three bedroom apartments (13%).

Based on an analysis of a number of Class 2 apartment designs throughout Australia; the following similarities have been found:

- Combined kitchen/living area with full width and full height glazing (kitchen located furthest from the window);
- Balcony adjoining living area with overshadowing from above balcony (or other external shading on top level);
- Bedrooms with smaller (width: 30-50% of wall) full height glazing;
- Bathrooms located internally to the apartment or closest to the core



Specification	Measure
Total Average Floor Area (2 Bedroom Apartments)	91m ²
Total Average Floor Area (All Apartments)	86m ²
Average Unconditioned Area	6.5%
Window Height	2400mm
Ceiling Height	2700mm
Window to Conditioned Floor ratio	22%

STATE	CLIMATE ZONE	MID LEVEL THERMAL SPECIFICATIONS	ROOF LEVEL THERMAL SPECIFICATIONS
ACT	Canberra	Wall: Concrete, R2.0, Floor: Concrete slab Glazing: Single low e glazing	Roof: Metal deck- medium, R5.0 Wall: Concrete, R2.0, Floor: Concrete slab Glazing: Single low e glazing
NSW	Wagga Wagga, Nowra, Sydney East Sydney	Apartments 1 & 4: Wall: Concrete, R1, Floor: Concrete slab Glazing: Single glazing Apartments 2 & 3: Wall: Concrete, R0, Floor: Concrete slab Glazing: Single glazing Apartments 5 & 6: Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing Apartments 1 & 4: Wall: Concrete, R1, Floor: Concrete slab Glazing: Single glazing Apartments 2 & 3: Wall: Concrete, R0, Floor: Concrete slab Glazing: Single glazing Apartments 5 & 6: Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing	Apartments 1, 4, 5 & 6: Roof: Concrete slab, R2.5 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing Apartments 2 & 3: Roof: Concrete slab, R1.5 Wall: Concrete, R1, Floor: Concrete slab Glazing: Single glazing Apartments 1, 2, 3 & 4: Roof: Concrete slab, R2.5 Wall: Concrete, R1, Floor: Concrete slab Glazing: Single glazing Apartments 5 & 6: Roof: Concrete slab, R2.5 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing Apartments 1, 3, 4, 5 & 6: Roof: Concrete slab, R2.5 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing Apartment 2: Roof: Concrete slab, R1.5 Wall: Concrete, R1, Floor: Concrete slab Glazing: Single glazing
NT	Darwin	All apartments: Wall: Concrete, R0.0 Floor: Concrete slab Glazing: Single glazing	Apartments 1, 2 & 3: Roof: Metal deck- medium, R0 Wall: Concrete, R0.0 Floor: Concrete slab Glazing: Single glazing Apartments 4, 5 & 6: Roof: Metal deck- medium, R3.5 Wall: Concrete, R0.0 Floor: Concrete slab Glazing: Single glazing
QLD	Brisbane Cairns	All apartments: Wall: Concrete, R0.0 Floor: Concrete slab Glazing: Single glazing Apartments 1, 2, 3, 5 & 6: Wall: Concrete, R0.0 Floor: Concrete slab Glazing: Single glazing	Apartment 1: Roof: Metal deck-medium, R1.5 Wall: Concrete, R0.0 Floor: Concrete slab Glazing: Single glazing Apartments 2,3,4: Roof: Metal deck-medium, R1.0 Wall: Concrete, R0.0 Floor: Concrete slab Glazing: Single glazing Apartments 5,6: Roof: Metal deck-medium, R2.5 Wall: Concrete, R0.0 Floor: Concrete slab Glazing: Single glazing Apartments 1 & 2: Roof: Metal deck-medium, R0 Wall: Concrete, R0.0 Floor: Concrete slab Glazing: Single glazing Apartment 3,4,5: Roof: Metal deck-medium, foil Wall: Concrete, R0 Floor: Concrete slab Glazing: Single glazing Apartments 6: Roof: Metal deck-medium, R2.5 Wall: Concrete, R0.0 Floor: Concrete slab Glazing: Single glazing
SA	Adelaide	Apartments 1,2,3,4&5: Wall: Fibre cement, R2.0, Floor: Concrete slab Glazing: Single glazing All apartment 6: Wall: Fibre cement, R2.0, Floor: Concrete slab Glazing: Low e glazing	Apartments 1,2,3&4: Roof: Metal deck- medium, R2.5 Wall: Fibre cement, R2.0, Floor: Concrete slab Glazing: Single glazing Apartment 5: Roof: Metal deck- medium, R3.5 Wall: Fibre cement, R2.0, Floor: Concrete slab Glazing: Double glazing Apartment 6: Roof: Metal deck- medium, R2.5 Wall: Fibre cement, R2.0, Floor: Concrete slab Glazing: Double glazing
TAS	Hobart	All apartments: Wall: Concrete, R1.0, Floor: Concrete slab Glazing: Double glazing	All apartments: Roof: Metal deck- medium, R3.5 Wall: Concrete, R1.0, Floor: Concrete slab Glazing: Double glazing
VIC	Melbourne	Apartments 1, 2, 3, 4 & 5: Wall: Concrete, R2.0, Floor: Concrete slab Glazing: Improved single glazing Apartment 6: Wall: Concrete, R2.0, Floor: Concrete slab Glazing: Double glazing	Apartments 1, 2, 3, 4 & 5: Roof: Concrete slab, R4.1 Wall: Concrete, R2.0, Floor: Concrete slab Glazing: Improved single glazing Apartment 6: Roof: Concrete slab, R4.1 Wall: Concrete, R2.0, Floor: Concrete slab Glazing: Double glazing
WA	Broome	All apartments: Wall: Concrete, R0, Floor: Concrete slab Glazing: Single glazing	Apartments 1,2,3,4&5: Roof: Metal deck- medium, R4.1 Wall: Concrete, R0, Floor: Concrete slab Glazing: Single glazing Apartments 6: Roof: Metal deck- medium, R4.1 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing toned

