Residential construction and renovation: key findings from FirstRate5

2014/15 data release

FirstRate5®
house energy rating software

Abstract

FirstRate5 is a home energy rating tool that has been in available online since 2014. This report outlines some of the key findings from data collected through the financial year 2014-15.

Introduction

FirstRate5® is an easy-to-use interactive software tool that enables building designers and thermal performance assessors to generate Home Energy Ratings (HER). The principal purpose of HERs is to demonstrate compliance of a dwelling design with the National Construction Code prior to construction. It estimates the annual heating and cooling energy required to maintain a comfortable indoor environment in that dwelling design and rates this on a 10 star scale, 6 stars being the minimum allowable for a new dwelling design.

Historically, FirstRate5 was an entirely desktop software application, allowing users to assess dwelling designs and produce Home Energy Rating certificates on their computer. These were submitted as part of a Building Permit application to the local council. Records were retained by individual councils, and were neither rich in data nor easily searchable. No central repository of Home Energy Rating certificates existed.

On 1 May 2014, FirstRate5 added an online platform to allow it to move to a fee-per-certificate model. This enabled FirstRate5 to recover its own costs, and allowed Home Energy Rating data to be collected in a central repository. It was estimated in 2012 that FirstRate5 accounted for 95% of all Home Energy Ratings carried out in Victoria and 45% of those carried out in Australia. This data is a rich store of information on new and existing Australian dwellings in a searchable database.

Sustainability Victoria is very pleased to be able to provide these data extracts for the first time. This report is a snapshot of Home Energy Ratings for the 2014/15 financial year. This data extract will form the baseline for any future snapshots, allowing for trends to emerge over time. The analysis below is based on questions developed by SV following discussion with industry and government in Victoria. It is expected to prompt further questions from readers.

If you would like to comment on the data or suggest future analyses not in this report, please contact support@fr5.com.au

FirstRate5 usage in Australia

Uptake of the FirstRate5 tool has been strongest in the southern states, with the vast majority of Home Energy Rating (HER) assessments being undertaken in Victoria for the 2014-15 financial year. Smaller numbers of HER assessments were conducted in South Australia, NSW, Tasmania and Western Australia. By comparison, FirstRate5 use in the Northern Territory and Queensland has so far been very low compared to other jurisdictions.

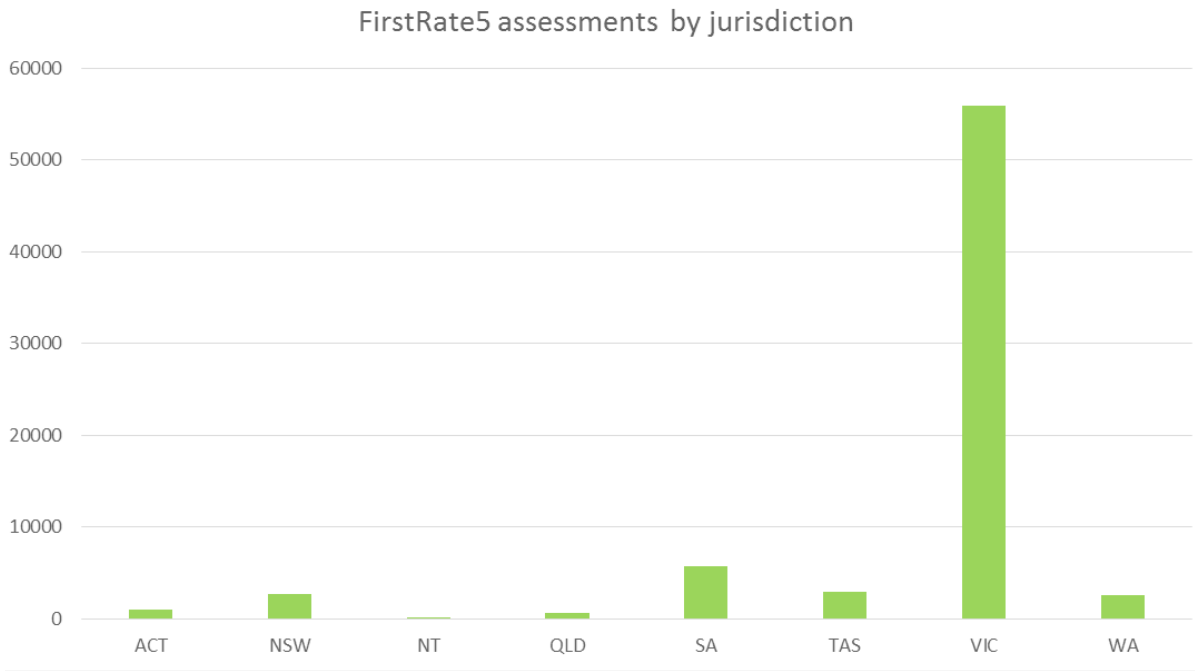


Figure 1 FirstRate5 uptake by state/territory

Five versions of the FirstRate5 have been accredited at various times since the online platform was launched in 2014. The graph below shows a gradual transition between versions as users update their software.

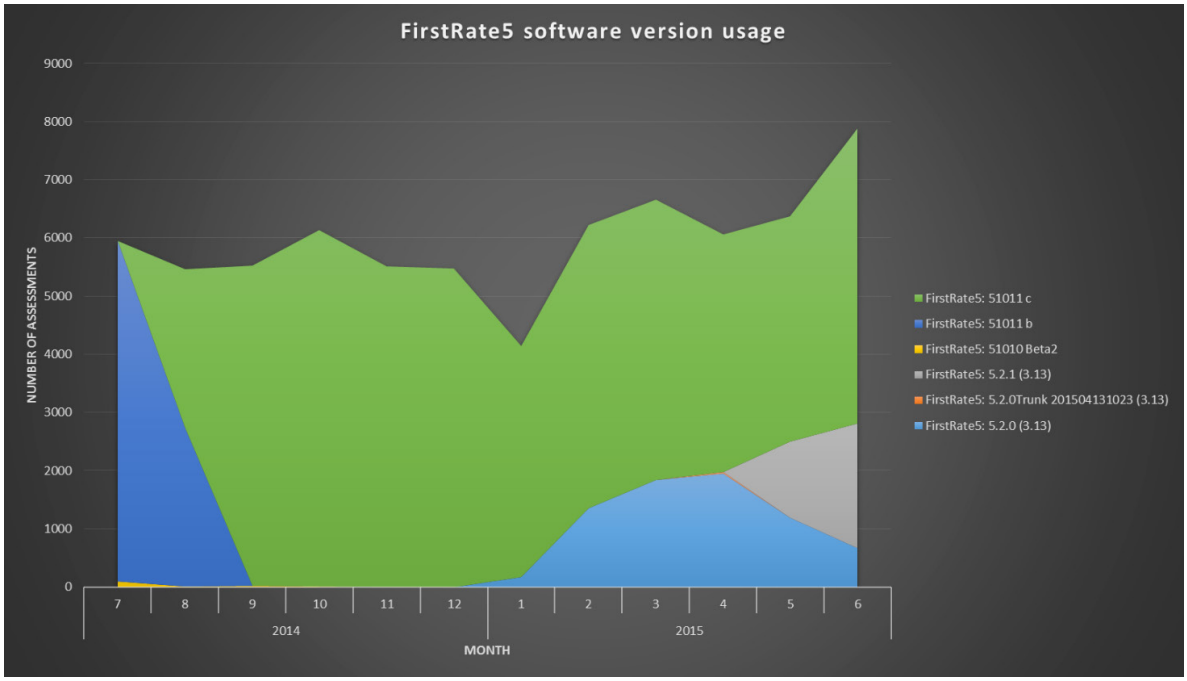


Figure 2 FirstRate5 software version uptake (FY 2014/15)

Property classes were assigned to HER assessments when FirstRate5 Version 5.2 was launched in January 2015, so that houses (class 1a) could be distinguished from apartments (class 2). Previous software versions did not distinguish classes, and so the breakdown of Home Energy Ratings by property type are becoming clearer as users transition to the current version of the FirstRate5 software.

Table 1: Breakdown of HER dwelling types for FY2014-15 (includes period where apartments were not differentiated from houses)

	Building type			
	Houses (Class 1a)	**Apartments (Class 2)**	**Unknown**	**Grand Total**
ACT	23	155	792	970
NSW	1,126	17	1,543	2,686
NT	59		113	172
QLD	197	41	344	582
SA	485	39	5,248	5,772
TAS	674	10	2,281	2,965
VIC	6,640	638	48,602	55,880
WA	399	191	1,962	2,552
Grand Total	**9,603**	**1,091**	**60,885**	71,579

Across all states and territories, the bulk of HERs were calculated on new homes. HER assessments on building alterations usually account for less than 10% of ratings for any given jurisdiction.

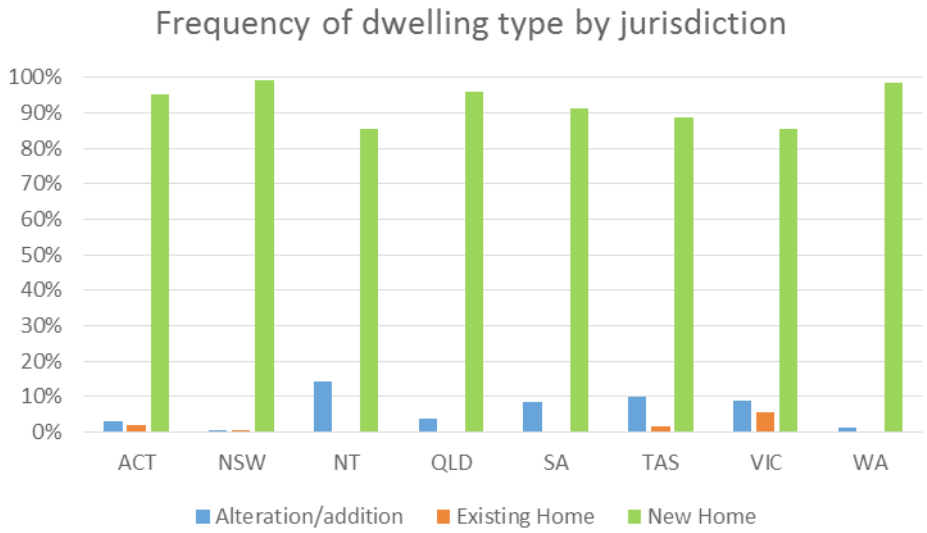


Figure 3: Frequency of assessments on new and existing homes and alterations (see comment on graph)

FirstRate5 assessments by postcode shows that nineteen of the top 20 postcodes were located in Victoria. Duntroon was the only non-Victorian postcode, with 646 ratings conducted in the 2014/15 financial year.

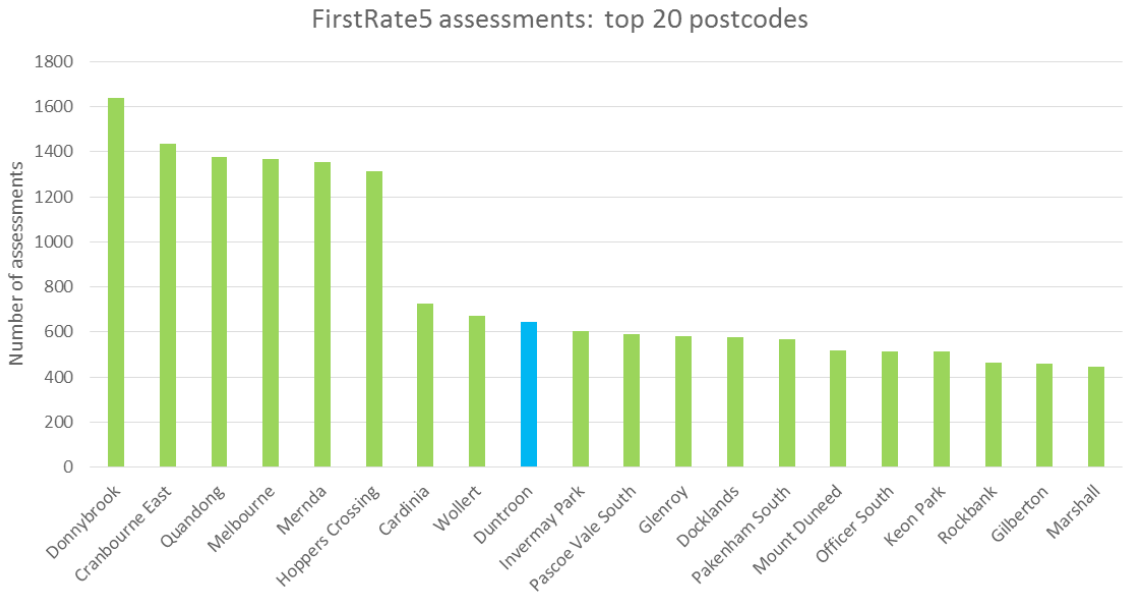


Figure 4: Top 20 postcodes for FirstRate5 assessments

This data includes assessments on new homes, alterations, additions and existing homes.

FirstRate5 usage

New homes comprised 90% of the home energy ratings where a building class was nominated (for the financial year 2014/15).

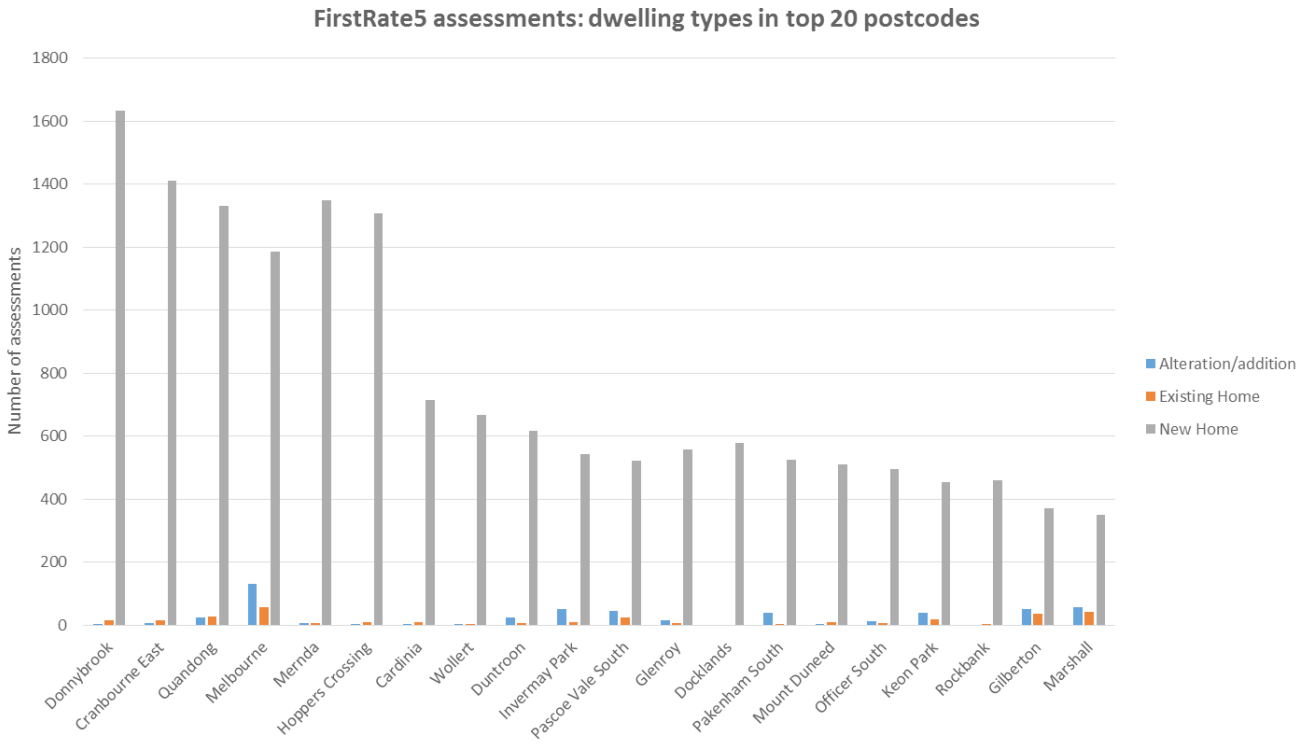


Figure 5: Top 20 postcodes certificates issued

Assessor accreditation

There was a sharp increase in the number of assessments submitted by accredited assessors in June 2015. All existing and new assessors were required to have completed Certificate 4 in NATHERS assessment by an initial deadline of July 1st 2015, a deadline which was then extended to 31st December 2015. The increase could also represent a number of large apartment buildings being certified recently by accredited assessors. It will be interesting to see how this ratio changes over time.

