Cost and Benefits of upgrading building fabric from 6 to 7 stars

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Executive Summary

Benefits and costs assessed from a householder perspective.

This report describes the costs and benefits of increasing ratings in Class 1 dwellings from 6 to 7 stars, and in Class 2 buildings from a 6-star average (with a minimum of 5 stars) to 7 average (with a minimum of 6-stars). Benefits were evaluated from a householder perspective rather than the Societal Cost perspective used in the Whole of Home report by EES. The EES report assesses benefit-cost ratios for all proposed building fabric, appliance, and PV requirements. A householder perspective was used for this report to provide detailed insight into how the proposed building fabric changes affect householders.

The benefit cost ratios used to evaluate the regulation in other reports uses a societal cost of energy. This concept is based on a time of use cost for energy to better reflect the impact of peak loads on the energy network and includes a $12 per tonne of GHG emissions consistent with the average cost of greenhouse abatement the government pays through other programs. In this report, householder energy savings are priced according to average flat-rate fuel tariffs which are more commonly used.

In addition to the Net Present Value of costs and benefits using a 7% real discount rate, as required by the Office of the Best Practice Regulator, two additional householder perspectives are presented to help explain householder impacts:

- Net cash flow. The difference between the increase in annual mortgage payments and annual energy savings which shows how householders are impacted from day 1. It is more useful than payback periods which imply householders must wait for several years to obtain a benefit.
- Alternative Investment. The cost of upgrading building fabric and the energy savings this produces is compared with the returns from other investment options for householders. A survey of long-term investment returns by the ASX was used to determine likely average long-term real investment returns. A real discount rate of 3% was used.

The CSIRO Australian Housing Data (AHD) portal is used to ensure that current 6-star solutions are representative of industry practice.

A sample of 10 Class 1 dwellings and a 24-unit 3 storey apartment building were used to establish the costs and benefits. Data was sourced from the AHD portal which contains the data from all NatHERS universal certificates generated since May 2016. This was used to ensure the 6-star solutions developed for this project were in line with the way that 6-stars is achieved in the field. The use of AHD portal data improves the accuracy of the predicted costs and benefits.

The Class 1 dwelling sample includes poorly-oriented dwellings and passive solar/well-ventilated dwellings, to define a range of costs and benefits.

The poorly-oriented dwellings have an even distribution of glazing on all sides were rated with their front door facing north. Windows in living areas – which have the highest energy demand – face the less favourable orientations of west, south and east. Upgrade costs for poorly-oriented buildings will be higher than for the passive solar/well ventilated dwellings which have the largest area of windows on more favourable orientations: north-facing living areas in cool and warm climates, south-facing living areas in hot climates. The four specialist dwellings are designed to promote cross-ventilation in order to minimise the need for artificial cooling on hot climates and uses passive solar gain to minimise heating loads in cool climates.

Evaluation of building fabric costs uses costs guides and a variety of industry sources.

Costs were developed from a range of sources including the Rawlinsons Cost Guide (2020), direct feedback from industry associations (AGWA and ICANZ), quotes from suppliers, and investigation of retail prices from at least three online sources for a variety of upgrades not covered by Rawlinsons or direct industry consultation.

The costs evaluated for this project in regional areas are based on the Rawlinsons building cost weighting for Regional areas. This weighting increases the prices of building in regional areas relative to in major urban areas.

Climate Zones include all capital cities and regional centres.

Costs and benefits were evaluated for all 8 NCC climate zones, including all capital cities, and for the same regional locations used for the 6-star RIS (ABCB, 2009). Melbourne and Sydney's metropolitan areas cover several climate zones. The climate zones used for this project were those with the highest construction volume for each building Class. Due to the significant difference in energy demand across NCC Climate Zone 1 (Hot humid), both Darwin and Cairns were evaluated. Table 2 shows the NatHERS climates used to represent the 8 NCC climate zones.

The increase in stringency to 7-stars is cost-effective in all climates except Brisbane and Sydney. Mildura and Adelaide are marginal but likely to be supported if those benefits not evaluated for this project are considered.,

The table below summarises the findings of this report for building fabric stringency increase:

Table 1 Summary of cost effectiveness for building fabric stringency increase

NCC Climate Zone	Population centre	State	Increase to 7-star cost-effectiveness	
			Class 1	Class 2
1	Darwin	NT	Yes	Yes
	Cairns	Qld	Yes	Yes
2	Brisbane	Qld	**No**	**No**
3	Longreach	Qld	Yes	Yes
4	Mildura	VIC/NSW	Yes, with non-costed benefits	Yes, with non-costed benefits
5	Adelaide	SA	Yes, with non-costed benefits	Yes, with non-costed benefits
	Sydney	NSW	**No**	Yes
	Perth	WA	Yes	Yes
6	Melbourne	Vic	Yes	Yes
7	Canberra	ACT	Yes	Yes
	Hobart	Tas	Yes	Yes
8	Thredbo*	NSW	Yes	Not evaluated*

** Class 2 in climate zone 8 was not evaluated because there is no record of any Class 2 dwellings in this climate zone in the AHD portal. Based on the evaluation of Class 2 costs and benefits in Climate Zone 7 which is a less severe cool climate, however, it is likely that 7-stars would be cost-effective for Class 2 dwellings in this climate.*

In some climates the benefits of increasing the building fabric rating to 7-stars exceed the costs as evaluated in this report. In those cases where the costs and benefits to the household were of a similar magnitude the

uncosted benefits would likely be sufficient to justify 7-stars (Mildura and Adelaide). In other climates, where the costs exceeded benefits in almost all cases, without detailed examination of uncosted benefits it was not possible to determine whether the net benefit would be positive (Sydney and Brisbane).

If the rating level is left at 6-stars in those climates where the cost effectiveness of 7-star building fabric is marginal, the potential energy savings delivered by NCC 2022 will be significantly lower. One way to maintain a higher but still cost-effective level of energy efficiency in these climates may be to allow limited trade-off between the building fabric and whole of home measures in these climates, e.g. in these climates building fabric at 6-stars is acceptable providing that additional Whole of Home measures (which are more cost effective) are implemented. If this approach is deemed acceptable, the DTS elemental provisions could be left at 7-stars so that those who wish to use the 6-star trade off would need to use NatHERS (or a Verification Method (VM)), rather than develop new elemental provisions for 6-stars which are consistent with the NatHERS 7-star provisions.

Even in those climates where the case for building fabric stringency increase is not strong, there may be a case to support higher stringency in all climates.

The proposed changes to NCC 2022 do not only increase the stringency of building fabric. They also include requirements which can improve the overall efficiency of heating, cooling, hot water, and pool pumps. And depending on the efficiency of appliances, the installation of renewable energy generation may be required, typically roof-top PV. Where the impact of all of these measures is positive, even if the cost effectiveness of increasing the stringency of the building fabric is marginal when measured on its own is not, it may nevertheless be acceptable to increase building fabric stringency in NCC 2022 because:

- The impact on householder cash flow is small: no worse than a cup of coffee a month in most cases,
- Where a rating offset of 1.0 stars (Climate Zones 1 and 2) is available for an outdoor living area, 6-stars is, in effect, the actual standard,
- Residential building fabric has a long-term impact on the energy network. The life of energy savings considered for this report is 40 years, but many dwellings may be in use for far longer. It may be better from a policy perspective to ensure that building fabric standard is increased now, even if the benefit-cost case is marginal.
- Not all benefits have been evaluated:
    - 7-star dwellings will have lower peak loads. The Bureau of Resource Economics (2014) has shown that the cumulative impact of energy efficiency improvements has affected peak loads. Because the proposed regulation includes improved efficiency for building fabric, appliances and PV, the impact on peak loads will be significant.
    - Lower peak loads also mean that the size of space conditioning equipment can be smaller. This reduction in appliance capacity will also reduce the cost of space conditioning appliances. To achieve the full extent of this benefit, however, industry practice for equipment sizing would need to better integrate NatHERS rating outcomes.
    - 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
    - The reduced energy demand from new homes including appliance and solar PV impacts may reduce the price of energy, and a number of projects evaluating energy efficiency programmes (including those in Australia e.g. the evaluation of 5-star building regulations in Victoria) have found they provide a stimulus to economic growth,
    - 7-star dwellings will provide greater resilience to climate change.

Whether these factors have sufficient weight to offset the negative benefit-cost impacts of the building fabric upgrade alone is a policy decision for Government.

Recent studies by CSIRO have shown that new houses have higher air leakage than assumed by NatHERS[1]. If this higher air leakage were considered and new elemental measures were developed to mitigate this higher air leakage, the benefit cost ratios found in this report would improve. Further development of air leakage reduction measures may find that 7-stars is justifiable in all climates.

The Trajectory project[2] did look at issues of peak load and space conditioning appliance size and found significant benefit. This information may be able to provide sufficient estimation of these benefits for the purposes of the RIS. The ability of consumers to achieve the capture the benefits of reduced appliance size, and therefore reduced cost, is limited by the ability of the appliance industry to reflect the performance characteristics of the dwelling. Development of an appropriate appliance sizing module in NatHERS tools would facilitate further cost savings for consumers. Development of such a module may involve preparation of a specific weather file which captures a fortnight of peak heating and cooling weather.

The cost of complying with DTS NatHERS varies depending on house design, and there may be one-off redesign costs

In the AHD portal, window areas in 7-star dwellings were found to be smaller than at 6-stars. In the first stage ratings, a window area reduction of half that shown in the AHD portal was applied. Ratings for this project were reviewed in light of predicted costs after the first stage rating. In some dwellings, the AHD observed reduction in window area resulted in a negative cost at 7-stars. In this case, window areas were increased to the original size and the house re-rated. In other dwellings improvement costs were found to be well above the average. This suggests that developing alternative designs with lower compliance costs may be needed at 7-stars. In some climates, specific design modifications were found to add far more cost than their rating benefit would justify, e.g., adding under-roof reflective insulation if it was not present at 6-stars in cooler climates, or R2.7 wall insulation. These features were therefore removed, and an alternative, cheaper rating solution was derived.

The typical dwellings in this study were deliberately sited on a non-optimal orientation with living areas facing south, east and west. A sample of specialist passive solar and well-ventilated designs with ideal window orientation was also evaluated. These specialist designs showed cost savings of between 25 and 50% compared to the typical houses.

Some of the typical dwellings had substantially higher costs to achieve 7-stars than the other typical dwellings of similar size and accommodation. This finding suggests that, in a highly competitive market, such dwellings designs would either be abandoned in favour of dwelling designs which were cheaper to upgrade or only used on lots where a more favourable orientation allows lower costs.

These findings suggest that the cost of applying the DTS NatHERS is not fixed. By better understanding how the rating works with the updated weather data, assessors and designers will be able to contain construction cost increases. While this is good news, it also implies that assessors and designers will need more time to optimise a design with the updated weather data and higher stringency levels than would routinely be done at 6-stars with the current weather data. This more involved design process will involve some one-off costs. It may suggest a more extended transition period for the introduction of 7-stars would be needed for the industry to adapt.

[1] Ambrose MD, James M, Law A, Osman P, White S (2013) The Evaluation of the 5-Star Energy Efficiency Standard for Residential Buildings. CSIRO, Australia

[2] *Trajectory for Low Energy Buildings*, Commonwealth of Australia 2018

Overview

This report evaluates the costs and benefits of increasing building fabric rating levels in Class 1 dwellings from 6 to 7 stars, and in Class 2 buildings from a 6 star average (with a minimum of 5 stars) to 7 average (with a minimum of 6 stars). It assesses these costs and benefits for 18 Class 1 dwellings (9 on a timber floor and 9 on a slab floor in each climate zone) and 24 Class 2 dwellings in 14 different NatHERS climate zones. This information will be used to help develop the Regulatory Impact Statement for the proposed changes to the NCC energy efficiency regulations in 2022.

Considerable effort has gone into ensuring the costs and benefits evaluated for the dwellings in this project will be as representative of the market response to the proposed increase to building fabric stringency as possible. There will be dwellings constructed in the field where the cost of achieving 7-stars will be higher or lower than the costs found in this report. In some cases, higher costs will be a result of design decisions which implicitly value other factors more than the benefits of an energy-efficient dwelling design. It is not clear whether such costs arising from personal preferences which are not cost-effective should be attributed to minimum regulatory requirements.

Climate Zones evaluated

This report shows the impacts of increasing NCC building fabric performance requirements to 7-stars for a variety of climate zones. The table below shows the NatHERS climate zones used and their corresponding NCC climate zone.

Table 2 Climate zones evaluated in this report

NCC Climate Zone	Population centre	State	NatHERS Climate Zone
Climate zone 1	Darwin	NT	1
Climate zone 1	Cairns	Qld	32
Climate zone 2	Brisbane	Qld	10
Climate zone 3	Longreach	Qld	3
Climate zone 4	Mildura	VIC/NSW	27
Climate zone 5	Adelaide	SA	16
Climate zone 5	Sydney	NSW	56 (Mascot)for Class 2, 28 (West Sydney) for Class 1
Climate zone 5	Perth	WA	13
Climate zone 6	Melbourne	Vic	60 (Tullamarine) for Class 1, 21 (Melbourne) for Class 2
Climate zone 7	Canberra	ACT	24
Climate zone 7	Hobart	Tas	26
Climate zone 8	Thredbo*	NSW	69 (Class 1 only)

** because there is no Class 2 construction shown in the CSIRO dashboards for Class 2 in Thredbo, the impacts of increasing rating performance to 7-stars was not evaluated.*

Climate zones were selected to include all capital cities and to provide consistency with previous regulatory impact statements for building fabric energy efficiency.

Where more than one NatHERS Climate Zone was available to represent a capital city, the climate zone with the highest construction volume shown in the CSIRO Australian Housing Data (AHD) portal

(https://ahd.csiro.au/dashboards/) was selected. The AHD portal collects data from NatHERS Universal Certificates.

Impact of changes to weather data

The version of NatHERS software that will be available for use in NCC 2022 uses new weather data. The weather data was updated to improve data quality and better represent the weather conditions in more recent times, rather than historical averages from the complete historical data record.

Adopting new weather data meant that new star bands had to be developed for the scheme. These new star bands were developed to ensure the average rating of dwellings at 6-stars was maintained. The 10-star rating level was also revised. Experience with 10-stars had shown that achieving 10-stars was not possible in all climate zones, even the highest building specification in climatically appropriate dwelling designs. 10-star energy loads were increased to ensure that 10-stars is achievable in all climates. This change to 10-stars flowed back through to the 7-to-9-star levels.

The change to the star bands associated with the new weather data has made 7-stars effectively easier to achieve to varying degrees across all NatHERS climate zones. The table below indicates the impact of the new star bands on 7-star stringency. It shows the average increase to ratings of current 7-star Class 1 and 2 dwellings.

Table 3 Average increase in the rating of 7-star houses with the updated weather data

NatHERS Climate Zone	NCC Climate Zone	Average Rating Change at 7-stars	
		Class 1	Class 2
1 Darwin	CZ01	0.52	0.44
32 Cairns	CZ01	0.17	0.20
10 Brisbane	CZ02	0.08	-0.20
3 Longreach	CZ03	0.31	-0.03
27 Mildura	CZ04	0.10	0.17
28 Richmond	CZ05	0.02	NA
56 Mascot	CZ05	NA	-0.03
13 Perth	CZ05	0.03	-0.03
16 Adelaide	CZ05	0.15	0.13
21 Melbourne	CZ06	NA	-0.01
60 Tullamarine	CZ06	0.12	NA
24 Canberra	CZ07	0.14	0.09
26 Hobart	CZ07	0.13	0.04
69 Thredbo	CZ08	0.44	0.27

The updated weather and star bands in NatHERS mean that the extent of building performance improvement delivered by an increase to 7-star stringency will be, on average, slightly less than would have occurred if the weather data had remained the same. The impact of the change will be to reduce both the average energy savings and the cost of upgrades compared to seven stars with the current weather data. Because the weather data is a more accurate representation of climatic conditions, energy-saving predictions will be more robust.

Section 12 shows changes to individual dwelling ratings at 7-stars in the 14 climate zones included in this project.

Dwelling selection

The plans and rating files used in this project were provided to the ABCB by the NatHERS Administrator. These dwellings had been used to assist the NatHERS Administrator to recalibrate NatHERS star bands for the updated weather data. The NatHERS project produced versions of each dwelling at 5-, 6-- and 7-stars in each of the climates used for this project. Their use saved considerable time and resources.

Class 1

In each climate zone, 9 Class 1 dwellings are evaluated. These dwellings are rated with both a timber floor suspended over an enclosed subfloor space and a slab on ground or waffle pod slab floor. Each dwelling was selected to represent specific market segments in terms of size, number of stories and whether they were detached or semi-detached.

Four Class 1 dwellings which were designed to suit specific climates were also included in the dwelling sample. The three dwellings most suited to each climate were assessed. These dwellings are referred to as specialist designs.

The non-specialist designs were rated with the front door facing the street. Because these dwellings are designed to have living areas with connection to the backyard, this means that living areas mainly had east, south, and west facing glazing. Orienting these dwellings with living areas to the north would significantly improve their rating and reduce the cost of achieving 7-stars.

By assessing a sample of dwellings with non-optimum orientation and a selection of climatically appropriate designs on their best orientation, an upper and lower bound to the cost of achieving 7-stars is defined. It demonstrates the extent of the reduction in construction costs that are available through better design.

The plans of the dwellings used for this project are shown in Section 11 Appendix 2: Dwelling Plans.

The dwellings selected contain the same level of accommodation that one would find in houses of their size which are constructed today. For example, the largest two-storey house has four bedrooms, three living areas, two bathrooms and a double car garage, while the smallest house has one living area, three bedrooms, two bathrooms and a single car garage.

This project used data from the AHD portal to ensure that the base 6-star versions of the dwellings represented the current market response to achieving compliance. This approach helps to ensure that the predicted costs of upgrading from 6- to 7-stars are realistic. Not all AHD portal data on construction is available at the NatHERS climate zone level. Where this was not available, a combination of jurisdiction-based and NCC Climate Zone-based information was used.

The AHD portal data assisted the development of the 6-star dwellings by helping to define:

- Most common wall, window frame, floor, and roof constructions,
- Typical insulation levels for all elements including roofs, ceilings, walls and floors,
- Colours of walls and roofs,
- The extent of hard floor surface covering,
- Average window to floor area ratios and the distribution of window areas across orientations,
- Typical window U and SHGC values, and
- The number of ceiling fans used in each NCC climate zone.

Information on insulation levels and window size were also available by star rating, so this also provided some guidance on how the industry had responded to achieving 7-stars. 7-star dwellings were found to have a lower window to floor area ratio on average than 6-star dwellings.

While the dwellings used may not look like the latest houses on offer from builders, in terms of modelling energy savings and upgrade costs it is not the appearance that matters, but the set of geometric and thermal properties of the dwelling that affect the accuracy of these predictions.

Class 2

The range of built form for Class 2 dwellings is much greater than for Class 1 dwellings. They can encompass anything from a small two-unit infill site in a suburban location area to a 30-storey apartment building in the CBD. Class 2 dwellings on upper floors of an apartment building are exposed to much higher wind speeds which can make energy performance worse in cold climates and better in hot climates. The openability of windows may be restricted to comply with safety regulations which may limit the extent of cross ventilation available. Favourably oriented north-facing windows may be covered by screens or use obscure glass to maintain privacy for other dwellings, and this can limit the benefits of good window orientation. It is difficult to adequately capture the full extent of the range of built forms of Class 2 construction in a sufficiently small sample to facilitate analysis within the timeframe needed to develop new regulations.

The apartment building selected for analysis in this project is the same as that was assessed for the 6-star RIS.[3] Using this apartment building provides a level of continuity and comparability with previous regulatory benefit-cost evaluation. It is also a building with 'a little bit of everything'. It contains:

- Three levels each with eight apartments around a central common services core,
- a lower level above a car park, a middle level with shared floors and ceilings and a roof level,
- apartments with only one major façade orientation facing north, east, west and south,
- apartments with two main facades with a variety of orientation combinations, and
- two-bedroom apartments at around the average size of Class 2 dwellings across Australia.

This diversity means that it is an excellent building to use to develop benefits and cost for Class 2 dwellings.

The AHD portal allows data to be disaggregated by building Class. This data enabled customisation of the units in the apartment building to reflect the current market response to minimum building fabric regulations in each climate in a similar fashion to the way this data was used for Class 1 dwellings.

[3] ABCB (Australian Building Codes Board) (2009). *Consultation Regulation Impact Statement: proposal to revise the energy efficiency requirements of the Building Code of Australia for residential buildings – classes 1, 2, 4 and 10*, Consultation RIS 2009-03, ABCB , Canberra.

Optimisation to 7-stars

The techniques used to develop 7-star solutions were generally those which are used by assessors in the field today.

Limits to insulation levels used in walls, floors and ceilings were developed: R2.7 in walls, R6.0 in attic roofs and R5.0 in flat roofs, R4.0 in suspended timber floors and waffle pods for slab floors. Beyond these limits, more expensive insulation types would be needed to fit the insulation within conventional construction, which would not be cost-effective.

A standard palette of glazing types was used:

- single clear,
- single tinted,
- single tinted with a heavy tint,
- single low e coated, high solar heat gain,
- single low e coated, low solar heat gain,
- double clear low e coated argon filled (high solar heat gain).

All windows used in the NatHERS ratings were taken from high volume manufacturers with a sufficient range of window types in NatHERS software to cover the various combinations of glazing types and window openability needed. Window frames were all assumed to be aluminium without a thermal break based on AHD portal information. One manufacturer was used for Class 1 and another for Class 2. Neither manufacturer's products were 'high end' products.

Some less frequently used techniques to achieve 7-stars were also applied selectively if more conventional strategies were exhausted:

- **The colour of the window frame** can add as much as 0.2 stars and is a simple, no-cost improvement. Colour affects the amount of solar radiation an external surface can absorb. The AHD portal generally shows that, on average, industry uses wall and roof colours which work best in each climate, e.g. lighter colours in warmer climates, darker colours in colder climates and medium in mixed climates. BERSPro and FirstRate have recently expanded solar absorptance choices for windows frames to allow more window frame options to be modelled. Modifying window frame colour to achieve 7-stars simply extends the current market response to climate seen in walls and roofs to window frames. While the selection of the colour of window frames is an aesthetic consideration, colour selection also has an energy efficiency cost or benefit.
- **Insulation of subfloor walls**. This strategy is not a commonly used technique in Australia. It is not as effective as insulating floors in cold climates and so was not applied in these climates. Floor insulation can be problematic in warm and hot climates because it will increase cooling requirements. In warm and hot climates, subfloor wall insulation reduces both heating and cooling. It can add as much as 0.2 stars, the area of subfloor wall is small, so the cost is reasonable, and installation is straightforward. Subfloor wall insulation must resist moisture and must be trimmed around subfloor ventilation openings. Insulation R-values above R1.0 were not used.

Increased eaves depth was not used due to the high cost and potential negative impact on heating loads. External blinds were also not used due to their high cost.

The AHD portal showed that the average window to floor area ratio in 7-star dwellings was lower than in 6-star dwellings. On average across Australia, 7-star dwellings have around 15% smaller windows as a proportion of floor area. Reducing window area may be a response to contain overall glazing costs because a greater proportion of windows will need to be high-performance in a 7-star dwelling. It is not clear that the market response to a minimum regulation would be the same as in a voluntary market so, in initial ratings, only 60% of the observed window area reduction was implemented.

In the field, energy ratings are subject to review and revision by the client before the rating is finalised. A similar process was used in this project. After the initial rating, the costs of achieving 7-stars were reviewed. Some rating strategies were found to be too expensive, e.g.

- the incremental cost of R2.7 wall insulation is high and the marginal benefit small,
- adding reflective insulation roof insulation in cold climates, if it was not already present at 6-stars, was similarly expensive for marginal benefit.

In these cases, the rating was revised to eliminate high-cost techniques.

The observed trend to use lower window areas at 7-stars would be a rational response to higher window costs, if higher performance windows are needed to achieve this rating. However, higher performance windows were not always needed to achieve 7-stars. In this case, the rating review found that the reduction in window area sometimes led to a negative or very low incremental cost to move from 6- to 7-stars. Where very low incremental costs were found due to window area reduction, there is clearly no economic shock associated with the increase to 7-stars. In these dwellings, the window area was therefore restored to the same as 6-stars, and the dwelling optimisation to 7-stars was repeated.

Class 2

There are a variety of different ways to meet the current minimum 5-star, average 6-star requirements of NCC 2019. In larger apartment buildings, the construction process advantages of using the same size windows and types of glazing in every apartment may outweigh the additional cost of an average window performance rating above the minimum required. This rating technique can be called a homogenous approach, i.e. windows in all units have the same properties. In smaller developments, individual apartments may be customised to achieve minimum compliance without using the same window areas in all apartments. This rating technique can be characterised as a heterogeneous, i.e. units have different properties.

The table below shows that there is significant over-compliance reported in Class 2 by the AHD portals.

Table 4 Average Ratings in different NCC climate zones reported in the AHD portal

NCC Climate Zone	*State*	*Number of ratings*	*Average Rating since May 2016 (last 12 months)*	*Comment on stringency applied by jurisdiction*
01	NT, WA, QLD	379	7 (7.1)	NT only requires a minimum of 3.5 stars, QLD outdoor living area allowance
02	QLD, NSW	13,743	6.2 (6.1)	QLD allowance for outdoor living area sets a minimum of 5-stars, BASIX in NSW
03	NT, WA, QLD	22	6.4 (6.2)	(concessions as above available)
04	NSW, VIC, SA, WA	494	6.8 (6.9)	NSW: BASIX caps apply in parts of this zone, which deliver a similar average (in more recent times) but allow lower minimums.
05	NSW, SA, WA, QLD	141,048	6.1 (6.3)	BASIX caps apply in parts of this zone. QLD: outdoor living area allowance also applies in some parts
06	VIC, NSW, SA, WA	83,657	6.6 (7.0)	VIC: BESS planning requirements adopted by some councils require 6.5 average
07	VIC, NSW, TAS	2,839	7.0 (7.0)	Generally NCC minimums only, a small number of dwellings may be affected by BESS (VIC) and BASIX (NSW)
08	TAS, VIC, NSW	No Data	-	-

Some care should be taken with interpreting the data in the table above because:

- it may not include work undertaken by non-accredited assessors,
- it may not include buildings where a Verification Method has been used, and
- it will include ratings done for a planning permit, and the final construction rating may be different.

The task for this project is to identify the benefits and costs of increasing building fabric requirements from the current NCC minimum to the proposed minimum in 2022. Some allowance will need to be included in the RIS for the trend to over-compliance observed in the AHD portal. This level of over-compliance also makes the optimisation process more complicated. The industry preferred method of keeping window areas and type uniform across all units in a building often leads to over-compliance because the window sizes and types that achieve minimum compliance on the worst orientation will lead to significantly higher ratings on the best orientation. An alternative approach has been taken to facilitate the evaluation of compliance with minimums. Rather than use the homogenous approach, a heterogeneous approach was used.

The homogenous approach means that all windows to all units will be the same size and type regardless of orientation. This approach is not consistent with the principles of good energy-efficient design. The design of a dwelling needs to respond to the impacts of the different solar exposure of different orientations. For example, a passive solar Class 1 dwelling oriented to the west would require significant modification to achieve minimum compliance. The application of the homogenous approach in Class 2 is only made possible by the averaging allowed by the NCC, where in order to achieve the average rating a range of, typically +/- 1 star are permitted.

The NatHERS Star Bands update project provided this project with 5-, 6- and 7-star versions of each Class 2 apartment. These 5-, 6- and 7-star rated apartments were combined in a way that just complies with the minimum 5-, average 6-star NCC 2019 requirements:

- Those apartments which required the most significant change to design and specification to increase the rating from 5- to 6-stars were left at 5-stars for 2019 compliance.
- Those apartments which required the least change to increase their rating to 7-stars were selected to achieve a 7-star rating. Note even with no improvements at all, some apartments easily exceeded 7-stars, e.g. north-facing apartments with one exposed façade in Melbourne.
- The rating achieved by the remaining apartments were adjusted until the average of 6-stars was just achieved.

The units were re-rated using the new weather data, and the process was repeated for the new stringency level of 6-stars minimum and 7-stars average. In some cases, the rating of the worst apartments dropped below 6-stars with the new weather data. These apartments were re-optimised to achieve 6-stars. In other cases, the apartment ratings increased with the new weather data, and it was difficult to contain the building to an average rating as low as 7-stars. In this case, some units were de-specified to enable the 7-star average to be achieved.

The final minimally-compliant building will be much more heterogeneous that is likely to be found in the field today. Window areas and thermal properties can vary significantly across the building. Some units may not require wall insulation, while others will. Some aspects of a more homogenous approach were applied. If floor insulation to the basement was needed in some units, it was generally applied to all units. The same level of roof insulation was generally used to all units on the top floor.

The net result of the heterogeneous approach is that the cost of building fabric improvements will be higher in some units and lower in others than found in individual buildings in the field. Across the whole building, this variation in individual unit upgrade costs should average out to reflect the cost of a more homogenous, but still minimally-compliant case.

Costing building fabric upgrades

A comprehensive schedule of unit costs for energy efficiency improvements was developed for this project. The schedule of unit costs is shown in 10 Appendix 1 Unit Costs.

The schedule was developed from multiple sources:

- Rawlinsons Construction Cost Guide 2020.

  Rawlinsons provided critical data on the variation of costs across the climate zones studied, such as:

  - the base cost of wall constructions (used when window areas were reduced),
  - the cost of different insulation and glazing systems, as well as
  - prices of other items such as ceiling fans and floor coverings.

  This data formed a baseline against which other cost research could be compared. A phone meeting was held with the editor or Rawlinsons to discuss their methodology for establishing costs. It was acknowledged that lower prices were available in the field, particularly for large supply contracts.

- The Australian Glass and Window Association (AGWA)

  Rawlinsons data did not include a sufficient range of glazing types to cost all the options which were evaluated. AGWA arranged quotes on the supply and installation for full range of window products used in the optimisation process from two window manufacturers for the 9 Class 1 dwellings and two standard unit plans in the Class 2 apartment building. The basis of the quotes requested was that they should not be priced for a one-off job, but should also not be at the level supplied to high-volume customers. Quotes for the supply and installation of higher-performance glazing showed significantly lower cost differential to single clear glazing than found in Rawlinsons, particularly for Class 1 dwellings.

- Insulation Council of Australia and New Zealand (ICANZ)

  Retail prices for a wide range of insulation products were obtained from several web sites: Bunnings, Pricewise Insulation, and Insulation Depot. These three sources showed very similar prices. ICANZ provided advice on how these retail prices would compare to supply and install prices in the industry, e.g. the extent of trade discounts available and the labour proportion of typical supply and install contracts. Even with an allowance for profit and overheads, insulation costs were generally lower than those found in Rawlinsons.

- A variety of other sources were used to check retail prices against those in Rawlinsons for various items including:
  - Floors coverings: hard floor surfaces can improve ratings but are generally more expensive than carpet. This research confirmed the differential price between carpet and ceramic tile floors, and
  - ceiling fans: larger diameter ceiling provide a significant improvement to the NatHERS rating. While the price differential for larger diameter fans appeared low in Rawlinsons, a variety of web sites like Bunnings, Beacon Lighting and Ceiling Fans Direct confirmed that the marginal cost of larger diameter fans was small.

Estimating annual energy bill savings for households

The Whole of Home evaluation undertaken by Energy Efficient Strategies (EES) includes the cost of building fabric upgrade. This evaluation used the societal cost of energy which is similar to the cost of energy for consumers who use a time of use tariff, plus a small allowance for the cost of greenhouse gas emissions. Time of use tariffs better reflect the cost of providing energy at different times to the energy sector. Time of use tariffs also offers opportunities to the consumer to contain some costs by using energy at different times when costs are lower, e.g. running dishwashers or clothes driers later in the evening.