STATE	CLIMATE ZONE	MID LEVEL THERMAL SPECIFICATIONS	ROOF LEVEL THERMAL SPECIFICATIONS
Albany		Apartments 1,2,3,4&5: Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing Apartments 6: Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Double glazing	Apartments 1,2,3&4: Roof: Metal deck- medium, R4.1 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing All apartments 5: Roof: Metal deck- medium, R4.1 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Improved single glazing All apartments 6: Roof: Metal deck- medium, R4.1 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Double glazing
Perth		All apartments: Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing	Apartments 1,2,3&4: Roof: Metal deck- medium, R4.1 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing All apartments 5: Roof: Metal deck- medium, R4.1 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Improved single glazing All apartments 6: Roof: Metal deck- medium, R4.1 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Improved double glazing
Swanbourne		Apartments 1,2,3,4&5: Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing Apartments 6: Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Improved single glazing	Apartments 1,2,3&4: Roof: Metal deck- medium, R4.1 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Single glazing All apartments 5&6: Roof: Metal deck- medium, R4.1 Wall: Concrete, R1.5, Floor: Concrete slab Glazing: Double glazing

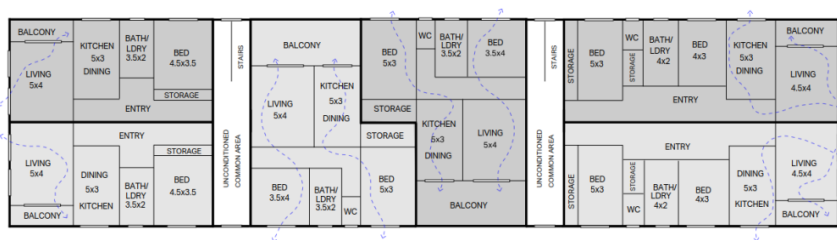
* Building materials were initially determined based on the list of references provided on page 6. Where dwelling was found to achieve a star rating >0.5 stars above the jurisdiction average when modelled, the thermal specification was reduced.

Class 2: Typical 1990's

The majority of pre NCC apartments generally consisted of larger floorplates and lower window-wall ratios.