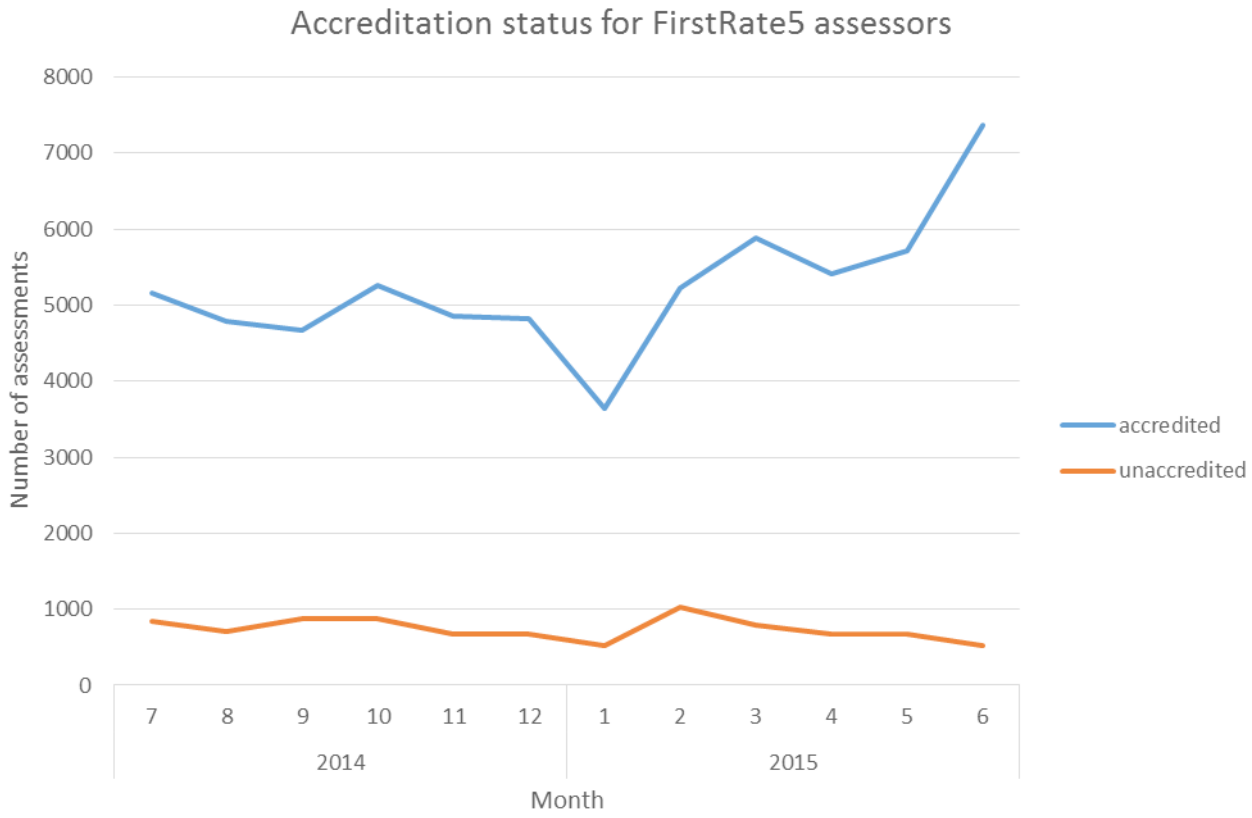


Figure 6: Monthly assessments by accredited and unaccredited assessors

The graph below shows that the number of assessments are highest in Victoria, and that 94% of those assessments are conducted by accredited assessors.

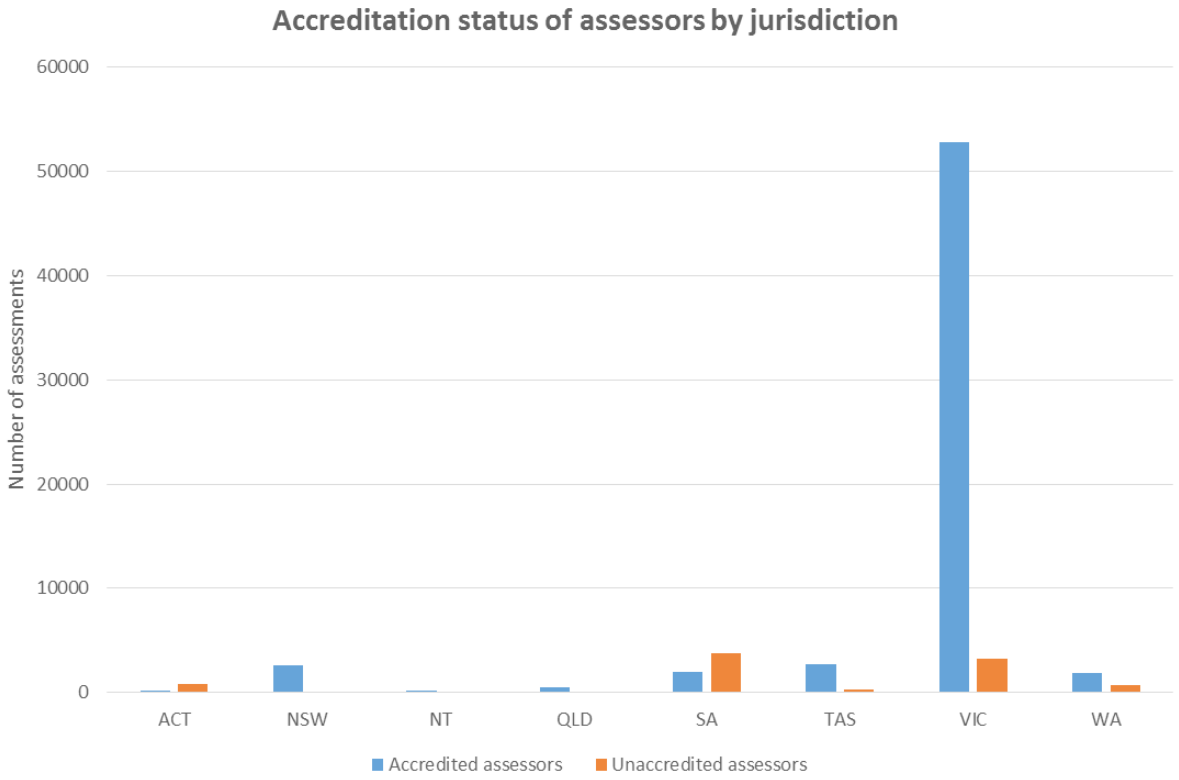


Figure 7: Assessor accreditation status by jurisdiction

The graph below shows the number of assessments undertaken by accredited and unaccredited assessors in the 2014-15 financial year.

The majority (77%) of unaccredited assessors undertook less than 10 assessments through the year. Assessors who undertake more than 20 assessments are more likely to be accredited assessors. Beyond 130 assessments per year, the vast majority of assessors are accredited.

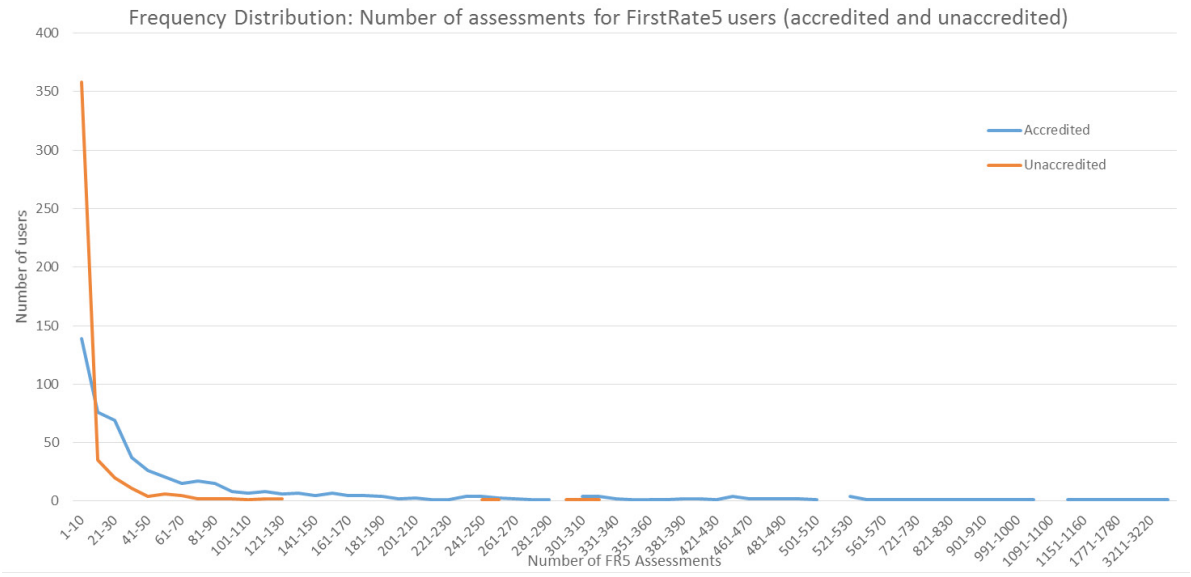


Figure 8: FR5 usage for accredited and unaccredited assessors

Home energy rating distributions

The frequency of home energy ratings for houses and apartments shows that apartments have a broader spread of ratings than houses do. This is to be expected as apartments must average 6 stars and not rate lower than 5 stars.

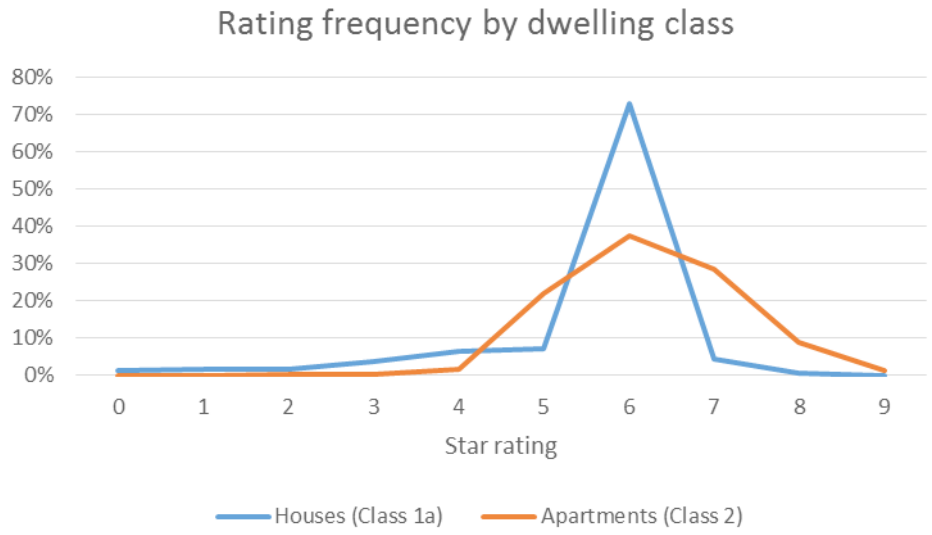


Figure 9: Rating frequency by property class

New houses (class 1a)

The frequency of FirstRate5 star ratings was mapped for new properties across all states and territories. Rating distributions for houses shows, in the southern states and WA, a high incidence of home energy rating 6 for new houses. Queensland and NT scores are skewed slightly towards the lower end in comparison with the southern states, which may be due to the inclusion of outdoor rooms in the calculation of the ratings. The most common ratings in NSW were 4 and 5. This may be due to the way thermal performance contributes to BASIX.

Figure 10: House star rating frequency jurisdictional comparison (FY 2014/15)

In some states and territories the sample sizes were comparatively small (see table below). It should be noted that data is from FY2014-15 and version 2.0 of the software was launched in January 2015 to distinguish houses and apartments. Data sets for houses and apartments will be much larger in subsequent years as users upgrade to current software versions.

Table 2: Numbers of star rating scores registered for new houses (FY Jan-June 2015)

Class 1a new houses								
Star rating	**ACT**	**NSW**	**NT**	**QLD**	**SA**	**TAS**	**VIC**	**WA**
0								
1		1					1	
2							3	1
3	4	71					5	3
4	4	353		7			9	
5	26	360	14	40	6		121	2
6	201	169	28	117	390	518	4917	355
7	25	70	1	21	19	53	217	19
8	3	10				9	30	
9								
Grand Total	**263**	**1034**	**43**	**185**	**415**	**580**	**5303**	**380**

New apartments

In comparison to new houses, there is more variability in home energy ratings in the new apartment market in Australian states and territories.

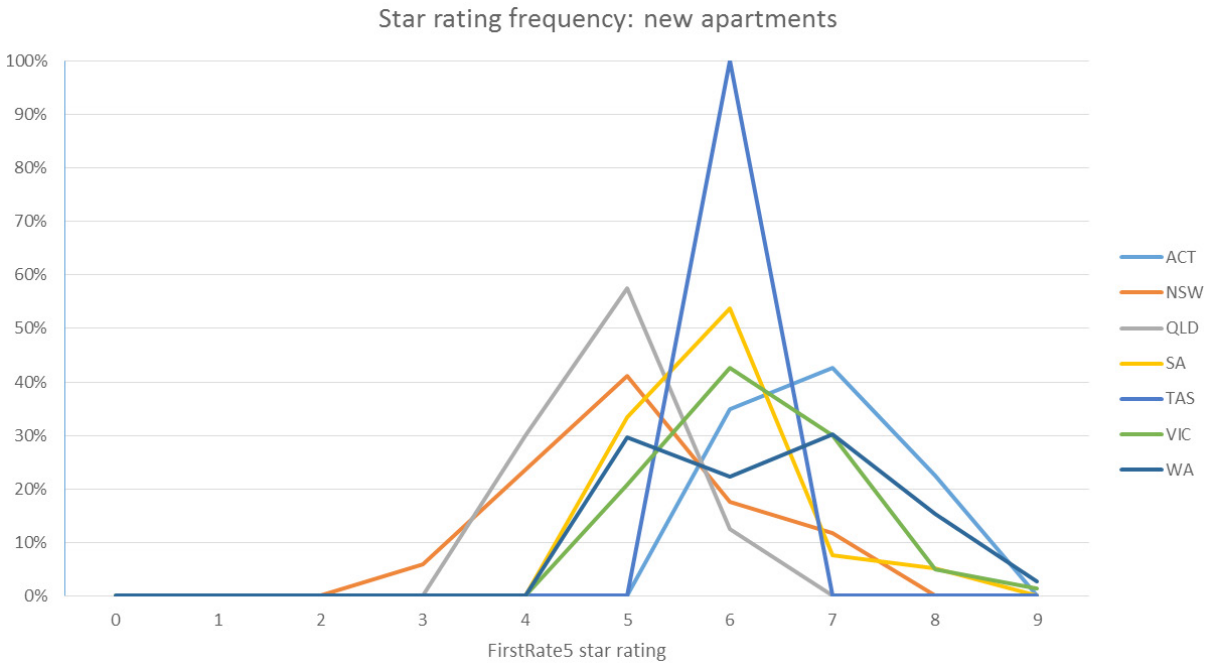


Figure 11: FirstRate5 star rating frequency for new apartments, jurisdictional comparison (FY 2014/15)

Available data suggest higher ratings are recorded for new apartments in WA, Victoria and the ACT. Comparatively lower scores were recorded for NSW and Queensland, however sample sizes in these jurisdictions were small (see table 3) due to software versions in use at the time of sampling.

Table 3: Star ratings registered for new apartments

HER	ACT	NSW	QLD	SA	TAS	VIC	WA
0							
1							
2							
3		1					
4		4	12				
5		7	23	13		124	56
6	54	3	5	21	7	254	42
7	66	2		3		179	57
8	35			2		30	29
9						8	5
Grand Total	155	17	40	39	7	595	189

Home energy ratings by postcode (top 20)

The average home energy ratings were calculated for the top 20 postcodes for FirstRate5 usage. Most postcodes have an average home energy rating of 6. Average ratings were slightly higher in Docklands and Duntroon.

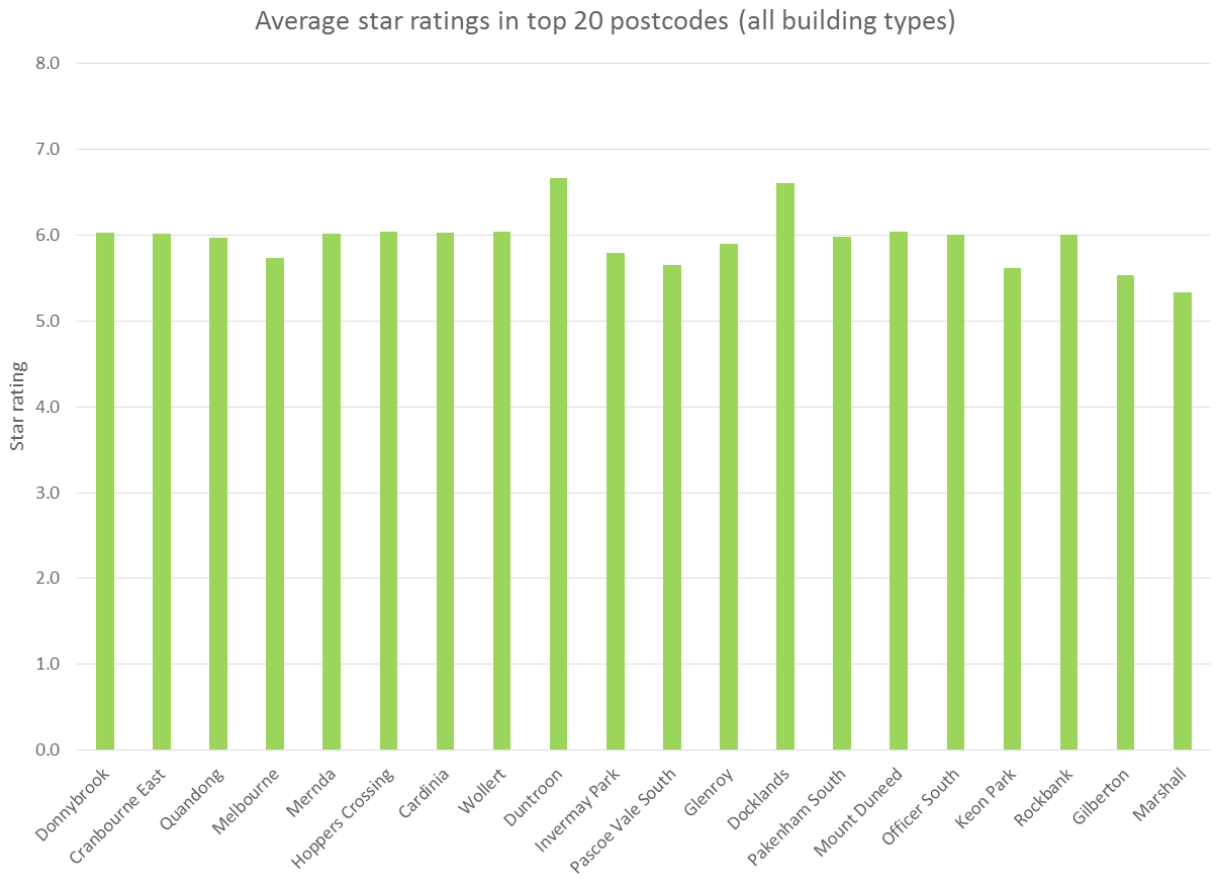


Figure 12: Average FirstRate5 star rating by postcode (top 20)

Dwelling size

National data for floor area of new houses and apartments shows that most apartments are between 30-80 square metres in size, whereas houses (as expected) have a much broader spread. This data represents the total area of all dwelling zones, including garages and other unconditioned zones.