Despite the energy industry's preference for time of use tariffs, most households use flat-rate energy tariffs. There is an extensive range of tariffs available to consumers with various discount arrangements for on-time payment. A survey of energy tariffs across Australia by EES undertaken in 2020 for this project established average flat-rate energy tariffs for each jurisdiction. These energy tariffs have been used in this report. Daily connection costs have been excluded.

While the NatHERS assumed occupancy is perfectly suitable for the establishment of a building fabric efficiency rating, translating star ratings to energy bills is a complicated process. Developing energy bill savings requires:

- the use of average hours of occupancy and thermostat settings,
- assumptions about the average efficiency of the various space conditioning appliances that are used by households,
- statistical information about the market penetration of the different kinds of space conditioning appliances used by households including the use of multiple space conditioning appliances, and
- consideration of the area of each house that can be heated or cooled by each appliance.

Hours of Use and thermostat settings

The energy bill savings use a different occupancy pattern to the standard NatHERS occupancy:

- The cooling thermostat is set to the air-conditioned thermal neutrality rather than the free-running (i.e. without air conditioning) thermal neutrality temperature used in NatHERS. In air-conditioned houses, adaptive comfort principles show that free-running thermal neutrality is a higher temperature than air-conditioned thermal neutrality. In Darwin, for example, this means using a thermostat temperature of 25 instead of 26.5.
- The hours of occupancy are changed to represent the average household occupancy found in ABS studies[4]. An all-day occupancy pattern (16 hours per day) and a working-day occupancy pattern (8 hours per day) are used. The energy savings for each are weighted to give an average occupancy: 60% all day and 40% working day. No parts of the house are heated overnight, but bedrooms are assumed to be cooled overnight in each occupancy pattern.

Appliance Efficiency

- Energy bill savings are shown for the most common space conditioning appliances used in the climate zone. Appliance efficiencies for reverse cycle systems are assumed to be of an average value based on the reported star ratings from the E3 program, as shown in the CSIRO dashboards (https://ahd.csiro.au/dashboards/fixtures-and-appliances/air-conditioning/). Ducted reverse cycle systems have a larger capacity, and the efficiency of higher capacity systems is lower than smaller capacity systems. Ducted systems also have heat gains/losses through the ducts. It is assumed that ducts which comply with current regulations will reduce overall system efficiency by 15%.

[4] *How Australians use their time* (Time Use Survey) ABS4153.

Area of the house heated and cooled

- Depending on the number and type of appliances installed to provide space-conditioning, not all of the dwelling may have access to space conditioning. Energy bill savings are therefore provided for living and bedroom conditioning and living area only to allow industry-wide impacts to be calculated based on the extent of appliance penetration.
- Energy bill savings are presented for the two or three most common space conditioning appliances used in each climate zone.

Benefits which are not reflected in annual energy bills

- If habitable rooms in dwellings do not have space conditioning available, upgrading to 7 stars will not produce energy savings in these rooms. The improved performance of these rooms still has a value in terms of the additional comfort this upgrade provides and the associated improvements to health and well-being. For example, in the case of house SBH04 in Darwin, cooling the whole home using split system air conditioners shows an energy bill saving benefit of around $100, while cooling only the living area reduces this benefit to roughly $63. From a variety of perspectives, the additional comfort provided in bedrooms by the upgrade could be valued at more than the $37 energy bill difference, e.g. this is less than the cost of one visit to the doctor a year. The predicted energy bill savings for space-conditioning the whole house may, therefore, be a suitable proxy for the other more difficult to quantify benefits.
- Energy bill savings do not represent all of the benefits of the increase in the rating from 6 to 7 stars. The capacity of space conditioning systems in 7-star dwellings need not be as large as those in 6-star dwellings due to the lower heat flows. This reduction in appliance capacity can potentially reduce both the capital cost of the space conditioning equipment and reduce peak loads on the energy network. This project has not evaluated either of these critical benefits. Further evaluation of these benefits would improve the Net Present Values of achieving 7-stars shown in this report.
- Even where a fixed appliance is not available to provide space conditioning, in cooler climates, there may still be some heating of these spaces with plug-in heaters. Plug-in heaters use high-cost day/peak rate electricity and may not have thermostatic control resulting in significant costs.

Appliance Penetration

Heaters

The analysis of benefits and costs of building fabric improvement is presented for the three heater types with the highest penetration in each climate zone. The table below shows heater penetration in each jurisdiction.

Table 5 Installation of various types of heaters in different jurisdictions showing the most common options used

Type of heater	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
Mains Gas non-ducted	23.2%	19.2%	1.3%	16.2%	21.8%	1.4%	0.2%	8.5%
LPG Gas non-ducted	2.5%	1.0%	0.6%	1.9%	0.7%	1.6%	3.8%	0.0%
Mains Gas ducted	2.2%	37.6%	0.1%	2.9%	1.4%	2.0%	0.0%	28.5%
Resistive Electric	6.8%	6.1%	7.1%	4.1%	2.6%	10.9%	4.0%	5.3%
Reverse Cycle AC non-ducted	31.4%	18.3%	36.8%	42.1%	35.6%	51.4%	5.7%	42.6%
Reverse Cycle AC ducted	6.9%	3.2%	3.2%	11.9%	4.9%	5.7%	0.3%	10.6%
Wood Closed Combustion	10.7%	11.4%	5.1%	14.9%	9.8%	25.7%	1.0%	3.5%
Wood Open Fires	0.3%	0.1%	0.9%	0.2%	0.2%	0.3%	0.0%	0.0%
No Main Space Heating/Other	16.0%	3.0%	45.0%	6.0%	23.0%	1.0%	85.0%	1.0%

Where ‘no heating’ has a high share, the case for whole-house heating assumes electric resistive heating in bedrooms, e.g. 45% of dwellings in Queensland have no installed fixed heater.

The penetration of heater ownership is slightly different outside of capital cities. BIS Shrapnel survey data showed that wood-fired heating is much more prevalent in country areas of Tasmania, South Australia and Victoria than it is in capital cities.

Air conditioners

The analysis of benefits and costs of building fabric improvement is presented for the two air conditioner types with the highest penetration in each climate zone. The table below shows air-conditioner penetration in each jurisdiction.

Table 6 Installation of various types of coolers in different jurisdictions showing the most common options used

Type of Cooler	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
Evaporative cooling	5.1%	23.2%	1.5%	23.7%	21.5%	0.8%	6.8%	14.6%
Ducted Reverse Cycle	11.5%	8.8%	4.5%	20.9%	10.3%	6.7%	1.0%	13.1%
Ducted Cooling Only	0.6%	1.2%	1.5%	1.8%	2.2%	0.0%	1.9%	1.3%
Non-ducted Reverse Cycle	42.0%	41.6%	58.9%	41.0%	48.8%	47.7%	52.9%	36.6%
Non-ducted Cooling Only	4.7%	5.2%	8.2%	3.6%	3.2%	0.7%	34.4%	7.3%
None/other	36.0%	20.0%	25.5%	9.0%	14.0%	44.0%	3.0%	27.0%

The penetration of air conditioning ownership is slightly different outside of capital cities. BIS Shrapnel survey data was showed that cooling is has a significantly higher market penetration in the regional areas of Western Australia, South Australia and the Northern Territory than in capital cities.

Appliance Efficiency

The appliance efficiencies shown in the table below were assumed to calculate the cost savings due to the improvement in building fabric. The appliance efficiencies are based on estimates shown in the Whole of Home Annex document prepared for this project by EES. Data for the average efficiency of reverse cycle systems were taken from the AHD portal, and gas appliances were assumed to be 5-stars. The wood heating efficiency is typical of closed combustion systems assuming appropriate maintenance. The efficiency of electric plug-in resistive systems takes into account the lack of thermostatic control for these heaters which results in some overheating.

Table 7 Assumed Space Conditioning appliance efficiencies used in this report

Appliance Type	Average efficiency
Reverse Cycle AC non-ducted Cooling	3.70
Reverse Cycle AC ducted Cooling (includes duct losses)	2.70
Reverse Cycle AC non-ducted Heating	3.70
Reverse Cycle AC ducted Heating (includes duct losses)	2.70
Evaporative Cool	10.0
Gas Ducted heating (includes duct losses)	0.65
Gas Space heating	0.75
LPG Space heating	0.75
Resistive Electric heating (plugin/off peak)	0.90/1.0
Wood closed combustion	0.60

Fuel Costs

The fuel costs were assumed to be an average value for each fuel, and flat-rate tariffs were used. The data comes from a survey of fuel prices by EES for this project.

Table 8 Assumed average fuel tariffs assumed in this report

EES 2020 Survey Average price	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
Electricity Flat-rate	27.66	26.48	23.11	36.18	28.82	21.25	26.05	24.05
Electricity off peak	12.99	19.27	15.63	19.79	11.84	13.29	26.05	14.62
Solar Feed in	9	12	10	11	7	9.5	26	9
Gas	3.4	2.4	4.9	4.2	4	3.7	3.7	3.6
LPG	4.8	4.5	5.4	5.8	5.8	5.3	4.8	5.5
Firewood ($300 / tonne)	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85

Balancing costs and benefits for households

The evaluation of recurrent benefits against initial costs is assessed by comparing the Present Value (PV) of recurrent benefits against the initial cost to derive a Net Present Value (NPV). The PV discounts the value of future benefits.

The Office of Best Practice Regulation ensures all major decisions of Government are supported by the best possible evidence and analysis. Accordingly, it has set the discount rate for the study of energy-efficiency regulations for NCC 2022 to 7% real, i.e. over the rate of inflation. A 7% discount rate means that the future value of 40 years of energy savings is worth around 13 years of savings at today's value. NPV allows the costs and benefits of this policy to be compared directly with other policies.

The way in which households experience the benefits and costs of improving building fabric performance from 6 to 7-stars can be evaluated in a variety of ways. Providing further analysis from the householder perspective provides important additional information to help inform policy decisions. After all, it is not the Government who is paying for the higher efficiency standard, it is the household. If an increase in building standards is to be implemented, it will be important that householders can see that they benefit. How the policy affects households is also important to the building industry. They want to make sure that their clients will derive benefit from the policy.

Two further ways of evaluating costs and benefits are therefore reported:

The impact on householder cash flow.

This compares the annual energy savings delivered by the improved building fabric with the yearly increase in mortgage payments (at 4% interest rate) needed to construct a dwelling to this standard. Cash flow is far more relevant to households than NPV. If the improvement to building fabric means that households have more money in their pocket from day 1, then households are more likely to feel comfortable about the policy change.

Cash flow is also far more relevant than payback periods. A long payback period sounds like the household will need to wait many years to derive a benefit, and the household may have sold the house before the payback period is finished. If cash flow is improved, then benefits accrue from Day 1.

Alternative investment

Households will also want to see whether they would have been better off using the money spent to improve building performance in other ways. To assist householders to better understand the benefits/disbenefits of improved building fabric, this project compared the annual energy bill savings with the return from an alternative investment. For example, will a household make more money by investing the money that would have spent on upgrading from 6 to 7 stars on, for example, the stock market?

Russell Investments & the ASX[5] evaluated long term investment returns from a variety of investments. This report showed that a variety of asset classes had earned from 2.1% (cash) to 6.3% (Australian shares) above the inflation rate before tax (excluding investment property returns). After-tax, this reduced to a return of between -0.1% and 3.5%. The return depends on the tax rate of the individual and the type of investment.

[5] Russell Investments & ASX (2018). *2018 long-term investing report: The journey matters as much as the destination*, https://russellinvestments.com/-/media/files/au/insights/2018-russell-investmentsasx-long-term-investing-report.pdf?la=en-au&hash=18B8B58D5FD13A599B577128C453D9E8463A3129 (viewed 18 May 2020).

Unlike alternative investments, savings from energy efficiency are tax-free. Further, if residential energy tariffs increase above the inflation rate, then the future value of energy savings will also increase. AEMO's retail energy price forecasts show a modest rise above inflation to 2040.[6]

The alternative investment scenario compares energy savings to an investment with a 3% after-tax return, which is at the higher end of long-term investment returns reported by Russell Investments and the ASX.

Both alternative ways of evaluating the benefits of improved energy efficiency assume that the households are economically rational. It can be rational from a householder's perspective to make decisions which value short-term over long-term gain. The recent withdrawals from Superannuation to help households cope with reduced financial circumstances brought about by the COVID pandemic is one example where short-term gain is favoured over the long-term. Nevertheless, providing information for householders and the building industry about impacts on the individual, in addition to the societal cost metric, can provide a level of reassurance that the policy selected – whether that be to adopt or reject building fabric stringency increase – is the right decision.

Cost elasticity of energy-efficient building fabric improvements using NatHERS

Evaluating the improvements needed to achieve 7-stars was a two-stage process. The first stage involved improving the rating of each dwelling from 6 to 7 stars in the manner which seemed to make the most sense for an experienced NatHERS assessor. The second stage involved reviewing the rating considering the cost of these improvements. This second stage identified outliers in terms of costs. Trimming glazing areas at 7-stars as shown in the AHD portal resulted in a negative cost in some cases, so glazing areas were increased, and other specifications were changed. The benefits of some improvements were found to increase cost out of proportion to the benefit that was derived. These improvements were deleted and the required performance improvement was obtained through more cost effective design and specification changes.

The dwellings evaluated in each climate zone included 6 volume builder style dwellings with poor orientation and three specialist design dwellings which were well suited to the specific climate being modelled. The specialist designs showed significantly lower costs to achieve 7-stars than the poorly oriented volume builder dwellings. These savings for specialist designs were generally in the range of 25-50% lower than poorly oriented volume builder style dwellings.

The extent to which building fabric savings through more climatically-appropriate design can be achieved in the field is not the same in every case. In cooler climates, or for lots with overshadowing to the north of buildings, or where the lot shape does not facilitate orienting living areas to the north, the extent of cost savings from more climatically-appropriate design are limited. Other low-cost measures, like reducing window size or selecting more climatically-appropriate colour schemes, also involve decisions around aesthetics or amenity that individuals may not be willing to make in order to lower costs.

Nevertheless, the cost elasticity found in this project makes it clear that the costs for the poorly-oriented volume builder dwellings used in this project may not be representative of industry-wide practice. Lower costs will be possible, for example by matching the dwelling design to a building lot which facilitates better window orientation in all climates. The cost of achieving 7-stars is therefore not a fixed cost added to the dwelling, but can, to a certain extent, be minimised by the designer and NatHERS assessor to a more acceptable value for their client.

[6] AEMO (Australian Energy Market Operator) (2015). *Electricity market forecasts: 2015*, report prepared by Frontier Economics for AEMO, April 2015, Canberra.

1 NCC Climate Zone 1

As shown in Table 3 above, changes to the star bands for the updated and improved weather data mean that houses that were formerly 7.0 stars now achieve a rating of around 7.5 stars in Darwin and 7.2 stars in Cairns. This increase in ratings has reduced the cost of achieving 7-stars. It has also reduced the energy-saving benefits. Both factors are accounted for in the results shown below.

1.1 Class 1 Dwellings

1.1.1 Darwin Dwelling Costs

Table 9 Costs of improving building fabric from 6 to 7 stars in Class 1 in Darwin

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost (/m2)
SBH01	Slab	Large	Two	Detached	$1,102	$3.94
SBH01	Timber	Large	Two	Detached	$574	$2.06
SBH02	Slab	Large	One	Detached	$658	$2.53
SBH02	Timber	Large	One	Detached	$449	$1.73
SBH03	Slab	Medium	Two	Detached	$188	$1.01
SBH03	Timber	Medium	Two	Detached	$1,019	$5.45
SBH04	Slab	Medium	One	Detached	$725	$5.38
SBH04	Timber	Medium	One	Detached	$425	$3.16
SBH05	Slab	Small	One	Detached	$1,244	$8.53
SBH05	Timber	Small	One	Detached	$1,527	$10.46
SBH06	Slab	Small	One	Detached	$1,785	$17.67
SBH06	Timber	Small	One	Detached	$1,308	$12.94
SBH08	Timber	Small	Two	Tropical detached, elevated	$113	$0.00
SBH15	Slab	Small	One	Semi-detached	$1,964	$20.99
SBH15	Timber	Small	One	Semi-detached	$3,342	$35.72
SBH19	Slab	Small	One	Passive Hi Vent detached	$1,884	$11.66
SBH19	Timber	Small	One	Passive Hi Vent detached	$1,129	$6.99

Table 10 Summary of dwelling upgrade costs for Class 1 in Darwin

Type of Design	Total Cost	Cost per m^2
All	$1,143	$8.84
Non tropical	$1,267	$10.61
Specialist Designs (SBH03, 08, 19)	$753	$4.28

The cost of improving the NatHERS rating of Class 1 dwellings from 6-stars to 7-stars varies from around $1 to $35 per square metre. Higher costs indicate that the dwelling design modelled is poorly suited to the climate. It is likely that the building industry would not accept the high costs found for SBH15 and would develop lower cost designs in response to the increase in building fabric stringency. Eliminating SBH15 would lower average costs by $2.40 per square metre. The average across all non-specialist designed dwellings on less-favourable orientations is around $11/$m^2$. In contrast, specialist well-oriented designs (main living areas face south) which are well suited to the Darwin climate can achieve around $6/m2 cost savings.

Two-storey and timber floored Class 1 dwellings generally have the highest costs.

1.1.2 Darwin: summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 11 Changes to Roof and Ceiling specifications needed to meet 7-stars for Class 1 in Darwin

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	2.6	2.9
Area ceiling 1	116.7	117.1
R-value ceiling 2	0.4	0.4
Area ceiling 2	22.1	21.8
Area roof insulated	3.0	3.0
Area roof uninsulated	179.6	179.6
R-value roof blanket	R 1.3 in 2 houses	R 1.3 in 2 houses
R-value ceiling Flat	1.1	1.1
Area roof insulated (Flat)	21.6	21.6
Area roof uninsulated (Flat)	14.9	14.9
Foil under roof?	100%	89%
Ventilated roof?	39%	44%
Roof colour	0.32	0.30

Notes on the table:

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased Ceiling R-values, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation, and
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

Ceiling insulation levels used to obtain 7-stars were slightly lower than would be required by NCC 2019 elemental even after allowing for the light-coloured roofs and the installation of reflective foil. At 7-stars ceiling insulation levels were increased, on average, by around R0.5.

The table above shows that substantial changes were not made to roof/ceiling features to increase ratings to 7-stars. Ceiling insulation levels increased, and lighter colours were used although the dwellings already used predominantly light roofs at 6-stars. In some cases, roof ventilation was added, or reflective foil removed, but these features remained substantially the same at 6- and 7-stars.

Table 12 Changes to External and Internal wall and floor specifications needed to meet 7-stars, Class 1 in Darwin

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	25%	38%
R-value walls	1.6	1.3
Percentage of walls insulated *	60%	45%
Area uninsulated *	143.8	137.4
Area walls insulated (Garage and roof space)*	0.0	0.0
Area walls uninsulated (Garage and roof space)*	13.1	11.2
Foil layer walls	0%	0%
If yes emissivity	None	None
Wall colour	0.39	0.32
Internal Walls		
No dwellings with insulated internal walls	3	4
R-value (if insulated)	1.5	1.3
Insulated area	15.0	15.3
Floors		
Area floor insulated	0.0	0.0
Waffle pod?	0.0	0.0
R-value floor	0.0	0.0
Foil underfloor	0%	0%
R-value subfloor walls	5 Houses Average R: 1.3	4 Houses Average R: 1.4
Area subfloor walls insulated	18.5	18.5
Area ceramic tile floor surface	76.8	76.8

* in dwellings with wall insulation

All the dwellings used concrete block walls except the two specialist designed houses which used lightweight framed walls as consistent the principles of good tropical design. Framed walls were insulated at both 6- and 7-stars. The only dwellings which needed to insulate their concrete block walls were the two-storey dwellings. In these dwellings, the large wall surface area made it challenging to achieve 7-stars without insulating some walls. At 7-stars, the average R-value of insulation was 1.3, and around 45% of the walls were insulated in those houses with wall insulation.

Lighter coloured walls were used on average at 6-stars, and slightly lighter colours were used at 7-stars.

The internal wall between the house and the garage was also required to be insulated in 4 of the dwellings at 7-stars. Dwellings which insulated walls to the garage include the specialist designs which used framed walls, so only two dwellings with concrete block walls were required to insulate the internal wall to the garage. The extent of insulation to garage walls is significantly less than would be needed for the proposed elemental provisions, demonstrating the additional flexibility that using a NatHERS simulation provides.

Floors over enclosed subfloor spaces were not required to be insulated because this would increase cooling requirements in Darwin. Some timber floored dwellings were required to insulate their subfloor walls. In the optimisation process, it was found that one of the 6-star dwelling no longer needed to install subfloor wall insulation. Four dwellings were required to install between R1.0 and R1.5 insulation around their subfloor walls. Subfloor wall insulation must not be affected by moisture and must not cover required vents.

Table 13 Changes to Ceiling fan and Window specifications needed to meet 7-stars, Class 1 in Darwin

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	1.2	0.5
No. 1200	4.2	3.0
No. 1400	0.6	4.4
Windows		
Area single glazed clear	29.2	17.4
Area single low e	0.0	0.0
Area single glazed tinted	0.9	1.3
Area single glazed heavy tinted	0.0	11.3
Area single low e tint	6.3	2.7
Area double glazed argon fill low e	0.0	0.0
Total Window Area	40.3	36.9
Frame colour (abs)	0.40	0.28
Area external Blinds	0.0	0.0
Highly openable windows louvre	5 x Houses 11.8 m2	7 x Houses 9.6 m2
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre heavy tint	NA	1 x Houses 4.5 m2
Highly openable windows louvre low e	NA	NA
Highly openable windows louvre low e tint	2 x Houses 3.2 m2	1 x Houses 5.1 m2

In 7-star dwellings more ceiling fans were installed at 7-stars (an increase from 6 to 8). Ceiling fan diameter was also increased to improve the impact of the fans.

The total window area at 7-stars was reduced by around 8%. The majority of windows in 6-star dwellings were able to use single clear glazing, with a small area of single low-e tinted glazing. Some of the dwellings also used some modest areas of louvre windows. At 7-stars around one-third of windows were required to be tinted. While the number of dwellings using louvre windows increased, only modest areas were used due to the impact on costs. Louvre windows were only used where the use of modest areas of louvre windows made a significant difference to the rating. Note that in the two specialist designs louvre windows were used as consistent with hot climate design principles.

1.1.3 Darwin Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES[7]. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 14 Cooling energy bill savings for various appliances and area of dwelling cooled, Class 1 in Darwin

		Cooling Savings			
		Whole House		Living areas only	
House No	Floor-type	AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
SBH01	SLA	$227.01	$311.58	$184.48	$253.22
SBH01	TIM	$179.81	$246.80	$119.55	$164.09
SBH02	SLA	$227.94	$312.87	$156.69	$215.07
SBH02	TIM	$196.65	$269.92	$130.90	$179.67
SBH03	SLA	$185.65	$254.82	$171.10	$234.85
SBH03	TIM	$188.43	$258.64	$168.14	$230.78
SBH04	SLA	$99.59	$136.69	$63.22	$86.77
SBH04	TIM	$126.95	$174.26	$53.90	$73.98
SBH05	SLA	$143.35	$196.76	$125.18	$171.82
SBH05	TIM	$93.76	$128.69	$267.36	$366.97
SBH06	SLA	$58.77	$80.67	$32.85	$45.09
SBH06	TIM	$49.47	$67.90	$70.72	$97.07
SBH08	TIM	$79.81	$109.54	$68.98	$94.68
SBH15	SLA	$93.44	$128.25	$67.17	$92.19
SBH15	TIM	$132.57	$181.96	$108.20	$148.51
SBH19	SLA	$131.67	$180.72	$131.17	$180.04
SBH19	TIM	$86.96	$119.36	$91.81	$126.02

[7] Reference to be inserted when final version is prepared

1.1.3.1 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 15 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Darwin

House no.	Floor-type	Upgrade Cost	Mortgage payment increase	Annual Cash flow impact			
				Whole House		Living areas only	
				AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
SBH01	Slab	$1,101.69	$5.26	$163.89	$248.47	$121.37	$190.10
SBH01	Timber	$573.81	$2.74	$146.94	$213.93	$86.68	$131.22
SBH02	Slab	$657.50	$3.14	$190.27	$275.20	$119.02	$177.40
SBH02	Timber	$448.50	$2.14	$170.96	$244.23	$105.20	$153.97
SBH03	Slab	$187.88	$0.90	$174.89	$244.06	$160.34	$224.09
SBH03	Timber	$1,018.54	$4.86	$130.08	$200.29	$109.79	$172.43
SBH04	Slab	$724.50	$3.46	$58.08	$95.19	$21.71	$45.26
SBH04	Timber	$425.46	$2.03	$102.58	$149.88	$29.52	$49.60
SBH05	Slab	$1,244.24	$5.94	$72.07	$125.48	$53.89	$100.53
SBH05	Timber	$1,527.11	$7.29	$6.27	$41.20	$179.87	$279.48
SBH06	Slab	$1,785.08	$8.52	-$43.50	-$21.60	-$69.42	-$57.18
SBH06	Timber	$1,307.80	$6.24	-$25.45	-$7.02	-$4.21	$22.14
SBH08	Timber	$113.02	$0.54	$73.33	$103.07	$62.50	$88.20
SBH15	Slab	$1,964.39	$9.38	-$19.10	$15.72	-$45.37	-$20.35
SBH15	Timber	$3,342.14	$15.96	-$58.90	-$9.51	-$83.27	-$42.96
SBH19	Slab	$1,884.25	$9.00	$23.72	$72.78	$23.22	$72.10
SBH19	Timber	$1,129.25	$5.39	$22.27	$54.67	$27.12	$61.32

Household cash flow is positive in the majority of dwellings, even with only living areas cooled.

1.1.3.2 The net present value of building fabric induced energy savings versus capital cost

The table below shows the Net Present Value of energy savings discounted at 7% over 40 years less the cost of building fabric improvements. Figures in red indicate that the net present value is negative, i.e., the discounted value of energy savings over 40 years is less than the value of the capital cost of improvements required to achieve 7-stars. A 7% real discount rate is the policy evaluation metric recommended for this project by the OBPR.

Table 16 Net Present Value of Cost and Benefits, Class 1 in Darwin

		Cooling Savings Whole House		Living areas only	
House No	Floor-type	AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
SBH01	SLA	$1,924.69	$3,052.26	$1,357.81	$2,274.17
SBH01	TIM	$1,823.36	$2,716.50	$1,020.00	$1,613.83
SBH02	SLA	$2,381.35	$3,513.57	$1,431.46	$2,209.77
SBH02	TIM	$2,173.21	$3,150.01	$1,296.60	$1,946.79
SBH03	SLA	$2,287.14	$3,209.29	$2,093.22	$2,943.11
SBH03	TIM	$1,493.58	$2,429.55	$1,223.03	$2,058.19
SBH04	SLA	$603.18	$1,097.85	$118.28	$432.29
SBH04	TIM	$1,267.06	$1,897.66	$293.08	$560.80
SBH05	SLA	$666.86	$1,378.89	$424.58	$1,046.35
SBH05	TIM	-$277.14	$188.57	$2,037.19	$3,365.18
SBH06	SLA	-$1,001.58	-$709.67	-$1,347.11	-$1,183.94
SBH06	TIM	-$648.26	-$402.52	-$365.01	-$13.74
SBH08	TIM	$950.95	$1,347.37	$806.57	$1,149.19
SBH15	SLA	-$718.67	-$254.54	-$1,068.94	-$735.32
SBH15	TIM	-$1,574.75	-$916.25	-$1,899.65	-$1,362.21
SBH19	SLA	-$128.90	$525.11	-$135.50	$416.05
SBH19	TIM	$94.74	$550.77	$30.09	$462.03

Net Present Value at 7% discount rate is positive, i.e. benefits exceed costs, in 73% of the cases reported above. Smaller dwellings like SBH05 and SBH06 have a negative NPV. Similar-sized dwellings with better orientation (SBH08 and 19) show positive NPV.

1.1.3.3 The net present value of costs and benefits: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 17 Net Present Value of costs and benefits at 3% discount rate, Class 1 in Darwin

		Cooling Savings			
		Whole House		Living areas only	
House No	Floor-type	AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
SBH01	SLA	$4,145.51	$6,100.51	$3,162.63	$4,751.44
SBH01	TIM	$3,582.46	$5,131.00	$2,189.57	$3,219.15
SBH02	SLA	$4,611.32	$6,574.38	$2,964.39	$4,313.83
SBH02	TIM	$4,097.08	$5,790.67	$2,577.19	$3,704.50
SBH03	SLA	$4,103.36	$5,702.20	$3,767.14	$5,240.70
SBH03	TIM	$3,337.02	$4,959.82	$2,867.94	$4,315.96
SBH04	SLA	$1,577.47	$2,435.13	$736.73	$1,281.16
SBH04	TIM	$2,509.07	$3,602.42	$820.36	$1,284.53
SBH05	SLA	$2,069.26	$3,303.80	$1,649.19	$2,727.23
SBH05	TIM	$640.11	$1,447.57	$4,652.74	$6,955.23
SBH06	SLA	-$426.63	$79.50	-$1,025.72	-$742.80
SBH06	TIM	-$164.27	$261.79	$326.83	$935.86
SBH08	TIM	$1,731.71	$2,419.03	$1,481.38	$2,075.42
SBH15	SLA	$195.47	$1,000.19	-$411.85	$166.59
SBH15	TIM	-$277.80	$863.91	-$841.13	$90.70
SBH19	SLA	$1,159.21	$2,293.14	$1,147.77	$2,277.44
SBH19	TIM	$880.83	$1,629.75	$992.92	$1,783.60

At 3% discount rate the NPV shows significantly larger benefits and smaller disbenefits than at 7%. Note that if a 7% investment return was available after-tax and assuming a real growth in energy prices, as shown in AEMO (2015), NPV would be similar to the values shown above.

1.1.4 Conclusion: Class 1 Darwin

Adoption of a 7-star minimum fabric requirement in Class 1 dwellings in similar climates to Darwin in Climate Zone 1 ***is recommended***:

- NPV at 7% is strongly positive for the majority of dwellings,
- If NPV is negative, better design and orientation offers the scope to reduce costs and provide positive NPV values,
- Even in those cases where the NPV is negative, analysis of annual household cash flow impact shows that this is generally less than $1 per week.
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment in almost all cases,
- Inclusion of Whole of Home measures may result in a much larger benefit which could outweigh the cases reported above where the benefits are negative.