Based on an analysis of a number of pre NCC Class 2 apartment designs throughout Australia; the following similarities have been found:

- More enclosed rooms, larger 2 bedroom apartments;
- Balcony adjoining living area with overshadowing from above balcony;
- Bathrooms have access to natural light



Specification	Measure
Total Average Floor Area (2 Bedroom Apartments)	95m ²
Total Average Floor Area (All Apartments)	86m ²
Average Unconditioned Area	9%
Window Height	2100mm
Ceiling Height	2400mm
Window to Conditioned Floor ratio	18%

STATE	CLIMATE ZONE	THERMAL SPECIFICATIONS
QLD	Brisbane, Cairns	Roof ^{3,9} : Metal deck - medium, R0.0 Wall ^{3,9} : Double Brick, R0.0 Floor ⁹ : Concrete slab, R0.0 Glazing ⁹ : Single clear glazing
ACT	Canberra	Roof ^{4,9} : Concrete Slab/tile, R0.0 Wall ^{4,9} : BV, R0.0 Floor ⁹ : Concrete slab, R0.0 Glazing ⁹ : Single clear glazing
NSW	Wagga Wagga, Nowra, Sydney East, Sydney	
NT	Darwin	
SA	Adelaide	
TAS	Hobart	
VIC	Melbourne	
WA	Broome, Albany, Perth, Swanbourne	

References

Reference Number	Source	Notes
1	CSIRO July 2017, <i>What is being built?</i>	Compiled data from a year of AccuRate and BERSpro ratings to illustrate the insulation levels used in ceilings and walls and the types of glazing installed in each State. Note that CSIRO also provided this data to AECOM in excel format.
2	CSIRO June 2016, <i>What is being designed?</i>	Compiled data from a year of past Accurate ratings to illustrate construction types in each State. Note that CSIRO also provided this data to AECOM in excel format.
3	Reference group evidence	Two reference groups were used in the development of this report; a jurisdictional reference group consisting of state government representatives from each state and territory and a specialist reference group consisting of those considered specialists in the area of energy efficiency including those who had completed work in this area previously. Representative organisations are listed below: <ul style="list-style-type: none"> - Department of the Environment and Energy – residential buildings - Department of the Environment and Energy – appliances - Climate Works - Strategy Policy Research - CSIRO - Energy Consult - Sustainability Victoria - Tony Isaacs Consulting - CRCLCL - Energy Efficient
4	Realestate.com.au	Each location was searched to gather an understanding of visually represented housing aspects (namely roof type and colour)
5	Google Maps	Imagery from Google Maps was used to ascertain general roof type and colour
6	Commonwealth of Australia W. McLennan, 1995, ' <i>Australian Social Trends, 1995</i> ', Australian Bureau of Statistics Catalogue No. 4102	Trends in Housing – Housing Stock – Housing Materials. Outlined the outer wall materials of housing stock between 1911 and 1994.
7	RMIT University Centre for Design, 31 July 2009, <i>Analysis of assessment tool options for the disclosure of the sustainability of Victorian homes</i>	Default R values for batts were based on expert opinion.
8	ABS, ' <i>Energy Use and Conservation</i> ', March 2005, Mar 2008, Mar 2011, Mar 2014	Details wall construction types per state. Majority wall type used in base case.
9	Assumption	Where a reference source could not be found, an assumption has been made. This assumption has been verified by each jurisdiction.
10	Regulatory Impact Statement	Specific analysis of Class 2 developments in South Australia.

Reference Number	Source	Notes
	for a South Australian variation to the National Construction Code to increase the energy efficiency requirements for Class 2 residential buildings, Marsden Jacob Associates	
11	Residential construction and renovation: key findings from FirstRate5 2014/2015 data release	Data on housing design and construction for dwellings modelled in FirstRate 5.0 over 2014/2015