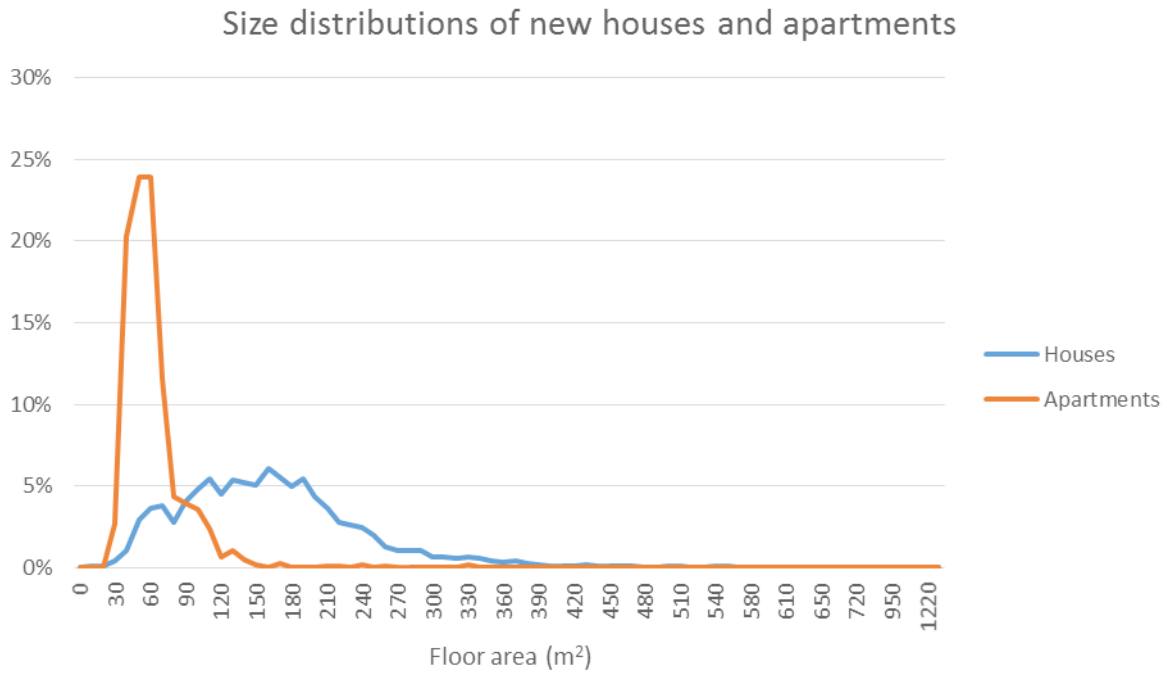


Figure 13: Size distributions of houses and apartments (national)

The graph below shows distribution of floor areas for new houses by the number of bedrooms.

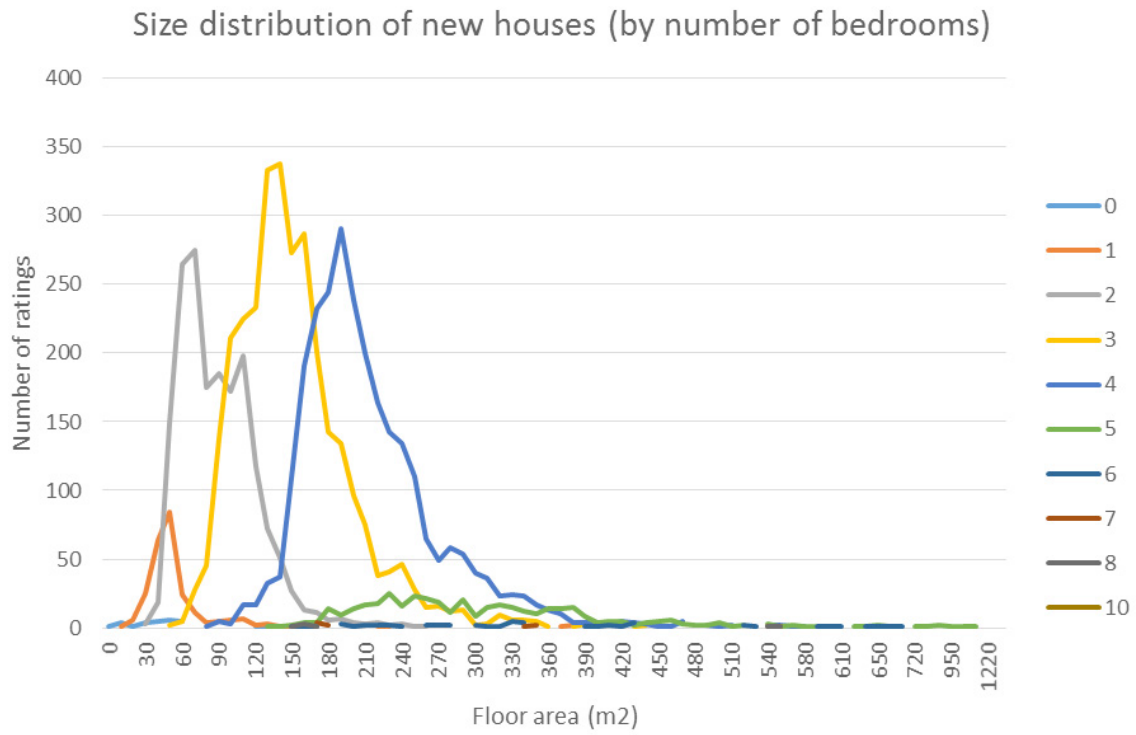


Figure 14: Floor area distribution for houses, by number of bedrooms

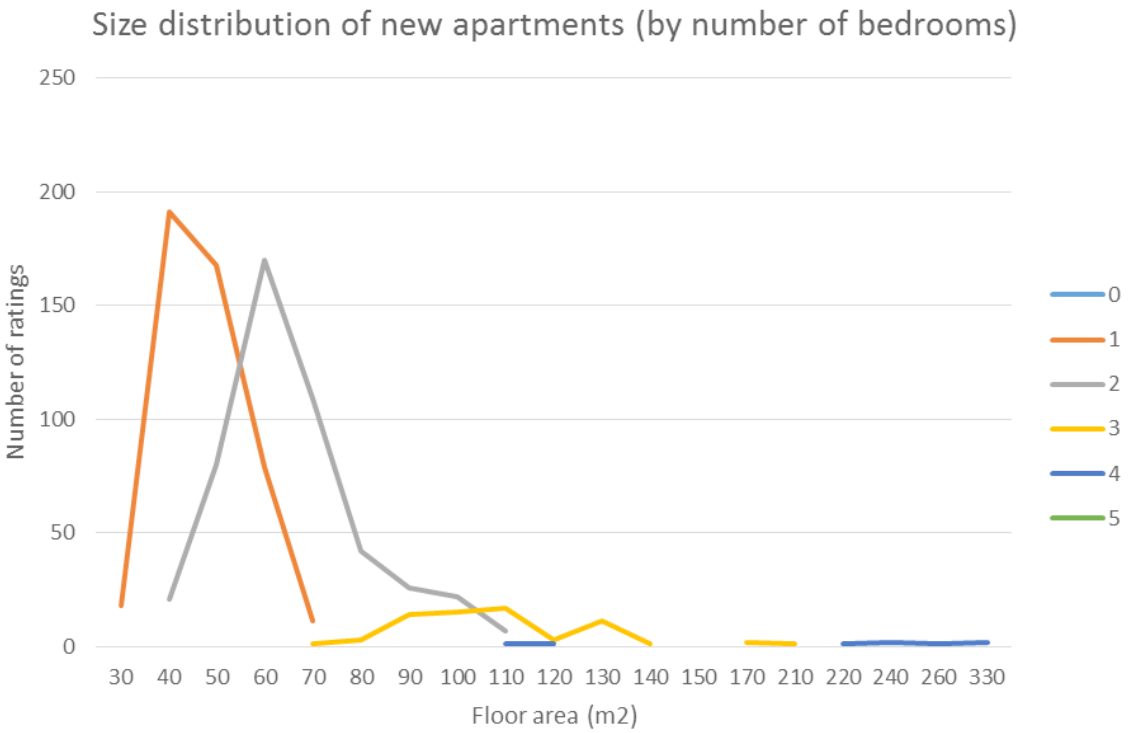


Figure 15: Floor area distribution for apartments,, by number of bedrooms

Home energy ratings include a record of the number of zones in a dwelling. The predefined zone types in FirstRate5 are as follows:

- Living
- Kitchen/Living
- Daytime
- Unconditioned
- Night Time
- Bedroom
- Garage
- Garage Conditioned

Below is a frequency distribution of the number of zones recorded in houses, indicating that most rated houses had between 9 and 15 zones.

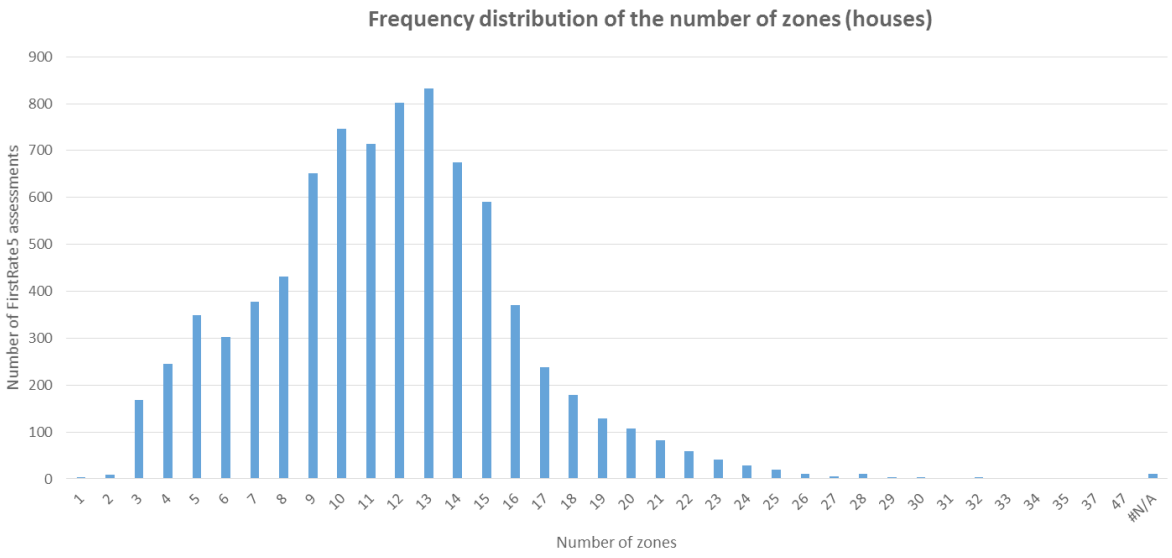


Figure 16: Frequency distribution of the number of zones in houses

The most common number of zones in rated apartments was 3.

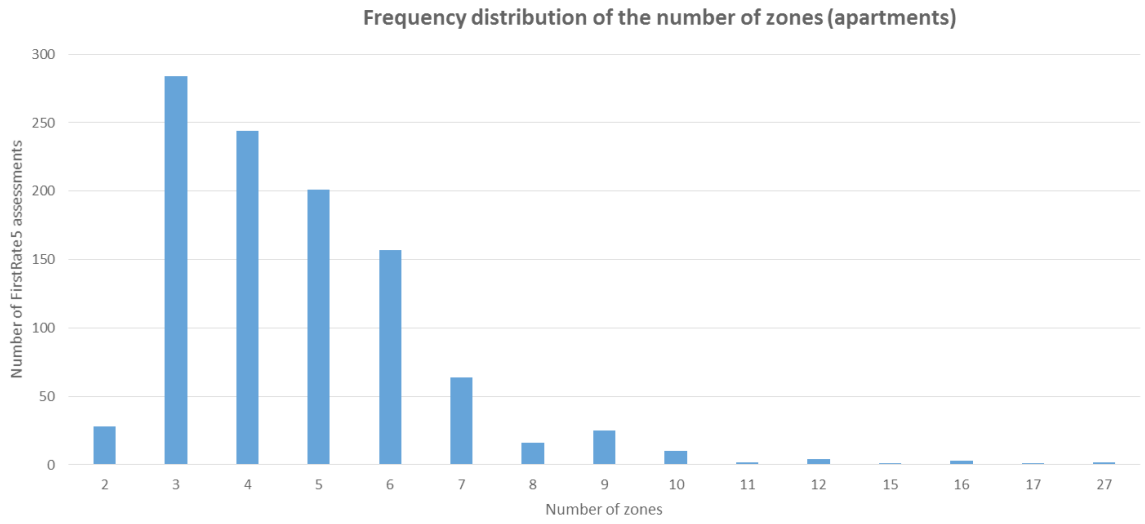


Figure 17: Frequency distribution of the number of zones in apartments

State/territory comparison of dwelling size

Frequency distributions of floor area bands for new housess shows that West Australian houses tend to be larger than new houses in Tasmania and South Australia.

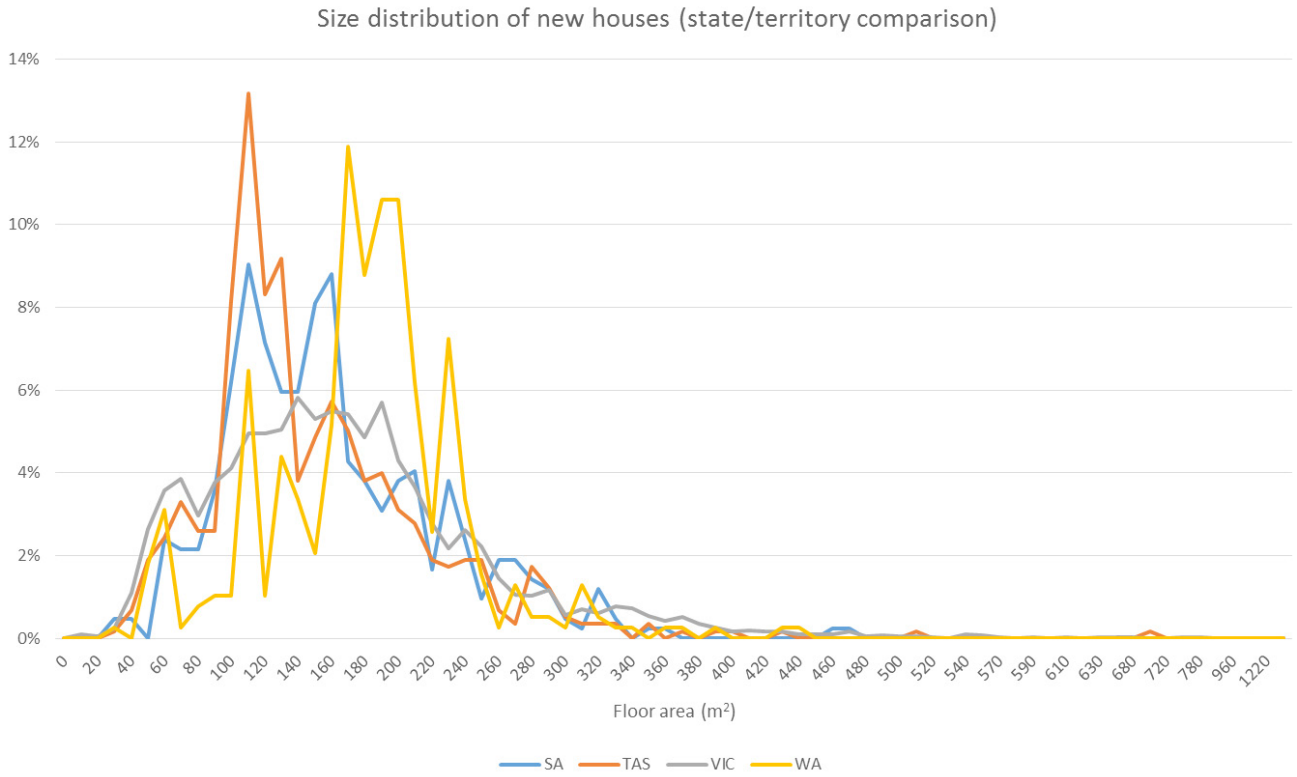


Figure 18: Frequency of floor area in new houses (state comparison)

Floor area comparison for new, existing and extended homes

The average total floor area was graphed for existing houses, new houses and alterations in South Australia, Tasmania and Victoria. The data indicates that floor areas for Victorian houses were slightly larger than South Australian and Tasmanian houses. The data also indicates that that new houses are usually 30% larger than existing homes across these states, and that house alterations usually increase the size of a dwelling by at least 40%.