1.1.5 Cairns Dwelling Costs

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 18 Costs of improving building fabric from 6 to 7 stars in Class 1 in Cairns

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost (per m^2)
SBH01	Slab	Large	Two	Detached	$1,000	$3.59
SBH01	Timber	Large	Two	Detached	$892	$3.20
SBH02	Slab	Large	One	Detached	$877	$3.38
SBH02	Timber	Large	One	Detached	$982	$3.78
SBH03	Slab	Medium	Two	Detached	$981	$5.25
SBH03	Timber	Medium	Two	Detached	$950	$5.09
SBH04	Slab	Medium	One	Detached	$467	$3.46
SBH04	Timber	Medium	One	Detached	$648	$4.81
SBH05	Slab	Small	One	Detached	$778	$5.55
SBH05	Timber	Small	One	Detached	$755	$5.39
SBH06	Slab	Small	One	Detached	$311	$3.07
SBH06	Timber	Small	One	Detached	$539	$5.33
SBH07	Slab	Medium	One	Passive Hi Vent Conc Block	$322	$1.69
SBH15	Slab	Small	One	Semi-detached	$330	$3.29
SBH18	Timber	Small	One	Semi-detached	$680	$7.55
SBH19	Slab	Small	One	Passive Hi Vent Conc Block	$563	$3.63

Table 19 Summary of dwelling upgrade costs for Class 1 in Cairns

House Type	Cost (total)	Cost (per m^2)
All	$692	$4.26
Non specialist	$708	$4.37
Specialist Designs	$469	$3.04

The cost of improving the NatHERS rating of a Class 1 dwellings from 6-stars to 7-stars varies from around $2 to $8 per square metre. Higher costs indicate that the dwelling design is not well suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $4/$m^2$Specialist well-oriented designs (main living areas face south) which are well suited to the Cairns climate can achieve around $1/m2 cost savings. Note that this saving is small because performance in Cairns is particularly sensitive to air movement which can be provided using ceiling fans.

Two-storey Class 1 dwellings have the highest costs.

1.1.6 Cairns, summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 20 Changes to Roof and Ceiling specifications needed to meet 7-stars, Class 1 in Cairns

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	1.9	2.2
Area ceiling 1	128.9	128.9
R-value ceiling 2	0.1	0.1
Area ceiling 2	10.9	8.7
Area roof insulated	2.8	2.8
Area roof uninsulated	199.2	199.2
R-value roof blanket	R 1.5 in 1 house	R 1.5 in 1 house
R-value ceiling Flat	1.0	1.0
Area roof insulated (Flat)	23.3	25.7
Area roof uninsulated (Flat)	10.4	8.1
Foil under roof?	94%	94%
Ventilated roof?	63%	63%
Roof colour	0.41	0.35

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased Ceiling R-value, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

Ceiling insulation levels used to obtain 7-stars were lower than would be required by NCC 2019 elemental even after allowing for the light-coloured roofs and the installation of reflective foil. At 7-stars ceiling insulation levels were increased, on average, by around R0.3.

The table above shows that changes to roof/ceiling features needed to achieve 7-stars were not large. Ceiling insulation levels increased, and lighter colours were used although the dwellings already used predominantly light roofs at 6-stars.

Table 21 Changes to External and Internal wall and floor specifications needed to meet 7-stars, Class 1 in Cairns

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	6%	0%
R-value walls	R 2.0	R 0.0
Proportion of walls insulated	4%	0%
Area walls uninsulated	135.5	141.5
Area walls insulated (Garage and roof space)	0.0	0.0
Area walls uninsulated (Garage and roof space)	30.0	30.0
Foil layer walls	13%	0%
If yes emissivity	0.1	None
Wall colour	0.43	0.41
Internal Walls		
No dwellings with insulated internal walls	0	0
R-value (if insulated)	0.0	0.0
Insulated area	0.0	0.0
Floors		
Area floor insulated	0.0	6.3
Waffle pod?	0%	0%
R-value floor	0.0	0.0
Foil underfloor	0%	0%
R-value subfloor walls	1 Houses Average R: 1	1 Houses Average R: 1
Area subfloor walls insulated	28.7	28.7
Area ceramic tile floor surface	48.3	48.3

All the dwellings used concrete block walls except the two specialist designed houses (SBH07 and 19) which used framed walls as consistent the principles of good tropical design. These walls were insulated at 6-stars but did not need insulation when light colours were used at 7-stars. Dwellings with Concrete Block walls did not need wall insulation.

Lighter coloured walls were used on average at 6-stars, and slightly lighter colours were used at 7-stars.

The wall to the garage was not required to be insulated to achieve 7-stars. Elemental provisions would require this wall to be insulated, demonstrating the additional flexibility that using a NatHERS simulation provides.

Floors over enclosed subfloor spaces were not required to be insulated because this would increase cooling requirements in Cairns. One timber floored dwelling was required to insulate its subfloor walls. Subfloor wall insulation must not be affected by moisture and must not cover required floor vents.

Table 22 Changes to Ceiling fan and Window specifications needed to meet 7-stars, Class 1 in Cairns

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	1.9	0.3
No. 1200	4.0	3.2
No. 1400	0.4	4.3
Windows		
Area single glazed clear	32.0	25.5
Area single low e	0.0	0.0
Area single glazed tinted	2.0	3.9
Area single glazed heavy tinted	0.1	2.2
Area single low e tint	2.7	3.2
Area double glazed argon fill low e	0.0	0.0
Total Window Area	40.3	38.3
Frame colour (abs)	0.43	0.34
Area external Blinds	0.0	0.0
Highly openable windows louvre	2 x Houses 20.2 m2	1 x Houses 12.1 m2
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre heavy tint	NA	NA
Highly openable windows louvre low e	NA	NA
Highly openable windows louvre low e tint	1 x Houses 16.4 m2	4 x Houses 10.8 m2

In 7-star dwellings more ceiling fans were installed at 7-stars (an increase from 6 to 9). Ceiling fan diameter was also increased to improve the impact of the fans.

The total window area at 7-stars was reduced by around 5%. The majority of windows in 6-star dwellings were able to use single clear glazing, with a small area of single tinted and low e tinted glazing. The specialist designed dwellings all used some areas of louvre windows. At 7-stars the area of tinted windows was slightly increased, and several the dwellings also used more highly openable louvre windows to address cross ventilation issues in particular rooms. Louvre windows were only added at 7-stars where they made a significant difference to the rating due to their higher cost.

1.1.7 Cairns Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 23 Cooling energy bill savings for various appliances and area of dwelling cooled, Class 1 in Cairns

		Cooling Savings			
		Whole House		Living areas only	
House No	Floor-type	AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
SBH01	SLA	$157	$215	$125	$172
SBH01	TIM	$126	$173	$113	$155
SBH02	SLA	$136	$187	$89	$122
SBH02	TIM	$115	$158	$86	$118
SBH03	SLA	$106	$146	$85	$117
SBH03	TIM	$108	$148	$98	$135
SBH04	SLA	$58	$80	$56	$77
SBH04	TIM	$47	$65	$34	$47
SBH05	SLA	$73	$100	$59	$81
SBH05	TIM	$78	$107	$50	$68
SBH06	SLA	$63	$87	$54	$74
SBH06	TIM	$71	$97	$51	$71
SBH07	SLA	$118	$162	$88	$120
SBH15	SLA	$34	$47	$30	$41
SBH18	TIM	$52	$72	$48	$66
SBH19	SLA	$75	$103	$59	$81

1.1.7.1 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 24 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Cairns

House no.	Floor-type	Upgrade Cost	Mortgage payment increase	Annual Cash flow impact			
				Whole House		Living areas only	
				AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
SBH01	Slab	$1,000	$57	$100	$158	$68	$115
SBH01	Timber	$892	$51	$75	$122	$62	$104
SBH02	Slab	$877	$50	$86	$137	$39	$72
SBH02	Timber	$982	$56	$59	$101	$29	$61
SBH03	Slab	$981	$56	$50	$90	$29	$61
SBH03	Timber	$950	$54	$54	$94	$44	$81
SBH04	Slab	$467	$27	$31	$53	$30	$51
SBH04	Timber	$648	$37	$10	$28	-$3	$10
SBH05	Slab	$778	$45	$28	$56	$14	$36
SBH05	Timber	$755	$43	$35	$64	$7	$25
SBH06	Slab	$311	$18	$45	$69	$36	$56
SBH06	Timber	$539	$31	$40	$67	$21	$40
SBH07	Slab	$322	$18	$100	$143	$69	$102
SBH15	Slab	$330	$19	$15	$28	$11	$22
SBH18	Timber	$680	$39	$13	$33	$9	$27
SBH19	Slab	$563	$32	$43	$71	$26	$48

Cash flow impacts are positive an all but one of the dwellings.

1.1.7.2 The net present value of building fabric induced energy savings versus capital cost

The table below shows the Net Present Value of energy savings discounted at 7% over 40 years less the cost of building fabric improvements. Figures in red indicate that the net present value is negative, i.e., the discounted value of energy savings over 40 years is less than the value of the capital cost of improvements required to achieve 7-stars. A 7% real discount rate is the policy evaluation metric recommended for this project by the OBPR.

Table 25 Net Present Value of Cost and Benefits at 7% discount rate over 40 years, Class 1 in Cairns

		Cooling Savings Whole House		Living areas only	
House No	Floor-type	AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
SBH01	SLA	$1,092	$1,871	$673	$1,296
SBH01	TIM	$786	$1,411	$610	$1,170
SBH02	SLA	$938	$1,614	$312	$754
SBH02	TIM	$549	$1,119	$160	$585
SBH03	SLA	$435	$962	$157	$581
SBH03	TIM	$491	$1,028	$362	$851
SBH04	SLA	$309	$598	$285	$565
SBH04	TIM	-$17	$219	-$190	-$19
SBH05	SLA	$195	$557	$7	$300
SBH05	TIM	$282	$668	-$90	$158
SBH06	SLA	$530	$844	$404	$670
SBH06	TIM	$408	$761	$148	$403
SBH07	SLA	$1,251	$1,837	$847	$1,283
SBH15	SLA	$128	$298	$66	$213
SBH18	TIM	$19	$279	-$40	$198
SBH19	SLA	$442	$816	$220	$512

Net Present Value at 7% discount rate is positive, i.e. benefits exceed costs, in 92% of the cases reported above. Smaller dwellings like SBH04, 05 and 18 have a negative NPV but are only small negatives. Similar sized dwellings with better orientation (SBH08 and 19) show positive NPV.

1.1.7.3 The net present value of costs and benefits: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 26 Net Present Value of costs and benefits at 3% discount rate, Class 1 in Cairns

		Cooling Savings			
		Whole House		Living areas only	
House No	Floor-type	AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
SBH01	SLA	$2,627	$3,978	$1,901	$2,981
SBH01	TIM	$2,017	$3,100	$1,713	$2,683
SBH02	SLA	$2,269	$3,441	$1,183	$1,951
SBH02	TIM	$1,672	$2,661	$998	$1,735
SBH03	SLA	$1,474	$2,389	$992	$1,727
SBH03	TIM	$1,549	$2,480	$1,325	$2,172
SBH04	SLA	$878	$1,380	$836	$1,321
SBH04	TIM	$446	$854	$146	$442
SBH05	SLA	$908	$1,537	$584	$1,091
SBH05	TIM	$1,043	$1,713	$398	$828
SBH06	SLA	$1,147	$1,691	$928	$1,390
SBH06	TIM	$1,103	$1,715	$651	$1,095
SBH07	SLA	$2,405	$3,420	$1,705	$2,461
SBH15	SLA	$464	$759	$356	$612
SBH18	TIM	$531	$983	$429	$842
SBH19	SLA	$1,179	$1,828	$795	$1,301

At 3% discount rate the NPV shows significantly larger benefits and smaller disbenefits than at 7%. Note that if a 7% investment return was available after-tax and assuming a real growth in energy prices as shown in AEMO, 2015, NPV would be similar to the values shown above.

1.1.8 Conclusion: Class 1 Cairns

Adoption of a 7-star minimum fabric requirement in Class 1 dwellings in similar climates to Cairns in Climate Zone 1 ***is recommended***:

- NPV at 7% is positive for 92% of the dwellings evaluated,
- If NPV is negative, better design and orientation of dwellings offer the scope to reduce costs and provide positive NPV values,
- Even in those cases where the NPV is negative, analysis of annual household cash flow impact shows that cash flow impacts are only negative in one case,
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment in all cases,
- Inclusion of Whole of Home measures may result in a much larger benefit which could outweigh the cases reported above where the benefits are negative.

1.2 Class 2 dwellings

1.2.1 Darwin Dwelling Costs

Table 27 Costs of improving building fabric from 6 to 7 stars in Class 2 in Darwin

House Number	Position	Cost (total)	Cost (/m^2)
SBA01	Corner	$452	$4.73
SBA02	Middle	$368	$4.12
SBA03	Corner	$691	$7.23
SBA04	Middle	$1,377	$15.40
SBA05	Corner	$1,013	$10.61
SBA06	Middle	$803	$8.99
SBA07	Corner	$741	$7.76
SBA08	Middle	$1,010	$11.29
SBA11*	Corner	$0	$0.00
SBA12*	Middle	$0	$0.00
SBA13	Corner	$1,086	$11.37
SBA14*	Middle	$0	$0.00
SBA15	Corner	$372	$3.90
SBA16*	Middle	$0	$0.00
SBA17	Corner	$83	$0.87
SBA18*	Middle	$0	$0.00
SBA21*	Corner	$0	$0.00
SBA22	Middle	$1,315	$14.70
SBA23*	Corner	$0	$0.00
SBA24*	Middle	$0	$0.00
SBA25	Corner	$954.44	$9.99
SBA26	Middle	$592.23	$6.62
SBA27*	Corner	$0.00	$0.00
SBA28	Middle	$522.14	$5.84

* Note these units did not need to be altered to increase the rating to an average 7-stars.

The cost of improving the NatHERS ratings of a Class 2 building from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the updated weather data varies from around $4 to $15 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $5/m^2.

Table 28 Summary of dwelling upgrade costs for Class 2 in Darwin

Building-wide cost	Cost
Building-wide	$11,380.10
Cost per unit	$474.17
Cost per square metre	$5.13

1.2.2 Darwin: Changes to design and specification Class 2

Table 29 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans, Class 2 in Darwin

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling	3.0	3.0			Nil
Area ceiling	92.5	92.5	739.7	739.7	Nil
External Walls	**Per unit**		**Whole Building**		
R-value walls	1.4	1.9			136%
Area walls insulated	28.1	29.3	674	702	104%
Area walls uninsulated	9.9	8.7			88%
Wall colour	0.48	0.42			87%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.0	0.0			Nil
Insulated area	0.0	0.0			Nil
Floors	**Per unit**		**Whole Building**		
Area floor insulated	14.3	22.4	115	179	156%
R-value floor	0.25	0.25			Nil
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	0.6	0.3	14	6	-8
No. 1200	2.4	2.4	57	57	0
No. 1400	0.5	1.6	12	39	27

Roof insulation was not required to be increased at 7-stars. Although increasing insulation did improve the rating, other measures were more effective.

Wall insulation R-values were increased by, on average, R0.5. The area of wall insulated also increased, although this was mainly due to the reduction in the window area.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show that floor insulation levels can be reduced where the floor is over an enclosed car park. Note that with an average Floor R-value of only R0.25, this may be able provided under the floor covering.

Not all dwellings required floor insulation to achieve 7-stars, and those dwellings which required floor insulation were generally those with lower heat gains through windows. Note that the car park is assumed to be unenclosed. If the car park were enclosed, no floor insulation would be required.

There was a significant increase in both the number and diameter of ceiling fans used to increase the rating from 6 (min 5) to 7 (min 6) stars.

Table 30 Changes to building design and specification to increase stringency: Windows Class 2 in Darwin

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	17.3	9.3	414.9	222.9	54%
Area single low e	0.0	0.0	0.0	0.0	Nil
Area single glazed tinted	2.4	1.6	58.0	39.1	67%
Area single glazed heavy tinted	0.0	6.9	0.0	165.1	Nil
Area single low e tint	1.1	1.4	27.0	34.7	128%
Area double glazed argon fill low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre	1.7	1.6	40.8	37.6	92%
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e tint	0.0	0.0	0.0	0.0	Nil
Total Window Area	**22.5**	**20.8**	**540.6**	**499.3**	**92%**
Frame colour (abs)	0.4	0.3			63%
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	3.0	2.6	72.7	62.2	86%
E area Day	2.7	2.4	64.9	58.2	90%
S area Day	2.8	2.6	67.9	61.2	90%
W area Day	3.0	2.8	73.0	68.3	93%
N area Night	3.4	3.0	80.5	73.1	91%
E area Night	2.7	2.6	65.0	62.6	96%
S area Night	2.6	2.5	62.1	61.1	98%
W area Night	2.3	2.2	54.6	52.6	96%

Total window area across all units was reduced by around 8%. There was a significant reduction in the use in single clear glazing and a corresponding increase in the use of tinted, heavy tinted and low-e tinted glazing. Heavy tints and low-e tinted glazing were exclusively used on orientations with high solar gains such as east- and west-facing glazing. Window frame colours were made lighter. At 6-stars window frames were already assumed to be a light-medium colour.

No external blinds were used in part because of their high cost but also because the units all had balconies which provided some protection from solar gain. In this building the management of solar heat gains could be sufficiently handled through the use of lower solar heat gain coefficient, i.e. tinted, windows.

1.2.3 Darwin Costs and Energy Bill Savings

The extent of improvement costs for individual units varied significantly. This variation is in part because a heterogeneous approach to rating was adopted, i.e. there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to the average benefits for all units in the development.

Most Class 1 dwellings in Darwin will likely have one or more Reverse Cycle Space Cooling appliances installed. The installation rate of air-conditioning installation in the NT is almost universal. Ducted cooling is less common, and may be even less common in Class 2, but may be installed in higher-end apartments. The results for Ducted Cooling systems are shown below but may not represent a significant proportion of dwellings.

Table 31 Financial analysis of benefits and costs for Class 2 dwellings in Darwin: Appliance Mix 1

Appliance Mix 1 :	**Reverse Cycle Space Cooling**	
Financial Impact for the area of unit conditioned:	**Whole House**	**Living Areas Only**
Building Fabric improvement cost per unit	$474.17	$474.17
Energy-saving per unit Total	$78.22	$67.06
Energy-saving per unit Heating	-	-
Energy-saving per unit Cooling	$78.22	$67.06
Increase to annual mortgage payments	$27.17	$27.17
Annual Cash Flow: **Total Annual Energy Bill Saving - Mortgage Increase**	$51.06	$39.90
Net Present Value @ 7%	$568.69	$419.87
Net Present Value @ 5%	$868.09	$676.54
Net Present Value @ 3%	$1,333.97	$1,075.94

Table 32 Financial analysis of benefits and costs for Class 2 dwellings in Darwin: Appliance Mix 2

Appliance Mix 2 :	**Reverse Cycle Ducted Cooling**	
Financial Impact	**Whole House**	**Living Areas Only**
Cost per unit	$474.17	$474.17
Energy-saving per unit	$107.37	$92.05
Energy-saving per unit Total	$107.37	$92.05
Energy-saving per unit Heating	$0.00	$0.00
Increase to annual mortgage payments	$27.17	$27.17
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$80.20	$64.88
Net Present Value @ 7%	$957.24	$752.97
Net Present Value @ 5%	$1,368.18	$1,105.27
Net Present Value @ 3%	$2,007.64	$1,653.48

1.2.4 Conclusion: Class 2 Darwin

Average costs and benefits across the apartment building are favourable in Darwin from every perspective. Adoption of a 7-star average, 6-star minimum fabric requirement in Class 2 dwellings in similar climates to Darwin in Climate Zone 1 ***is recommended***.

1.2.5 Cairns Dwelling Costs

Table 33 Costs of improving building fabric from 6 to 7 stars in Class 2 in Cairns

House Number	Floor-type	Position	Cost (total)	Cost (/m^2)
SBA01	Slab	Corner	$933	$9.77
SBA02**	Slab	Middle	-$180	-$2.02
SBA03	Slab	Corner	$402	$4.21
SBA04	Slab	Middle	$801	$8.96
SBA05	Slab	Corner	$371	$3.89
SBA06*	Slab	Middle	$0	$0.00
SBA07	Slab	Corner	$166	$1.74
SBA08	Slab	Middle	$409	$4.57
SBA11	Slab	Corner	$340	$3.56
SBA12*	Slab	Middle	$0	$0.00
SBA13	Slab	Corner	$671	$7.03
SBA14	Slab	Middle	$199	$2.22
SBA15	Slab	Corner	$473	$4.95
SBA16	Slab	Middle	$138	$1.55
SBA17	Slab	Corner	$466	$4.88
SBA18	Slab	Middle	$657	$7.34
SBA21	Slab	Corner	$68	$0.71
SBA22*	Slab	Middle	$0	$0.00
SBA23	Slab	Corner	$175	$1.84
SBA24	Slab	Middle	$556	$6.22
SBA25**	Slab	Corner	-$198	-$2.07
SBA26*	Slab	Middle	$0	$0.00
SBA27	Slab	Corner	$149	$1.56
SBA28	Slab	Middle	$420	$4.70

* Note these units did not need to be altered to increase the rating to an average 7-stars

** Note the rating of these units improved with the updated weather data and star bands and could be de-specified while still achieving the minimum requirements. The cost is, therefore, negative.

The cost of improving the NatHERS ratings of a Class 2 building from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the updated weather data varies from around $1 to $10 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $3/m^2.

Table 34 Summary of dwelling upgrade costs for Class 2 in Cairns

Building-wide cost	Cost
Building-wide cost	$7,016
Cost per unit	$292
Cost per m2	$3.16

1.2.6 Cairns: Changes to design and specification Class 2

Table 35 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans in Cairns

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling 1	3.0	3.0			Nil
Area ceiling 1	92.2	92.2	737.7	737.7	Nil
External Walls	**Per unit**		**Whole Building**		
R-value walls	0.6	0.7			114%
Area walls insulated	24.6	26.9	589	646	110%
Area walls uninsulated	13.4	11.0			82%
Wall colour	0.44	0.38			87%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.0	0.0			Nil
Insulated area	0.0	0.0			Nil
Floors	**Per unit**		**Whole Building**		
Area floor insulated	0.0	0.0	0	0	Nil
R-value floor	0.00	0.00			Nil
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	0.6	0.0	15	0	-15
No. 1200	2.5	0.8	61	18	-43
No. 1400	0.8	3.3	18	80	62

Roof/ceiling insulation was not required to be increased at 7-stars. Although increasing insulation did improve the rating, other measures were more effective.

Wall insulation R-values were increased by, on average, R0.1. The area of wall insulated also increased, although this was mainly due to the reduction in the window area. Some units did not require wall insulation to achieve the 6-star minimum and 7-star average rating over the building. These were generally units which had lower solar exposure orientations.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show a significant increase over the current assumption.

No dwellings required floor insulation to achieve 7-stars. Note that the car park is assumed to be unenclosed. If the car park were enclosed, the rating would be increased, and the extent of change to design and specifications would be reduced.

There was a significant increase in both the number and diameter of ceiling fans used to increase the rating from 6 (min 5) to 7 (min 6) stars.

Table 36 Changes to building design and specification to increase stringency: Windows in Cairns

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	16.8	8.3	404.4	199.8	49%
Area single low e	0.0	0.0	0.0	0.0	Nil
Area single glazed tinted	1.9	4.8	45.7	114.1	250%
Area single glazed heavy tinted	8.0	11.1	193.0	266.6	138%
Area single low e tint	0.0	0.8	0.0	20.3	Nil
Area double glazed argon fill low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e tint	0.0	0.0	0.0	0.0	Nil
Total Window Area	**26.8**	**25.0**	**643.0**	**600.8**	**93%**
Frame colour (abs)	0.4	0.3			82%
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	3.7	3.5	89.3	83.3	93%
E area Day	3.1	3.0	73.6	72.0	98%
S area Day	3.4	3.1	81.4	75.4	93%
W area Day	3.3	3.0	78.0	72.2	93%
N area Night	3.7	3.4	88.1	81.2	92%
E area Night	2.7	2.5	65.6	59.4	91%
S area Night	3.5	3.4	84.3	82.0	97%
W area Night	3.2	2.9	76.3	69.8	92%

Total window area across all units was reduced by around 7%. There was a significant reduction in the use in single clear glazing and a corresponding increase in the use of tinted, heavy tinted and low-e tinted glazing. Heavy tints and low-e tinted glazing were exclusively used on orientations with high solar gains such as east and west facing glazing. Window frame colours were made lighter. At 6-stars window frames were already assumed to be a light-medium colour.

No external blinds were used in part because of their high cost but also because the units all had balconies which provided some protection from solar gain. Management of solar heat gains could be sufficiently handled through the use of lower solar heat gain coefficient, i.e. tinted, windows.

1.2.7 Cairns Costs and Energy Bill Savings

A heterogeneous approach to rating was adopted, i.e. there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to average benefits for all units in the development for a variety of common appliance combinations and conditioned areas.

Most Class 1 dwellings in Darwin will likely have one or more reverse cycle space cooling appliances installed. The installation rate of air-conditioning installation in Northern Queensland is over 75%. Ducted cooling is less common, and may be even less common in Class 2, but may be installed in higher-end apartments. The results for Ducted Cooling systems are shown below but may not represent a significant proportion of dwellings.

Table 37 Financial analysis of benefits and costs for Class 2 dwellings in Cairns: Appliance Mix 1

Appliance Mix 1 : Financial Impacts	Reverse Cycle Space Heating & Cooling	
	Whole House	Living Areas Only
Cost per unit	$292.33	$292.33
Energy-saving per unit Total	$38.36	$18.40
Energy-saving per unit Heating	-$0.05	-$0.04
Energy-saving per unit Cooling	$38.41	$18.44
Increase to annual mortgage payments	$16.75	$16.75
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$21.62	$1.65
Net Present Value @ 7%	$219.13	-$47.05
Net Present Value @ 5%	$365.96	$23.37
Net Present Value @ 3%	$594.44	$132.94

Table 38 Financial analysis of benefits and costs for Class 2 dwellings in Cairns: Appliance Mix 2

Appliance Mix 2 : Financial Impact	Resistive Electric day rate Heating & Reverse Cycle Ducted Cooling	
	Whole House	Living Areas Only
Cost per unit	$292.33	$292.33
Energy-saving per unit	$52.53	$25.14
Energy-saving per unit Total	$52.53	$25.14
Energy-saving per unit Heating	-$0.19	-$0.17
Increase to annual mortgage payments	$16.75	$16.75
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$35.79	$8.40
Net Present Value @ 7%	$408.04	$42.87
Net Present Value @ 5%	$609.11	$139.10
Net Present Value @ 3%	$921.98	$288.84

1.2.8 Conclusion: Class 2 Cairns

Adoption of a 7-star average, 6-star minimum fabric requirement in Class 2 dwellings in similar climates to Cairns in Climate Zone 1 ***is recommended***:

- While the financial analysis shows that benefits are not as great as Darwin, average costs and benefits across the apartment building are positive in Cairns from almost every perspective.
- NPV at 7% is negative for apartments that only cool the living areas with space conditioners.
- Cairns is a hot-humid climate which makes sleeping at night difficult, particularly in apartments which have limited cross ventilation. While the use of ceiling fans helps, there will be many occasions where even ceiling fans do not allow comfortable conditions for sleeping.
- Multiple air conditioner ownership is high in Queensland so it is likely that some bedroom areas will be cooled.
- The impact on cash flow is positive, and the alternative investment analysis for the householder (NPV at 3%) is also positive.

2 NCC Climate Zone 2: Brisbane

As shown in Table 3 above, the rating of dwellings which achieve 7.0 stars with the current weather and star bands is virtually unchanged with the updated weather data and star bands. While ratings remained unchanged, there was a significant shift in the balance of heating and cooling loads toward cooling in Brisbane.

2.1 Class 1 Dwellings

2.1.1 Dwelling Costs

Table 39 Costs of improving building fabric from 6 to 7 stars in Class 1 in Brisbane

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost (per m^2)
SBH01	Slab	Large	Two	Detached	$520	$1.87
SBH01	Timber	Large	Two	Detached	$1,773	$6.37
SBH02	Slab	Large	One	Detached	$511	$1.97
SBH02	Timber	Large	One	Detached	$1,354	$5.21
SBH03	Slab	Medium	Two	Detached	$427	$2.29
SBH03	Timber	Medium	Two	Detached	$1,407	$7.53
SBH04	Slab	Medium	One	Detached	$513	$3.80
SBH04	Timber	Medium	One	Detached	$570	$4.23
SBH05	Slab	Small	One	Detached	$489	$3.49
SBH05	Timber	Small	One	Detached	$1,551	$11.07
SBH06	Slab	Small	One	Detached	$218	$2.15
SBH06	Timber	Small	One	Detached	$404	$4.00
SBH09	Slab	Small	One	Passive Solar BV	-$63	-$0.33
SBH17	Slab	Small	One	Semi-detached	$819	$9.10
SBH18	Timber	Small	One	Semi-detached	$89	$0.99
SBH19	Slab	Small	One	Passive Solar BV	-$115	-$0.74

Table 40 Summary of dwelling upgrade costs for Class 1 in Brisbane

House Type	Cost (total)	Cost (per m^2)
All	$654	$3.94
Non specialist	$718	$4.03
Specialist Designs	$283	$2.66

The cost of improving the NatHERS rating of a Class 1 building from 6-stars with the current weather data to 7-stars with the new weather data varies from around $1 to $11 per square metre, depending on how well the design of the dwelling is suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $4/$m^2$. In contrast, specialist well-oriented designs (main living areas face south) which are well suited to the Brisbane climate can achieve around $1.50/$m^2$ cost savings.

2.1.2 Brisbane: summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 41 Changes to Roof and Ceiling specifications needed to meet 7-stars in Brisbane

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	3.0	3.5
Area ceiling 1	125.2	125.2
R-value ceiling 2	0.9	1.0
Area ceiling 2	12.6	12.6
Area roof insulated (Attic)	2.8	2.8
Area roof uninsulated (Attic)	186.3	186.3
R-value roof blanket	R 1.3 in 1 house	R 1.3 in 1 house
R-value ceiling 3	1.0	1.3
Area roof insulated (Flat)	22.0	24.3
Area roof uninsulated (Flat)	11.2	8.8
Foil under roof?	88%	88%
Ventilated roof?	13%	13%
Roof colour	0.41	0.41

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased Ceiling R-values, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several potential areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation,
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

At 7-stars ceiling insulation levels were increased, on average, by around R0.5.

The table above shows that changes to roof/ceiling features at 7-stars were not large. Ceiling insulation levels increased, and lighter colours were used although the dwellings already used predominantly light roofs at 6-stars. In some cases, roof ventilation was added or reflective foil removed, but these features remained substantially the same at 6- and 7-stars.

Table 42 Changes to External and Internal wall and floor specifications needed to meet 7-stars in Brisbane

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	81%	100%
R-value walls	R 2	R 2.03
Proportion of walls insulated	89%	85%
Area walls uninsulated	31.5	23.9
Area walls insulated (Garage and roof space)	3.1	3.1
Area walls uninsulated (Garage and roof space)	25.5	25.5
Foil layer walls?	63%	44%
If yes emissivity	0.1	0.2
Wall colour (Solar Abs)	0.45	0.45
Internal Walls		
No dwellings with insulated internal walls	15	16
R-value	1.9	1.9
Insulated area	32.2	33.6
Floors		
Area floor insulated	18.6	25.0
Waffle pod?	13%	13%
R-value floor	0.0	0.0
Foil underfloor?	0%	0%
R-value subfloor walls	3 Houses Average R: 1	5 Houses Average R: 1
Area subfloor walls insulated	32.7	32.7
Area ceramic tile floor surface	41.4	40.4

All the dwellings used Brick Veneer walls except the two specialist designed houses which used some framed walls. At 6-stars, some walls did not need to use bulk insulation. But all walls were required to be insulated at 7-stars.

No change to wall colour was needed to achieve 7-stars, and walls were assumed to be a medium colour.

The wall to the garage was required to be insulated to achieve 7-stars, although this was also needed at 6-stars.

Floors over enclosed subfloor spaces were not required to be insulated because this would increase cooling requirements in Brisbane. Five timber-floored dwellings were required to insulate their subfloor walls at 7-stars, an increase of one. Subfloor wall insulation is less effective than underfloor insulation in reducing heating energy demand. Subfloor wall insulation improves both heating and cooling performance, costs less than full underfloor insulation and, while it is not in common use, is a useful additional design strategy in this climate. Subfloor wall insulation must not be affected by moisture and must not cover required floor vents.