Reference Group Feedback

Feedback	AECOM Response
<p>Attachment C - Whole of House Verification Short Report – my only comment at this stage is that climate zone 8 (alpine) does not seem to be covered by localities noted?</p> <p>Attachment D – Follow-up questions – I would like to seek an extension on response time to 22 January 2018 if possible?</p>	<p>Noted. This was a deliberate decision based on the number of housing present in alpine areas. This decision may be further explored in the Stage 2 works.</p>
<p>I've had a look at the AECOM overview we're concerned that the focus is on "whole of house" which seems to exclude the "whole of building" approach that is required for apartment buildings. If the whole of house for Class 1 buildings is extrapolated to Class 2 buildings all common area energy consumption would be excluded.</p> <p>Is it still possible to make these common areas a focus of research for AECOM?</p>	<p>Class 2 common areas are excluded from this stage of works but may be further considered in other works into the future.</p>
<p>While recognising that the AECOM Short report seeks to define/re-confirm some fairly generic dwelling forms that are considered typical across multiple jurisdictions, our urban design specialists make the following observations regarding apartment design in NSW. In particular SEPP 65, and the Apartment Design Guide that this legislation activates, sets standards above NCC minimum that are generally tested for and delivered for apartments in buildings of 3 storeys or greater.</p> <p>Apartment Plans submitted to Councils contain conformance tables that confirm the design meets, or by how far it falls short of – for example – the minimum cross ventilation and mid-winter solar access 'rules'. Thus as DA stage there is generally strong compliance with the policy requirements.</p> <p>Further specific comments below</p> <ol style="list-style-type: none"> 1. For New South Wales the baselines should meet all the requirements of SEPP65 as they are required to by law. 2. Class 2 NCC plan <ol style="list-style-type: none"> a. The comment that the balconies over shade the living room windows below is incorrect unless at least 70% [in this case 5/6] of living room windows below receive at least 2 hours sun in mid-winter (i.e. this is a SEPP 65/ ADG 'rule') – common practice is to have the face of the living room stepped forward to allow this or for the balcony to be in front of the living room. b. The living room in the south east corner should be at least 4 metres wide. c. The internal circulation common area should have an openable window d. The placement of the windows should ensure that at least 50% of the combined living area is within the cross ventilation path of the apartment for the 4 apartments that are cross ventilated e. Laundries and storage are missing from the plans 3. Class 2 pre NCC <ol style="list-style-type: none"> a. The internal circulation common area should have an openable window b. The placement of the windows should ensure that at least 50% of the combined living area is within the cross ventilation path of the apartment for the 3 of the 4 apartments that are cross ventilation. c. Laundries and storage are missing from the plans. <p>I hope this detail enables further refinement of the modelling work.</p>	<p>The apartments have been redesigned to take this into account. Specifically:</p> <p>Natural Ventilation SEPP 65/ ADG:</p> <ul style="list-style-type: none"> - 60% of apartments are naturally cross ventilated (achieved) - Depth of cross-over or cross through does not exceed 18m (achieved) <p>Better Apartment Design Standards:</p> <ul style="list-style-type: none"> - 40% of dwellings should achieve cross ventilation (achieved) - maximum breeze path of 18m (achieved) <p>Daylight SEPP 65/ ADG:</p> <p>70% of living room windows receive at least 2 hours sun in mid-winter (achieved – sun path calculations can be provided)</p> <p>Storage now included in accordance with SEPP 65/ ADG. (assumed 50% outside of apartment)</p> <p>Pre NCC laundries are included in bathrooms, post NCC are included in bathrooms or kitchens.</p> <p>Internal circulation common areas now have windows.</p> <p>South east living room now 4 meters wide.</p>
<p>As to the AECOM Whole of House Verification Short Report, we have no specific amendments to suggest. However, we would like</p>	<p>The work being undertaken is to identify a range of pathways/opportunities to</p>