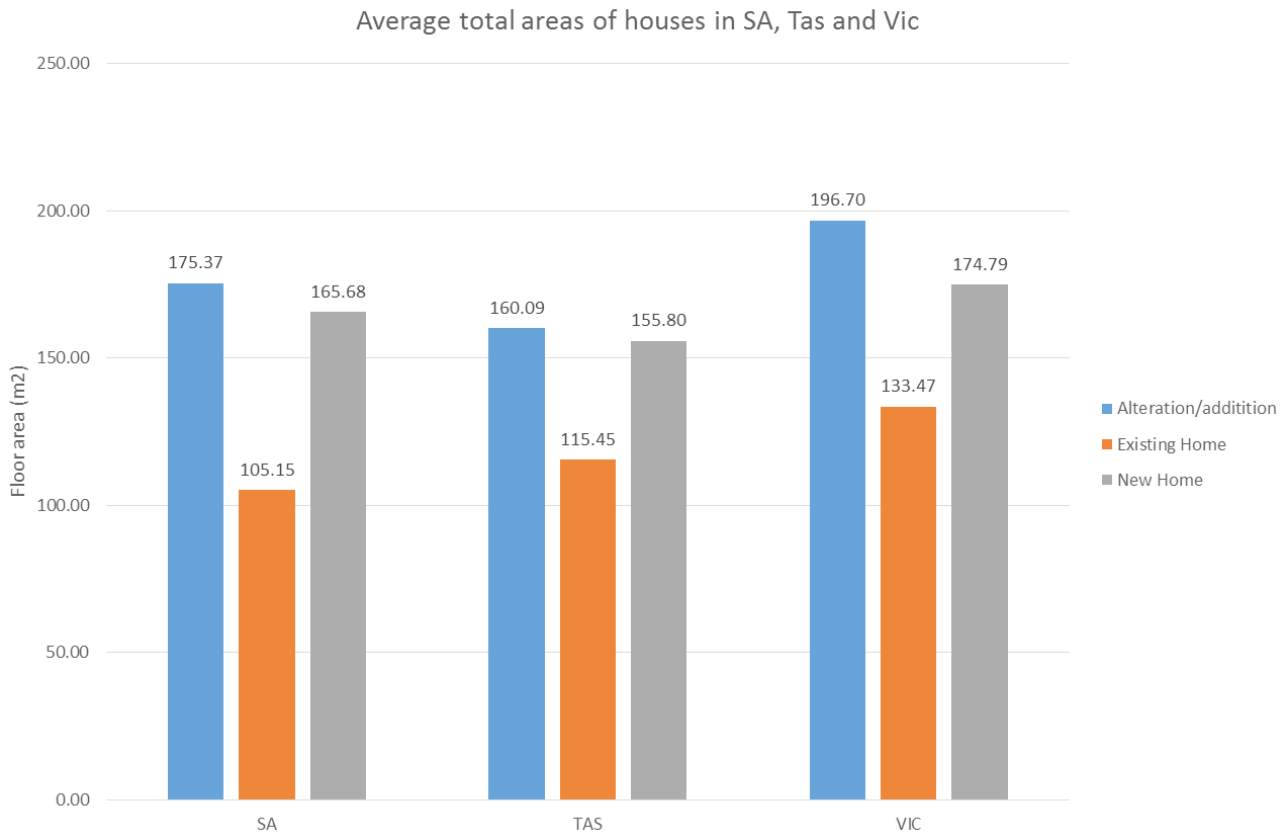


Figure 19: Average total areas, houses by state

Average wall height

The data below shows that, for new homes in most states, wall heights in Class 2 dwellings (apartments) are higher than wall heights in Class 1a dwellings (houses).

Please note that this data represents the average per house of the maximum wall height in each zone/room, leading to a single figure for each project/rating. Thus projects with very large numbers of walls do not skew the average.

There are certain infrequent situations where an assessor will model two walls, say 1200mm high, stacked one above another to represent one full height wall to a zone. We do not record when this stacking occurs, and each of these walls will be counted as a separate wall. While rare, these instances may contribute to an under-representation of average wall heights in individual properties and across the state/territory average.

In all other circumstances when an assessor enters the wall height it should represents the distance between the internal floor and ceiling level of the zone. In apartments it is conceivable that assessors interpret this as underside of slab if the apartment includes a dropped ceiling.

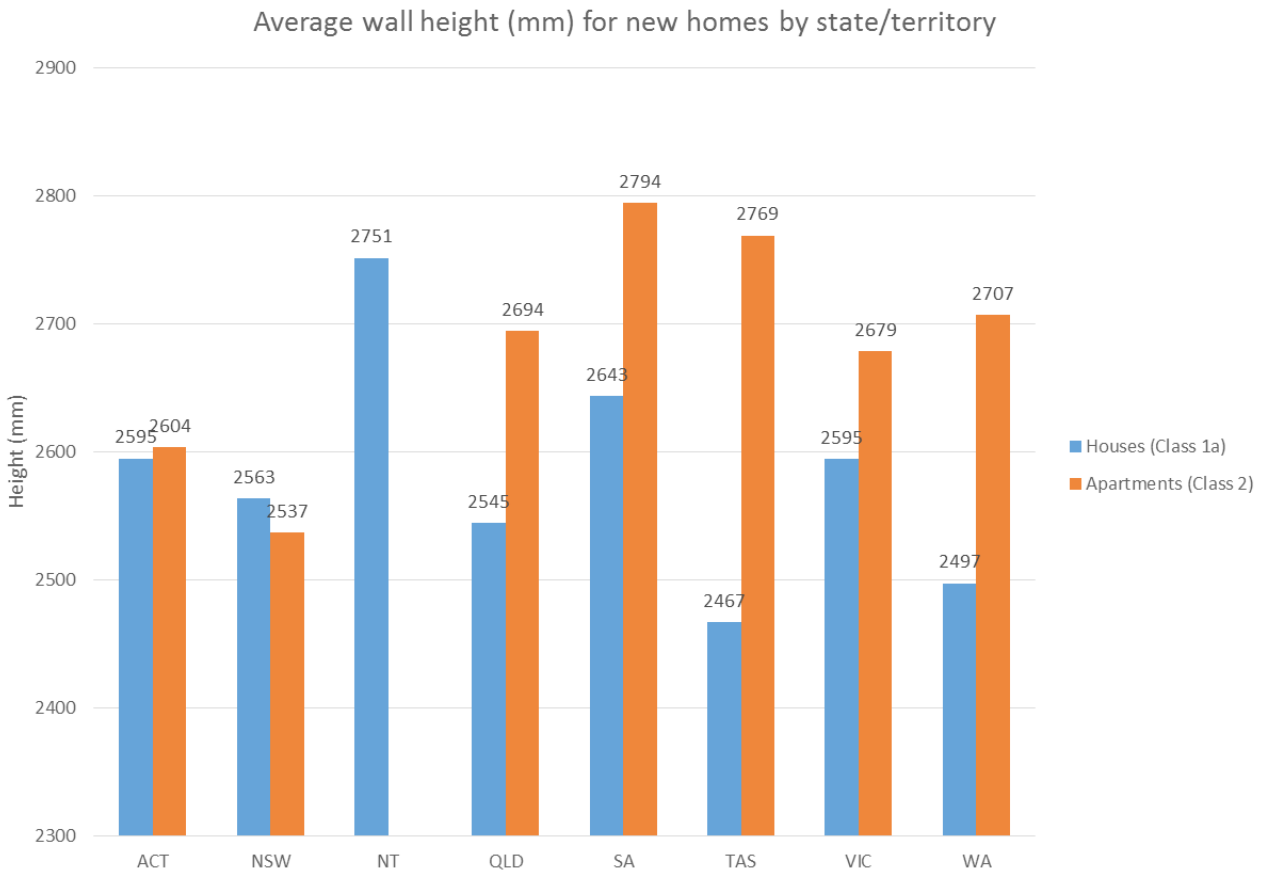


Figure 20: Average wall heights for new homes by state/territory

For comparison, average wall heights for existing dwellings are provided below.

Figure 21: Average wall heights for existing homes by state/territory

Insulation

FirstRate5 home energy ratings require the presence of roof, ceiling, wall and floor insulation to be recorded.

Insulation in houses (class 1a)

Insulation data was collated for all houses to determine the levels of insulation being installed around Australia. Data from all states and territories shows that 92% of houses have ceiling bulk installed, and that 43% of houses have both reflective and bulk ceiling insulation.

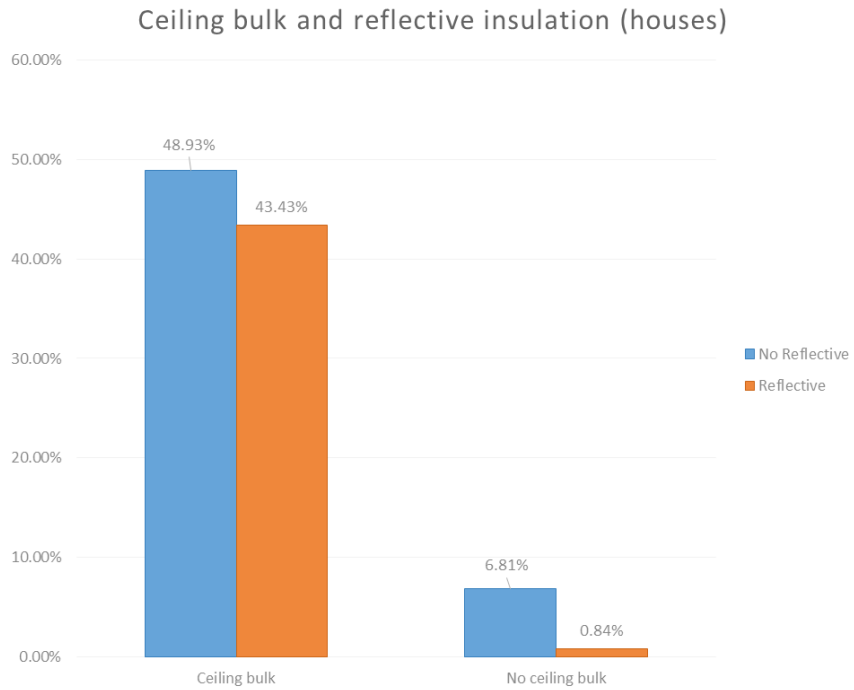


Figure 22: National incidence of bulk and reflective insulation in houses

State by state comparison shows that houses in the colder states are most likely to have bulk ceiling insulation installed.

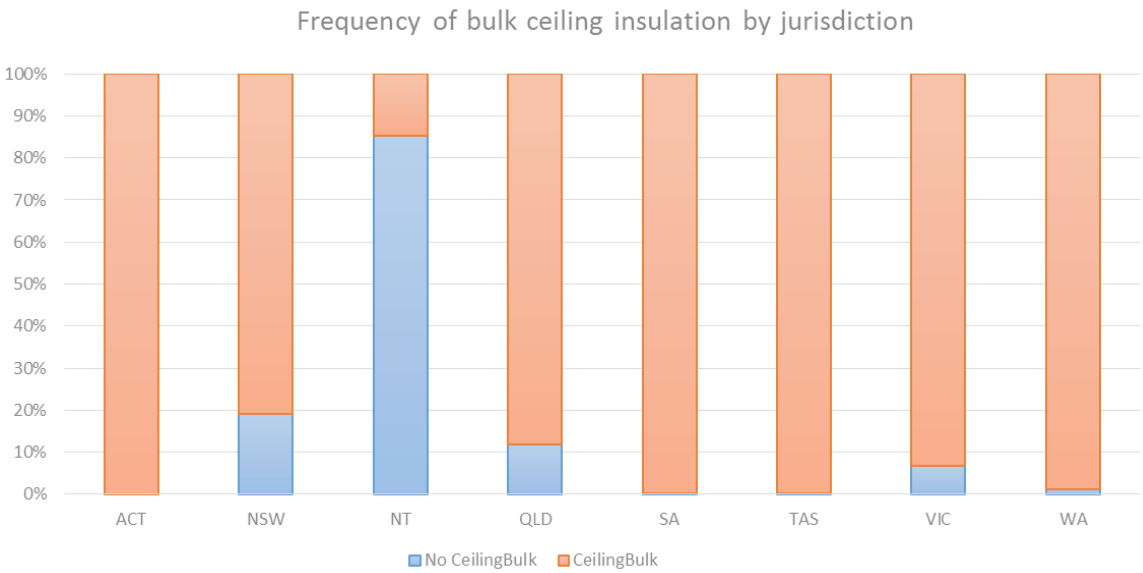


Figure 23: Jurisdictional comparison of the incidence of ceiling bulk insulation in houses

Data from all floors (including timber and concrete slab) shows that floor insulation (in houses) is more common in Tasmania and the ACT.

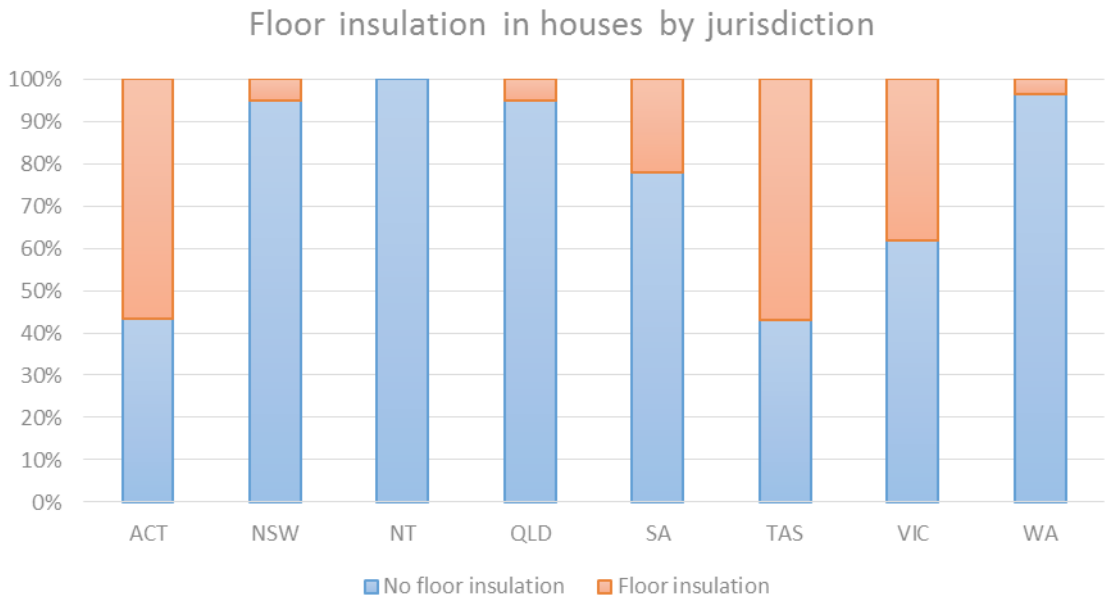


Figure 24: Jurisdictional comparison of the incidence of floor insulation in houses

Highest rates of reflective roof insulation were recorded in houses in WA, Queensland and South Australia. Surprisingly, the Northern Territory has the lowest incidence of reflective insulation.

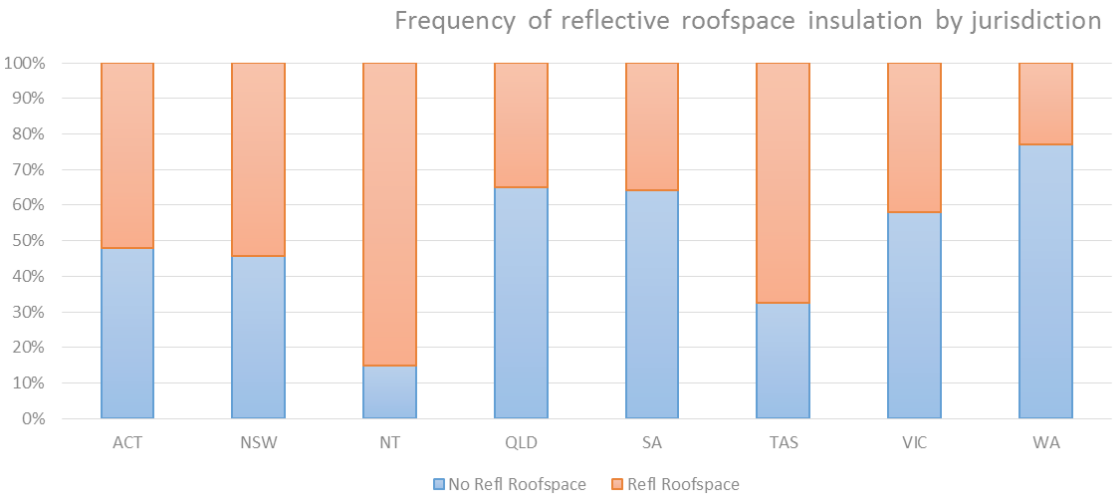


Figure 25: Jurisdictional comparison of the incidence of reflective roof insulation in houses

Bulk and reflective insulation was recorded in 63% of house walls.