Table 43 Changes to Ceiling fan and Window specifications needed to meet 7-stars in Brisbane

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	0.8	0.3
No. 1200	2.8	2.1
No. 1400	0.7	3.1
Windows		
Area single glazed clear	32.1	28.4
Area single low e	1.1	0.8
Area single glazed tinted	0.0	0.0
Area single glazed heavy tinted	0.0	0.0
Area single low e tint	3.1	4.3
Area double glazed argon fill low e	0.0	0.2
Total Window Area	39.9	38.0
Frame colour (abs)	0.43	0.40
Area external Blinds	0.0	0.0
Highly openable windows louvre	1 x Houses 37.9 m2	1 x Houses 37.9 m2
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre tint H	NA	NA
Highly openable windows louvre low e	1 x Houses 3.6 m2	1 x Houses 14.9 m2
Highly openable windows louvre low e tint	1 x Houses 16.4 m2	1 x Houses 16.4 m2

In 7-star dwellings more ceiling fans were installed at 7-stars (an increase from 4 to 5). Ceiling fan diameter was also increased to improve the impact of the fans.

The total window area at 7-stars was reduced by around 5%. The majority of windows in 6-star dwellings were able to use single clear glazing, with a small area of single tinted and low-e tinted glazing. One of the specialist designed dwellings all used some areas of louvre windows.

At 7-stars, the area of single low-e tinted windows was slightly increased. Lighter window frame colours were used in some dwellings.

2.1.3 Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 44 Cooling and heating energy bill savings for various appliances and area of dwelling conditioned

		Heating Savings						Cooling Savings			
		Whole House			Living Areas only			Whole House		Living areas only	
House No	Floor-type	AC Heat	Resistive Elec	AC Heat Duct	AC Heat	Resistive Elec	AC Heat Duct	AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
01	SLA	$3	$10	$4	$2	$6	$2	$29	$40	$18	$24
01	TIM	$2	$8	$3	$0	$1	$0	$23	$31	$17	$24
02	SLA	-$0	-$1	-$0	-$2	-$7	-$3	$16	$22	$14	$19
02	TIM	$7	$27	$10	$7	$24	$9	$22	$30	$13	$18
03	SLA	$4	$14	$5	$3	$9	$3	$15	$20	$11	$15
03	TIM	$6	$24	$9	$6	$21	$8	$14	$19	$13	$18
04	SLA	$4	$15	$6	$3	$13	$5	$13	$18	$12	$16
04	TIM	$5	$18	$7	$4	$14	$5	$13	$17	$11	$14
05	SLA	$2	$8	$3	$2	$6	$2	$14	$19	$9	$13
05	TIM	$1	$5	$2	$1	$5	$2	$17	$23	$11	$16
06	SLA	$3	$10	$4	$2	$9	$3	$6	$8	$5	$6
06	TIM	$2	$8	$3	$2	$7	$3	$8	$11	$8	$11
09	SLA	$4	$15	$5	$3	$11	$4	$16	$21	$15	$20
17	SLA	$8	$28	$11	$5	$17	$6	$6	$8	$6	$8
18	TIM	$0	$1	$0	$0	$0	$0	$11	$15	$10	$14
19	SLA	$1	$5	$2	-$1	-$4	-$1	$23	$32	$12	$17

Note that heating energy is increased in some circumstances (red values). The increase in heating energy occurs because:

- In improving the rating to 7 stars, the energy rating improvement has focused on cooling which is the largest energy load, and
- In the work-day occupancy profile, heating and cooling are not applied from 9 am till 6 pm. Energy savings during the day in the NatHERS rating are therefore not counted.

The table below shows the combined heating and cooling annual energy savings using the most common appliance combinations:

- Reverse Cycle heating/cooling space conditioning (whole house and living areas only)
- Reverse Cycle heating/cooling space conditioning to living areas and resistive electric heating in bedrooms, and
- Whole house heating and cooling using a ducted reverse cycle system.

2.1.3.1 Energy Bill savings for common appliance combinations

The table below shows the total heating and cooling energy savings for the most common space conditioning appliance combinations in the Brisbane climate.

Table 45 Space conditioning energy bill savings for common space conditioning appliances

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only RC Space	Living areas RC, resistive heating to bedrooms	Whole House RC Ducted
SBH01	Slab	$32	$29	$33	$44
SBH01	Timber	$25	$23	$29	$34
SBH02	Slab	$16	$16	$23	$22
SBH02	Timber	$29	$22	$24	$40
SBH03	Slab	$19	$15	$20	$26
SBH03	Timber	$20	$14	$17	$28
SBH04	Slab	$17	$13	$15	$23
SBH04	Timber	$17	$13	$16	$24
SBH05	Slab	$16	$14	$16	$22
SBH05	Timber	$18	$17	$17	$25
SBH06	Slab	$9	$6	$7	$12
SBH06	Timber	$10	$8	$9	$14
SBH09	Slab	$20	$16	$19	$27
SBH17	Slab	$13	$6	$17	$18
SBH18	Timber	$11	$11	$12	$16
SBH19	Slab	$24	$23	$31	$33

2.1.3.2 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 46 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Brisbane

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House	Living areas only	Living areas, resistive heating to bedrooms	Whole House
SBH01	Slab	-$5	-$8	-$4	$7
SBH01	Timber	-$77	-$79	-$72	-$68
SBH02	Slab	-$17	-$16	-$10	-$11
SBH02	Timber	-$49	-$56	-$53	-$38
SBH03	Slab	-$14	-$18	-$13	-$7
SBH03	Timber	-$72	-$79	-$76	-$65
SBH04	Slab	-$16	-$20	-$17	-$9
SBH04	Timber	-$24	-$29	-$25	-$17
SBH05	Slab	-$19	-$21	-$19	-$13
SBH05	Timber	-$71	-$72	-$72	-$64
SBH06	Slab	-$10	-$13	-$12	-$7
SBH06	Timber	-$16	-$19	-$17	-$13
SBH09	Slab	-$1	-$5	-$1	$6
SBH17	Slab	-$34	-$41	-$30	-$29
SBH18	Timber	-$16	-$16	-$16	-$12
SBH19	Slab	-$4	-$6	$3	$5

Cash flow impacts for building fabric improvements for the householder is negative for almost all cases. The amount is small (worst case -$79) and may be offset by other aspects of the Whole of Home measures.

2.1.3.3 The net present value of building fabric induced energy savings versus capital cost

The table below shows the Net Present Value of energy savings discounted at 7% over 40 years less the cost of building fabric improvements. Figures in red indicate that the net present value is negative, i.e., the discounted value of energy savings over 40 years is less than the value of the capital cost of improvements required to achieve 7-stars. A 7% real discount rate is the policy evaluation metric recommended for this project by the OBPR.

Table 47 Net Present Value of Cost and Benefits at 7% discount rate over 40 years, Class 1 in Brisbane

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House	Living areas only	Living areas, resistive heating to bedrooms	Whole House
SBH01	Slab	-$217	-$252	-$201	-$59
SBH01	Timber	-$1,444	-$1,472	-$1,383	-$1,321
SBH02	Slab	-$356	-$354	-$264	-$276
SBH02	Timber	-$967	-$1,063	-$1,032	-$822
SBH03	Slab	-$329	-$380	-$315	-$236
SBH03	Timber	-$1,345	-$1,431	-$1,389	-$1,244
SBH04	Slab	-$346	-$400	-$367	-$262
SBH04	Timber	-$487	-$551	-$507	-$401
SBH05	Slab	-$393	-$421	-$398	-$312
SBH05	Timber	-$1,312	-$1,330	-$1,330	-$1,222
SBH06	Slab	-$217	-$252	-$241	-$174
SBH06	Timber	-$328	-$358	-$340	-$277
SBH09	Slab	-$101	-$153	-$103	-$4
SBH17	Slab	-$642	-$745	-$596	-$576
SBH18	Timber	-$329	-$332	-$322	-$272
SBH19	Slab	-$174	-$191	-$80	-$53

Net Present Value at a 7% discount rate for building fabric improvements for the householder is negative for almost all cases. The amount is small and may be offset by other aspects of the Whole of Home measures.

2.1.3.4 The net present value of costs and benefits: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 48 Net Present Value of costs and benefits at 3% discount rate

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House	Living areas only	Living areas, resistive heating to bedrooms	Whole House
SBH01	Slab	$94	$33	$121	$367
SBH01	Timber	-$1,203	-$1,250	-$1,097	-$990
SBH02	Slab	-$198	-$195	-$39	-$60
SBH02	Timber	-$682	-$849	-$796	-$432
SBH03	Slab	-$146	-$236	-$122	$15
SBH03	Timber	-$1,146	-$1,294	-$1,222	-$970
SBH04	Slab	-$180	-$274	-$216	-$33
SBH04	Timber	-$317	-$427	-$352	-$167
SBH05	Slab	-$234	-$282	-$242	-$94
SBH05	Timber	-$1,136	-$1,167	-$1,167	-$981
SBH06	Slab	-$133	-$193	-$175	-$58
SBH06	Timber	-$228	-$280	-$249	-$140
SBH09	Slab	$90	-$0	$87	$259
SBH17	Slab	-$512	-$690	-$432	-$398
SBH18	Timber	-$217	-$223	-$207	-$120
SBH19	Slab	$64	$35	$228	$274

Net Present Value at a 3% discount rate for building fabric improvements for the householder is negative for almost all cases. The amount is small and may be offset by other aspects of the Whole of Home measures.

2.1.4 Conclusion: Class 1 Brisbane

Based on the costs and benefits of building fabric improvements and energy savings to the consumer alone, increasing the NCC requirements in Climate Zone 2 ***cannot be cost effective***. However, other factors may make the adoption of 7-stars an appropriate policy option:

- The impact on householder cash flow is small: no worse than a cup of coffee a month in most cases,
- The benefits of Whole of Home requirements including the requirement for the installation of PV will more than offset the negative impacts of building fabric,
- Where a rating offset of 1.0 stars is available for an outdoor living area, 6-stars is, in effect, the actual standard, and
- Not all benefits have been evaluated:
    - 7-star dwellings will have lower peak loads. Lower peak loads provide savings to both the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
    - 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
    - 7-star dwellings will provide greater resilience to climate change. In Brisbane, this particularly true with the updated weather data which has significantly shifted the balance of heating and cooling loads in Brisbane toward cooling.

Whether these factors have sufficient weight to offset the negative impacts of the building fabric upgrade is a policy decision for government.

2.2 Class 2 dwellings

2.2.1 Dwelling Costs

Table 49 Costs of improving building fabric from 6 to 7 stars in Class 2 in Brisbane

House Number	Floor-type	Position	Cost (total)	Cost (/m^2)
SBA01	Slab	Corner	$601	$6.29
SBA02	Slab	Middle	$337	$3.77
SBA03	Slab	Corner	$419	$4.39
SBA04	Slab	Middle	$1,191	$13.32
SBA05	Slab	Corner	$504	$5.28
SBA06	Slab	Middle	$1,528	$17.09
SBA07	Slab	Corner	$692	$7.24
SBA08	Slab	Middle	$160	$1.78
SBA11*	Slab	Corner	$0	$0.00
SBA12*	Slab	Middle	$0	$0.00
SBA13*	Slab	Corner	$0	$0.00
SBA14*	Slab	Middle	$0	$0.00
SBA15*	Slab	Corner	$0	$0.00
SBA16	Slab	Middle	$540	$6.04
SBA17	Slab	Corner	$215	$2.25
SBA18	Slab	Middle	$552	$6.17
SBA21	Slab	Corner	$998	$10.45
SBA22	Slab	Middle	$780	$8.72
SBA23	Slab	Corner	$734	$7.68
SBA24	Slab	Middle	$940	$10.51
SBA25	Slab	Corner	$554	$5.80
SBA26	Slab	Middle	$339	$3.79
SBA27	Slab	Corner	$419	$4.39
SBA28	Slab	Middle	$403	$4.51

* Note these units did not need to be altered to increase the rating to an average 7-stars

Table 50 Summary of dwelling upgrade costs for Class 2 in Brisbane

Summary	Cost
Building-wide cost	$11,906.46
Cost per unit	$496.10
Cost per m2	$5.37

The cost of improving the NatHERS ratings of a Class 2 building from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the new weather data varies from around $1 to $17 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $5/$m^2$.

2.2.2 Brisbane: Changes to design and specification Class 2

Table 51 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans in Brisbane

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling 1	3.1	3.5			112%
Area ceiling 1	92.4	92.4	739.1	739.1	Nil
External Walls	**Per unit**		**Whole Building**		
R-value walls	0.9	0.9			0.04
Area walls insulated	19.4	20.6	466	494	106%
Area walls uninsulated	18.5	17.4			94%
Wall colour	0.45	0.41			93%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.0	0.0			Nil
Insulated area	0.0	0.0			Nil
Floors	**Per unit**		**Whole Building**		
Area floor insulated	92.5	92.5	740	740	Nil
R-value floor	1.50	1.63			108%
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	0.4	0.2	9	4	-5
No. 1200	2.5	1.8	61	42	-19
No. 1400	0.5	2.0	13	48	35

Roof/ceiling insulation levels increased at 7-stars by around R-0.4.

Wall insulation R-values remained the same although some units which did not require wall insulation at 6-stars had to include wall insulation at 7-stars. Not all units were required to install wall insulation at 7-stars. These were generally units which had lower solar exposure orientations.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show a significant increase over the current assumption.

All dwellings over the car park required floor insulation to achieve 7-stars. Note that the car park is assumed to be unenclosed. If the car park were enclosed, the rating would be increased, and the extent of change to design and specifications would be reduced.

There was a significant increase in both the number and diameter of ceiling fans used to increase the rating from 6 (min 5) to 7 (min 6) stars.

Table 52 Changes to building design and specification to increase stringency: Windows in Brisbane

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	19.2	8.8	461.8	210.1	45%
Area single low e	0.0	0.0	0.0	0.0	Nil
Area single glazed tinted	2.9	4.9	68.9	118.4	172%
Area single glazed heavy tinted	1.7	2.4	41.0	57.5	140%
Area single low e tint	1.9	7.2	44.7	171.8	384%
Area double glazed argon fill low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre	0.1	0.3	2.7	6.8	250%
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.2	0.1	4.4	3.2	71%
Highly openable windows louvre low e tint	0.0	0.0	0.0	0.0	Nil
Total Window Area	**26.0**	**23.7**	**623.6**	**567.7**	**91%**
Frame colour (abs)	0.4	0.4			86%
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	3.7	3.5	88.1	84.6	96%
E area Day	3.2	2.9	77.0	70.3	91%
S area Day	3.2	2.9	76.3	68.5	90%
W area Day	3.0	2.8	72.5	67.6	93%
N area Night	3.6	3.5	87.5	83.2	95%
E area Night	2.8	2.5	68.1	60.2	88%
S area Night	3.2	2.8	77.2	67.7	88%
W area Night	2.9	2.5	70.4	59.1	84%

Total window area across all units was reduced by around 9%. There was a significant reduction in the use in single clear glazing and a corresponding increase in the use of tinted, heavy tinted and low-e tinted glazing. Heavy tints and low-e tinted glazing were exclusively used on orientations with high solar gains such as east and west facing glazing. Window frame colours were unchanged. At 6-stars window frames were already assumed to be a light-medium colour.

No external blinds were used in part because of their high cost but also because the units all had balconies which provided some protection from solar gain. Management of solar heat gains could be sufficiently handled through the use of lower solar heat gain coefficient, i.e. tinted, windows.

2.2.3 Energy Bill Savings

The extent of improvement costs for individual units varied significantly. This variation is in part because a heterogeneous approach to rating was adopted, i.e. there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to average benefits for all units in the development for a variety of common appliance combinations and conditioned areas.

Table 53 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 1 : Financial Impacts	Reverse Cycle Heating & Reverse Cycle Cooling	
	Whole House	Living Areas Only
Cost per unit	$496.10	$496.10
Energy-saving per unit Total	$15.43	$8.35
Energy-saving per unit Heating	$0.46	$0.36
Energy-saving per unit Cooling	$14.97	$7.99
Increase to annual mortgage payments	$28.42	$28.42
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	-$12.99	-$20.07
Net Present Value @ 7%	-$290.36	-$384.73
Net Present Value @ 5%	-$231.29	-$352.75
Net Present Value @ 3%	-$139.38	-$303.00

Table 54 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 2

Appliance Mix 2 : Financial Impact	Reverse Cycle Ducted Heating & Reverse Cycle Ducted Cooling	
	Whole House	Living Areas Only
Cost per unit	$496.10	$496.10
Energy-saving per unit	$21.18	$11.47
Energy-saving per unit Total	$21.18	$11.47
Energy-saving per unit Heating	$0.63	$0.49
Increase to annual mortgage payments	$28.42	$28.42
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	-$7.24	-$16.95
Net Present Value @ 7%	-$213.70	-$343.23
Net Present Value @ 5%	-$132.63	-$299.34
Net Present Value @ 3%	-$6.48	-$231.05

2.2.4 Conclusion: Class 2 Brisbane

Based on the costs and benefits of building fabric improvements and energy savings to the consumer alone, increasing the NCC requirements in Climate Zone 2 ***cannot be supported***. However, other factors may make the adoption of 7-stars an appropriate policy option:

- The impact on householder cash flow is small: no worse than a cup of coffee a month in most cases,
- The benefits of Whole of Home requirements may offset the negative impacts of building fabric,
- Where a rating offset of 1.0 stars is available for an outdoor living area, 6-stars is, in effect, the actual standard, and
- Not all benefits have been evaluated:
    - 7-star dwellings will have lower peak loads. The lower peak load results in savings to the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
    - 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
    - 7-star dwellings will provide greater resilience to climate change. ThIn Brisbane, this is particularly true because the updated weather data which has significantly shifted the balance of heating and cooling loads toward cooling.

Whether these factors have sufficient weight to offset the negative impacts of the building fabric upgrade is a policy decision for government.

3 NCC Climate Zone 3: Longreach

As shown in Table 3 above, changes to the star bands for the updated and improved weather data mean that houses that were formerly 7.0 stars now achieve a rating of around 7.3 stars in Longreach This has reduced the cost of achieving 7-stars. It has also reduced the energy-saving benefits. Both factors are accounted for in the results shown below.

3.1 Class 1 Dwellings

3.1.1 Dwelling Costs

Table 55 Costs of improving building fabric from 6 to 7 stars in Class 1 in Longreach

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost (/m^2)
SBH01	Slab	Large	Two	Detached	$689	$2.49
SBH01	Timber	Large	Two	Detached	$886	$3.20
SBH02	Slab	Large	One	Detached	$473	$1.82
SBH02	Timber	Large	One	Detached	$889	$3.42
SBH03	Slab	Medium	Two	Detached	$2,668	$14.28
SBH03	Timber	Medium	Two	Detached	$3,532	$18.91
SBH04	Slab	Medium	One	Detached	$542	$4.02
SBH04	Timber	Medium	One	Detached	$964	$7.16
SBH05	Slab	Small	One	Detached	$586	$4.02
SBH05	Timber	Small	One	Detached	$1,043	$7.14
SBH06	Slab	Small	One	Detached	$589	$5.83
SBH06	Timber	Small	One	Detached	$3,252	$32.18
SBH09	Slab	Small	Elevated	Tropical detached	$706	$3.72
SBH15	Slab	Small	One	Semi-detached	$567	$6.05
SBH15	Timber	Small	One	Semi-detached	$470	$5.03
SBH19	Slab	Small	One	Passive solar hybrid	$737	$4.56

Table 56 Summary of dwelling upgrade costs for Class 1 in Longreach

Type of Dwelling	Total average cost	Average cost per m^2
All	$1,190	$7.95
Non tropical	$1,316	$8.73
Specialist Designs	$584	$3.90

The cost of improving the NatHERS rating of a Class 1 dwelling from 6-stars with the current weather data to 7-stars with the new weather data varies from around $2 to $32 per square metre, depending on how well the design of the dwelling is suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $9/m^2. In contrast, specialist well-oriented designs (main living areas face south) which are well suited to the Darwin climate can achieve around $4/m2 cost savings.

Two-storey and timber floored poorly oriented Class 1 dwellings have the highest costs.

3.1.2 Longreach: summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 57 Changes to Roof and Ceiling specifications needed to meet 7-stars in Longreach

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	2.7	3.4
Area ceiling 1	125.2	125.2
R-value ceiling 2	0.1	0.1
Area ceiling 2	4.9	4.9
Area roof insulated (Attic)	7.8	7.8
Area roof uninsulated (Attic)	189.4	189.4
R-value roof blanket	R 1.4 in 2 houses	R 1.4 in 2 houses
R-value ceiling 3	1.1	1.3
Area roof insulated (Flat)	61.2	61.2
Area roof uninsulated (Flat)	8.6	8.6
Foil under roof?	100%	100%
Ventilated roof?	50%	50%
Roof colour	0.33	0.31

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased Ceiling R-values, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation,
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

At 7-stars ceiling insulation levels were increased, on average, by around R0.7.

The table above shows that upgrading to 7-stars did not require large changes to roof/ceiling features. Ceiling insulation levels increased, and some lighter colours were used although the dwellings already used predominantly light roofs at 6-stars. The use of roof ventilation and reflective foil under roofs remained the same at 6- and 7-stars.

Table 58 Changes to External and Internal wall and floor specifications needed to meet 7-stars in Longreach

Roof colour	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	19%	25%
R-value walls	R 1.3	R 1.3
Proportion of walls insulated	38%	32%
Area walls uninsulated	157.7	155.6
Area walls insulated (Garage and roof space)	0.0	0.0
Area walls uninsulated (Garage and roof space)	11.3	11.3
Foil layer walls?	0%	0%
If yes emissivity	None	None
Wall colour (Solar Abs)	0.38	0.35
Internal Walls		
No dwellings with insulated internal walls	4	4
R-value	1.3	1.3
Insulated area	16.6	16.6
Floors		
Area floor insulated	0.0	0.0
Waffle pod?	0%	0%
R-value floor	0.0	0.0
Foil underfloor?	0%	0%
R-value subfloor walls	3 Houses Average R: 1	6 Houses Average R: 1.2
Area subfloor walls insulated	30.7	30.0
Area ceramic tile floor surface	78.7	80.0

All the dwellings used concrete block walls except the two specialist designed houses which used framed walls as consistent the principles of good tropical design. These walls were insulated at both 6- and 7-stars. Only one dwelling with Concrete Block walls required wall insulation to some of its walls to achieve 7-stars.

Lighter coloured walls were used on average at 6 stars, and slightly lighter colours were used at 7-stars.

The wall to the garage was not required to be insulated to achieve 7-stars. The proposed elemental provisions would require garage walls to be insulated, which demonstrates the additional flexibility that using a NatHERS simulation provides.

Floors over enclosed subfloor spaces were not required to be insulated because this would increase cooling requirements in Longreach. Six timber floored dwellings were required to insulate their subfloor walls. Subfloor wall insulation must not be affected by moisture and must not cover required subfloor vents.

Table 59 Changes to Ceiling fan and Window specifications needed to meet 7-stars in Longreach

Area ceramic tile floor surface	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	0.3	0.4
No. 1200	4.1	2.1
No. 1400	0.5	3.2
Windows		
Area single glazed clear	27.0	21.7
Area single low e	0.0	0.0
Area single glazed tinted	1.1	1.0
Area single glazed heavy tinted	0.9	2.6
Area single low e tint	11.0	13.3
Area double glazed argon fill low e	0.0	0.0
Total Window Area	40.2	39.0
Frame colour (abs)	0.38	0.32
Area external Blinds	0.0	0.0
Highly openable windows louvre	1 x Houses 1.6 m2	1 x Houses 1.6 m2
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre tint H	NA	NA
Highly openable windows louvre low e	NA	NA
Highly openable windows louvre low e tint	1 x Houses 3.2 m2	1 x Houses 3.2 m2

In 7-star dwellings, ceiling fan diameter was also increased to improve the impact of the fans.

The total window area at 7-stars was reduced by around 3%. The majority of windows in 6-star dwellings were able to use single clear glazing, with a small area of single tinted and low e tinted glazing. The specialist designed dwellings all used some areas of louvre windows. At 7-stars the area of tinted windows was slightly increased, and window frame colour was lighter.

3.1.3 Longreach Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on Flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 60 Heating and cooling energy bill savings for various appliances and area of dwelling conditioned

		Heating Savings						Cooling Savings			
		Whole House			Living Areas only			Whole House		Living areas only	
House No	Floor-type	AC Heat	Resistive Elec	Wood	AC Heat	Resistive Elec	Wood	AC Cool	Evap Cool	AC Cool	Evap Cool
01	SLA	$7	$25	$12	$8	$29	$14	$102	$38	$86	$32
01	TIM	$10	$37	$18	$9	$34	$16	$90	$33	$81	$30
02	SLA	$14	$50	$24	$12	$45	$22	$73	$27	$73	$27
02	TIM	$0	$0	$0	$1	$4	$2	$80	$30	$89	$33
03	SLA	-$6	-$22	-$11	-$1	-$5	-$2	$116	$43	$113	$42
03	TIM	$23	$85	$41	$17	$63	$30	$107	$40	$83	$31
04	SLA	$1	$3	$1	$1	$4	$2	$51	$19	$60	$22
04	TIM	-$14	-$53	-$26	-$9	-$32	-$16	$76	$28	$82	$30
05	SLA	$6	$22	$11	$6	$23	$11	$69	$26	$69	$25
05	TIM	$9	$34	$16	$9	$33	$16	$71	$26	$50	$18
06	SLA	$2	$6	$3	$1	$4	$2	$29	$11	$34	$13
06	TIM	$4	$13	$6	$3	$12	$6	$53	$20	$71	$26
09	SLA	$3	$12	$6	$4	$13	$6	$81	$30	$57	$21
15	SLA	-$3	-$11	-$5	-$2	-$6	-$3	$32	$12	$32	$12
15	TIM	-$0	-$1	-$1	$1	$2	$1	$43	$16	$61	$23
19	SLA	-$1	-$2	-$1	$0	$2	$1	$90	$33	$40	$15

Note that heating energy is increased in some circumstances (red values). The increase in heating occurred because:

- In improving the rating to 7 stars, the energy rating improvement has focused on cooling which is the largest energy load, and
- In the work-day occupancy profile, heating and cooling are not applied from 9 am till 6 pm. Energy savings during the day in the NatHERS rating are therefore not counted.

The table below shows the combined heating and cooling annual energy savings using the most common appliance combinations:

- Reverse Cycle heating/cooling space conditioning (whole house and living areas only)
- Reverse Cycle heating/cooling space conditioning to living areas and resistive electric heating in bedrooms, and
- Whole house heating and cooling using a ducted reverse cycle system.

3.1.3.1 Energy Bill savings for common appliance combinations

The table below shows the total heating and cooling energy savings for the most common space conditioning appliance combinations in the Longreach climate.

Table 61 Space conditioning energy bill savings for common space conditioning appliances

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only RC Space	Living areas RC, resistive heating to bedrooms	Evaporative Cool, electric plug-in heat
SBH01	Slab	$108	$94	$90	$66
SBH01	Timber	$100	$90	$94	$67
SBH02	Slab	$86	$85	$90	$72
SBH02	Timber	$80	$90	$86	$34
SBH03	Slab	$110	$111	$94	$38
SBH03	Timber	$130	$100	$121	$103
SBH04	Slab	$52	$61	$60	$23
SBH04	Timber	$61	$73	$53	$28
SBH05	Slab	$75	$75	$74	$49
SBH05	Timber	$80	$59	$60	$59
SBH06	Slab	$31	$35	$37	$15
SBH06	Timber	$57	$74	$76	$31
SBH09	Slab	$84	$61	$59	$43
SBH17	Slab	$29	$30	$26	$6
SBH18	Timber	$42	$62	$58	$18
SBH19	Slab	$90	$41	$37	$35

3.1.3.2 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 62 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Longreach

		Space Conditioning			Ducted conditioning
House Number	Floor-type	RC to the Whole House	RC to Living areas only	RC to Living areas, resistive heating to bedrooms	Evaporative Cool, electric plug-in heat
SBH01	Slab	$69	$54	$51	$56
SBH01	Timber	$49	$40	$43	$50
SBH02	Slab	$59	$58	$63	$90
SBH02	Timber	$30	$39	$35	-$12
SBH03	Slab	-$50	-$49	-$66	-$127
SBH03	Timber	-$76	-$107	-$85	-$40
SBH04	Slab	$21	$30	$29	-$4
SBH04	Timber	$6	$18	-$3	-$60
SBH05	Slab	$42	$41	$40	$38
SBH05	Timber	$20	-$1	$0	$31
SBH06	Slab	-$3	$1	$3	-$14
SBH06	Timber	-$129	-$112	-$110	-$143
SBH09	Slab	$52	$28	$27	$24
SBH17	Slab	-$3	-$2	-$7	-$33
SBH18	Timber	$15	$35	$31	-$7
SBH19	Slab	$47	-$2	-$5	-$5

Cash flow impacts for building fabric improvements for the householder is generally positive except in houses SBH03 and 06 and where evaporative cooling is used.

Longreach is an inland climate, and while Evaporative Cooling is not common in Queensland in general, may be more prevalent in Longreach. Evaporative cooling is highly efficient, but it does not provide the same level of comfort that refrigerative cooling provides.

The amount is small (worst case -$127, but generally much lower) and may be offset by other aspects of the Whole of Home measures.

3.1.3.3 The net present value of building fabric induced energy savings versus capital cost

The table below shows the Net Present Value of energy savings discounted at 7% over 40 years less the cost of building fabric improvements. Figures in red indicate that the net present value is negative, i.e., the discounted value of energy savings over 40 years is less than the value of the capital cost of improvements required to achieve 7-stars. A 7% real discount rate is the policy evaluation metric recommended for this project by the OBPR.

Table 63 Net Present Value of Cost and Benefits at 7% discount rate over 40 years, Class 1 in Climate

		Space Conditioning			Ducted conditioning
House Number	Floor-type	RC to the Whole House	RC to Living areas only	RC to Living areas, resistive heating to bedrooms	Evaporative Cool, electric plug-in heat
SBH01	Slab	$756	$562	$515	$579
SBH01	Timber	$444	$319	$365	$459
SBH02	Slab	$676	$660	$727	$1,094
SBH02	Timber	$184	$309	$253	-$375
SBH03	Slab	-$1,323	-$1,307	-$1,534	-$2,353
SBH03	Timber	-$1,869	-$2,272	-$1,981	-$1,389
SBH04	Slab	$150	$274	$261	-$188
SBH04	Timber	-$148	$15	-$264	-$1,023
SBH05	Slab	$417	$411	$401	$366
SBH05	Timber	$21	-$260	-$242	$173
SBH06	Slab	-$178	-$120	-$101	-$332
SBH06	Timber	-$2,492	-$2,259	-$2,236	-$2,681
SBH09	Slab	$562	$245	$228	$192
SBH17	Slab	-$175	-$166	-$224	-$574
SBH18	Timber	$91	$355	$308	-$205
SBH19	Slab	$756	$562	$515	-$244

Net Present Value at a 7% discount rate for building fabric improvements for the householder is positive for around 2/3's of cases. The negative amounts are generally small and may be offset by other aspects of the Whole of Home measures. The exceptions are SBH03 and SBH06 on a timber floor. These two dwellings may be examples of designs that are simply not suited to the Longreach climate. Because similar dwellings have shown much lower costs, builders will have the option of developing new designs which avoid the higher costs associated with SBH03 and 04.