Feedback	AECOM Response
<p>to point out that the AECOM baseline for construction types and climate variances seems quite general. We do see the need for generalisation in a project establishing a baseline for housing across the whole of Australia, but we still wonder if it would be possible to take more climate regions and/or dwelling types into account. As a reference point, the Final Report of the NSW Housing Typology Development Project (University of Wollongong, Feb 2016) identifies 8 different typologies for Class 1&2 buildings. We would also like to suggest to indicate the source for the pre NCC performance specifications.</p>	<p>achieving net zero energy and unfortunately cannot be ultimately extensive.</p> <p>Work may be completed separately in the future to investigate other typologies, construction methodologies etc.</p> <p>Source for specifications is identified on Page 4 of this report.</p>
<p>Double glazing is rare to non-existent in Tas, even on post-NCC houses – certainly not standard. Most houses are built to DTS here.</p> <p>Conditioned floor area of 80 sqm for Class 2s is much lower than ABS or other sources (NEXIS), particularly for the existing stock.</p>	<p>Note that “post NCC” is considered to be representative of new housing on the market. CSIRO data (collated from Accurate/ BERS pro) suggests that new housing in Tasmania uses majority double glazing. This is also substantiated by the 2014/2015 data release ‘Residential construction and renovation: key findings from FirstRate5’ by Sustainability Victoria.</p> <p>Note that apartment designs have been updated and the average apartment size is now 85m². This is consistent with CSIRO data and is averaged across the floorplate (1, 2 and 3 bedroom apartments represented)</p>
<p>2700mm ceiling height for class 2 seems high, I would expect 2400mm to be a lot more common, so this might be questioned</p>	<p>2700mm is the minimum ceiling height required for Class 2 developments in the Better Apartment Guidelines. The existing Class 2 apartment ceiling heights have been revised to 2400mm.</p>
<p>It is stated that the study will consider “a ‘whole of house’ approach to achieving net zero energy building for new and existing dwellings.”</p> <p>We believe for this study it would be sensible to consider both zero net energy (ZNE) and zero net carbon (ZNC) approaches in the analysis.</p> <p>In Victorian homes, there is a greater reliance on gas for space heating, water heating and cooking. This means that to achieve ZNE status (if this is defined as generating the same amount of energy on-site as used in the home), a mixed fuel house will need to offset a larger energy footprint compared to an all-electric house. A ZNE approach may set the hurdle too high for mixed fuel houses and may force houses to be all electric. Alternatively, if ZNE is defined to mean just generating on same amount of electricity as is used on site, this would mean an all-electric house would achieve ZNC status, but not a mixed fuel house.</p> <p>A ZNC approach will not disadvantage mixed fuel houses in the same way because gas has a lower GHG intensity compared to electricity.</p> <p>It would be useful for the study to examine both a ZNE and a ZNC approach and examine the implications of each approach.</p>	<p>Noted. Energy and carbon will be considered in the Stage 2 works.</p>
<p>The construction characteristics for Victorian homes listed in the ‘Class 1: Post National Construction Code’ table don’t quite match what the FirstRate5 activity data shows.</p> <p>In 2016, Sustainability Victoria (SV) released a FirstRate5 data report for the 2014/15 financial year which analyses the data</p>	<p>This construction was based on the CSIRO data gathered from BERS Pro/ Accurate. We note that as FirstRate is more heavily used in Victoria, CSOG will be used for the Melbourne climate. Updated.</p>

Feedback

AECOM Response

construction data contained in the FirstRate5 NatHERS Universal Certificates. The report shows that across all houses 39% of glazing is double glazing and waffle pod slabs were not heavily used for floors.

It appears that construction characteristics for Victorian homes should be reconsidered.

The 2014/15 FirstRate5 data report can be downloaded here: <https://www.fr5.com.au/home/2016/10/25/2014-15-firstrate5-data-report-released>

The construction characteristics for Victorian homes listed in the 'Class 1: Pre National Construction Code' table could benefit from a greater number of categories. Ideally there should be two high level categories.

- 1) Pre 1991: No minimum insulation requirements and they would not have insulation in the wall
- 2) 1991- 2005: Houses built during this period needed to meet regulated minimum insulation levels. The insulation levels are set out on pages 51-52 of this [document](#). Generally, R2.5 was used in the ceilings and walls needed either reflective foil or insulation batts depending upon the floor construction.

Also, the majority of homes constructed before the 1980s in Victoria would have suspended timber floors. Therefore, it would be sensible to have a suspended floor variation for existing houses.

Unfortunately the analysis had to be limited and all housing designs and constructions could not be accounted for.

The pre NCC housing is typically representative of a house built in the 90s.

Older pre-2003 EE Provisions houses in SA were possibly better suited to heat wave conditions, energy security and Climate Change resilience. This would be worth looking at.

My experience with construction and living in apartments was 25-30 years ago in Wollongong and Sydney. They were all cavity brick with single brick internal walls and concrete floors. The better floor plans went from external wall to external wall through the building so crossflow ventilation was good unlike the plans supplied.