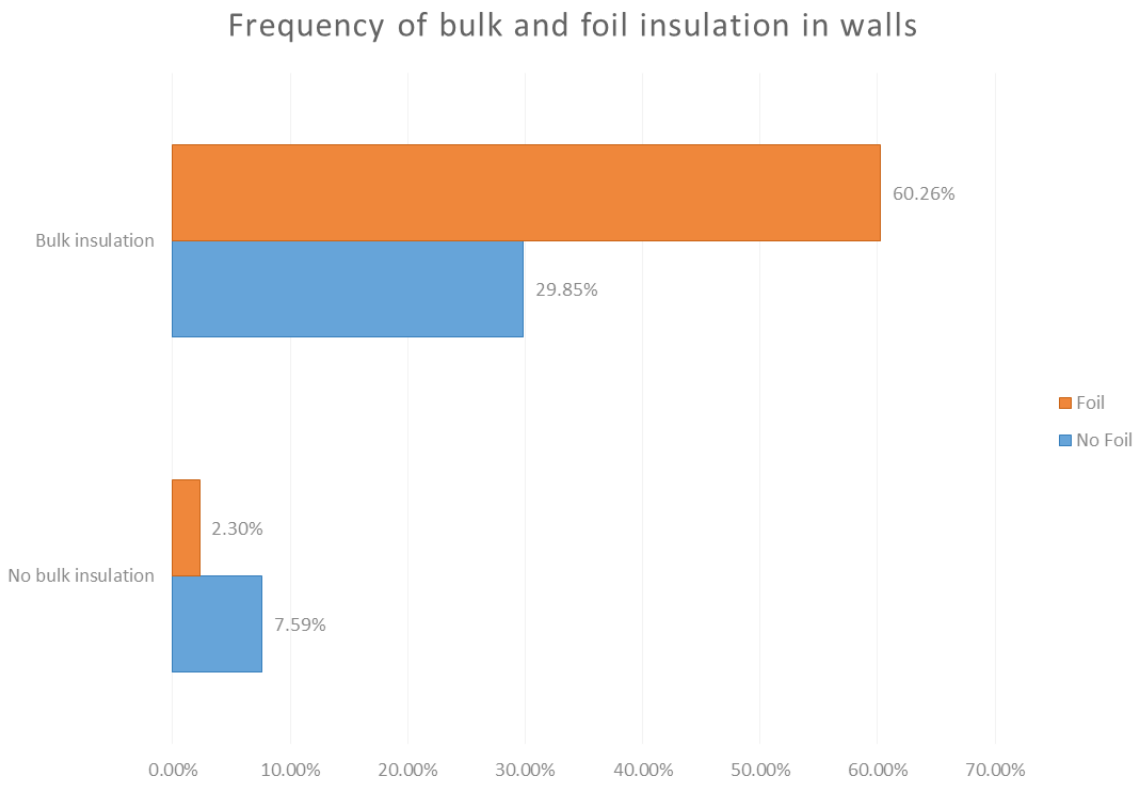


Figure 26: Frequency of wall insulation (bulk and foil)

Glazing

Window orientation

State territory breakdown of window orientation shows that houses in Tasmania were most likely to have at least one north facing window recorded in FirstRate5. Northerly windows include windows orientated between North West and North East. This data includes new houses only.

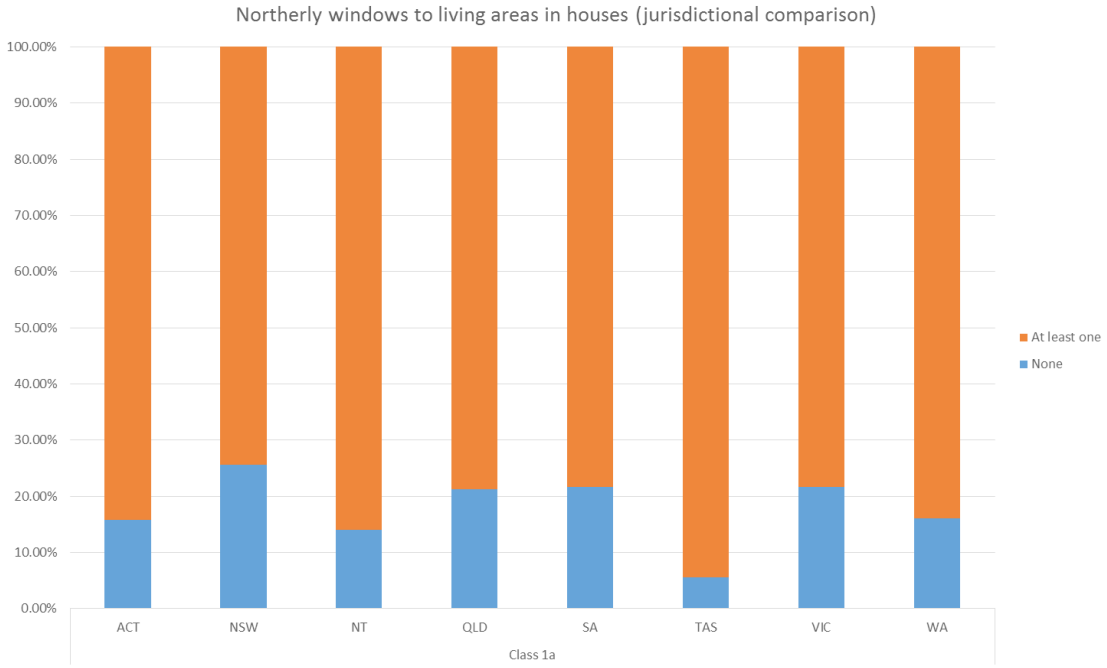


Figure 27: Incidence of at least one northerly window in new houses, jurisdictional comparison

All FirstRate5 assessments of Tasmanian apartments had at least one north facing window recorded. It should be noted that the sample size for Tasmania was 10. NSW and Victoria had the lowest incidence of apartments with one or more north facing window.

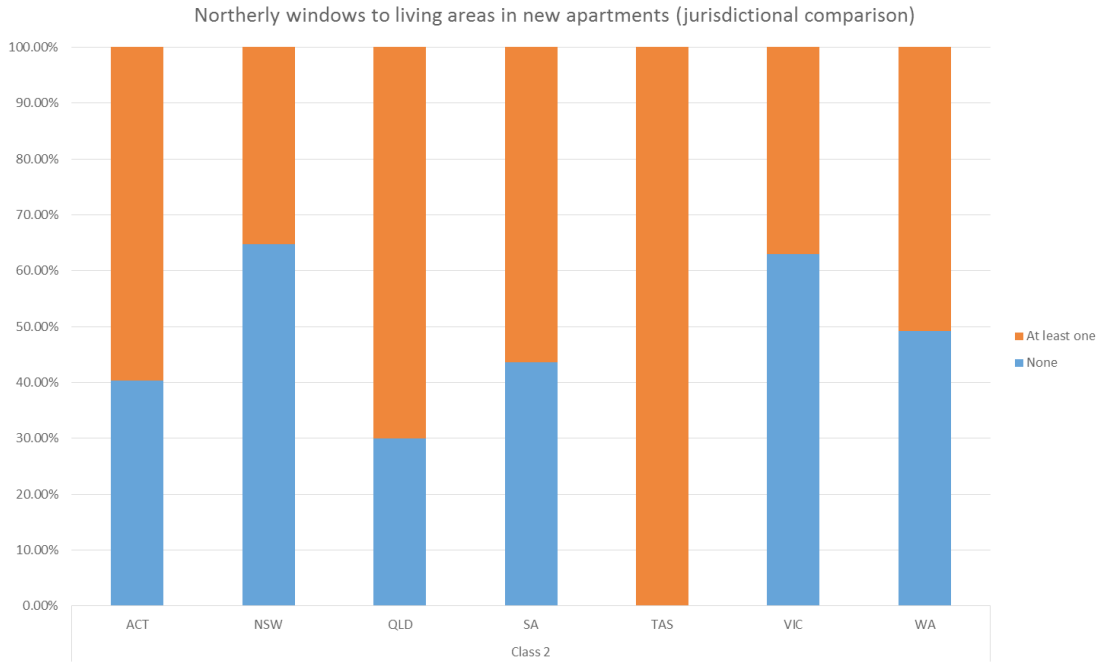


Figure 28: Incidence of at least one northerly window in new apartments, jurisdictional comparison

Double glazing

Glazing area (m2) and type (single, double, triple) is recorded for all certificates issued for new and existing homes and alterations. Across all certificates issued nationally, the breakdown of glazing types is:

- 39% is double glazed
- 0.1% is triple glazed
- 61% is single glazed

The following graph gives a breakdown of the frequency of glazing type (based on total areas of glazing types) for new, existing homes and alterations. It shows the highest proportion of double glazing was recorded in alterations, additions and new homes, compared to a much lower ratio in existing homes.

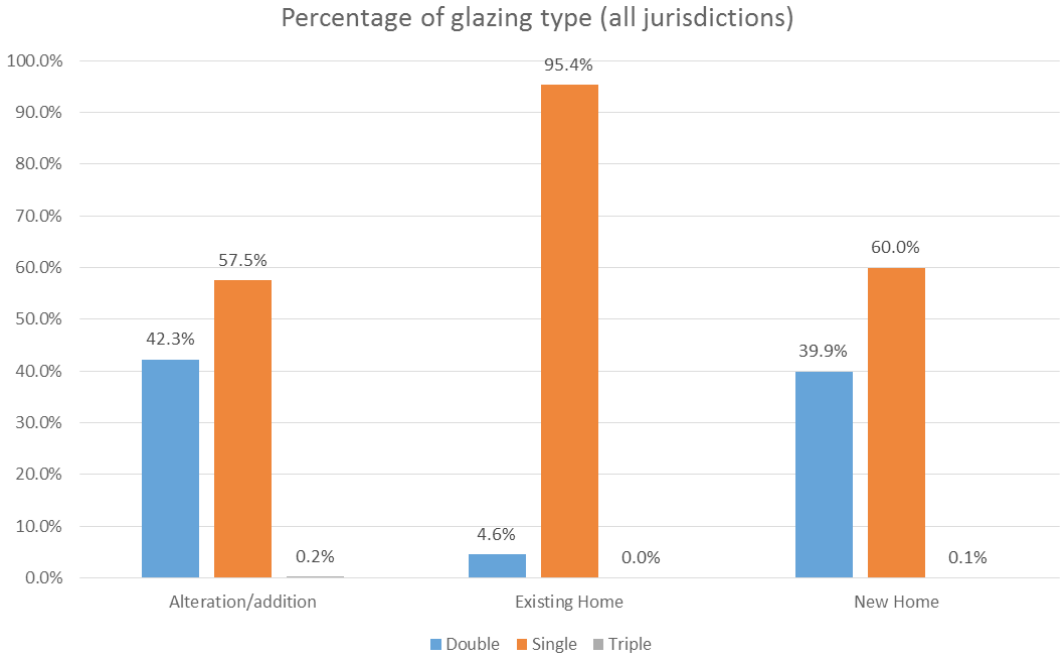


Figure 29: Frequency of glazing type for certificates issued (all jurisdictions)

Jurisdictional breakdowns show that the highest ratio of double glazing was recorded in Tasmania (76.7%), second highest in ACT (47.7%) and Victoria (40.7%). The lowest double glazing ratio was recorded in the Northern Territory (1.6%).

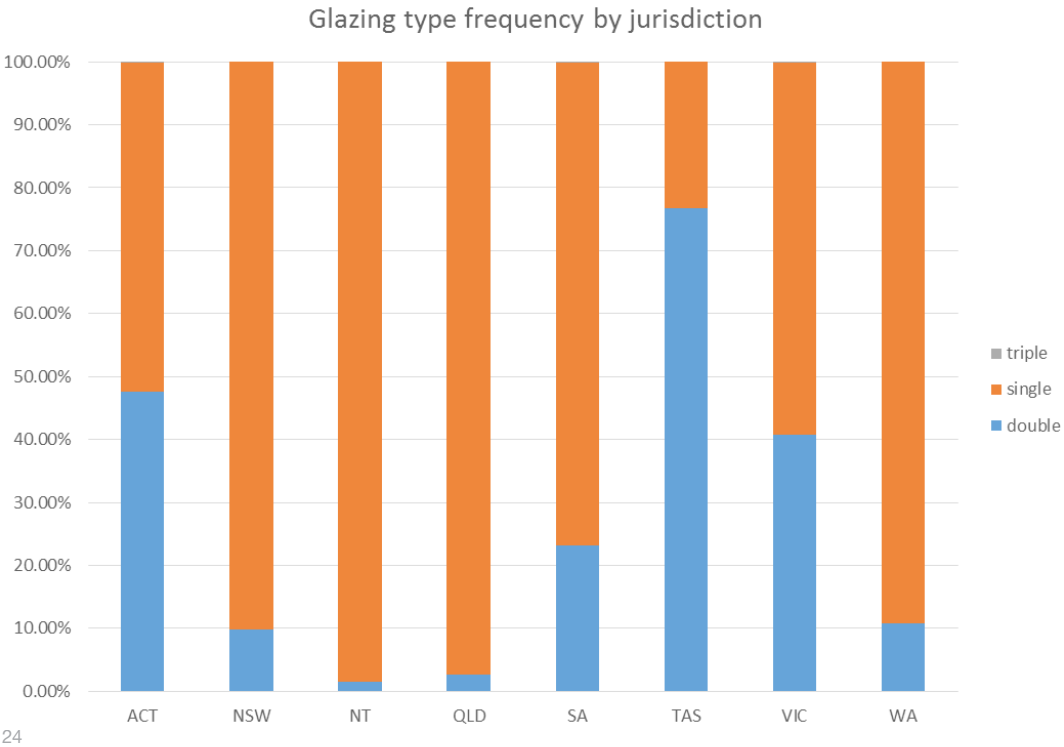


Figure 30: Glazing type frequency by jurisdiction

U-value

'U-value' is a measurement of the thermal transmission of a building element. Windows generally have a U-value of between 1 and 7 approximately. A low U-values indicates a better insulating window.

The total area of glazing and respective U-values were graphed for each jurisdiction, showing a preference in Tasmania for windows with lower rates of thermal transmission, and higher rates of transmission in glazing in the Northern Territory and NSW. U-value peaks of 3.5 and 6 may represent single and double glazing.

It should be noted that U-values refer to the entire window, ie, glass + frame. It should also be noted that assessors are only able to select windows from fixed window libraries. During the data period (July 2014-June 2015) three window libraries were available: NatHERS Generic, NatHERS Default, as well as historical Custom Windows. The Generic and Default libraries contain single glazed options with U-values as good as 3.7 W/m2K and double glazed options with U-values as poor as 5.2 W/m2K.

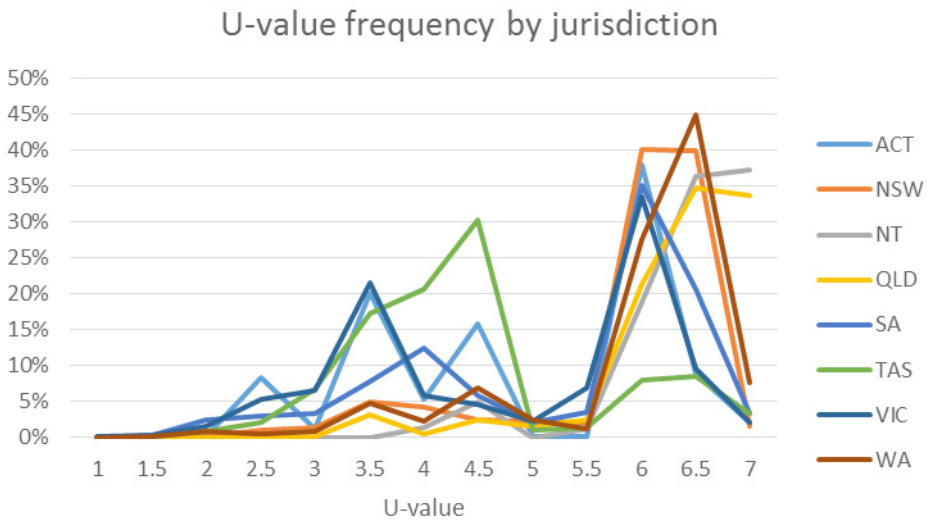


Figure 31: U-value frequency by jurisdiction

The overall national pattern correlates strongly with the U-value frequency profile for Victoria because of the high numbers of HER assessments carried out in that state.