3.1.3.4 The net present value of costs and benefits: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 64 Net Present Value of costs and benefits at 3% discount rate

		Space Conditioning			Ducted conditioning
House Number	Floor-type	RC to the Whole House	RC to Living areas only	RC to Living areas, resistive heating to bedrooms	Evaporative cooling, no heating
SBH01	Slab	$1,817	$1,479	$1,398	$1,510
SBH01	Timber	$1,420	$1,203	$1,282	$1,446
SBH02	Slab	$1,519	$1,491	$1,608	$2,244
SBH02	Timber	$972	$1,188	$1,091	$2
SBH03	Slab	-$245	-$218	-$612	-$2,031
SBH03	Timber	-$598	-$1,297	-$793	$233
SBH04	Slab	$658	$874	$851	$73
SBH04	Timber	$450	$733	$250	-$1,066
SBH05	Slab	$1,153	$1,142	$1,126	$1,065
SBH05	Timber	$801	$314	$346	$1,065
SBH06	Slab	$123	$225	$257	-$143
SBH06	Timber	-$1,935	-$1,530	-$1,490	-$2,262
SBH09	Slab	$1,388	$839	$809	$748
SBH17	Slab	$113	$128	$27	-$579
SBH18	Timber	$503	$961	$879	-$11
SBH19	Slab	$1,337	$203	$113	$119

The Net Present Value of costs and benefits at a 3% discount rate for the householder generally positive for almost all cases. Where NPV is negative, the amount is small and may be offset by other aspects of the Whole of Home measures, or an alternative lower compliance cost design may be used.

At 3% discount rate the NPV shows significantly larger benefits and smaller disbenefits than at 7%. Note that if a 7% investment return was available after-tax and assuming a real growth in energy prices as shown in AEMO, 2015, NPV would be similar to the values shown above.

3.1.4 Conclusion: Class1, Longreach

While some dwelling designs show that costs exceed benefits, on the whole, the balance of benefits exceeds costs, ***adopting 7-stars for Climate Zone 3 is therefore recommended***.

The fact that there are dwelling designs which have positive financial impacts and others which do not suggests that there is significant scope for improving dwelling design to achieve 7-stars in Longreach for lower costs. The Whole of Home measures may also offset higher costs for those dwellings where building fabric costs exceeded energy-saving benefits.

Furthermore, there are benefits which have not been evaluated in this report:

- 7-star dwellings will have lower peak loads. Lower peak loads provide a saving to the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
- 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
- 7-star dwellings will provide greater resilience to climate change.

3.2 Class 2 dwellings

3.2.1 Dwelling Costs

Table 65 Costs of improving building fabric from 6 to 7 stars in Class 2 in Longreach

House Number	Floor-type	Position	Cost (total)	Cost (/m^2)
SBA01	Slab	Corner	$393	$4.11
SBA02	Slab	Middle	$94	$1.05
SBA03	Slab	Corner	$320	$3.35
SBA04	Slab	Middle	$661	$7.39
SBA05	Slab	Corner	$941	$9.85
SBA06	Slab	Middle	$351	$3.93
SBA07*	Slab	Corner	$0	$0.00
SBA08	Slab	Middle	$1,647	$18.42
SBA11*	Slab	Corner	$0	$0.00
SBA12*	Slab	Middle	$0	$0.00
SBA13	Slab	Corner	$828	$8.67
SBA14*	Slab	Middle	$0	$0.00
SBA15	Slab	Corner	$1,308	$13.69
SBA16	Slab	Middle	$315	$3.52
SBA17	Slab	Corner	$237	$2.48
SBA18	Slab	Middle	$772	$8.63
SBA21	Slab	Corner	$222	$2.32
SBA22	Slab	Middle	$385	$4.31
SBA23	Slab	Corner	$638	$6.68
SBA24	Slab	Middle	$1,607	$17.97
SBA25	Slab	Corner	$324	$3.39
SBA26	Slab	Middle	$0	$0.00
SBA27	Slab	Corner	$272	$2.84
SBA28	Slab	Middle	$789	$8.82

* Note these units did not need to be altered to increase the rating to an average 7-stars

Table 66 Summary of dwelling upgrade costs for Class 2 in Longreach

Building-wide cost	Cost
Building-wide cost	$12,101
Cost per unit	$504
Cost per m2	$5.45

The cost of improving the NatHERS ratings of a Class 2 dwelling from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the new weather data varies from around $2 to $18 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $5/$m^2$.

3.2.2 Longreach: Changes to design and specification Class 2

Table 67 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans in Longreach

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling 1	3.0	3.1			104%
Area ceiling 1	92.2	92.2	737.7	737.7	Nil
External Walls	**Per unit**		**Whole Building**		
R-value walls	0.5	0.6			0.13
Area walls insulated	21.8	24.6	524	589	112%
Area walls uninsulated	16.1	13.4			83%
Wall colour	0.52	0.41			80%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.0	0.0			Nil
Insulated area	0.0	0.0			Nil
Floors	**Per unit**		**Whole Building**		
Area floor insulated	23.2	57.4	186	459	247%
R-value floor	0.38	0.50			133%
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	1.5	0.9	36	22	-14
No. 1200	2.0	1.1	49	27	-22
No. 1400	0.2	2.4	4	57	53

Roof insulation was slightly increased at 7-stars.

Wall insulation R-values were increased by, on average, R0.1. The area of wall insulated also increased, although some units did not require wall insulation for the building to achieve its minimum and average rating requirements.

Not all dwellings required floor insulation to achieve 7-stars, but there was a significant increase in the number of dwellings requiring floor insulation at 7-stars. Note that the car park is assumed to be unenclosed. If the car park were enclosed, no floor insulation would likely be required, or other specifications could be lowered.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show a significant increase over the current assumption.

There was a significant increase in both the number and diameter of ceiling fans used to increase the rating from 6 (min 5) to 7 (min 6) stars.

Table 68 Changes to building design and specification to increase stringency: Windows in Longreach

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	23.3	16.4	560.4	393.2	70%
Area single low e	0.0	0.0	0.0	0.0	Nil
Area single glazed tinted	1.3	2.2	30.8	53.5	174%
Area single glazed heavy tinted	3.5	6.3	84.2	150.9	179%
Area single low e tint	0.3	1.0	7.2	23.4	325%
Area double glazed argon fill low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e tint	0.0	0.2	0.0	4.4	Nil
Total Window Area	**28.4**	**26.1**	**682.6**	**625.4**	**92%**
Frame colour (abs)	0.6	0.4			65%
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	4.0	4.0	96.5	95.2	99%
E area Day	3.2	3.0	77.0	73.1	95%
S area Day	3.5	3.2	83.4	77.0	92%
W area Day	3.5	2.8	83.5	66.3	79%
N area Night	4.0	3.8	94.8	90.0	95%
E area Night	2.8	2.5	68.0	59.2	87%
S area Night	3.7	3.5	89.5	83.5	93%
W area Night	3.5	3.1	82.8	74.6	90%

Total window area across all units was reduced by around 8%. There was a significant reduction in the use in single clear glazing and a corresponding increase in the use of tinted, heavy tinted and low-e tinted glazing. Heavy tints and low-e tinted glazing was exclusively used on orientations with high solar gains such as east and west facing glazing. Window frame colours were made lighter.

No external blinds were used in part because of their high cost but also because the units all had balconies which provided some protection from solar gain. Management of solar heat gains could be sufficiently handled through the use of lower solar heat gain coefficient, i.e. tinted, windows.

3.2.3 Energy Bill Savings

The extent of improvement costs for individual units varied significantly. This variation is in part because a heterogeneous approach to rating was adopted, i.e. there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to average benefits for all units in the development for a variety of common appliance combinations and conditioned areas.

Table 69 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 1 :	Reverse Cycle Heating & Cooling	
Financial Impacts	Whole House	Living Areas Only
Cost per unit	$504.21	$504.21
Energy-saving per unit Total	$60.49	$41.54
Energy-saving per unit Heating	$4.51	$3.69
Energy-saving per unit Cooling	$55.97	$37.85
Increase to annual mortgage payments	$28.89	$28.89
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$31.60	$12.65
Net Present Value @ 7%	$302.16	$49.54
Net Present Value @ 5%	$533.66	$208.52
Net Present Value @ 3%	$893.89	$455.90

Table 70 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 2

Appliance Mix 2 :	Reverse Cycle Ducted Heating Cooling	
Financial Impact	Whole House	Living Areas Only
Cost per unit	$504.21	$504.21
Energy-saving per unit	$83.02	$57.01
Energy-saving per unit Total	$83.02	$57.01
Energy-saving per unit Heating	$6.20	$5.06
Increase to annual mortgage payments	$28.89	$28.89
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$54.13	$28.13
Net Present Value @ 7%	$602.60	$255.86
Net Present Value @ 5%	$920.35	$474.07
Net Present Value @ 3%	$1,414.80	$813.62

Table 71 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 2

Appliance Mix 3 :	Resistive Electric Day rate Heating & Reverse Cycle Cooling	
Financial Impact	**Whole House**	**Living Areas Only**
Cost per unit	$504.21	$504.21
Energy-saving per unit	$74.53	$53.01
Energy-saving per unit Total	$74.53	$53.01
Energy-saving per unit Heating	$18.56	$15.16
Increase to annual mortgage payments	$28.89	$28.89
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$45.64	$24.13
Net Present Value @ 7%	$489.41	$202.53
Net Present Value @ 5%	$774.67	$405.43
Net Present Value @ 3%	$1,218.56	$721.16

3.2.4 Conclusion: Class 2 Longreach

Average costs and benefits across the apartment building are positive in Longreach from every perspective. Adoption of a 7-star average, 6-star minimum fabric requirement in Class 2 dwellings in similar climates to Longreach in Climate Zone 1 ***is recommended***.

4 NCC Climate Zone 4: Mildura

As shown in Table 3 above, the rating of dwellings which achieve 7.0 stars with the current weather and star bands is virtually unchanged with the updated weather data and star bands.

4.1 Class 1 Dwellings

4.1.1 Dwelling Costs

Table 72 Costs of improving building fabric from 6 to 7 stars in Class 1 in Climate

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost (per m^2)
SBH01	Slab	Large	Two	Detached	$2,640	$9.43
SBH01	Timber	Large	Two	Detached	$2,951	$10.54
SBH02	Slab	Large	One	Detached	$926	$3.57
SBH02	Timber	Large	One	Detached	$2,665	$10.26
SBH03	Slab	Medium	Two	Detached	$1,855	$9.93
SBH03	Timber	Medium	Two	Detached	$2,209	$11.83
SBH04	Slab	Medium	One	Detached	$1,621	$12.03
SBH04	Timber	Medium	One	Detached	$1,825	$13.55
SBH05	Slab	Small	One	Detached	$1,157	$8.26
SBH05	Timber	Small	One	Detached	$1,735	$12.39
SBH06	Slab	Small	One	Detached	$768	$7.60
SBH06	Timber	Small	One	Detached	$1,251	$12.38
SBH11	Slab	Small	One	Passive Solar BV	$1,697	$8.94
SBH16	Slab	Small	One	Semi-detached	$919	$9.17
SBH16	Timber	Small	One	Semi-detached	$711	$7.09
SBH19	Slab	Small	One	Passive Solar BV	$1,481	$9.55

Table 73 Summary of dwelling upgrade costs for Class 1 in Climate

House Type	Cost (total)	Cost (per m^2)
All	$1,651	$9.78
Non specialist	$1,704	$9.84
Specialist Designs	$1,371	$8.86

The cost of improving the NatHERS rating of a Class 1 dwelling from 6-stars with the current weather data to 7-stars with the new weather data varies from around $7 to $14 per square metre, depending on how well the design of the dwelling is suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $10/$m^2$. In contrast, specialist well-oriented designs (main living areas face south) which are well suited to the Darwin climate can achieve around $5/$m^2$ cost savings.

Two-storey and timber floored poorly oriented Class 1 dwellings have the highest costs.

4.1.2 Mildura, summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 74 Changes to Roof and Ceiling specifications needed to meet 7-stars in Mildura

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	3.5	4.8
Area ceiling 1	127.9	129.9
R-value ceiling 2	0.9	1.0
Area ceiling 2	14.9	14.9
Area roof insulated	0.0	1.2
Area roof uninsulated	197.0	195.8
R-value roof blanket	0.0	0.0
R-value ceiling Flat	1.4	1.9
Area roof insulated (Flat)	24.6	24.6
Area roof uninsulated (Flat)	9.7	9.7
Foil under roof?	75%	94%
Ventilated roof?	6%	6%
Roof colour	0.43	0.39

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased Ceiling R-values, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation,
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

Ceiling insulation levels used to obtain 7-stars were significantly increased by, on average R1.3. Several dwellings were also required to add reflective foil under the roof in addition to the increased ceiling insulation. Roofs were made slightly lighter.

Table 75 Changes to External and Internal wall and floor specifications needed to meet 7-stars in Mildura

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	100%	100%
R-value walls	R 2.34	R 2.48
Proportion of walls insulated	100%	100%
Area walls uninsulated	0.0	0.0
Area walls insulated (Garage and roof space)	3.6	3.6
Area walls uninsulated (Garage and roof space)	24.5	24.5
Foil layer walls	100%	100%
If yes emissivity	0.1	0.1
Wall colour	0.50	0.45
Internal Walls		
No dwellings with insulated internal walls	14	16
R-value (if insulated)	2.2	2.4
Insulated area	37.7	34.7
Floors		
Area floor insulated	69.0	91.4
Waffle pod?	56%	56%
R-value floor	2 Houses, R 2.5	5 Houses, R 2.9
Foil underfloor	0%	0%
R-value subfloor walls	6 Houses Average R: 1	2 Houses Average R: 1
Area subfloor walls insulated	33.1	33.1
Area ceramic tile floor surface	33.4	33.4

All dwellings used Brick Veneer walls which were all insulated at both 6- and 7-stars. Insulation levels were slightly increased by R0.14 on average. All walls at 6- and 7-stars used a reflective wrap in addition to bulk insulation.

Medium coloured walls were used on average at 6 stars, and slightly lighter colours were used at 7-stars.

The wall to the garage was required to be insulated in all dwellings at 7-stars. The R-value used is, on average, R0.2 higher.

Some dwellings required floors over enclosed subfloor spaces to be insulated, while others insulated subfloor walls. Five of the nine dwellings on a slab floor used a waffle pod slab. In general terms, the houses which required floor insulation or were built on a waffle pod slab were those which had significantly higher heating energy demand. Floor insulation and waffle pod slabs can decrease the rating in Mildura if cooling energy demand is higher than average.

Table 76 Changes to Ceiling fan and Window specifications needed to meet 7-stars in Mildura

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	0.6	0.1
No. 1200	0.8	0.1
No. 1400	0.2	1.6
Windows		
Area single glazed clear	29.5	21.1
Area single low e	0.0	0.5
Area single glazed tinted	0.0	0.1
Area single glazed heavy tinted	0.0	0.0
Area single low e tint	0.1	0.5
Area double glazed argon fill low e	10.7	14.9
Total Window Area	40.2	37.1
Frame colour (abs)	0.48	0.43
Area external Blinds	0.0	0.0
Highly openable windows louvre	NA	NA
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre heavy tint	NA	NA
Highly openable windows louvre low e	NA	NA
Highly openable windows louvre low e tint	NA	NA

In 7-star dwellings where ceiling fans were installed, ceiling fan diameter was also increased to improve the impact of the fans. Note that ceiling fans only have a significant rating impact in Mildura if the house has higher than average cooling demand.

The total window area at 7-stars was reduced by around 8%. At 6-stars, on average, 27% of windows were required to be double glazed. At 7-stars this increased to 40%. Medium coloured frames were used with a small increase in lighter coloured frames.

4.1.3 Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on Flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 77 Heating and cooling energy bill savings for various appliances and area of dwelling conditioned

		Heating Savings						Cooling Savings			
		Whole House			Living Areas only			Whole House		Living areas only	
House No	Floor-type	AC Heat	AC Heat Duct	Gas Space	AC Heat	AC Heat Duct	Gas Space	AC Cool	Evap Cool	AC Cool	Evap Cool
01	SLA	$88	$101	$55	$73	$83	$45	$66	$24	$41	$15
01	TIM	$127	$147	$79	$96	$111	$60	$35	$13	$37	$14
02	SLA	$39	$45	$24	$32	$37	$20	$74	$28	$45	$17
02	TIM	$158	$182	$98	$143	$165	$89	-$5	-$2	$27	$10
03	SLA	$59	$68	$37	$57	$66	$35	$65	$24	$38	$14
03	TIM	$80	$92	$50	$56	$64	$35	$36	$13	$26	$10
04	SLA	$36	$41	$22	$32	$37	$20	$56	$21	$47	$17
04	TIM	$44	$50	$27	$28	$32	$17	$50	$18	$42	$16
05	SLA	$50	$58	$31	$46	$53	$29	$48	$18	$38	$14
05	TIM	$51	$59	$32	$33	$38	$21	$56	$21	$41	$15
06	SLA	$38	$44	$24	$37	$42	$23	$39	$14	$29	$11
06	TIM	$66	$76	$41	$60	$69	$38	$17	$6	$23	$9
11	SLA	$92	$106	$57	$21	$24	$13	$144	$53	$33	$12
16	SLA	$6	$7	$4	$0	$0	$0	$35	$13	$30	$11
16	TIM	$20	$23	$12	$12	$14	$8	$34	$12	$32	$12
19	SLA	$22	$25	$14	$19	$21	$12	$50	$19	$35	$13

The table below shows the combined heating and cooling annual energy savings using the most common appliance combinations:

- Reverse Cycle heating/cooling space conditioning (whole house and living areas only)
- Reverse Cycle cooling space conditioning to living areas and gas space heating, and
- Whole house gas ducted heating and cooling living areas using a reverse cycle system
- Whole house gas ducted heating and cooling living areas using an evaporative system.

4.1.3.1 Energy Bill savings for common appliance combinations

The table below shows the total heating and cooling energy savings for the most common space conditioning appliance combinations in the Mildura climate.

Table 78 Space conditioning energy bill savings for common space conditioning appliances

		Space Conditioning		Ducted conditioning	
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool to living areas	Gas ducted, Evap cool
SBH01	Slab	$113	$86	$142	$125
SBH01	Timber	$133	$97	$184	$159
SBH02	Slab	$78	$66	$91	$73
SBH02	Timber	$171	$116	$210	$180
SBH03	Slab	$95	$74	$106	$92
SBH03	Timber	$82	$61	$118	$106
SBH04	Slab	$79	$67	$88	$62
SBH04	Timber	$70	$59	$92	$69
SBH05	Slab	$84	$67	$96	$76
SBH05	Timber	$75	$62	$100	$80
SBH06	Slab	$66	$52	$73	$58
SBH06	Timber	$84	$61	$99	$83
SBH11	Slab	$54	$46	$139	$159
SBH16	Slab	$30	$30	$37	$20
SBH16	Timber	$45	$40	$55	$35
SBH19	Slab	$53	$46	$60	$44

4.1.3.2 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 79 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Mildura

		Space Conditioning		Ducted conditioning	
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool to living areas	Gas ducted, Evap cool
SBH01	Slab	-$38	-$65	-$9	-$26
SBH01	Timber	-$36	-$72	$14	-$10
SBH02	Slab	$25	$13	$38	$20
SBH02	Timber	$18	-$36	$57	$28
SBH03	Slab	-$11	-$33	-$0	-$14
SBH03	Timber	-$44	-$66	-$8	-$21
SBH04	Slab	-$14	-$26	-$5	-$31
SBH04	Timber	-$35	-$45	-$12	-$36
SBH05	Slab	$18	$0	$29	$9
SBH05	Timber	-$25	-$38	$0	-$20
SBH06	Slab	$22	$8	$29	$14
SBH06	Timber	$12	-$11	$28	$11
SBH11	Slab	-$43	-$51	$42	$62
SBH16	Slab	-$22	-$23	-$16	-$33
SBH16	Timber	$4	-$1	$15	-$5
SBH19	Slab	-$31	-$38	-$25	-$41

Cash flow impacts for building fabric improvements for the householder is negative for almost all cases. The amount is small (worst case -$65) and may be offset by other aspects of the Whole of Home measures. Where ducted gas heating is used the impact on household cash flow is positive in 56% of cases. Ducted gas heating is the dominant appliance used for heating in Victoria. It has double the market penetration of any other heating system, so the market-weighted average of results would be skewed toward this type of heating.

4.1.3.3 The net present value of building fabric induced energy savings versus capital cost

Table 80 Net Present Value of Cost and Benefits at 7% discount rate over 40 years, Class 1 in Climate

		Space Conditioning		Ducted conditioning	
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool to living areas	Gas ducted, Evap cool
SBH01	Slab	-$1,130	-$1,496	-$748	-$968
SBH01	Timber	-$1,175	-$1,662	-$505	-$827
SBH02	Slab	$112	-$52	$284	$45
SBH02	Timber	-$391	-$1,113	$130	-$263
SBH03	Slab	-$585	-$873	-$441	-$629
SBH03	Timber	-$1,113	-$1,396	-$630	-$800
SBH04	Slab	-$573	-$734	-$451	-$796
SBH04	Timber	-$896	-$1,036	-$593	-$909
SBH05	Slab	-$35	-$269	$117	-$150
SBH05	Timber	-$742	-$911	-$404	-$674
SBH06	Slab	$107	-$78	$200	$5
SBH06	Timber	-$137	-$442	$74	-$149
SBH09	Slab	-$979	-$1,083	$155	$421
SBH17	Slab	-$517	-$518	-$429	-$652
SBH18	Timber	-$116	-$177	$28	-$239
SBH19	Slab	-$46	-$469	$331	$172

Net Present Value at 7% discount rate for building fabric improvements for the householder is negative for almost all cases for space conditioned and evaporatively-cooled options. The amount is small and may be offset by other aspects of the Whole of Home measures. Dwellings with ducted gas heating and reverse cycle cooling to living areas show over half the dwellings have a positive NPV at 7%.

Evaporative cooling does not use a great deal of energy but does not provide an equivalent level of comfort to reverse cycle cooling.

Ducted gas heating is the dominant appliance used for heating in Victoria. It has double the market penetration of any other heating system, so the market-weighted average of results would be skewed toward this type of heating.

Net Present Value at 7% discount rate is positive, i.e. benefits exceed costs, in 19% of the cases reported above, however, 44% of dwellings with ducted gas heating have a positive NPV.

4.1.3.4 The net present value of costs and benefits: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 81 Net Present Value of costs and benefits at 3% discount rate

		Space Conditioning		Ducted conditioning	
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool to living areas	Gas ducted, Evap cool
SBH01	Slab	-$22	-$657	$640	$259
SBH01	Timber	$128	-$715	$1,291	$733
SBH02	Slab	$874	$590	$1,172	$757
SBH02	Timber	$1,278	$25	$2,181	$1,500
SBH03	Slab	$347	-$153	$596	$270
SBH03	Timber	-$309	-$799	$528	$234
SBH04	Slab	$196	-$83	$408	-$190
SBH04	Timber	-$214	-$456	$311	-$237
SBH05	Slab	$787	$382	$1,052	$589
SBH05	Timber	-$13	-$306	$574	$104
SBH06	Slab	$750	$428	$910	$573
SBH06	Timber	$681	$152	$1,046	$659
SBH09	Slab	-$451	-$632	$1,514	$1,975
SBH17	Slab	-$221	-$225	-$69	-$456
SBH18	Timber	$320	$214	$569	$107
SBH19	Slab	-$247	-$409	-$93	-$470

At 3% discount rate the NPV shows significantly larger benefits and smaller disbenefits than at 7%. Note that if a 7% investment return was available after-tax and assuming a real growth in energy prices as shown in AEMO, 2015, NPV would be similar to the values shown above.

Net Present Value at 3% discount rate is positive, i.e. benefits exceed costs, in 64% of the cases reported above, however, 88% of dwellings with ducted gas heating have a positive NPV.

4.1.4 Conclusion: Class 1, Mildura

The financial benefits of improving building fabric for Class 1 dwellings in Mildura are marginal for space heated and evaporatively cooled dwellings. Financial impacts for dwellings with ducted gas heating, the heating system with the greatest penetration in Victoria, while not universally positive, are favourable.

Climate Zone 4 also spans a vast distance and includes several NatHERS climates which are more severe than Mildura like Moree, Oodnadatta, Dubbo, Giles, Meekatharra and Cobar. Many of the northern climates in Climate Zone 4 have much higher cooling demand and would have similar costs and benefits to Longreach where the increase in stringency to 7-stars is recommended.

Furthermore, the other parts of the Whole of Home requirements are likely to more than make up for the small negative impacts on cash flow for non-ducted heating options. In addition, there are several benefits which have not been modelled e.g.:

- 7-star dwellings will have lower peak loads. This lower peak load provides a saving to the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
- 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
- 7-star dwellings will provide greater resilience to climate change.

It is considered likely that, given all the factors discussed above, the increase in stringency will be cost-effective. It is therefore **recommended that building fabric stringency be increased to 7-stars in Climate Zone 4, subject to further review of the factors discussed above.**

4.2 Class 2 dwellings

4.2.1 Dwelling Costs

Table 82 Costs of improving building fabric from 6 to 7 stars in Class 2 in Mildura

House Number	Floor-type	Position	Cost (total)	Cost (/m^2)
SBA01*	Slab	Corner	-$507.06	-$5.31
SBA02	Slab	Middle	$0.00	$0.00
SBA03	Slab	Corner	$396.09	$4.15
SBA04	Slab	Middle	$864.98	$9.67
SBA05	Slab	Corner	$898.19	$9.40
SBA06	Slab	Middle	$0.00	$0.00
SBA07	Slab	Corner	$598.58	$6.27
SBA08	Slab	Middle	$695.35	$7.78
SBA11	Slab	Corner	$406.06	$4.25
SBA12*	Slab	Middle	-$659.52	-$7.38
SBA13	Slab	Corner	$0.00	$0.00
SBA14	Slab	Middle	$262.39	$2.93
SBA15	Slab	Corner	$501.10	$5.25
SBA16	Slab	Middle	$0.00	$0.00
SBA17	Slab	Corner	$822.92	$8.62
SBA18	Slab	Middle	$0.00	$0.00
SBA21	Slab	Corner	$0.00	$0.00
SBA22	Slab	Middle	$0.00	$0.00
SBA23	Slab	Corner	$207.36	$2.17
SBA24	Slab	Middle	$0.00	$0.00
SBA25	Slab	Corner	$1,901.43	$19.91
SBA26	Slab	Middle	$665.25	$7.44
SBA27	Slab	Corner	$1,670.45	$17.49
SBA28	Slab	Middle	$1,104.95	$12.36

* Note these costs are negative because the mix of apartments which achieve minimum 6- and average 7-stars was changed.

The cost of improving the NatHERS ratings of a Class 2 dwelling from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the new weather data varies from around $2 to $20 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $4/m^2.

Table 83 Summary of dwelling upgrade costs for Class 2 in Climate

Summary	Cost
Building-wide cost	$9,828.51
Cost per unit	$409.52
Cost per m2	$4.43

4.2.2 Mildura: Changes to design and specification Class 2

Table 84 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans in Mildura

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling 1	2.7	2.7			Nil
Area ceiling 1	92.5	92.5	739.7	739.7	Nil
External Walls	**Per unit**		**Whole Building**		
R-value walls	0.9	1.5			0.63
Area walls insulated	17.4	28.5	417	683	164%
Area walls uninsulated	20.6	9.5			46%
Wall colour	0.59	0.54			90%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.0	0.0			Nil
Insulated area	0.0	0.0			Nil
Floors	**Per unit**		**Whole Building**		
Area floor insulated	70.2	81.3	561	651	116%
R-value floor	1.44	1.69			117%
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	0.0	0.0	0	0	0
No. 1200	0.0	0.0	0	0	0
No. 1400	0.0	0.0	0	0	0

Roof insulation was slightly unchanged at 7-stars. Additional insulation will improve the rating; however, other methods of improving the rating were selected in preference to this.

Wall insulation R-values were increased by, on average, R0.6. The area of wall insulated also increased, although some units (mainly north-facing) still did not require wall insulation for the building to achieve its minimum and average rating requirements.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show a significant increase over the current assumption.

Not all dwellings required floor insulation to achieve 7-stars, but there was a significant increase in the number of dwellings requiring floor insulation at 7-stars. The level of insulation required also increased slightly. Note that the car park is assumed to be unenclosed. If the car park was enclosed, floor insulation R-values could likely be reduced, or other specifications lowered.

There were no ceiling fans used at either 6-stars (min 5) or 7-stars (min 6).

Table 85 Changes to building design and specification to increase stringency: Windows in Mildura

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	26.1	21.7	626.8	520.5	83%
Area single low e	0.0	0.0	0.0	0.0	Nil
Area single glazed tinted	0.0	0.0	0.0	0.0	Nil
Area single glazed heavy tinted	0.0	0.2	0.0	4.4	Nil
Area single low e tint	0.8	0.3	20.0	7.6	38%
Area double glazed argon fill low e	0.0	2.4	0.0	58.6	
Highly openable windows louvre	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e tint	0.0	0.0	0.0	0.0	Nil
Total Window Area	**27.0**	**24.6**	**646.9**	**591.1**	**91%**
Frame colour (abs)	0.6	0.6			99%
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	3.7	3.5	88.9	84.2	95%
E area Day	3.2	3.0	76.4	72.3	95%
S area Day	3.2	3.0	77.8	71.1	91%
W area Day	3.3	2.8	79.1	68.2	86%
N area Night	4.1	3.8	97.9	90.2	92%
E area Night	2.9	2.7	69.4	65.2	94%
S area Night	3.1	2.7	75.1	65.0	87%
W area Night	3.2	2.8	75.8	68.4	90%

Total window area across all units was reduced by around 9%. There was a 17% reduction in the use in single clear glazing and a corresponding increase in the use of single low-e or double glazing. Window frame colours were unchanged.

No external blinds were used in part because of their high cost but also because the units all had balconies which provided some protection from solar gain. Management of solar heat gains could be sufficiently handled through the use of lower solar heat gain coefficient, i.e. tinted, windows.

4.2.3 Energy Bill Savings

The extent of improvement costs for individual units varied significantly. This variation is in part because a heterogeneous approach to rating was adopted, i.e. there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to average benefits for all units in the development for a variety of common appliance combinations and conditioned areas.

Table 86 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 1 : Financial Impacts	Reverse Cycle Heating & Reverse Cycle Cooling Whole House	Living Areas Only
Cost per unit	$409.52	$409.52
Energy-saving per unit Total	$30.07	$16.04
Energy-saving per unit Heating	$11.12	$6.74
Energy-saving per unit Cooling	$18.95	$9.30
Increase to annual mortgage payments	$23.46	$23.46
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$6.61	-$7.42
Net Present Value @ 7%	-$8.60	-$195.68
Net Present Value @ 5%	$106.50	-$134.29
Net Present Value @ 3%	$285.61	-$38.75

Table 87 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 2

Appliance Mix 2 : Financial Impact	Gas Space Heating & Evaporative Cooling Whole House	Living Areas Only
Cost per unit	$409.52	$409.52
Energy-saving per unit	$24.91	$14.29
Energy-saving per unit Total	$24.91	$14.29
Energy-saving per unit Heating	$17.90	$10.86
Increase to annual mortgage payments	$23.46	$23.46
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$1.45	-$9.17
Net Present Value @ 7%	-$77.40	-$218.95
Net Present Value @ 5%	$17.95	-$164.23
Net Present Value @ 3%	$166.31	-$79.10

Table 88 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 3

Appliance Mix 3 : Financial Impact	Gas Space Heating & Reverse Cycle Cooling	
	Whole House	Living Areas Only
Cost per unit	$409.52	$409.52
Energy-saving per unit	$36.85	$20.15
Energy-saving per unit Total	$36.85	$20.15
Energy-saving per unit Heating	$17.90	$10.86
Increase to annual mortgage payments	$23.46	$23.46
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$13.39	-$3.31
Net Present Value @ 7%	$81.78	-$140.86
Net Present Value @ 5%	$222.83	-$63.74
Net Present Value @ 3%	$442.31	$56.28

4.2.4 Conclusion: Class 2, Mildura

The financial benefits of improving building fabric for Class 1 dwellings in Mildura are marginal for space heating and evaporative cooling appliances. Financial impacts for dwellings which condition both bedrooms and living areas are favourable.