Noted.

Noted. The floor plans have been updated in order to improve cross ventilation.

QLD Dwelling Designs - Class 1: Post-National Construction Code

QLD Locations	NCC Climate Zone (NatHERS File)	Design Specs (detached house)
Charleville	3 (19)	Roof: Metal deck-light, R2.5 Wall: BV, foil insulation Floor: Slab on ground Glazing: Clear, single glazing
Townsville	1 (5)	Roof: Metal deck-light, R2.5 Wall: Concrete block, foil insulation Floor: Slab on ground Glazing: clear, single glazing
Brisbane Ipswich	2 (10) 2 (9)	Roof: Metal deck-light, R2.5 Wall: BV, foil insulation Floor: Slab on ground Glazing: Clear, single glazing

All items updated with the exception of the added base case for Ipswich. The report used for climate bundling "NatHERS Star bands for proposed 2015 version of Chenath including new weather data" by Tony Isaacs Consulting, Floyd Energy and Pitt & Sherry (2014), suggests that Brisbane and Ipswich return very similar results and therefore the pathway for Brisbane will be representative of Ipswich.

Feedback

AECOM Response

Oakey	5 (50)	Roof: Metal deck-medium, R2.5 Wall: BV, foil insulation Floor: Slab on ground Glazing: Clear, single glazing
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QLD Dwelling Designs - Class 1: Pre-National Construction Code

All items updated.

QLD Locations	NCC Climate Zone (NatHERS File)	Design Specs (detached house)
Charleville	3 (19)	Roof: Metal deck-light, no insulation Wall: Timber clad, (no foil) Floor: Timber frame Glazing: Clear, single glazing
Townsville	1 (5)	Roof: Metal deck-light (no insulation) Wall: Timber clad (no foil) Floor: Timber framed Glazing: Clear, single glazing
Brisbane	2 (10)	<u>House 1:</u> Roof: Tile-medium (no insulation) Wall: BV Roof: Metal deck-medium (no insulation) Glazing: Clear, single glazing <u>House 2:</u> Roof: Metal deck-medium (no insulation) Wall: Timber clad (no foil) Floor: Slab on ground Floor: Timber framed Glazing: Clear, single glazing
Oakey	5 (50)	Roof: Tile-medium (no insulation) Wall: Cavity brick(no foil) Floor: Slab on ground Glazing: Clear, single glazing

Feedback

AECOM Response

QLD Dwelling Designs - Class 2: Post-National Construction Code

All items updated.

QLD Locations	NCC Climate Zone (NatHERS File)	Design Specs (up to 10-storey, medium-rise units)
Brisbane Cairns	2 (10) 1 (32)	Roof: Metal deck-medium, R2.5 Wall: Concrete Floor: Concrete slab Glazing: Clear, single glazing

QLD Dwelling Designs - Class 2: Pre-National Construction Code

All construction types updated. There will be a very minor difference between modelling a floorplate at 9m and a floorplate at 3m off the ground. For modelling simplicity, will be considered at 9m as per report.

QLD Locations	NCC Climate Zone (NatHERS File)	Design Specs ('6-pack', 2-storey walk-up units)
Brisbane Cairns	2 (10) 1 (32)	Roof: Metal deck-medium, R0.0 Wall: Cavity brick, R0.0 Floor: Concrete slab, R0.0 Glazing: Clear, single glazing

Given apartments are noted in the report to have overtaken houses as the major form of new dwellings in Australia, the modelling would benefit from analysing the different types of apartments e.g.

There is limited scope to include additional case studies. Further heights may be considered in future stages of work.

- small-rise, such as a 2-storey walk-up
- medium-rise, such as up to 5-storeys, and
- high-rise, such as >10-storey tower.

Climate zone 56 is more representative of the Greater Sydney suburban area than climate zone 17, as previously mentioned to Cth and AECOM representatives. To illustrate, please find attached the map (from the NatHERS website) indicating the distribution of zone 56 (light green) vs. zone 17 (red) in coastal Sydney.

We have now included NatHERS Climate Zone 56 for analysis.