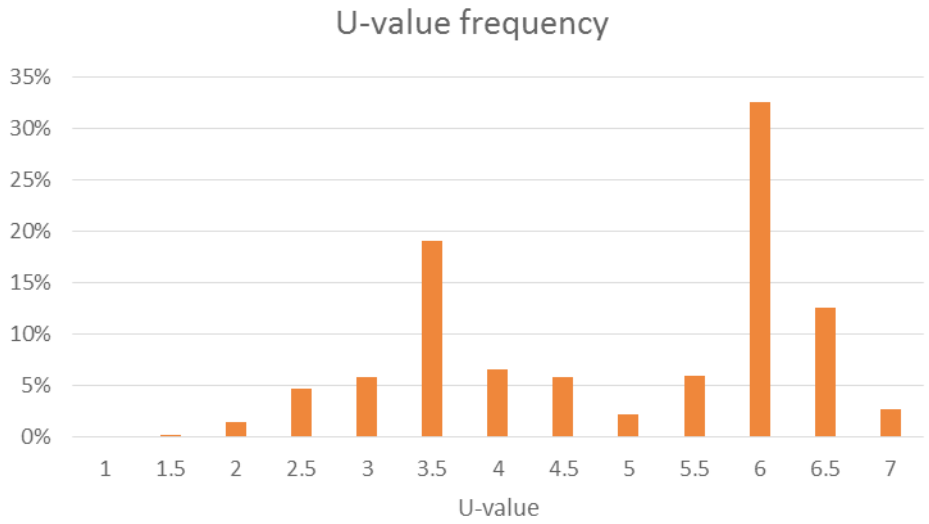


Figure 32: U-value frequency (all jurisdictions)

Solar heat gain coefficient (SHCG)

Solar Heat Gain Coefficient (SHCG) is the fraction of incident solar radiation admitted through a window. SHCG is expressed as a number between 0 and 1. The lower a window's SHCG, the less solar heat it transmits. In a cool climate, windows which have a high SHCG allow a greater amount of solar radiation to pass through, which helps to heat the home.

The graph below shows a jurisdictional comparison of the frequency of SHCG values, measured by the area of glazing recorded for various SHCG values. It shows a comparative preference in the Northern Territory for windows with low transmission of solar radiation, compared to other jurisdictions where windows tend to have higher SHGC values.

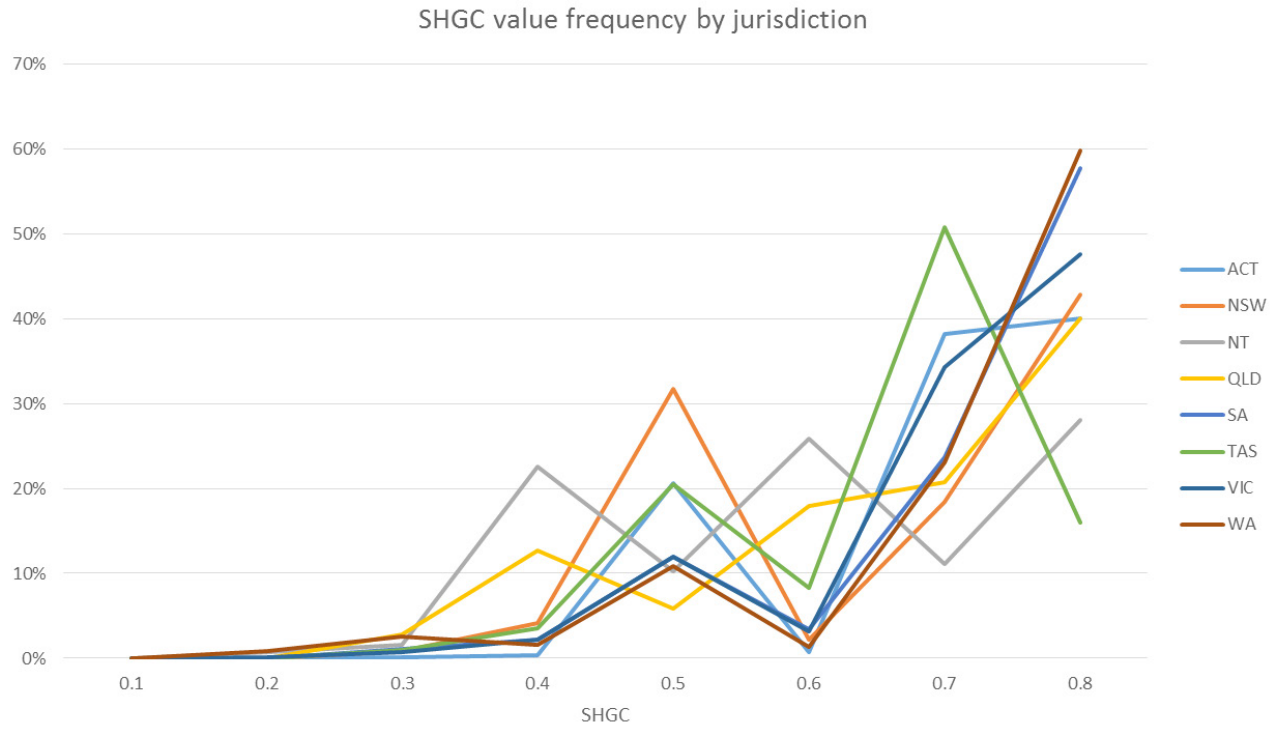


Figure 33: SHGC value frequency by jurisdiction

Glazing ratios and window performance

Glazing ratios were graphed against window performance (average U-values) in habitable rooms .The graph below shows data for all Australian states, and indicates a correlation between better performing windows (lower U-values) and higher glazing to floor area ratios.

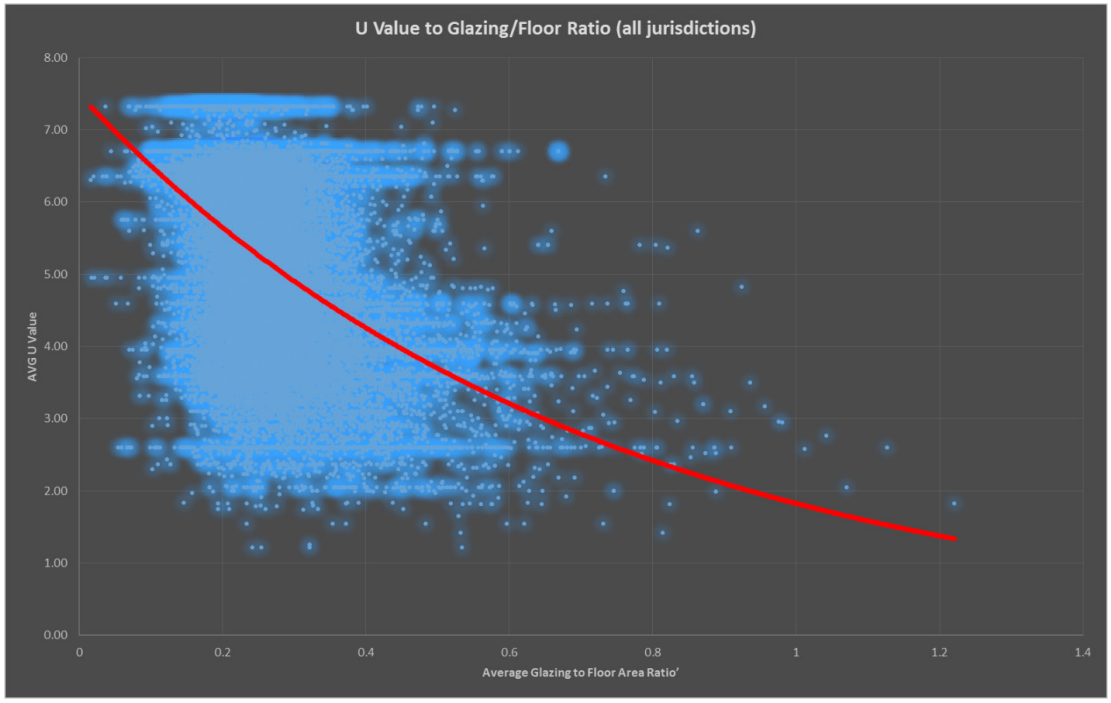


Figure 34: Average U-value to glazing to floor area ratio (all jurisdictions)

Victorian data is shown in the graph below. Victorian data accounts for the majority of the national dataset, so both graphs are very similar.

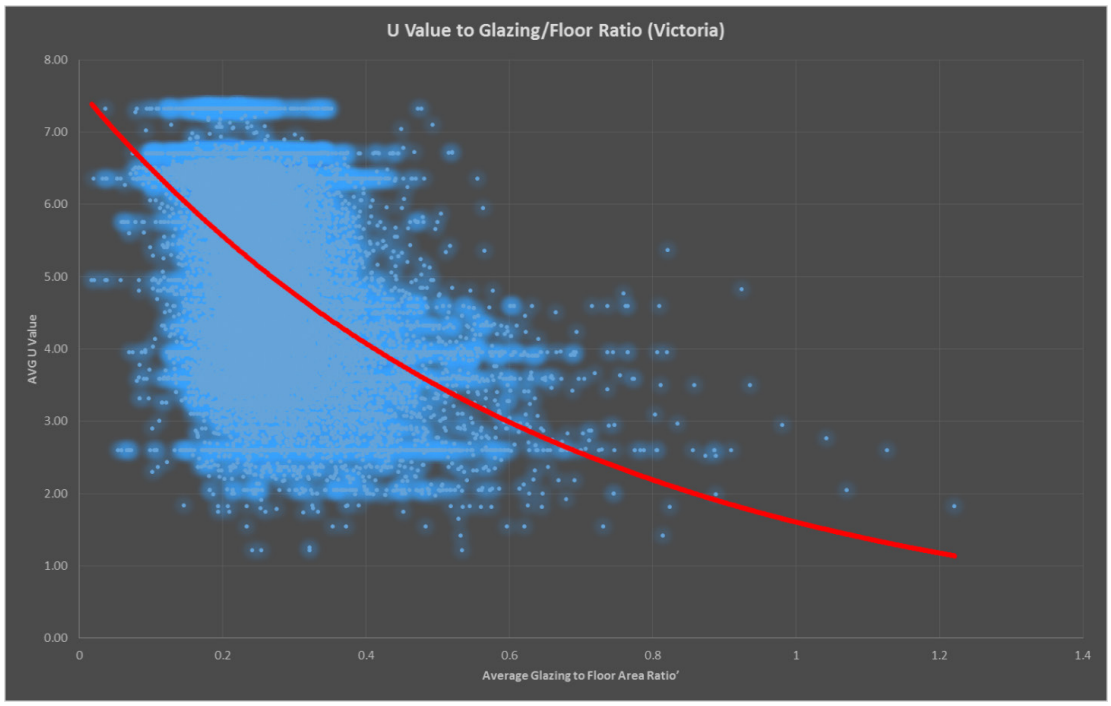


Figure 35: Average U-value correlation with glazing:floor area ratio (Victoria)

Tasmanian data is shown below. The lowest U-values recorded in Tasmania were around 2, which is higher than the minimum U-values recorded in Victoria. The pattern again shows that houses with high glazing/floor area ratios tend to use better quality windows.

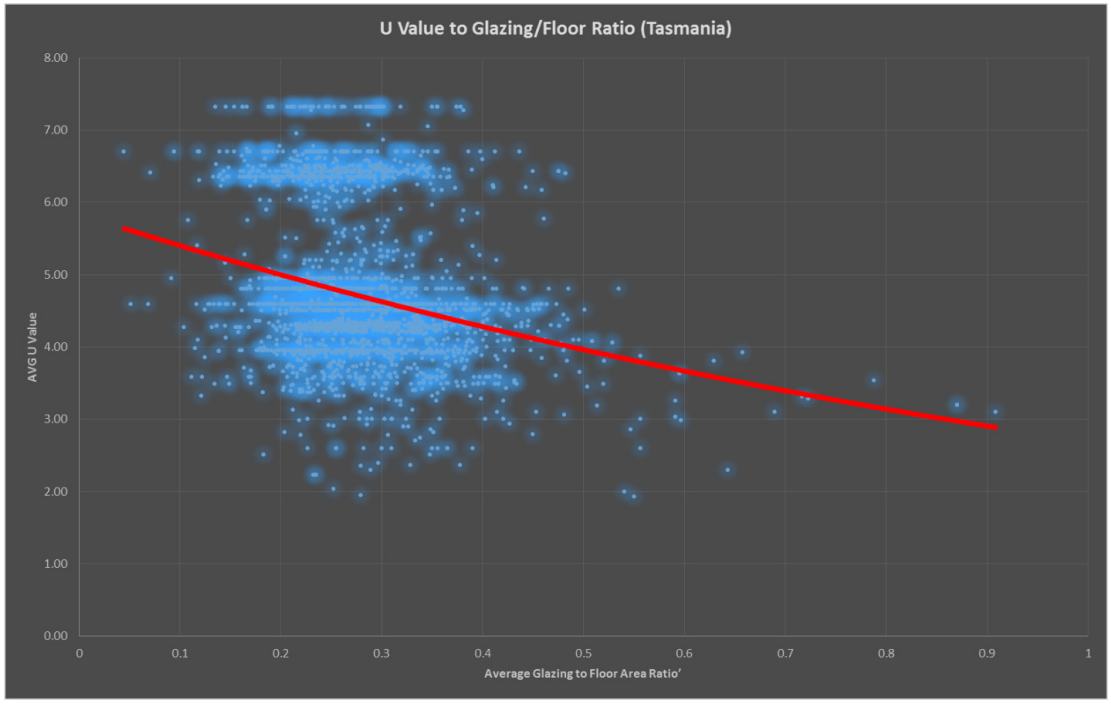


Figure 36: Average glazing to floor area ratio (Tasmania)

Queensland data below indicates that there is little correlation between U-value and glazingto floor area ratios in Queensland dwellings. This indicates that most installed windows have a low resistance to heat flow, regardless of the glazing/floor area ratios.

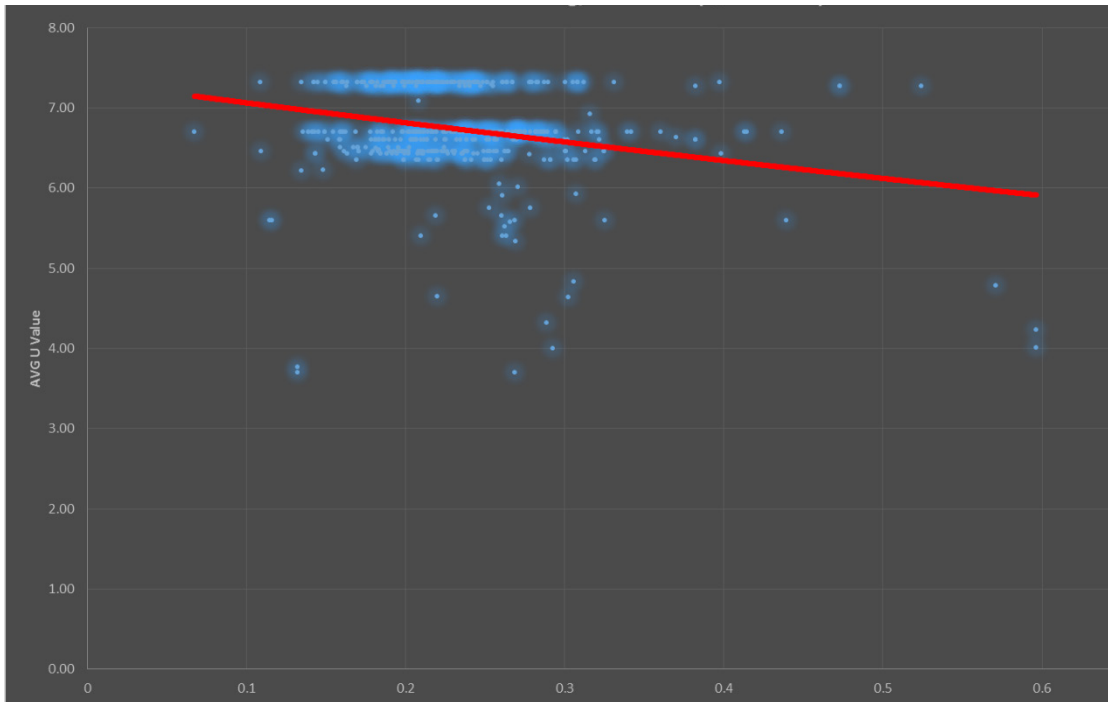


Figure 37: Average glazing to floor area ratio (Queensland)

Dwelling size and glazing area relationship

The graph below indicates a linear relationship between dwelling size (measured by the floor area of liveable zones) and the area of glazing recorded in FirstRate5 assessments. This data includes all states and territories, and confirms a range of approximately 0.125 to 0.75.

Figure 38: Zone area to glazing area relationship

Jurisdictional analysis of window choice and glazing area to zone area ratio

The following graph is an investigation into whether there is a relationship between choice of window type in new dwellings (single, double, or combination of single/double), and the prevalence of glazing in new dwellings. Glazing to zone area ratios (nationally, and in various jurisdictions) were graphed against glazing type. The number of dwellings for each window type was also included to indicate the size of the dataset in each jurisdiction.

The data indicates that in general, where double glazing is exclusively used, the average glazing to zone area ratio is higher (around 30%). Glazing ratios tend to be lower (around 22%) in dwellings where single glazing is exclusively used. The data sets for Tasmanian and Queensland dwellings were much smaller in the 2014-15 financial year, however this data will become more indicative as FirstRate5 assessments accumulate for these jurisdictions.