Climate Zone 4 also spans a vast distance and includes several NatHERS climates which are more severe than Mildura like Moree, Oodnadatta, Dubbo, Giles, Meekatharra and Cobar. Many of the northern climates in Climate Zone 4 are cooling dominated and would have similar costs and benefits to Longreach, where the increase in stringency to 7-stars is recommended.

Furthermore, the other parts of the Whole of Home requirements are likely to more than make up for the small negative impacts on cash flow for non-ducted heating options. In addition, there are several benefits which have not been modelled, e.g.:

- 7-star dwellings will have lower peak loads. Lower peak loads provide a saving to the electricity network and consumers by reducing required appliance size and therefore cost,
- 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
- 7-star dwellings will provide greater resilience to climate change.

It is considered likely that, given all the factors discussed above, the increase in stringency. It is therefore **recommended that building fabric stringency be increased to 7-stars in Climate Zone 4, subject to further review of the factors discussed above.**

5 NCC Climate Zone 5

The NatHERS Richmond Climate zone 28 used for Western Sydney is currently classified as NCC Climate Zone 6, i.e. the same as Melbourne. The work undertaken to develop elemental provisions showed that it was not possible to produce appropriate elemental solutions for Western Sydney and Melbourne if these climates are to be contained in the one Climate zone. For example, dark coloured surfaces lower the requirement for ceiling insulation in Melbourne but increase it for Western Sydney. Consequently, it is recommended that Western Sydney be placed in NCC Climate Zone 5 for NCC 2022.

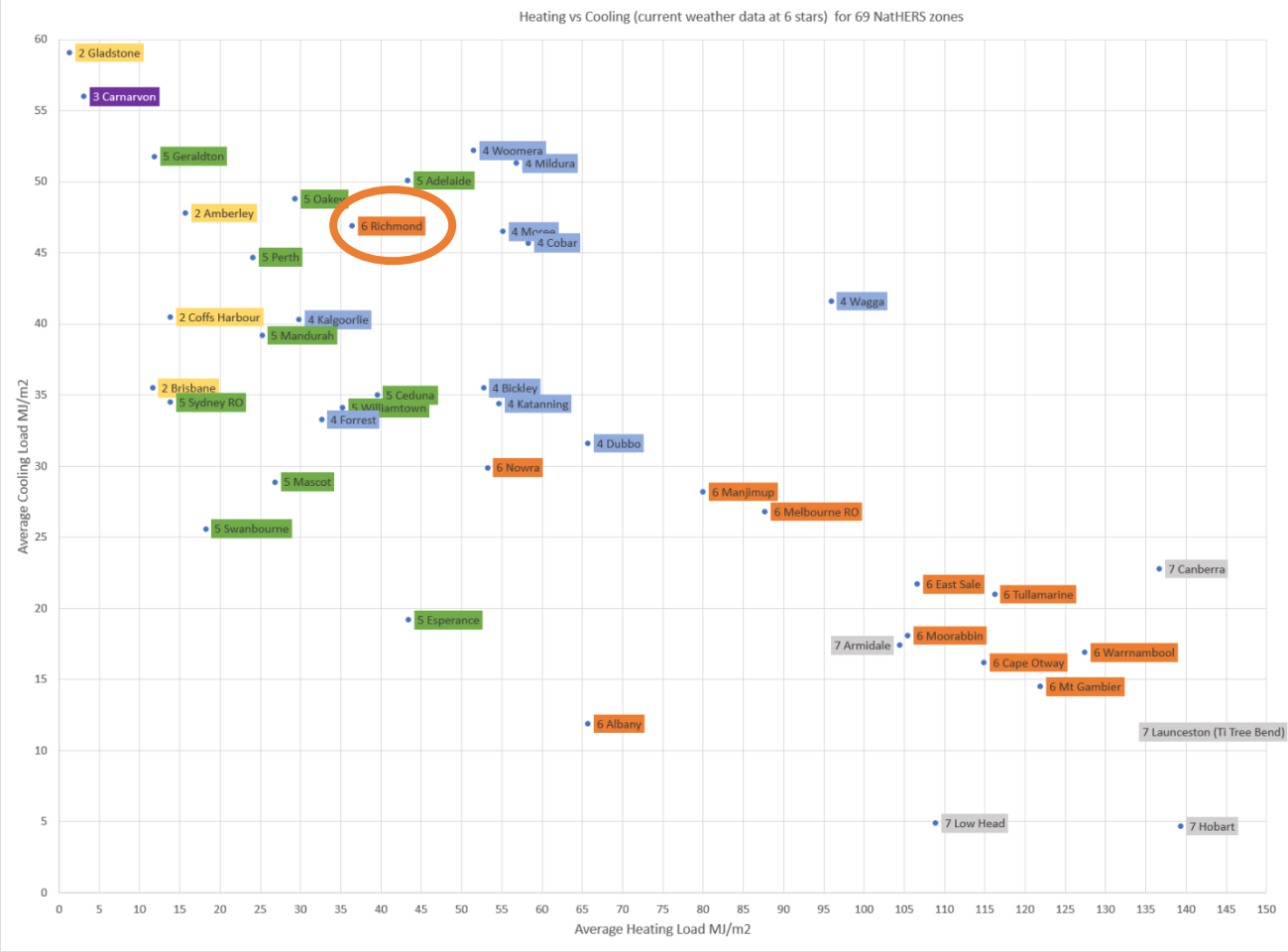
There are three capital cities in NCC Climate Zone 5 with distinct differences in construction (Brick Cavity Walls in Perth), and the balance of heating and cooling. For this reason, a separate analysis of costs and benefits is shown for Sydney, Perth, and Adelaide. The economic evaluation of benefits and costs for Sydney uses the NatHERS climate zones with the highest construction volumes:

- Class 1 dwellings: Western Sydney (NatHERS Climate 28), and
- Class 2 dwellings: Mascot (NatHERS Climate Zone 56).

As shown in Table 3 above, the average rating of dwellings which achieve 7.0 stars with the current weather and star bands is virtually unchanged for all the NatHERS climates assessed in this NCC climate zone with the updated weather data and star bands.

The figure below shows the average heating and cooling loads using the current NatHERS weather data for 6-star Class 1 dwellings for NatHERS Climate Zones with average heating loads up to 60 MJ/m^2 and heating loads up to 150 MJ/m^2. Each NatHERS Climate Zone is colour coded to show the NCC Climate Zone. The Richmond climate zone (NatHERS 28) used for Western Sydney has very different heating and cooling loads to all other NatHERS Climate Zones allocated to NCC Climate Zone 6.

Figure 1 Allocation of NatHERS Climate Zones to NCC Climate Zones



Legend:

NCC Climate Zone 2
NCC Climate Zone 3
NCC Climate Zone 4
NCC Climate Zone 5
NCC Climate zone 6
NCC Climate Zone 7

5.1 Class 1 Dwellings

5.1.1 Sydney (West Sydney) Dwelling Costs

Table 89 Costs of improving building fabric from 6 to 7 stars in Class 1 in Sydney

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost (per m^2)
SBH01	Slab	Large	Two	Detached	$2,923	$10.44
SBH01	Timber	Large	Two	Detached	$2,170	$7.75
SBH02	Slab	Large	One	Detached	$978	$3.77
SBH02	Timber	Large	One	Detached	$2,040	$7.86
SBH03	Slab	Medium	Two	Detached	$3,171	$16.98
SBH03	Timber	Medium	Two	Detached	$5,659	$30.30
SBH04	Slab	Medium	One	Detached	$1,758	$13.05
SBH04	Timber	Medium	One	Detached	$840	$6.24
SBH05	Slab	Small	One	Detached	$1,647	$11.75
SBH05	Timber	Small	One	Detached	$961	$6.86
SBH06	Slab	Small	One	Detached	$808	$8.00
SBH06	Timber	Small	One	Detached	$2,822	$27.93
SBH09*	Slab	Small	One	Passive Solar BV	-$34	-$0.18
SBH16	Slab	Small	One	Semi-detached	$1,231	$12.29
SBH16	Timber	Small	One	Semi-detached	$963	$9.62
SBH19	Slab	Small	One	Passive Solar BV	$997	$6.43

* Note that this design easily upgraded from 6 to 7 stars by merely increasing insulation, increasing the size of ceiling fans and trimming glazing areas. Note that this house already had significantly larger window areas than the other dwellings. Windows were reduced by only 7% in in a house which already a 33.5% window to net conditioned floor area ratio. In almost all cases these examples were revised to increase the window area because there is no great cost disadvantage to maintaining the window area at a larger size. This one example was left unchanged to demonstrate the elasticity of the upgrade costs where because the dwelling design is well suited to the climate.

Table 90 Summary of dwelling upgrade costs for Class 1 in Climate

House Type	Cost (total)	Cost (per m^2)
All	$1,809	$11.19
Non specialist	$1,811	$11.45
Specialist Designs (excl SBH03)	$1,350	$3.12

The cost of improving the NatHERS rating of a Class 1 dwelling from 6-stars with the current weather data to 7-stars with the new weather data varies from around $4 to $30 per square metre, depending on how well the design of the dwelling is suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $11/$m^2$. In contrast, specialist well-oriented designs (main living areas face north) which are well suited to the Western Sydney climate can achieve around $8/$m^2$ cost savings.

Two-storey and timber floored poorly-oriented Class 1 dwellings have the highest costs.

Note that House SBH03 is a significant outlier, particularly on a timber floor. This dwelling is a passive solar two-storey dwelling which was originally designed with an aerated autoclaved concrete upper floor and walls. In this project, it has been rated with a timber upper floor and Brick clad walls. Despite its good orientation, costs are 150 to 250% higher than the other detached two-storey dwelling, SBH01. The poor

rating of this dwelling is a surprising finding, and two experienced assessors checked and double-checked the rating and found no data input errors. It seems that this house is not particularly well suited to the Sydney climate without its original construction features. Note that when using the current weather data, this dwelling also had significant upgrade requirements, but to a lesser extent than with the updated weather data.

This example shows that there may be some one-off costs to reassess and redesign dwellings for the updated weather data. There are clearly lower-cost design options available, so the cost for SBH03 should not be taken to be representative. This unexpected finding suggests that the industry may need some time to adapt their designs to 7-stars with the new weather data if a 7-star stringency level is adopted.

5.1.2 Sydney, summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 91 Changes to Roof and Ceiling specifications needed to meet 7-stars in Sydney

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	3.6	4.3
Area ceiling 1	127.9	127.9
R-value ceiling 2	0.9	1.1
Area ceiling 2	14.9	14.9
Area roof insulated	0.0	0.0
Area roof uninsulated	197.0	197.0
R-value roof blanket	0.0	0.0
R-value ceiling Flat	1.4	1.4
Area roof insulated (Flat)	24.6	27.0
Area roof uninsulated (Flat)	9.7	7.4
Foil under roof?	63%	75%
Ventilated roof?	0%	0%
Roof colour	0.44	0.41

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased Ceiling R-values, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation,
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

Ceiling insulation levels used to obtain 7-stars increased by an average R0.7 to achieve 7-stars, some houses were required to install reflective foil under the roof, and the colour of the roof was made slightly lighter.

Table 92 Changes to External and Internal wall and floor specifications needed to meet 7-stars in Sydney

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	100%	100%
R-value walls	R 2.31	R 2.43
Proportion of walls insulated	100%	100%
Area walls uninsulated	0.0	0.0
Area walls insulated (Garage and roof space)	0.0	0.0
Area walls uninsulated (Garage and roof space)	29.4	29.4
Foil layer walls	75%	81%
If yes emissivity	0.1	0.1
Wall colour	0.50	0.46
Internal Walls		
No dwellings with insulated internal walls	14	15
R-value (if insulated)	2.3	2.4
Insulated area	33.3	36.5
Floors		
Area floor insulated	75.3	95.3
Waffle pod?	56%	67%
R-value floor	3 Houses, R 2	5 Houses, R 2.5
Foil underfloor	0%	0%
R-value subfloor walls	4 Houses Average R: 1	4 Houses Average R: 1.3
Area subfloor walls insulated	30.9	31.7
Area ceramic tile floor surface	32.8	33.6

All the dwellings used Brick Veneer walls. These walls were all insulated at both 6- and 7-stars and 7-star houses used slightly higher R-values.

Medium coloured walls were used on average at 6 stars, and slightly lighter colours were used at 7-stars. Changing wall colour did not have a large impact on the rating because the effects on heating and cooling cancelled each other.

The wall to the garage was also required to be insulated in all but one of dwellings at 7-stars.

Some dwellings required floors over enclosed subfloor spaces to be insulated, while others insulated subfloor walls. Note that fully insulating both subfloor walls and the floor itself is not required. Six of the nine dwellings on a slab floor used a waffle pod slab. In general terms, the houses which needed insulation of floors or were built on a waffle pod slab were those which had significantly higher heating energy demand. Floor insulation and waffle pod slabs can decrease the rating in this climate if cooling energy demand is higher than average.

In one dwelling, partial floor insulation was used in combination with subfloor wall insulation. This dwelling had one room with much higher cooling loads than the rest of the house, and floor insulation was omitted to this room to achieve 7-stars.

Table 93 Changes to Ceiling fan and Window specifications needed to meet 7-stars in Sydney

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	0.0	0.0
No. 1200	1.4	0.3
No. 1400	0.5	2.5
Windows		
Area single glazed clear	31.7	20.6
Area single low e	3.4	9.0
Area single glazed tinted	0.0	0.0
Area single glazed heavy tinted	0.0	0.0
Area single low e tint	1.0	2.5
Area double glazed argon fill low e	2.5	4.5
Total Window Area	39.7	37.4
Frame colour (abs)	0.50	0.42
Area external Blinds	0.0	0.0
Highly openable windows louvre	NA	NA
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre heavy tint	NA	NA
Highly openable windows louvre low e	1 x Houses 14.6 m2	1 x Houses 12.3 m2
Highly openable windows louvre low e tint	NA	NA

In 7-star dwellings, on average, one more ceiling fan was installed at 7-stars than 6-stars. Increasing ceiling fan diameter was the most effective strategy in this climate.

The total window area at 7-stars was reduced by around 6%. The majority of windows in 6-star dwellings were able to use single clear glazing, with a small area of single low-e tinted or double glazing. One of the specialist designs used modest areas of louvre windows. At 6-stars, around 20% of windows were required to use higher-performance glazing. The proportion of higher performance glazing required at 7-stars increased to 45% at 7-stars, with the majority of these being single low-e coated glazing.

5.1.3 Sydney Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on Flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 94 Heating and cooling energy bill savings for various appliances and area of dwelling conditioned

		Heating Savings						Cooling Savings			
		Whole House			Living Areas only			Whole House		Living areas only	
House No	Floor-type	AC Heat	Resistive Elec	Gas Space	AC Heat	Resistive Elec	Gas Space	AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
01	SLA	$45	$167	$99	$39	$146	$86	$36	$49	$39	$54
01	TIM	$24	$90	$53	$19	$70	$41	$71	$97	$63	$87
02	SLA	$30	$110	$65	$23	$86	$51	$36	$49	$30	$42
02	TIM	$25	$94	$55	$19	$71	$42	$54	$75	$51	$70
03	SLA	$35	$130	$77	$30	$111	$65	$36	$49	$34	$47
03	TIM	$44	$163	$96	$41	$151	$89	$27	$37	$20	$27
04	SLA	$19	$70	$41	$15	$54	$32	$20	$27	$20	$27
04	TIM	$26	$96	$56	$20	$74	$44	$22	$31	$19	$26
05	SLA	$11	$42	$25	$8	$30	$18	$31	$42	$28	$39
05	TIM	$14	$53	$31	$10	$35	$21	$34	$47	$27	$38
06	SLA	$30	$113	$66	$27	$100	$59	$10	$14	$10	$14
06	TIM	$28	$105	$62	$24	$88	$52	$10	$13	$14	$19
09	SLA	$22	$80	$47	$20	$75	$44	$47	$65	$48	$66
15	SLA	$15	$57	$34	$13	$47	$28	$18	$25	$17	$24
15	TIM	$21	$77	$45	$19	$71	$42	$18	$25	$16	$22
19	SLA	$24	$90	$53	$20	$75	$45	$21	$29	$17	$23

5.1.3.1 Energy Bill savings for common appliance combinations

The table below shows the combined heating and cooling annual energy savings using the most common appliance combinations:

- Reverse Cycle heating/cooling space conditioning (whole house and living areas only)
- Reverse Cycle heating/cooling space conditioning to living areas and resistive electric heating in bedrooms, and
- Whole house heating and cooling using a ducted reverse cycle system.

Table 95 Space conditioning energy bill savings for common space conditioning appliance combinations

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only RC Space	Living areas RC Space, resistive heating to bedrooms	Whole House RC Ducted
SBH01	Slab	$81	$36	$57	$148
SBH01	Timber	$95	$71	$91	$150
SBH02	Slab	$65	$36	$59	$114
SBH02	Timber	$80	$54	$77	$130
SBH03	Slab	$71	$36	$55	$126
SBH03	Timber	$71	$27	$38	$133
SBH04	Slab	$39	$20	$36	$69
SBH04	Timber	$48	$22	$44	$87
SBH05	Slab	$42	$31	$42	$67
SBH05	Timber	$48	$34	$52	$78
SBH06	Slab	$40	$10	$22	$80
SBH06	Timber	$38	$10	$27	$75
SBH09	Slab	$69	$47	$52	$112
SBH17	Slab	$34	$18	$28	$59
SBH18	Timber	$39	$18	$24	$70
SBH19	Slab	$45	$21	$35	$82

5.1.3.2 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 96 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Sydney

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only RC Space	Living areas RC Space, resistive heating to bedrooms	Whole House RC Ducted
SBH01	Slab	-$59	-$104	-$83	$8
SBH01	Timber	-$5	-$29	-$9	$50
SBH02	Slab	$9	-$20	$3	$58
SBH02	Timber	-$27	-$52	-$30	$23
SBH03	Slab	-$90	-$125	-$106	-$35
SBH03	Timber	-$240	-$284	-$272	-$178
SBH04	Slab	-$62	-$81	-$65	-$32
SBH04	Timber	-$0	-$26	-$4	$39
SBH05	Slab	-$46	-$57	-$46	-$21
SBH05	Timber	$0	-$14	$3	$30
SBH06	Slab	-$3	-$33	-$21	$37
SBH06	Timber	-$120	-$149	-$132	-$83
SBH09	Slab	$28	$6	$11	$71
SBH17	Slab	-$30	-$46	-$35	-$5
SBH18	Timber	-$3	-$23	-$17	$29
SBH19	Slab	-$12	-$36	-$22	$25

Cash flow impacts for building fabric improvements for the householder is negative for almost all cases. The amount is small (worst case -$284 for SBH03 on a timber floor which would not be built in this climate. -$149 in SBH06 is the next worst). The negative impact on cash flow may be offset to a degree by other aspects of the Whole of Home measures.

5.1.3.3 Net present value of building fabric induced energy savings versus capital cost

The table below shows the Net Present Value of energy savings discounted at 7% over 40 years less the cost of building fabric improvements. Figures in red indicate that the net present value is negative, i.e., the discounted value of energy savings over 40 years is less than the value of the capital cost of improvements required to achieve 7-stars. A 7% real discount rate is the policy evaluation metric recommended for this project by the OBPR.

Table 97 Net Present Value of Cost and Benefits at 7% discount rate over 40 years, Class 1 in Sydney

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only RC Space	Living areas RC Space, resistive heating to bedrooms	Whole House RC Ducted
SBH01	Slab	-$1,362	-$1,964	-$1,679	-$472
SBH01	Timber	-$481	-$805	-$536	$255
SBH02	Slab	-$109	-$504	-$190	$536
SBH02	Timber	-$799	-$1,137	-$835	-$131
SBH03	Slab	-$1,867	-$2,337	-$2,080	-$1,136
SBH03	Timber	-$4,475	-$5,062	-$4,908	-$3,647
SBH04	Slab	-$1,240	-$1,492	-$1,284	-$842
SBH04	Timber	-$200	-$544	-$255	$318
SBH05	Slab	-$969	-$1,120	-$969	-$640
SBH05	Timber	-$199	-$389	-$153	$195
SBH06	Slab	-$211	-$617	-$453	$317
SBH06	Timber	-$2,254	-$2,633	-$2,406	-$1,758
SBH09	Slab	$198	-$88	-$25	$771
SBH17	Slab	-$663	-$870	-$734	-$329
SBH18	Timber	-$207	-$483	-$403	$210
SBH19	Slab	-$393	-$717	-$526	$94

Net Present Value at 7% discount rate for building fabric improvements for the householder is negative for almost all cases except for Whole of Home ducted reverse cycle cooling. The lower NPV for building fabric changes may be offset by other aspects of the Whole of Home measures.

5.1.3.4 Net Present Value: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 98 Net Present Value of costs and benefits at 3% discount rate

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only RC Space	Living areas RC Space, resistive heating to bedrooms	Whole House RC Ducted
SBH01	Slab	-$569	-$1,612	-$1,119	$976
SBH01	Timber	$451	-$112	$355	$1,726
SBH02	Slab	$529	-$155	$389	$1,646
SBH02	Timber	-$21	-$606	-$82	$1,138
SBH03	Slab	-$1,175	-$1,989	-$1,544	$94
SBH03	Timber	-$3,782	-$4,800	-$4,532	-$2,346
SBH04	Slab	-$859	-$1,297	-$936	-$169
SBH04	Timber	$271	-$327	$175	$1,169
SBH05	Slab	-$560	-$821	-$560	$11
SBH05	Timber	$273	-$57	$353	$956
SBH06	Slab	$183	-$521	-$236	$1,099
SBH06	Timber	-$1,881	-$2,538	-$2,145	-$1,021
SBH09	Slab	$869	$371	$481	$1,862
SBH17	Slab	-$335	-$693	-$458	$244
SBH18	Timber	$172	-$306	-$169	$894
SBH19	Slab	$50	-$511	-$181	$894

Even at a 3% discount rate, the Net Present Value for building fabric improvements for the householder is negative for almost all cases,

5.1.4 Conclusion: Class 1, Sydney

Based on the costs and benefits of building fabric improvements and energy savings to the consumer alone, increasing the NCC requirements in Climate Zone 5 climates with similar climate and energy tariffs to Sydney in NSW ***cannot be cost effective***. However, other factors may make the adoption of 7-stars an appropriate policy option:

- The impact on householder cash flow is small: no worse than a cup of coffee a fortnight in most cases,
- The benefits of Whole of Home requirements including the requirement for the installation of PV will more than offset the negative impacts of building fabric,
- There are some dwellings designs with a substantially higher cost per square metre than others. There may therefore be scope to adapt dwelling design to lower costs in this climate zone, and
- Not all benefits have been evaluated:
    - 7-star dwellings will have lower peak loads. Lower peak loads provide a saving to the electricity network, and the consumer in terms of a reduced appliance capacity and therefore cost,
    - 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
    - 7-star dwellings will provide greater resilience to climate change.

Whether these factors have sufficient weight to offset the negative impacts of the building fabric upgrade is a policy decision for government.

5.1.5 Perth Dwelling Costs

Table 99 Costs of improving building fabric from 6 to 7 stars in Class 1 in Perth

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost (per m^2)
SBH01	Slab	Large	Two	Detached	$1,497	$5.35
SBH01	Timber	Large	Two	Detached	$651	$2.33
SBH02	Slab	Large	One	Detached	$749	$2.88
SBH02	Timber	Large	One	Detached	$874	$3.36
SBH03	Slab	Medium	Two	Detached	$1,481	$7.93
SBH03	Timber	Medium	Two	Detached	$1,201	$6.43
SBH04	Slab	Medium	One	Detached	$1,653	$12.26
SBH04	Timber	Medium	One	Detached	$1,581	$11.73
SBH05	Slab	Small	One	Detached	$582	$4.15
SBH05	Timber	Small	One	Detached	$993	$7.09
SBH06	Slab	Small	One	Detached	$945	$9.35
SBH06	Timber	Small	One	Detached	$1,051	$10.40
SBH09	Slab	Small	One	Passive Solar	$949	$5.00
SBH15	Slab	Small	One	Semi-detached	$1,043	$10.41
SBH15	Timber	Small	One	Semi-detached	$673	$6.72
SBH19	Slab	Small	One	Passive Solar	$827	$5.33

Table 100 Summary of dwelling upgrade costs for Class 1 in Perth

House Type	Cost (total)	Cost (per m^2)
All	$1,047	$6.92
Non specialist	$1,038	$6.84
Specialist Designs	$838	$5.92

The cost of improving the NatHERS rating of a Class 1 dwelling from 6-stars with the current weather data to 7-stars with the new weather data varies from around $2 to $12 per square metre, depending on how well the design of the dwelling is suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $7/$m^2$. In contrast, specialist well-oriented designs (main living areas face south) which are well suited to the Perth climate can achieve around $1/$m^2$ cost savings.

Note that cost savings for specialist designs are smaller in Perth because the high mass wall and floor construction routinely used in this climate is an essential part of passive solar design.

Two-storey and timber floored poorly-oriented Class 1 dwellings have the highest costs.

5.1.6 Perth, summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 101 Changes to Roof and Ceiling specifications needed to meet 7-stars in Perth

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	3.3	4.1
Area ceiling 1	127.9	127.9
R-value ceiling 2	0.1	0.1
Area ceiling 2	10.2	10.2
Area roof insulated	0.0	0.0
Area roof uninsulated	197.0	197.0
R-value roof blanket	0.0	0.0
R-value ceiling Flat	1.3	1.6
Area roof insulated (Flat)	24.6	27.0
Area roof uninsulated (Flat)	9.7	7.4
Foil under roof?	56%	63%
Ventilated roof?	0%	0%
Roof colour	0.45	0.49

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased ceiling R values, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation,
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

Ceiling insulation levels used to obtain 7-stars increased by an average R0.8 to achieve 7-stars, some houses were required to install reflective foil under the roof, and the colour of the roof was made slightly darker.

Table 102 Changes to External and Internal wall and floor specifications needed to meet 7-stars in Perth

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	63%	81%
R-value walls	R 0.27	R 0.62
Proportion of walls insulated (insulated houses)	100%	95%
Area walls uninsulated	51.1	27.9
Area walls insulated (Garage and roof space)	0.0	0.0
Area walls uninsulated (Garage and roof space)	29.4	29.4
Foil layer walls?	19%	50%
If yes emissivity	0.2	0.3
Wall colour (Solar Abs)	0.51	0.53
Internal Walls		
No dwellings with insulated internal walls	0	0
R-value (if insulated)	Nil	Nil
Insulated area	Nil	Nil
Floors		
Area floor insulated	42.8	60.8
Waffle pod?	33%	89%
R-value floor	0 Houses, R 0	0 Houses, R 0
Foil underfloor	0%	0%
R-value subfloor walls	1 Houses Average R: 1	1 Houses Average R: 1
Area subfloor walls insulated	32.6	32.6
Area ceramic tile floor surface	24.6	25.4

All the dwellings used Brick Cavity walls. The proportion of dwellings required to insulate walls at 7-stars increased. Insulation levels used were not high compared to framed walls. At 6-stars, on average, 10mm expanded polystyrene was all that was required. At 7-stars, on average, a reflective backed 10mm EPS board installed against the inner leaf is all that is required.

Medium coloured walls were used on average at 6 stars, and slightly darker colours were used at 7-stars. Changing wall colour did not have a large impact on the rating because the effects on heating and cooling cancelled each other.

The wall to the garage was not required to be insulated in all but one of dwellings at 7-stars.

No floors over enclosed subfloor spaces were required to be insulated, while one house was needed to insulate subfloor walls. Eight of the nine dwellings on a slab floor used a waffle pod slab, up from 3 at 6-stars. In general terms, the houses which required a waffle pod slab were those which had significantly higher heating energy demand. Floor insulation and waffle pod slabs can decrease the rating in this climate if cooling energy demand is higher than average.

Table 103 Changes to Ceiling fan and Window specifications needed to meet 7-stars in Perth

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	0.0	0.0
No. 1200	0.3	0.5
No. 1400	0.4	0.9
Windows		
Area single glazed clear	40.1	35.1
Area single low e	0.5	2.5
Area single glazed tinted	0.0	0.2
Area single glazed heavy tinted	0.0	0.0
Area single low e tint	0.0	0.0
Area double glazed argon fill low e	0.0	0.3
Total Window Area	40.6	38.1
Frame colour (abs)	0.49	0.49
Area external Blinds	0.0	0.0
Highly openable windows louvre	NA	NA
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre heavy tint	NA	NA
Highly openable windows louvre low e	NA	NA
Highly openable windows louvre low e tint	NA	NA

In 7-star dwellings one more ceiling fans was installed (an increase from 1 to 2). Ceiling fan diameter was also increased to improve the impact of the fans. Ceiling fans were only installed where they provided significant benefit: in living rooms with the highest cooling loads.

The total window area at 7-stars was reduced by around 13%. The majority of windows in 6-star dwellings were able to use single clear glazing, with a small area of single low-e tinted glazing. While there was a slight increase in the use of single low-e glazing at 7-stars, performance glazing was not needed for more than 10% of windows. Frame colours were assumed to be medium and 6-stars and were not changed at 7-stars.

5.1.7 Perth Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on Flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 104 Heating and cooling energy bill savings for various appliances and area of dwelling conditioned

		Heating Savings						Cooling Savings			
		Whole House			Living Areas only			Whole House		Living areas only	
House No	Floor-type	AC Heat	Resistive Elec	Gas Space	AC Heat	Resistive Elec	Gas Space	AC Cool	AC Cool Duct	AC Cool	AC Cool Duct
01	SLA	$47	$174	$116	$41	$152	$101	$37	$14	$41	$15
01	TIM	$25	$94	$63	$20	$73	$48	$74	$27	$66	$24
02	SLA	$31	$114	$76	$24	$90	$60	$37	$14	$32	$12
02	TIM	$26	$98	$65	$20	$74	$49	$57	$21	$53	$20
03	SLA	$37	$136	$90	$31	$116	$77	$37	$14	$35	$13
03	TIM	$46	$170	$113	$43	$158	$105	$28	$10	$21	$8
04	SLA	$20	$73	$49	$15	$57	$38	$21	$8	$21	$8
04	TIM	$27	$100	$66	$21	$77	$51	$23	$9	$20	$7
05	SLA	$12	$44	$29	$9	$32	$21	$32	$12	$30	$11
05	TIM	$15	$55	$37	$10	$37	$24	$35	$13	$29	$11
06	SLA	$32	$117	$78	$28	$104	$70	$10	$4	$11	$4
06	TIM	$30	$109	$73	$25	$92	$61	$10	$4	$14	$5
09	SLA	$22	$83	$55	$21	$78	$52	$49	$18	$50	$18
15	SLA	$16	$60	$40	$13	$49	$33	$19	$7	$18	$7
15	TIM	$22	$80	$53	$20	$74	$49	$19	$7	$17	$6
19	SLA	$25	$94	$62	$21	$79	$52	$22	$8	$18	$7

5.1.7.1 Energy Bill savings for common appliance combinations

The table below shows the combined heating and cooling annual energy savings using the most common appliance combinations:

- Reverse Cycle heating/cooling space conditioning (whole house)
- Heating only living areas with a gas space heater
- Heating and cooling only living areas with a reverse cycle heater, and heating bedrooms with an electric peak rate resistance heater, and
- Gas space heating to living areas and evaporative cooling to the whole house.

Table 105 Space conditioning energy bill savings for common space conditioning appliances

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only Gas Space	Living areas RC space, resistive heating to bedrooms	Gas Space + Evap Cool
SBH01	Slab	$85	$116	$107	$130
SBH01	Timber	$99	$63	$120	$90
SBH02	Slab	$68	$76	$92	$90
SBH02	Timber	$83	$65	$107	$86
SBH03	Slab	$74	$90	$94	$104
SBH03	Timber	$74	$113	$86	$123
SBH04	Slab	$41	$49	$57	$56
SBH04	Timber	$50	$66	$73	$75
SBH05	Slab	$44	$29	$55	$41
SBH05	Timber	$50	$37	$69	$50
SBH06	Slab	$42	$78	$55	$82
SBH06	Timber	$40	$73	$57	$77
SBH09	Slab	$71	$55	$76	$73
SBH17	Slab	$35	$40	$46	$47
SBH18	Timber	$40	$53	$47	$60
SBH19	Slab	$47	$62	$62	$70

5.1.7.2 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 106 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Perth

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only Gas Space	Living areas RC space, resistive heating to bedrooms	Gas Space + Evaporative Cool
SBH01	Slab	-$1	$30	$21	$44
SBH01	Timber	$62	$25	$83	$53
SBH02	Slab	$25	$33	$50	$47
SBH02	Timber	$33	$15	$56	$36
SBH03	Slab	-$4	$12	$16	$26
SBH03	Timber	$1	$40	$13	$50
SBH04	Slab	-$40	-$32	-$24	-$25
SBH04	Timber	-$13	$3	$10	$12
SBH05	Slab	$10	-$4	$22	$7
SBH05	Timber	$0	-$13	$19	-$0
SBH06	Slab	-$12	$24	$1	$28
SBH06	Timber	-$21	$13	-$3	$16
SBH09	Slab	$17	$1	$22	$19
SBH17	Slab	-$14	-$10	-$4	-$3
SBH18	Timber	$9	$21	$15	$28
SBH19	Slab	-$0	$15	$15	$23

Cash flow impacts for building fabric improvements for the householder are positive for 72% of the cases modelled. Where the impact is negative the amount is small (worst case -$40) and may be offset by other aspects of the Whole of Home measures.

5.1.7.3 Net present value of building fabric induced energy savings versus capital cost

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on Flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 107 Net Present Value of Cost and Benefits at 7% discount rate over 40 years, Class 1 in Perth

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only Gas Space	Living areas RC space, resistive heating to bedrooms	Gas Space + Evap Cool
SBH01	Slab	-$371	$48	-$74	$233
SBH01	Timber	$671	$182	$952	$546
SBH02	Slab	$157	$266	$484	$449
SBH02	Timber	$232	-$8	$546	$271
SBH03	Slab	-$378	-$156	-$111	$27
SBH03	Timber	-$292	$232	-$131	$370
SBH04	Slab	-$872	-$764	-$655	-$662
SBH04	Timber	-$434	-$216	-$132	-$102
SBH05	Slab	-$1	-$195	$156	-$38
SBH05	Timber	-$203	-$384	$43	-$209
SBH06	Slab	-$385	$97	-$214	$148
SBH06	Timber	-$522	-$79	-$286	-$29
SBH09	Slab	$3	-$213	$69	$29
SBH17	Slab	-$397	-$333	-$256	-$240
SBH18	Timber	-$15	$156	$68	$249
SBH19	Slab	-$198	$3	$0	$111

Net Present Value at a 7% discount rate for building fabric improvements for the householder is positive for 45% of the cases modelled. In those cases which are negative, the amount is small and may be offset by other aspects of the Whole of Home measures.

5.1.7.4 Net Present Value: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 108 Net Present Value of costs and benefits at 3% discount rate

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only Gas Space	Living areas RC space, resistive heating to bedrooms	Gas Space + Evap Cool
SBH01	Slab	$1,641	$794	$2,128	$1,425
SBH01	Timber	$822	$1,010	$1,389	$1,328
SBH02	Slab	$1,043	$628	$1,588	$1,112
SBH02	Timber	$343	$728	$807	$1,045
SBH03	Slab	$430	$1,339	$709	$1,578
SBH03	Timber	-$476	-$289	-$100	-$111
SBH04	Slab	$56	$433	$579	$631
SBH04	Timber	$425	$88	$698	$360
SBH05	Slab	$288	-$25	$715	$278
SBH05	Timber	$25	$861	$322	$949
SBH06	Slab	-$133	$634	$276	$721
SBH06	Timber	$701	$328	$816	$747
SBH09	Slab	-$55	$56	$190	$217
SBH17	Slab	$380	$676	$524	$837
SBH18	Timber	$263	$613	$607	$800
SBH19	Slab	$456	$1,182	$970	$1,503

Net Present Value at 3% discount rate is positive, i.e. benefits exceed costs, in 89% of the cases reported above.

5.1.8 Conclusion: Class 1, Perth

Adoption of a 7-star minimum fabric requirement in Class 1 dwellings in similar climates to Perth in WA Climate Zone 5 ***is recommended***:

- NPV at 7% is strongly positive for almost half of dwellings,
- If NPV is negative, better design and orientation of dwellings offer the scope to reduce costs and provide positive NPV values,
- Even in those cases where the NPV is negative, analysis of annual household cash flow impact shows that this is generally less than $1 per week,
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment in almost all cases,
- Inclusion of Whole of Home measures may result in a much larger benefit which could outweigh the cases reported above where the benefits are negative.

5.1.9 Adelaide Dwelling Costs

Table 109 Costs of improving building fabric from 6 to 7 stars in Class 1 in Adelaide

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost(/m^2)
SBH01	Slab	Large	Two	Detached	$2,360	$8.43
SBH01	Timber	Large	Two	Detached	$3,022	$10.80
SBH02	Slab	Large	One	Detached	$928	$3.57
SBH02	Timber	Large	One	Detached	$2,333	$8.98
SBH03	Slab	Medium	Two	Detached	$2,499	$13.38
SBH03	Timber	Medium	Two	Detached	$3,816	$20.43
SBH04	Slab	Medium	One	Detached	$1,818	$13.49
SBH04	Timber	Medium	One	Detached	$770	$5.71
SBH05	Slab	Small	One	Detached	$1,082	$7.72
SBH05	Timber	Small	One	Detached	$1,491	$10.64
SBH06	Slab	Small	One	Detached	$1,603	$15.86
SBH06	Timber	Small	One	Detached	$1,978	$19.57
SBH11	Slab	Small	One	Passive Solar BV	$1,913	$7.15
SBH16	Slab	Small	One	Semi-detached	$42	$0.42
SBH16	Timber	Small	One	Semi-detached	$1,598	$15.95
SBH19	Slab	Small	One	Passive Solar BV	$836	$5.39

Table 110 Summary of dwelling upgrade costs for Class 1 in Climate

House Type	Cost (total)	Cost (per m^2)
All	$1,756	$10.47
Non specialist	$1,901	$11.41
Specialist Designs	$844	$4.80

The cost of improving the NatHERS rating of a Class 1 dwelling from 6-stars with the current weather data to 7-stars with the new weather data varies from around $4 to $16 per square metre, depending on how well the design of the dwelling is suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $11/m^2. In contrast, specialist well-oriented designs (main living areas face north) which are well suited to the Adelaide climate can achieve around $6/m^2 cost savings.

Two-storey and timber floored poorly oriented Class 1 dwellings have the highest costs.

The Adelaide climate is another where house SBH03 is expensive to upgrade from 6 to 7-stars, particularly on a timber floor. Upgrade costs are approximately 60% higher than the other 2-storey dwelling, SHB01. The high costs for this one dwelling suggest that the industry may need time to develop alternative dwelling designs with lower-cost options in this climate.

5.1.10 Adelaide, summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 111 Changes to Roof and Ceiling specifications needed to meet 7-stars in Adelaide

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	3.6	4.8
Area ceiling 1	127.9	129.9
R-value ceiling 2	0.7	0.9
Area ceiling 2	27.8	27.8
Area roof insulated	0.0	1.2
Area roof uninsulated	198.1	198.1
R-value roof blanket	0.0	0.0
R-value ceiling Flat	1.3	1.5
Area roof insulated (Flat)	24.6	27.2
Area roof uninsulated (Flat)	8.6	8.6
Foil under roof?	69%	88%
Ventilated roof?	0%	0%
Roof colour	0.48	0.41

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased ceiling R-values, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation,
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

Ceiling insulation levels used to obtain 7-stars were increased, on average, by around R1.2 compared to 6-star dwellings. In addition, one dwelling was required to install foil under the roof. Slightly lighter roof colours were used to achieve 7-stars than at 6-stars.

Table 112 Changes to External and Internal wall and floor specifications needed to meet 7-stars in Adelaide

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	100%	100%
R-value walls	R 2.28	R 2.54
Proportion of walls insulated (insulated houses)	100%	100%
Area walls uninsulated	0.0	0.0
Area walls insulated (Garage and roof space)	3.4	3.4
Area walls uninsulated (Garage and roof space)	23.4	23.8
Foil layer walls?	94%	100%
If yes emissivity	0.1	0.1
Wall colour (Solar Abs)	0.52	0.44
Internal Walls		
No dwellings with insulated internal walls	15	16
R-value (if insulated)	2.1	2.4
Insulated area	38.7	38.0
Floors		
Area floor insulated	63.7	90.3
Waffle pod?	56%	56%
R-value floor	3 Houses, R 2	4 Houses, R 2.5
Foil underfloor	0%	6%
R-value subfloor walls	4 Houses Average R: 1.0	3 Houses Average R: 1.3
Area subfloor walls insulated	33.1	33.1
Area ceramic tile floor surface	23.7	26.4

All the dwellings used Brick Veneer walls. These walls were all insulated at both 6- and 7-stars and 7-star houses used slightly higher R-values.

Medium coloured walls were used on average at 6 stars, and slightly lighter colours were used at 7-stars. Changing wall colour did not have a large impact on the rating because the impacts on heating and cooling cancelled each other.

The internal garage wall was required to be insulated in all dwellings at 7-stars. A slightly higher insulation R-value was used in these walls.

Some dwellings required floors over enclosed subfloor spaces to be insulated, while others insulated subfloor walls. Note that fully insulating both subfloor walls and the floor itself is not required. Six of the nine dwellings on a slab floor used a waffle pod slab. In general terms, the houses which insulation of floors or were built on a waffle pod slab were those which had significantly higher heating energy demand. Floor insulation and waffle pod slabs can decrease the rating in this climate if cooling energy demand is higher than average.

Table 113 Changes to Ceiling fan and Window specifications needed to meet 7-stars in Adelaide

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	0.0	0.0
No. 1200	0.6	0.3
No. 1400	0.1	0.9
Windows		
Area single glazed clear	31.3	22.4
Area single low e	0.0	0.1
Area single glazed tinted	0.0	0.0
Area single glazed heavy tinted	0.0	0.0
Area single low e tint	0.0	0.0
Area double glazed argon fill low e	9.2	15.1
Total Window Area	40.5	37.6
Frame colour (abs)	0.48	0.46
Area external Blinds	0.3	0.1
Highly openable windows louvre	NA	NA
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre heavy tint	NA	NA
Highly openable windows louvre low e	NA	NA
Highly openable windows louvre low e tint	NA	NA

Few ceiling fans were required to achieve 7-stars in this climate. Ceiling fans only showed significant benefits in living areas with high cooling loads. Slightly larger diameter ceiling fans were installed in 7-star dwellings.

The total window area at 7-stars was reduced by around 7%. The majority of windows in 6-star dwellings were able to use single clear glazing, with 23% required to use double glazing. Some of the dwellings also used some modest areas of louvre windows. At 7-stars the proportion of windows required to use double glazing increased to 40%. Window frame colours were assumed to be medium at 6-stars and did not change significantly at 7-stars.

5.1.11 Adelaide Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on Flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 114 Heating and cooling energy bill savings for various appliances and area of dwelling conditioned

		Heating Savings						Cooling Savings			
		Whole House			Living Areas only			Whole House		Living areas only	
House No	Floor-type	AC Heat	AC Heat Duct	Gas Space	AC Heat	AC Heat Duct	Gas Space	AC Cool	Evap Cool	AC Cool	Evap Cool
01	SLA	$59	$81	$122	$51	$71	$106	$47	$17	$58	$21
01	TIM	$68	$94	$141	$57	$78	$117	$129	$48	$106	$39
02	SLA	$39	$53	$80	$30	$42	$63	$47	$17	$40	$15
02	TIM	$33	$45	$68	$25	$34	$52	$71	$26	$67	$25
03	SLA	$46	$63	$95	$39	$54	$81	$47	$17	$44	$16
03	TIM	$58	$79	$119	$54	$73	$110	$35	$13	$26	$10
04	SLA	$25	$34	$51	$19	$26	$40	$26	$10	$26	$10
04	TIM	$34	$46	$70	$26	$36	$54	$29	$11	$25	$9
05	SLA	$15	$20	$30	$11	$15	$22	$40	$15	$37	$14
05	TIM	$19	$26	$39	$12	$17	$26	$44	$16	$36	$13
06	SLA	$40	$55	$82	$35	$49	$73	$13	$5	$13	$5
06	TIM	$37	$51	$77	$31	$43	$64	$13	$5	$18	$7
11	SLA	$28	$39	$58	$26	$36	$55	$61	$23	$62	$23
16	SLA	$20	$28	$42	$17	$23	$34	$24	$9	$22	$8
16	TIM	$27	$37	$56	$25	$34	$52	$24	$9	$21	$8
19	SLA	$32	$44	$65	$27	$37	$55	$27	$10	$22	$8

5.1.11.1 Energy Bill savings for common appliance combinations

The table below shows the combined heating and cooling annual energy savings using the most common appliance combinations:

- Reverse Cycle heating/cooling space conditioning (whole house and living areas only),
- Gas space heating with Reverse Cycle cooling in living areas only,
- Whole house gas ducted heating and evaporative cooling.

Table 115 Space conditioning energy bill savings for common space conditioning appliance combinations

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only RC Space	Gas Space, RC cool	Gas space, Evaporative cool
SBH01	Slab	$128	$129	$164	$124
SBH01	Timber	$223	$184	$223	$165
SBH02	Slab	$100	$82	$103	$80
SBH02	Timber	$116	$101	$118	$78
SBH03	Slab	$110	$98	$125	$98
SBH03	Timber	$114	$100	$137	$123
SBH04	Slab	$60	$52	$66	$49
SBH04	Timber	$75	$61	$79	$65
SBH05	Slab	$60	$52	$59	$37
SBH05	Timber	$70	$53	$62	$42
SBH06	Slab	$68	$62	$87	$78
SBH06	Timber	$64	$61	$82	$69
SBH11	Slab	$100	$99	$117	$77
SBH16	Slab	$51	$45	$57	$43
SBH16	Timber	$61	$55	$73	$60
SBH19	Slab	$71	$59	$77	$65

5.1.11.2 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 116 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Adelaide

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only RC Space	Gas Space, RC cool	Gas space, Evaporative cool
SBH01	Slab	-$7	-$7	$29	-$12
SBH01	Timber	$50	$11	$50	-$8
SBH02	Slab	$47	$28	$49	$27
SBH02	Timber	-$17	-$33	-$15	-$56
SBH03	Slab	-$33	-$45	-$18	-$45
SBH03	Timber	-$104	-$119	-$82	-$95
SBH04	Slab	-$44	-$52	-$39	-$55
SBH04	Timber	$31	$17	$35	$21
SBH05	Slab	-$2	-$10	-$3	-$25
SBH05	Timber	-$15	-$32	-$24	-$43
SBH06	Slab	-$24	-$30	-$5	-$14
SBH06	Timber	-$50	-$53	-$31	-$44
SBH11	Slab	-$9	-$11	$7	-$32
SBH16	Slab	$49	$43	$54	$41
SBH16	Timber	-$31	-$36	-$19	-$31
SBH19	Slab	$23	$11	$29	$17

Cash flow impacts for building fabric improvements for the householder are positive for 32% of the cases modelled. Where the impact is negative the amount is small (worst case -$52 excluding SBH03) and may be offset by other aspects of the Whole of Home measures.

5.1.11.3 The net present value of building fabric induced energy savings versus capital cost

The table below shows the Net Present Value of energy savings discounted at 7% over 40 years less the cost of building fabric improvements. Figures in red indicate that the net present value is negative, i.e., the discounted value of energy savings over 40 years is less than the value of the capital cost of improvements required to achieve 7-stars. A 7% real discount rate is the policy evaluation metric recommended for this project by the OBPR.

Table 117 Net Present Value of Cost and Benefits at 7% discount rate over 40 years, Class 1 in Adelaide

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only RC Space	Gas Space, RC cool	Gas space, Evaporative cool
SBH01	Slab	-$653	-$647	-$173	-$713
SBH01	Timber	-$44	-$568	-$45	-$820
SBH02	Slab	$402	$160	$439	$138
SBH02	Timber	-$781	-$985	-$754	-$1,294
SBH03	Slab	-$1,036	-$1,189	-$828	-$1,191
SBH03	Timber	-$2,295	-$2,488	-$1,996	-$2,172
SBH04	Slab	-$1,017	-$1,122	-$945	-$1,160
SBH04	Timber	$236	$40	$280	$92
SBH05	Slab	-$280	-$391	-$292	-$589
SBH05	Timber	-$558	-$785	-$671	-$931
SBH06	Slab	-$703	-$775	-$449	-$566
SBH06	Timber	-$1,128	-$1,169	-$883	-$1,059
SBH09	Slab	-$579	-$597	-$354	-$883
SBH17	Slab	$643	$562	$715	$532
SBH18	Timber	-$787	-$860	-$630	-$795
SBH19	Slab	$112	-$53	$192	$33

Net Present Value at a 7% discount rate for building fabric improvements for the householder is positive for 23% of the cases modelled. In those cases which are negative, the amount is small and may be offset by other aspects of the Whole of Home measures.

5.1.11.4 The net present value of costs and benefits: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 118 Net Present Value of costs and benefits at 3% discount rate

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Whole House RC space	Living areas only RC Space	Gas Space, RC cool	Gas space, Evaporative cool
SBH01	Slab	$601	$611	$1,431	$496
SBH01	Timber	$2,141	$1,233	$2,139	$796
SBH02	Slab	$1,378	$958	$1,442	$921
SBH02	Timber	$357	$5	$404	-$531
SBH03	Slab	$37	-$227	$398	-$231
SBH03	Timber	-$1,178	-$1,513	-$661	-$966
SBH04	Slab	-$429	-$610	-$304	-$677
SBH04	Timber	$975	$635	$1,051	$724
SBH05	Slab	$309	$116	$287	-$228
SBH05	Timber	$128	-$266	-$68	-$519
SBH06	Slab	-$43	-$167	$398	$196
SBH06	Timber	-$505	-$576	-$80	-$385
SBH09	Slab	$401	$369	$791	-$126
SBH17	Slab	$1,147	$1,006	$1,271	$954
SBH18	Timber	-$193	-$318	$80	-$205
SBH19	Slab	$807	$522	$947	$671

At 3% discount rate the NPV shows significantly larger benefits and smaller disbenefits than at 7%. Note that if a 7% investment return was available after-tax and assuming a real growth in energy prices as shown in AEMO, 2015, NPV would be similar to the values shown above.

Net Present Value at a 3% discount rate for building fabric improvements for the householder is positive for 61% of the cases modelled. In those cases which are negative, the amount is small and may be offset by other aspects of the Whole of Home measures.

5.1.12 Conclusion: Class 1: Adelaide

Based on the costs and benefits of building fabric improvements and energy savings to the consumer alone, increasing the NCC requirements in SA Climate Zone 5 in Adelaide is a marginal case:

- NPV at 7% is negative for the majority of dwellings,
- In those cases where the NPV is negative, analysis of annual household cash flow impact shows that this is generally less than $1 per week,
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment in 61% all cases, and
- The benefits of Whole of Home requirements, including the requirement for the installation of PV, will more than offset the negative impacts of building fabric.

It is also acknowledged that not all benefits have been evaluated:

- 7-star dwellings will have lower peak loads. The lower peak loads provide a saving to the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
- 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
- 7-star dwellings will provide greater resilience to climate change.

It is therefore **recommended that building fabric stringency be increased to 7-stars in Climate Zone 5 in Adelaide and similar climates in SA, subject to further review of the factors discussed above.**

5.2 Class 2 dwellings

5.2.1 Sydney (Mascot) Dwelling Costs

Table 119 Costs of improving building fabric from 6 to 7 stars in Class 2 in Sydney

House Number	Floor-type	Position	Cost (total)	Cost (/m^2)
SBA01	Slab	Corner	$724	$7.58
SBA02*	Slab	Middle	$0	$0.00
SBA03	Slab	Corner	$457	$4.78
SBA04	Slab	Middle	$1,146	$12.81
SBA05	Slab	Corner	$626	$6.56
SBA06	Slab	Middle	$292	$3.26
SBA07	Slab	Corner	$678	$7.10
SBA08	Slab	Middle	$707	$7.90
SBA11	Slab	Corner	$85	$0.89
SBA12*	Slab	Middle	$0	$0.00
SBA13*	Slab	Corner	$0	$0.00
SBA14*	Slab	Middle	$0	$0.00
SBA15	Slab	Corner	$690	$7.22
SBA16	Slab	Middle	$141	$1.58
SBA17	Slab	Corner	$207	$2.16
SBA18	Slab	Middle	$191	$2.13
SBA21	Slab	Corner	$566	$5.93
SBA22	Slab	Middle	$760	$8.50
SBA23	Slab	Corner	$298	$3.12
SBA24	Slab	Middle	$676	$7.56
SBA25	Slab	Corner	$405	$4.24
SBA26	Slab	Middle	$399	$4.47
SBA27	Slab	Corner	$677	$7.09
SBA28	Slab	Middle	$131	$1.47

* Note these units did not need to be altered to increase the rating to an average 7-stars

Table 120 Summary of dwelling upgrade costs for Class 2 in Sydney

Summary	Cost
Building-wide cost	$9,855.80
Cost per unit	$410.66
Cost per m2	$4.44

The cost of improving the NatHERS ratings of a Class 2 dwelling from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the new weather data varies from around $1 to $13 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $4/$m^2$.

5.2.2 Sydney: Changes to design and specification Class 2

Table 121 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans in Sydney

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling 1	3.0	3.0			Nil
Area ceiling 1	92.4	92.4	739.1	739.1	Nil
External Walls	**Per unit**		**Whole Building**		
R-value walls	0.8	1.0			0.29
Area walls insulated	23.8	33.2	570	798	140%
Area walls uninsulated	14.2	4.7			33%
Wall colour	0.56	0.52			93%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.0	0.0			Nil
Insulated area	0.0	0.0			Nil
Floors	**Per unit**		**Whole Building**		
Area floor insulated	92.5	92.5	740	740	Nil
R-value floor	2.00	2.00			Nil
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	0.5	0.0	13	1	-12
No. 1200	0.5	0.9	12	21	9
No. 1400	0.3	1.8	6	43	37

Roof insulation was unchanged at 7-stars. Additional insulation will improve the rating; however, other methods of improving the rating were selected in preference to this.

Wall insulation R-values were increased by, on average, R0.2. The area of wall insulated also increased, and all units needed to have wall insulation for the building to achieve its minimum and average rating requirements.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show a significant increase over the current assumption.

All dwellings required floor insulation to achieve 7-stars. Note that the car park is assumed to be unenclosed. If the car park was enclosed, floor insulation R-values could likely be reduced, or other specifications lowered.

There were number and diameter of ceiling fans increased significantly (from 31 to 65) to achieve an average 7-stars with a minimum of 6-stars.

Table 122 Changes to building design and specification to increase stringency: Windows in Sydney

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	25.8	18.7	619.3	447.9	72%
Area single low e	1.8	3.6	42.3	85.7	203%
Area single glazed tinted	0.3	0.0	7.6	0.0	0%
Area single glazed heavy tinted	0.0	0.0	0.0	0.0	Nil
Area single low e tint	1.0	2.4	24.6	56.8	231%
Area double glazed argon fill low e	0.0	0.2	0.0	4.4	Nil
Highly openable windows louvre	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e tint	0.0	0.0	0.0	0.0	Nil
Total Window Area	**28.9**	**24.8**	**693.7**	**594.8**	**86%**
Frame colour (abs)	0.5	0.5			93%
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	4.5	3.6	107.8	86.8	81%
E area Day	3.4	2.9	82.0	69.3	85%
S area Day	2.9	2.9	68.5	69.5	101%
W area Day	3.6	3.0	85.9	71.2	83%
N area Night	4.4	3.7	104.6	88.1	84%
E area Night	3.2	2.6	77.1	62.7	81%
S area Night	3.2	3.0	75.7	71.5	94%
W area Night	3.5	2.9	84.9	68.5	81%

Total window area across all units was reduced by around 14%. There was a 28% reduction in the use in single clear glazing and a corresponding increase in the use of double glazing. Window frame colours were unchanged.

No external blinds were used in part because of their high cost but also because the units all had balconies which provided some protection from solar gain. Management of solar heat gains could be sufficiently handled through the use of lower solar heat gain coefficient, i.e. tinted, windows.

5.2.3 Sydney (Mascot) Energy Bill Savings

The extent of improvement costs for individual units varied significantly. This variation is in part because a heterogeneous approach to rating was adopted, i.e. there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to average benefits for all units in the development for a variety of common appliance combinations and conditioned areas.

Table 123 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 1 :	Reverse Cycle Heating & Cooling	
Financial Impacts	Whole House	Living Areas Only
Cost per unit	$410.66	$410.66
Energy-saving per unit Total	$26.33	$18.03
Energy-saving per unit Heating	$4.97	$3.90
Energy-saving per unit Cooling	$21.36	$14.13
Increase to annual mortgage payments	$23.53	$23.53
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$2.81	-$5.49
Net Present Value @ 7%	-$59.59	-$170.23
Net Present Value @ 5%	$41.19	-$101.21
Net Present Value @ 3%	$198.03	$6.20

Table 124 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 2

Appliance Mix 2 :	Gas Space Heating & Reverse Cycle Cooling	
Financial Impact	Whole House	Living Areas Only
Cost per unit	$410.66	$410.66
Energy-saving per unit	$32.21	$22.65
Energy-saving per unit Total	$32.21	$22.65
Energy-saving per unit Heating	$10.85	$8.52
Increase to annual mortgage payments	$23.53	$23.53
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$8.69	-$0.88
Net Present Value @ 7%	$18.82	-$108.71
Net Present Value @ 5%	$142.12	-$22.03
Net Present Value @ 3%	$333.98	$112.86

Table 125 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 3

Appliance Mix 3 : Financial Impact	Resistive Electric day rate Heating & Reverse Cycle Cooling Whole House	Living Areas Only
Cost per unit	$410.66	$410.66
Energy-saving per unit	$41.80	$30.17
Energy-saving per unit Total	$41.80	$30.17
Energy-saving per unit Heating	$20.44	$16.04
Increase to annual mortgage payments	$23.53	$23.53
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$18.27	$6.64
Net Present Value @ 7%	$146.61	-$8.45
Net Present Value @ 5%	$306.59	$107.01
Net Present Value @ 3%	$555.54	$286.69

The most common appliance mix in high rise apartments is likely to be an electric reverse cycle due to the difficulty associated with distributing gas and installing flues in these buildings. In lower rise apartments, gas may be more common. Sydney has a high proportion of dwellings without a fixed heating device (35.9%). In this case, a plug-in day-rate electric heater will be the only option. Heating using plug-in electric heaters due to the lack of a fixed heater may be more likely to occur at the lower end of the market.

The NPV of benefits and costs for Class 2 dwellings in Sydney at a 7% discount rate are negative for those dwellings which use reverse cycle heating and cooling. It is positive where gas space heating is used, and the whole dwelling is heated. Even if there is no installed heater in bedrooms, gas space heaters usually have sufficient capacity to heat bedrooms as well as heating the living area, or at least significantly increase temperatures in bedrooms, due to the smaller size of the apartment. NPV at 7% is positive where there is no installed fixed heater, and a plug-in electric heater is used.

Impacts on annual cashflow are relatively small positive and negative values depending on the type of space conditioning appliances used and the area of the dwelling conditioned.

NPV at 3% - the household alternative investment scenario – is a small positive value for all cases.

5.2.4 Conclusion: Class 2, Sydney

While NPV at 7% discount rate is negative in some cases, the small impact on cashflow and positive values at 3% mean that, ***on balance***, ***the increase in stringency for Class 2 dwellings in climates like Sydney in NSW is recommended***. Other aspects of the Whole of Home requirements will increase the benefits, and other aspects of the benefits have not been quantified in this report.

5.2.5 Perth Dwelling Costs

Table 126 Costs of improving building fabric from 6 to 7 stars in Class 2 in Perth

House Number	Floor-type	Position	Cost (total)	Cost (/m^2)
SBA01	Slab	Corner	$364	$3.81
SBA02*	Slab	Middle	$0	$0.00
SBA03	Slab	Corner	$416	$4.36
SBA04	Slab	Middle	$812	$9.08
SBA05	Slab	Corner	$1,226	$12.84
SBA06*	Slab	Middle	$0	$0.00
SBA07	Slab	Corner	$453	$4.75
SBA08	Slab	Middle	$820	$9.17
SBA11	Slab	Corner	$656	$6.87
SBA12*	Slab	Middle	$0	$0.00
SBA13*	Slab	Corner	$0	$0.00
SBA14*	Slab	Middle	$0	$0.00
SBA15	Slab	Corner	$499	$5.22
SBA16*	Slab	Middle	$0	$0.00
SBA17	Slab	Corner	$654	$6.84
SBA18	Slab	Middle	$638	$7.13
SBA21	Slab	Corner	$998	$10.45
SBA22*	Slab	Middle	$0	$0.00
SBA23	Slab	Corner	$832	$8.71
SBA24	Slab	Middle	$601	$6.72
SBA25	Slab	Corner	$565	$5.91
SBA26	Slab	Middle	$572	$6.40
SBA27	Slab	Corner	$238	$2.49
SBA28	Slab	Middle	$1,358	$15.18

* Note these units did not need to be altered to increase the rating to an average 7-stars

Table 127 Summary of dwelling upgrade costs for Class 2 in Perth

Building-wide cost	Cost
Building-wide cost	$11,700
Cost per unit	$488
Cost per m2	$5.27

The cost of improving the NatHERS ratings of a Class 2 dwelling from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the new weather data varies from around $3 to $13 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $5/m^2.

5.2.6 Perth: Changes to design and specification Class 2

Table 128 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans in Perth

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling 1	3.0	3.0			Nil
Area ceiling 1	93.3	93.3	746.2	746.2	Nil
External Walls	**Per unit**		**Whole Building**		
R-value walls	0.5	0.7			0.13
Area walls insulated	22.6	27.7	542	665	123%
Area walls uninsulated	16.1	11.0			68%
Wall colour	0.54	0.54			98%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.0	0.0			Nil
Insulated area	0.0	0.0			Nil
Floors	**Per unit**		**Whole Building**		
Area floor insulated	92.5	92.5	740	740	Nil
R-value floor	2.00	2.00			Nil
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	0.0	0.0	0	0	0
No. 1200	1.2	1.0	29	25	-4
No. 1400	0.2	1.0	4	25	21

Roof insulation was unchanged at 7-stars. Additional Insulation will improve the rating; however, other methods of improving the rating were selected in preference to this.