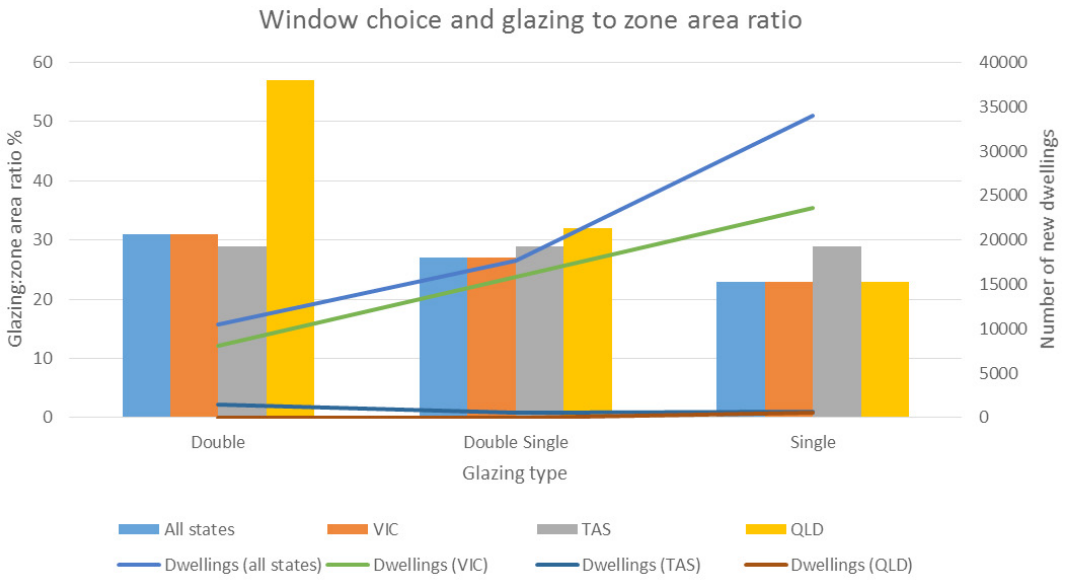


Figure 39: Window type and glazing to zone area ratio

Floors

The following graphs show the most common floor types, measured by floor area. Slab floors are most commonly found in both houses and apartments, followed by timber floors and then suspended slabs. The option to select Waffle Pod became available with FR5 v5.2.0 released during the sample period (27 January 2015). Consequently it may be under represented.

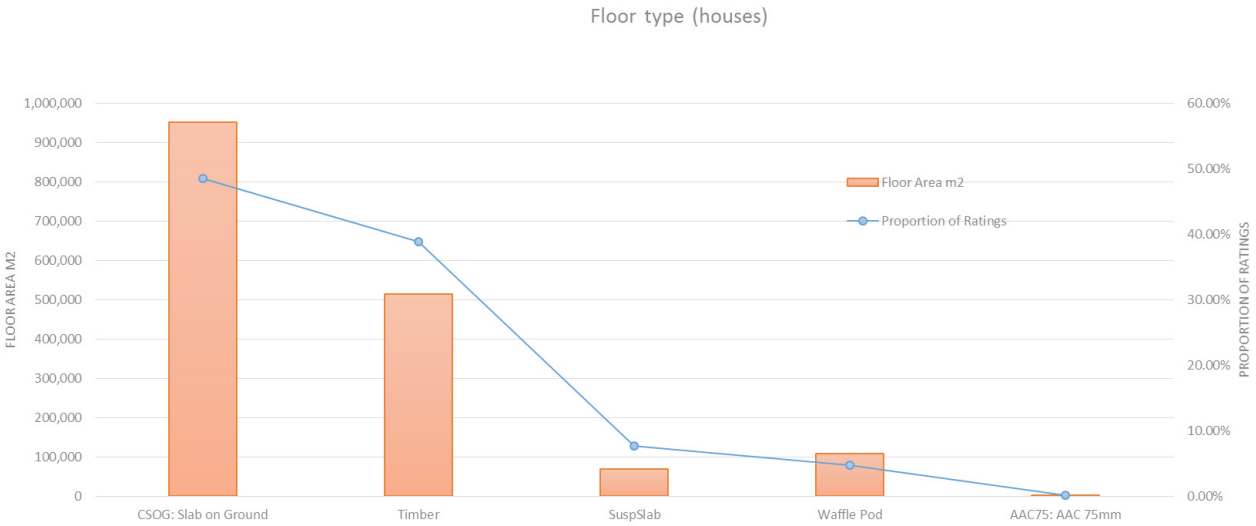


Figure 40: Floor types most commonly found in houses

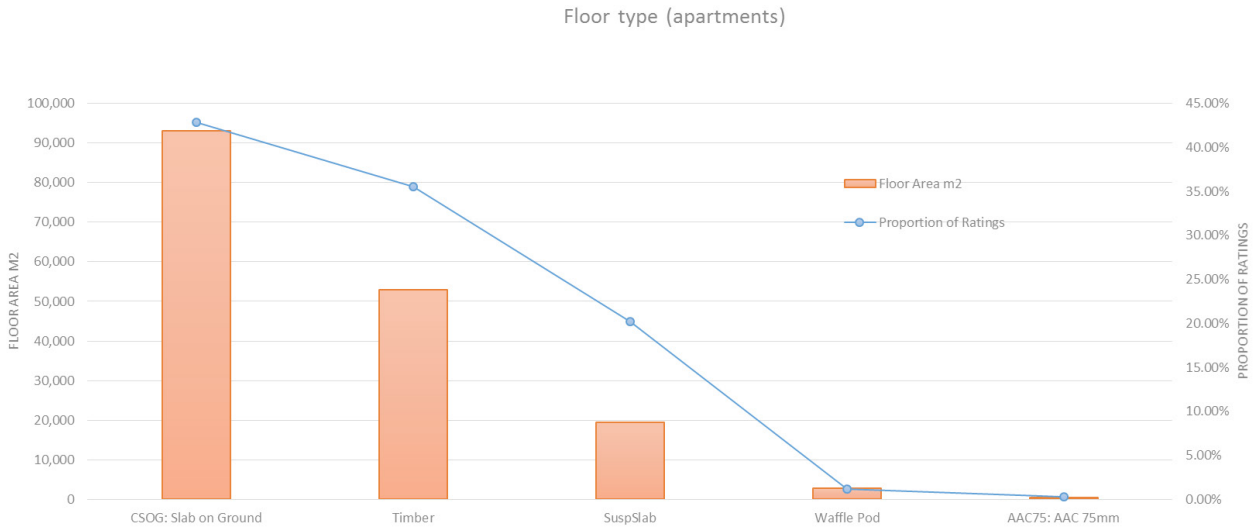


Figure 41: Floor types most commonly found in apartments

Building envelope

The following chart shows the level of use of different materials in wall construction.

FirstRate5 permits assessors to create custom wall constructions to match the building specifications. The custom wall is specified by multiple layers of known materials of specified thicknesses. For example, an uninsulated Brick Veneer wall might be 110mm of Brick, 130mm of Air, and 10mm of plasterboard, varying levels of insulation can be specified later.

FirstRate5 also includes a wall library of standard/common wall constructions, and assessors are able to use these standard walls and vary the level of insulation within this wall. In the case of the standard wall library the assessors are unable to modify the main construction elements.

In these reports walls from the standard library are represented by name, eg “Brick Veneer”. The reports do not name or distinguish the different custom walls used by assessors, partly because they are very numerous, and partly because the wall name does not always unambiguously describe the components. The custom wall names sometimes also include manufacturer and brand names. Some overlap may occur between custom walls and the other wall types.

Internal plasterboard stud walls are part of the standard wall library within FirstRate5, and is the default wall used for all normal internal walls. It is not typically used as an external wall, but it is used as a party wall between neighbours. These neighbour and party walls are counted as external walls in this report.

It should be noted that this data refers to the height and width of the wall only and do not take into account windows and doors. All windows must be placed within a wall even if that window might form most or all of the wall, as for example in curtain wall systems in high-rise apartment complexes. This leads to an over-reporting of wall type usage. In future versions of this report we expect to be able to adjust suitably for this issue, and wall type areas will more closely reflect what is seen in the building

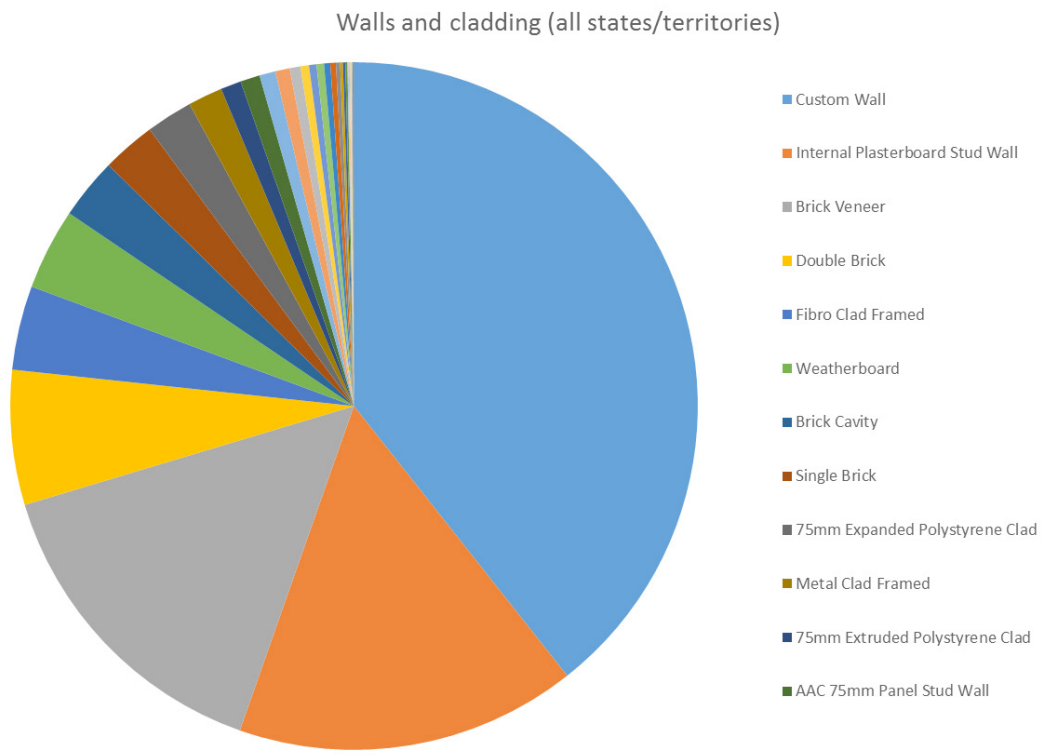


Figure 42: Walls and cladding materials

Heating and cooling loads

Analysis of heating and cooling loads shows that heating and cooling loads in new dwellings are significantly lower in new dwellings, when compared to existing dwellings.

As expected, the data shows the highest cooling loads in the hottest states (Northern Territory and Queensland), and the highest heating loads in the colder states (Tasmania, Victoria, ACT).

The table below shows average heating and cooling loads for new dwellings by state/territory.

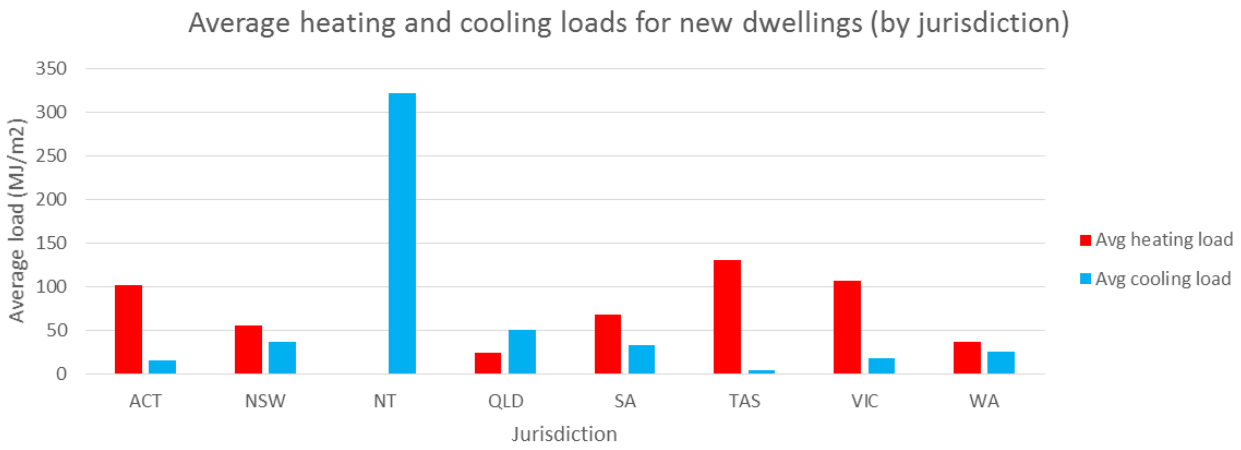


Figure 43: Average heating and cooling loads by jurisdiction (new homes only)

The table below shows average heating and cooling loads for existing dwellings. Note that no ratings have been undertaken on existing homes in the Northern Territory.

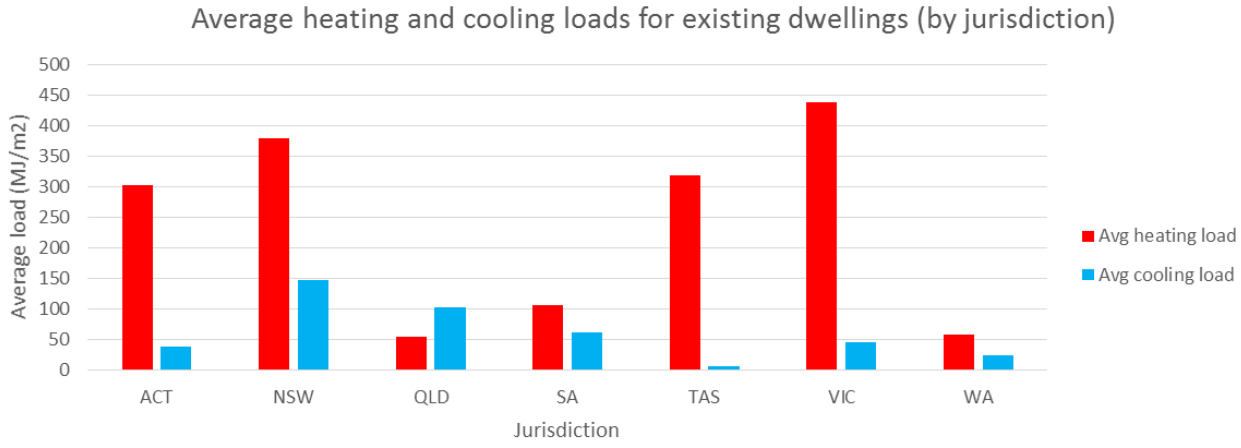


Figure 44: Average heating and cooling loads by jurisdiction (existing dwellings only)

Houses:

Floor areas of individual houses were plotted against their respective heating and cooling energy use and compared by jurisdictions. The following four graphs show the energy use in Tasmania, Victoria, South Australia and Queensland, and indicate similar heating and cooling loads in milder climates, and the dominance of heating loads in the colder jurisdictions.

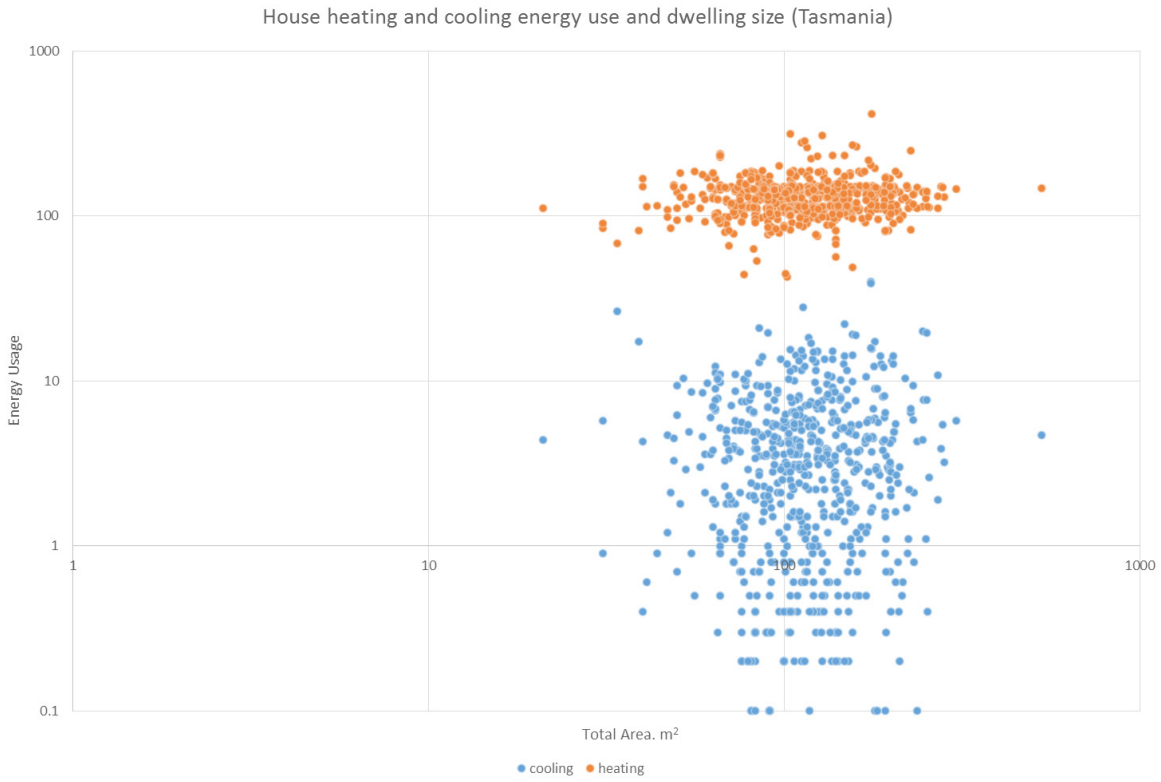


Figure 45: House heating and cooling loads (Tasmania)

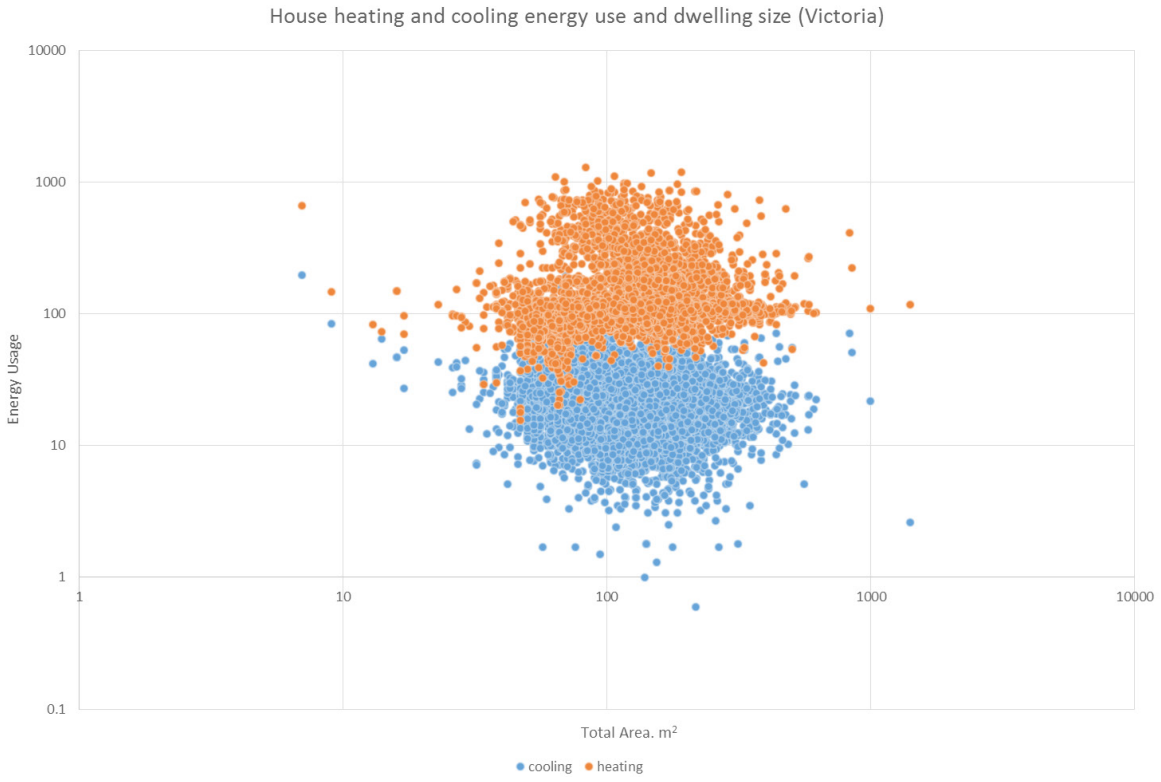


Figure 46: House heating and cooling loads (Victoria)

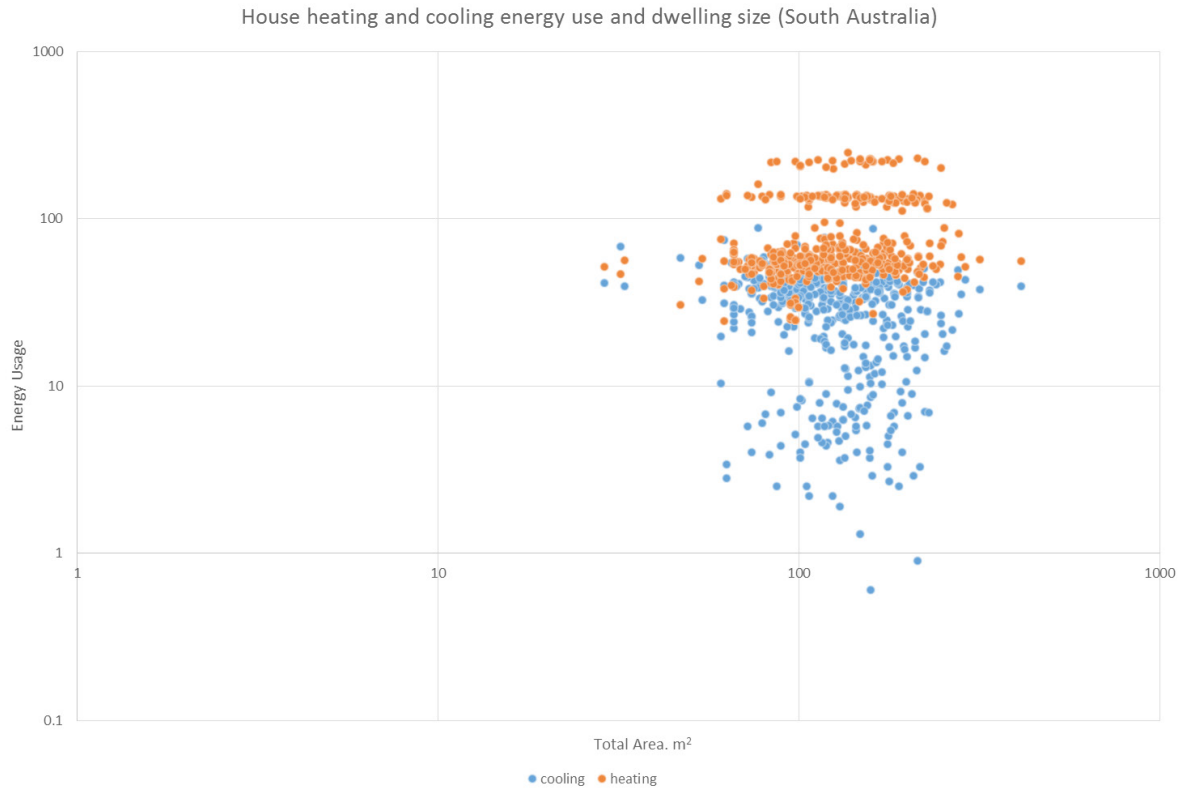


Figure 47: House heating and cooling loads (South Australia)

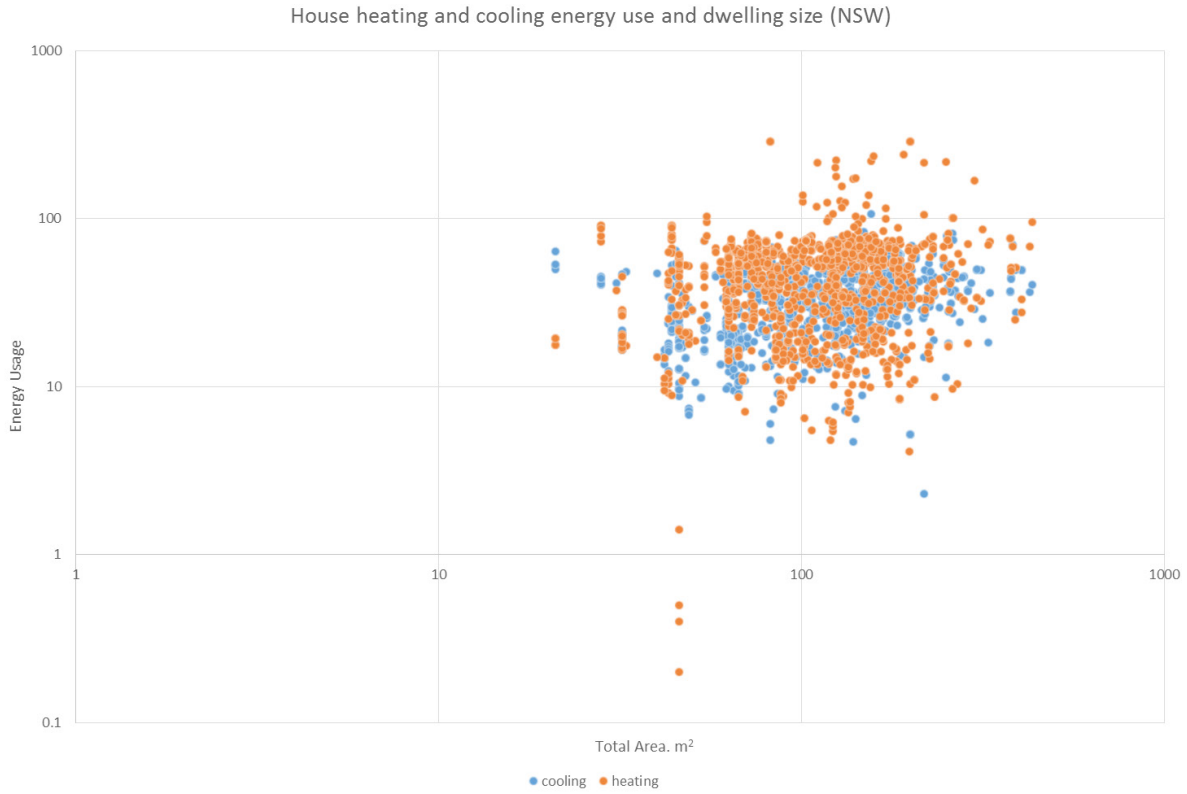


Figure 48: House heating and cooling loads (NSW)

Net conditioned floor area (NCFA)

The frequency of Net Conditioned Floor Area (as a percentage of total dwelling area) was graphed, and indicates the most common NCFA peak is at around 74%, followed by ratios around 90% and 100%. These peaks may represent the unconditioned space taken up by single and double garages and utility rooms.

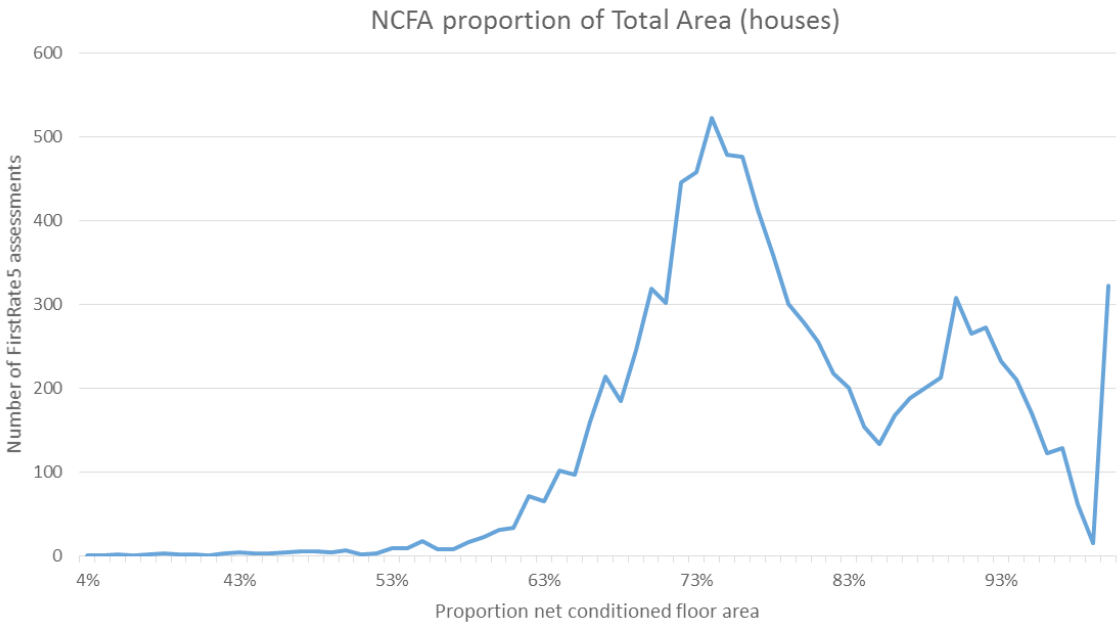


Figure 49: Net conditioned floor area (houses)

Data for apartments indicate that net conditioned floor area commonly ranges between 86% and 100% of total dwelling size.

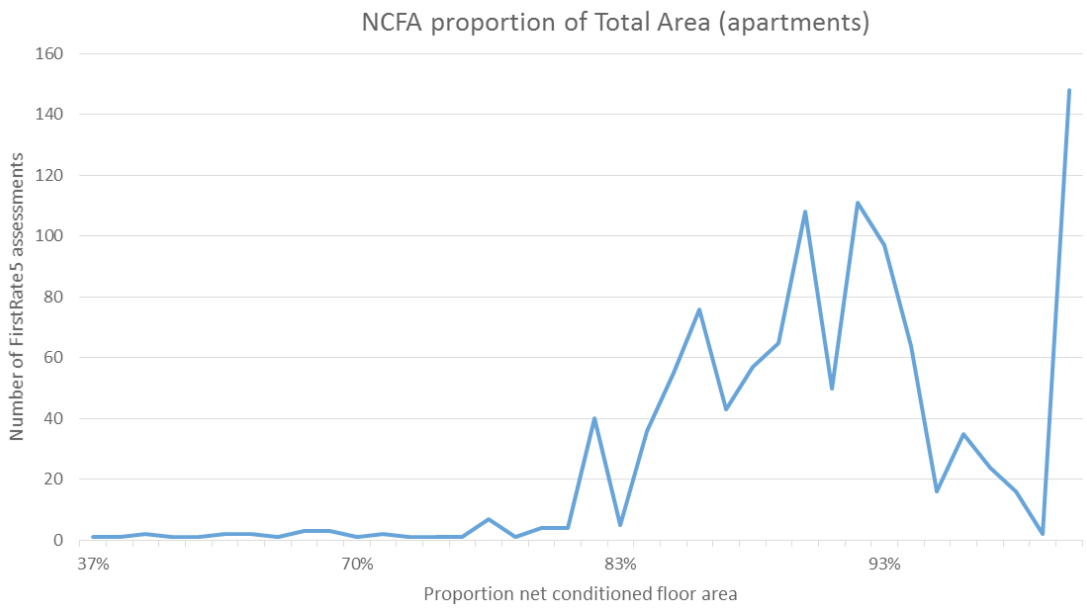
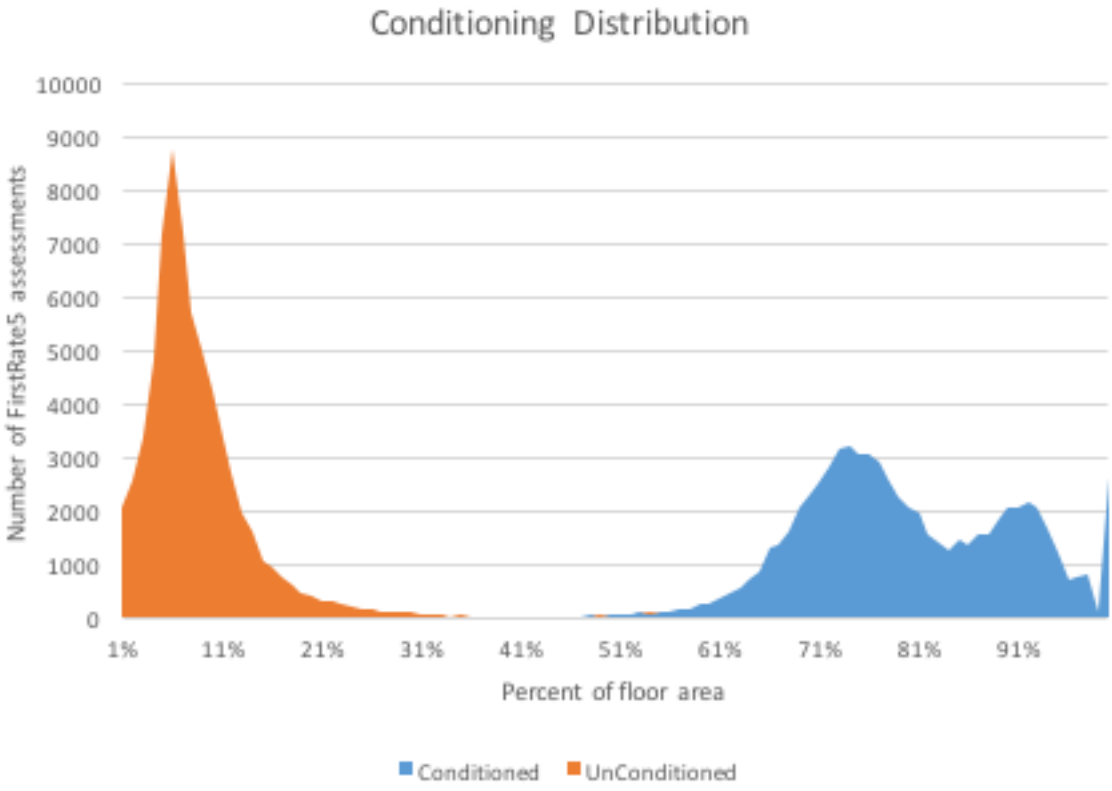


Figure 50: Net conditioned floor area (apartments)

The fraction of total floor area for conditioned and unconditioned areas was graphed below. The most common recording of un-conditioned floor area is 6%, which likely represents the proportion of total floor area that is taken up by garages.



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