Wall insulation R-values were increased by, on average, R0.2. The area of wall insulated also increased, and all units needed to have wall insulation for the building to achieve its minimum and average rating requirements.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show a significant increase over the current assumption.

All dwellings required floor insulation to achieve 7-stars. Note that the car park is assumed to be unenclosed. If the car park was enclosed, floor insulation R-values could likely be reduced, or other specifications lowered.

There were number and diameter of ceiling fans increased significantly (from 31 to 65) to achieve an average 7-stars with a minimum of 6-stars.

Table 129 Changes to building design and specification to increase stringency: Windows in Perth

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	26.2	16.1	629.2	386.1	61%
Area single low e	0.0	3.1	0.0	74.3	Nil
Area single glazed tinted	0.3	1.3	8.2	31.1	380%
Area single glazed heavy tinted	0.0	0.0	0.0	0.0	Nil
Area single low e tint	1.6	4.9	39.4	118.3	300%
Area double glazed argon fill low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e tint	0.0	0.0	0.0	0.0	Nil
Total Window Area	**28.2**	**25.4**	**676.8**	**609.9**	**90%**
Frame colour (abs)	0.5	0.5			91%
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	3.7	3.4	88.3	82.1	93%
E area Day	3.8	3.2	90.7	75.8	84%
S area Day	3.0	2.9	72.3	70.4	97%
W area Day	3.5	3.1	85.2	74.8	88%
N area Night	3.8	3.6	92.2	87.5	95%
E area Night	3.7	3.5	89.3	83.1	93%
S area Night	3.1	2.7	73.4	63.8	87%
W area Night	3.3	2.7	78.3	65.2	83%

Total window area across all units was reduced by around 10%. There was a 39% reduction in the use in single clear glazing, and there was a corresponding increase in the use of single low-e and tinted single low e glazing. Window frame colours were unchanged. The proportion of higher performance windows increased from 7% to 37%.

No external blinds were used in part because of their high cost but also because the units all had balconies which provided some protection from solar gain. Management of solar heat gains could be sufficiently handled through the use of lower solar heat gain coefficient, i.e. tinted, windows.

5.2.7 Perth Energy Bill Savings

The extent of improvement costs for individual units varied significantly. This variation is in part because a heterogeneous approach to rating was adopted; i.e., there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to the average benefits for all units in the development.

Table 130 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 1 : Financial Impacts	Reverse Cycle Heating & Reverse Cycle Cooling	
	Whole House	Living Areas Only
Cost per unit	$487.51	$487.51
Energy-saving per unit Total	$33.80	$23.49
Energy-saving per unit Heating	$7.22	$5.91
Energy-saving per unit Cooling	$26.57	$17.58
Increase to annual mortgage payments	$27.93	$27.93
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$5.87	-$4.44
Net Present Value @ 7%	-$36.96	-$174.41
Net Present Value @ 5%	$92.38	-$84.52
Net Present Value @ 3%	$293.66	$55.35

Table 131 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 2

Appliance Mix 2 : Financial Impact	Reverse Cycle Ducted Heating & Reverse Cycle Ducted Cooling	
	Whole House	Living Areas Only
Cost per unit	$487.51	$487.51
Energy-saving per unit	$46.39	$32.24
Energy-saving per unit Total	$46.39	$32.24
Energy-saving per unit Heating	$9.91	$8.11
Increase to annual mortgage payments	$27.93	$27.93
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$18.46	$4.31
Net Present Value @ 7%	$130.90	-$57.76
Net Present Value @ 5%	$308.44	$65.62
Net Present Value @ 3%	$584.71	$257.61

Table 132 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 3

Appliance Mix 3 : Financial Impact	Gas Space Heating & Reverse Cycle Cooling Whole House	Living Areas Only
Cost per unit	$487.51	$487.51
Energy-saving per unit	$44.38	$32.14
Energy-saving per unit Total	$44.38	$32.14
Energy-saving per unit Heating	$17.80	$14.56
Increase to annual mortgage payments	$27.93	$27.93
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$16.45	$4.21
Net Present Value @ 7%	$104.09	-$59.03
Net Present Value @ 5%	$273.93	$63.99
Net Present Value @ 3%	$538.21	$255.40

Apartments are likely only to use space conditioners, but high-end apartments may provide ducted cooling to larger units. The most common appliance mix in high rise apartments is expected to be an electric reverse cycle due to the difficulty associated with distributing gas and installing flues in these buildings. In lower rise apartments, gas may be more common. Even if there is no installed heater in bedrooms, gas space heaters usually have sufficient capacity to heat bedrooms as well as heating the living area, or at least significantly increase temperatures in bedrooms, due to the smaller size of the apartment.

The NPV at 7% discount rate is negative except for ducted cooling and gas heating where the whole apartment is conditioned. While the values are negative, they are small and will likely be improved significantly through other Whole of Home measures.

Household cash flow is improved by a small amount in all cases except where reverse cycle air conditioning is only used in the living area only. NPV at 3% - the household alternative investment scenario – is positive in all cases.

5.2.8 Conclusion: Class 2, Perth

While NPV at 7% discount rate is negative in some cases, the small impact on cashflow and positive NPV values at 3% mean that, ***on balance, the increase in stringency for Class 2 dwellings in climates like Perth in WA is recommended***. Other aspects of the Whole of Home requirements will increase the benefits, and other aspects of the benefits have not been quantified in this report.

5.2.9 Adelaide Dwelling Costs

Table 133 Costs of improving building fabric from 6 to 7 stars in Class 2 in Adelaide

House Number	Floor-type	Position	Cost (total)	Cost (/m^2)
SBA01	Slab	Corner	$391	4.10
SBA02	Slab	Middle	$694	7.77
SBA03	Slab	Corner	$371	3.89
SBA04	Slab	Middle	$279	3.13
SBA05	Slab	Corner	$735	7.70
SBA06	Slab	Middle	$251	2.81
SBA07	Slab	Corner	$413	4.33
SBA08	Slab	Middle	$917	10.25
SBA11	Slab	Corner	$637	6.67
SBA12*	Slab	Middle	$0	0.00
SBA13*	Slab	Corner	$0	0.00
SBA14*	Slab	Middle	$0	0.00
SBA15	Slab	Corner	$579	6.06
SBA16*	Slab	Middle	$0	0.00
SBA17	Slab	Corner	$331	3.46
SBA18	Slab	Middle	$871	9.74
SBA21*	Slab	Corner	$0	0.00
SBA22	Slab	Middle	$227	2.54
SBA23	Slab	Corner	$833	8.72
SBA24	Slab	Middle	$757	8.47
SBA25	Slab	Corner	$1,349	14.13
SBA26	Slab	Middle	$795	8.89
SBA27	Slab	Corner	$565	5.91
SBA28	Slab	Middle	$723	8.09

Notes:* Units marked with an asterisk have zero cost because these units did not need to be upgraded in moving from minimum 5-stars, average 6-stars to minimum 6-stars, average 7-stars.

Table 134 Summary of dwelling upgrade costs for Class 2 in Adelaide

Summary	Cost
Building-wide cost	$11,721
Cost per unit	$488.38
Cost per m2	$5.28

The cost of improving the NatHERS ratings of a Class 2 dwelling from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the new weather data varies from around $3 to $14 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $5/m^2.

5.2.10 Adelaide: Changes to design and specification Class 2

Table 135 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans in Adelaide

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling 1	3.0	3.0			Nil
Area ceiling 1	92.5	92.5	739.7	739.7	Nil
External Walls	**Per unit**		**Whole Building**		
R-value walls	1.1	1.7			0.54
Area walls insulated	24.1	32.4	579	778	134%
Area walls uninsulated	13.8	5.5			40%
Wall colour	0.59	0.51			88%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.0	0.0			Nil
Insulated area	0.0	0.0			Nil
Floors	**Per unit**		**Whole Building**		
Area floor insulated	88.1	88.1	705	705	Nil
R-value floor	1.69	1.88			111%
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	0.0	0.0	0	0	0
No. 1200	0.0	0.0	0	0	0
No. 1400	0.0	0.0	0	0	0

Roof insulation was unchanged at 7-stars. Additional Insulation will improve the rating; however, other methods of improving the rating were selected in preference to this.

Wall insulation R-values were increased by, on average, R0.6. The area of wall insulated also increased, and all units needed to have wall insulation for the building to achieve its minimum and average rating requirements.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show a significant increase over the current assumption.

All but one of the dwellings required floor insulation to achieve 7-stars and the level of insulation needed to be increased slightly. Note that the car park is assumed to be unenclosed. If the car park was enclosed, floor insulation R-values could likely be reduced, or other specifications lowered.

Table 136 Changes to building design and specification to increase stringency: Windows in Adelaide

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	25.3	18.6	607.3	446.6	74%
Area single low e	0.7	1.1	15.8	25.8	164%
Area single glazed tinted	0.0	0.0	0.0	0.0	Nil
Area single glazed heavy tinted	0.0	0.0	0.0	0.0	Nil
Area single low e tint	0.5	1.3	10.9	30.9	283%
Area double glazed argon fill low e	0.0	2.4	0.0	58.4	Nil
Highly openable windows louvre	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e tint	0.0	0.0	0.0	0.0	Nil
Total Window Area	**26.4**	**23.4**	**634.0**	**561.7**	**89%**
Frame colour (abs)	0.7	0.7			Nil
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	3.6	3.3	85.7	78.7	92%
E area Day	3.3	3.0	79.9	72.5	91%
S area Day	3.1	2.9	74.5	69.7	94%
W area Day	3.2	2.6	75.9	63.5	84%
N area Night	3.8	3.2	92.0	76.1	83%
E area Night	2.9	2.4	69.2	56.8	82%
S area Night	3.3	3.0	78.6	71.8	91%
W area Night	3.0	2.5	72.6	60.8	84%

Total window area across all units was reduced by around 11%. There was a 26% reduction in the use in single clear glazing, and there was a corresponding increase in the use of single low-e and tinted single low e glazing. Window frame colours were unchanged. The proportion of higher performance windows increased from 4% to 20%.

No external blinds were used in part because of their high cost but also because the units all had balconies which provided some protection from solar gain. Management of solar heat gains could be sufficiently handled through the use of lower solar heat gain coefficient, i.e. tinted, windows.

5.2.11 Adelaide Energy Bill Savings

The extent of improvement costs for individual units varied significantly. This variation is in part because a heterogeneous approach to rating was adopted; i.e., there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to the average benefits for all units in the development.

Table 137 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 1 :	Reverse Cycle Heating Cooling	
Financial Impacts	Whole House	Living Areas Only
Cost per unit	$488	$488
Energy-saving per unit Total	$44	$28
Energy-saving per unit Heating	$18	$14
Energy-saving per unit Cooling	$26	$14
Increase to annual mortgage payments	$28	$28
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$16	-$0
Net Present Value @ 7%	$103	-$121
Net Present Value @ 5%	$273	-$15
Net Present Value @ 3%	$537	$149

Table 138 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 2

Appliance Mix 2 :	Gas Space Heating & Reverse Cycle Cooling	
Financial Impact	Whole House	Living Areas Only
Cost per unit	$488	$488
Energy-saving per unit	$64	$42
Energy-saving per unit Total	$64	$42
Energy-saving per unit Heating	$37	$29
Increase to annual mortgage payments	$28	$28
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$36	$14
Net Present Value @ 7%	$358	$75
Net Present Value @ 5%	$601	$237
Net Present Value @ 3%	$980	$489

Table 139 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 3

Appliance Mix 3 : Financial Impact	Resistive Electric Day rate Heating & Evaporative Cooling Whole House	Living Areas Only
Cost per unit	$488	$488
Energy-saving per unit	$84	$62
Energy-saving per unit Total	$84	$62
Energy-saving per unit Heating	$74	$57
Increase to annual mortgage payments	$28	$28
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$56	$34
Net Present Value @ 7%	$630	$339
Net Present Value @ 5%	$952	$576
Net Present Value @ 3%	$1,451	$946

The most common appliance mix in high rise apartments is likely to be an electric reverse cycle due to the difficulty associated with distributing gas and installing flues in these buildings. In lower rise apartments, gas may be more common. Even if there is no installed heater in bedrooms, gas space heaters usually have sufficient capacity to heat bedrooms as well as heating the living area, or at least significantly increase temperatures in bedrooms, due to the smaller size of the apartment.

A small but significant proportion of the market in Adelaide has no heating or electric resistive heating. Around 25% of the market in Adelaide use Evaporative Cooling, but penetration in apartments is unclear. These two options were combined, more to cover all bases, than to provide information about a significant market segment.

The NPV at 7% discount rate is positive except for reverse cycle heating and cooling to living areas only. Household cash flow is improved by a small amount in all cases except reverse cycle heating and cooling to living areas only but the impact is almost 0. NPV at 3% - the household alternative investment scenario – is positive in all cases.

5.2.12 Conclusion: Class 2, Adelaide

While NPV at 7% discount rate is negative in some cases, the small impact on cashflow and positive NPV values at 3% mean that, ***on balance, the increase in stringency for Class 2 dwellings in climates like Adelaide in SA is recommended***. Other aspects of the Whole of Home requirements will increase the benefits, and other aspects of the benefits have not been quantified in this report.

6 NCC Climate Zone 6: Melbourne

As shown in Table 3 above, the rating of dwellings which achieve 7.0 stars with the current weather and star bands is virtually unchanged with the updated weather data and star bands. While ratings remained unchanged, there was a significant shift in the balance of heating and cooling loads toward cooling in the central Melbourne climate used for the analysis of Class 2 dwellings.

6.1 Class 1 Dwellings

6.1.1 Dwelling Costs

Table 140 Costs of improving building fabric from 6 to 7 stars in Class 1 in Melbourne

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost (/m^2)
SBH01	Slab	Large	Two	Detached	$3,782	$13.51
SBH01	Timber	Large	Two	Detached	$3,510	$12.54
SBH02	Slab	Large	One	Detached	$1,054	$4.06
SBH02	Timber	Large	One	Detached	$1,933	$7.44
SBH03	Slab	Medium	Two	Detached	$1,855	$9.93
SBH03	Timber	Medium	Two	Detached	$3,513	$18.81
SBH04	Slab	Medium	One	Detached	$1,740	$12.91
SBH04	Timber	Medium	One	Detached	$2,977	$22.09
SBH05	Slab	Small	One	Detached	$663	$4.55
SBH05	Timber	Small	One	Detached	$1,468	$10.06
SBH06	Slab	Small	One	Detached	$1,140	$11.28
SBH06	Timber	Small	One	Detached	$1,869	$18.50
SBH11	Slab	Small	One	Passive Solar	$1,109	$4.15
SBH16	Slab	Small	One	Passive Solar	$1,120	$11.18
SBH16	Timber	Small	One	Semi-detached	$809	$8.08
SBH19	Slab	Small	One	Semi-detached	$1,524	$9.83

Table 141 Summary of dwelling upgrade costs for Class 1 in Melbourne

House Type	Cost (total)	Cost (/m^2)
All	$1,879	$11.18
Non specialist	$1,968	$11.92
Specialist Designs	$1,496	$7.97

The cost of improving the NatHERS rating of a Class 1 dwelling from 6-stars with the current weather data to 7-stars with the new weather data varies from around $4 to $22 per square metre, depending on how well the design of the dwelling is suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $12/m^2. In contrast, specialist well-oriented designs (main living areas face south) which are well suited to the Darwin climate can achieve around $4/m^2 cost savings.

Two-storey and timber floored poorly-oriented Class 1 dwellings have the highest costs.

6.1.2 Melbourne, summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 142 Changes to Roof and Ceiling specifications needed to meet 7-stars in Melbourne

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	3.4	4.5
Area ceiling 1	128.2	128.2
R-value ceiling 2	0.0	1.3
Area ceiling 2	15.2	13.8
Area roof insulated (Attic)	1.6	1.6
Area roof uninsulated (Attic)	195.2	195.2
R-value roof blanket	0.0	0.0
R-value ceiling 3	1.0	1.1
Area roof insulated (Flat)	25.5	25.9
Area roof uninsulated (Flat)	8.6	8.6
Foil under roof?	13%	25%
Ventilated roof?	0%	0%
Roof colour	0.50	0.78

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased Ceiling R, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation,
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

Ceiling insulation levels used to obtain 7-stars were increased, on average, by around R1.1, and one dwelling was also required to install foil under the roof. At 7-stars there was a significant increase in the use of darker roof colours.

Table 143 Changes to External and Internal wall and floor specifications needed to meet 7-stars in Melbourne

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	100%	100%
R-value walls	R 2.19	R 2.48
Proportion of walls insulated (insulated houses)	100%	100%
Area walls uninsulated	0.0	0.0
Area walls insulated (Garage and roof space)	2.0	1.1
Area walls uninsulated (Garage and roof space)	26.6	26.6
Foil layer walls?	94%	81%
If yes emissivity	0.1	0.1
Wall colour (Solar Abs)	0.54	0.85
Internal Walls		
No dwellings with insulated internal walls	16	16
R-value (if insulated)	2.3	2.4
Insulated area	39.3	39.3
Floors		
Area floor insulated	84.1	93.6
Waffle pod?	78%	100%
R-value floor	7 Houses, R 1.9	7 Houses, R 2.6
Foil underfloor?	0%	0%
R-value subfloor walls	1 Houses Average R: 1	1 Houses Average R: 1
Area subfloor walls insulated	33.1	30.1
Area ceramic tile floor surface	44.2	39.1

All the dwellings used brick veneer walls. These walls were all insulated at both 6- and 7-stars and 7-star houses used slightly higher R-values. In two dwellings, the use of higher R-values meant that reflective wrap was no longer needed at 7-stars. There was a significant increase in the use of darker coloured walls.

The wall to the garage was also required to be insulated in all dwellings at 7-stars. A slightly higher insulation R-value was used in these walls.

All but one dwelling required floors over enclosed subfloor spaces to be insulated, while the other dwelling insulated subfloor walls. Note that fully insulating both subfloor walls and the floor itself is not required. All dwellings on a slab floor used a waffle pod slab.

Table 144 Changes to Ceiling fan and Window specifications needed to meet 7-stars in Melbourne

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	0.2	0.0
No. 1200	0.0	0.0
No. 1400	0.0	0.2
Windows		
Area single glazed clear	36.0	24.6
Area single low e	0.2	0.0
Area single glazed tinted	0.0	0.0
Area single glazed heavy tinted	0.0	0.0
Area single low e tint	0.0	0.0
Area double glazed argon fill low e	5.6	13.6
Total Window Area	41.8	38.1
Frame colour (abs)	0.50	0.83
Area external Blinds	0.0	0.0
Highly openable windows louvre	NA	NA
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre tint H	NA	NA
Highly openable windows louvre low e	NA	NA
Highly openable windows louvre low e tint	NA	NA

The total window area at 7-stars was reduced by around 9%. The majority of windows in 6-star dwellings were able to use single clear glazing, with a small area of double glazing (13%). At 7-stars, 37% of windows were required to be double glazed.

6.1.3 Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 145 Heating and cooling energy bill savings for various appliances and area of dwelling conditioned

		Heating Savings						Cooling Savings			
		Whole House			Living Areas only			Whole House		Living areas only	
House No	Floor-type	Gas Space	Gas Duct	AC Heat	Gas Space	Gas Duct	AC Heat	AC Cool	Evap Cool	AC Cool	Evap Cool
01	SLA	$183	$211	$114	$182	$209	$113	$5	$2	$8	$3
01	TIM	$183	$211	$114	$170	$196	$106	$7	$3	$14	$5
02	SLA	$143	$165	$89	$114	$131	$71	$23	$8	$18	$7
02	TIM	$181	$208	$112	$165	$189	$102	$6	$2	$9	$3
03	SLA	$144	$165	$89	$143	$165	$89	$16	$6	$16	$6
03	TIM	$153	$177	$95	$148	$170	$92	$14	$5	$11	$4
04	SLA	$106	$122	$66	$96	$110	$59	-$6	-$2	-$0	-$0
04	TIM	$121	$139	$75	$118	$136	$73	$8	$3	$5	$2
05	SLA	$119	$137	$74	$112	$129	$70	-$13	-$5	-$5	-$2
05	TIM	$110	$126	$68	$101	$116	$63	$10	$4	$9	$3
06	SLA	$81	$93	$50	$72	$83	$45	$2	$1	$2	$1
06	TIM	$82	$94	$51	$69	$79	$43	$3	$1	$5	$2
11	SLA	$106	$122	$66	$102	$117	$63	$12	$5	$13	$5
16	SLA	$71	$81	$44	$65	$75	$40	$16	$6	$13	$5
16	TIM	$78	$90	$49	$66	$76	$41	$9	$3	$11	$4
19	SLA	$150	$172	$93	$139	$160	$87	$14	$5	$11	$4

6.1.3.1 Energy Bill savings for common appliance combinations

The table below shows the combined heating and cooling annual energy savings using the most common appliance combinations:

- Gas space heating and reverse cycle cooling to living areas only
- Reverse Cycle heating and cooling to living areas only
- Gas Ducted heating to the whole house and reverse cycle cooling to living areas only,
- Gas Ducted heating and evaporative cooling to the entire house.

Table 146 Heating and cooling energy bill savings for various appliances and area of dwelling conditioned

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool	Gas ducted, Evaporative cool
SBH01	Slab	$190	$121	$219	$213
SBH01	Timber	$185	$120	$225	$214
SBH02	Slab	$132	$89	$183	$173
SBH02	Timber	$173	$111	$217	$210
SBH03	Slab	$160	$105	$181	$171
SBH03	Timber	$159	$103	$188	$182
SBH04	Slab	$96	$59	$122	$120
SBH04	Timber	$123	$79	$145	$142
SBH05	Slab	$107	$65	$132	$132
SBH05	Timber	$110	$72	$135	$130
SBH06	Slab	$74	$47	$95	$94
SBH06	Timber	$74	$48	$100	$95
SBH11	Slab	$115	$76	$135	$126
SBH16	Slab	$78	$54	$95	$87
SBH16	Timber	$77	$52	$101	$93
SBH19	Slab	$150	$97	$183	$177

6.1.3.2 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 147 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Melbourne

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool	Gas ducted, Evaporative cool
SBH01	Slab	-$27	-$95	$3	-$4
SBH01	Timber	-$17	-$81	$24	$12
SBH02	Slab	$69	$25	$120	$110
SBH02	Timber	$68	$6	$112	$105
SBH03	Slab	$53	-$1	$75	$65
SBH03	Timber	-$42	-$98	-$13	-$19
SBH04	Slab	-$4	-$40	$22	$20
SBH04	Timber	-$47	-$92	-$26	-$28
SBH05	Slab	$69	$27	$94	$94
SBH05	Timber	$26	-$12	$51	$46
SBH06	Slab	$9	-$18	$30	$28
SBH06	Timber	-$33	-$59	-$7	-$12
SBH11	Slab	$51	$13	$71	$63
SBH16	Slab	$14	-$10	$30	$23
SBH16	Timber	$31	$6	$54	$47
SBH19	Slab	$63	$10	$95	$90

Cash flow impacts for building fabric improvements for the householder are positive for 64% of the cases modelled. Where the impact is negative the amount is small (worst case -$95) and may be offset by other aspects of the Whole of Home measures. Gas heating represents around 58% of the market in Victoria, with even higher levels in Melbourne. It is therefore likely that the positive values for gas will outweigh the examples with negative cash flow using reverse cycle heating and cooling.

6.1.3.3 The net present value of building fabric induced energy savings versus capital cost

The table below shows the Net Present Value of energy savings discounted at 7% over 40 years less the cost of building fabric improvements. Figures in red indicate that the net present value is negative, i.e., the discounted value of energy savings over 40 years is less than the value of the capital cost of improvements required to achieve 7-stars. A 7% real discount rate is the policy evaluation metric recommended for this project by the OBPR.

Table 148 Net Present Value of Cost and Benefits at 7% discount rate over 40 years, Class 1 in Melbourne

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool	Gas ducted, Evaporative cool
SBH01	Slab	-$1,248	-$2,167	-$860	-$943
SBH01	Timber	-$1,050	-$1,911	-$511	-$664
SBH02	Slab	$655	$79	$1,336	$1,211
SBH02	Timber	$475	-$357	$1,054	$969
SBH03	Slab	$272	-$452	$564	$427
SBH03	Timber	-$1,387	-$2,134	-$1,007	-$1,090
SBH04	Slab	-$465	-$948	-$118	-$146
SBH04	Timber	-$1,332	-$1,929	-$1,049	-$1,079
SBH05	Slab	$765	$199	$1,098	$1,100
SBH05	Timber	-$1	-$511	$332	$263
SBH06	Slab	-$152	-$514	$130	$110
SBH06	Timber	-$883	-$1,229	-$540	-$599
SBH09	Slab	$420	-$93	$685	$572
SBH17	Slab	-$75	-$404	$141	$45
SBH18	Timber	$218	-$118	$532	$434
SBH19	Slab	$475	-$229	$912	$837

Net Present Value at a 7% discount rate for building fabric improvements for the householder is negative for 55% cases. These cases are mainly those where reverse cycle heating is used. Gas heating represents around 58% of the market in Victoria, with even higher levels in Melbourne. It is therefore likely that the positive values for gas will outweigh the examples with negative cash flow using reverse cycle heating and cooling.

6.1.3.4 The net present value of costs and benefits: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 149 Net Present Value of costs and benefits at 3% discount rate

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool	Gas ducted, Evaporative cool
SBH01	Slab	$611	-$981	$1,285	$1,140
SBH01	Timber	$755	-$737	$1,689	$1,425
SBH02	Slab	$1,943	$946	$3,124	$2,908
SBH02	Timber	$2,171	$729	$3,175	$3,027
SBH03	Slab	$1,832	$578	$2,339	$2,102
SBH03	Timber	$173	-$1,122	$832	$688
SBH04	Slab	$471	-$367	$1,073	$1,025
SBH04	Timber	-$126	-$1,159	$366	$314
SBH05	Slab	$1,813	$832	$2,390	$2,394
SBH05	Timber	$1,077	$191	$1,653	$1,533
SBH06	Slab	$573	-$56	$1,062	$1,026
SBH06	Timber	-$159	-$759	$436	$334
SBH09	Slab	$1,543	$652	$2,001	$1,806
SBH17	Slab	$691	$121	$1,067	$900
SBH18	Timber	$972	$390	$1,517	$1,345
SBH19	Slab	$1,941	$721	$2,699	$2,570

Net Present Value at 3% discount rate is positive, i.e. benefits exceed costs, in 86% of the cases reported above.

6.1.4 Conclusion: Class 1: Melbourne

Adoption of a 7-star minimum fabric requirement in Class 1 dwellings in similar climates to Melbourne in Climate Zone 6 ***is recommended***:

- NPV at 7% is positive in almost half of dwellings,
- Gas heating represents around 58% of the market in Victoria, with even higher levels in Melbourne. It is therefore likely that the positive values for gas will outweigh the examples with negative NPV using reverse cycle heating,
- Even in those cases where the NPV is negative, analysis of annual household cash flow impact shows that this is generally less than $1 per week,
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment in 86% of cases,
- Inclusion of Whole of Home measures will result in much larger benefits which will outweigh the cases reported above where the benefits are negative.
- Furthermore, not all benefits have been evaluated:
    - 7-star dwellings will have lower peak loads. Lower peak loads provide a saving to the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
    - 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
    - 7-star dwellings will provide greater resilience to climate change. This greater resilience is particularly true with the updated weather data in central Melbourne (NatHERS Climate 21), which has significantly shifted the balance of heating and cooling loads toward cooling.

6.2 Class 2 dwellings

6.2.1 Dwelling Costs

Table 150 Costs of improving building fabric from 6 to 7 stars in Class 2 in Melbourne

House Number	Floor-type	Position	Cost (total)	Cost (/m2)
SBA01	Slab	Corner	$540	$5.65
SBA02*	Slab	Middle	$0	$0.00
SBA03	Slab	Corner	$383	$4.01
SBA04*	Slab	Middle	$0	$0.00
SBA05	Slab	Corner	$1,362	$14.26
SBA06	Slab	Middle	$1,155	$12.92
SBA07	Slab	Corner	$1,132	$11.85
SBA08	Slab	Middle	$279	$3.12
SBA11*	Slab	Corner	$0	$0.00
SBA12*	Slab	Middle	$0	$0.00
SBA13*	Slab	Corner	$0	$0.00
SBA14*	Slab	Middle	$0	$0.00
SBA15*	Slab	Corner	$0	$0.00
SBA16	Slab	Middle	$319	$3.57
SBA17	Slab	Corner	$71	$0.74
SBA18	Slab	Middle	$387	$4.32
SBA21	Slab	Corner	$502	$5.26
SBA22	Slab	Middle	$621	$6.95
SBA23	Slab	Corner	$903	$9.46
SBA24	Slab	Middle	$912	$10.20
SBA25	Slab	Corner	$2,098	$21.96
SBA26	Slab	Middle	$691	$7.73
SBA27	Slab	Corner	$1,089	$11.41
SBA28	Slab	Middle	$434	$4.85

Notes: * Units marked with an asterisk have zero cost because these units did not need to be upgraded in moving from minimum 5-stars, average 6-stars to minimum 6-stars, average 7-stars.

Table 151 Summary of dwelling upgrade costs for Class 2 in Melbourne

Summary	Cost
Building-wide cost	$12,878.82
Cost per unit	$536.62
Cost per m2	$5.80

The cost of improving the NatHERS ratings of a Class 2 dwelling from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the new weather data varies from around $4 to $22 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $6/m^2.

6.2.2 Melbourne: Changes to design and specification Class 2

Table 152 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans in Melbourne

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling 1	2.6	3.3			124%
Area ceiling 1	92.5	92.5	739.7	739.7	Nil
External Walls	**Per unit**		**Whole Building**		
R-value walls	0.6	1.4			0.79
Area walls insulated	11.9	26.1	286	626	219%
Area walls uninsulated	26.0	11.8			45%
Wall colour	0.45	0.59			131%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.1	0.3			300%
Insulated area	0.3	0.9			300%
Floors	**Per unit**		**Whole Building**		
Area floor insulated	92.5	92.5	740	740	Nil
R-value floor	1.63	1.88			115%
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	0.0	0.0	0	0	0
No. 1200	0.0	0.0	0	0	0
No. 1400	0.0	0.0	0	0	0

Roof insulation was increased to achieve a 7-star average, 6-star minimum across the building by, on average, R0.7. Further increases insulation R-values will improve the rating; however, other methods of improving the rating were selected in preference to this.

Wall insulation R-values were increased by, on average, R0.8. The area of wall insulated also increased, and most units needed to have wall insulation for the building to achieve its minimum and average rating requirements.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show a significant increase over the current assumption.

All of the dwellings required floor insulation to achieve 7-stars, and the level of insulation needed to be increased slightly over 6-stars. Note that the car park is assumed to be unenclosed. If the car park was enclosed, floor insulation R-values could likely be reduced, or other specifications lowered.

Table 153 Changes to building design and specification to increase stringency: Windows in Melbourne

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	26.4	19.0	633.3	456.6	72%
Area single low e	0.0	0.2	0.0	4.4	Nil
Area single glazed tinted	0.0	0.0	0.0	0.0	Nil
Area single glazed heavy tinted	0.0	0.2	0.0	3.8	Nil
Area single low e tint	0.8	1.3	18.1	30.3	168%
Area double glazed argon fill low e	0.1	3.4	2.8	82.2	2945%
Highly openable windows louvre	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e tint	0.0	0.0	0.0	0.0	Nil
Total Window Area	**27.3**	**24.1**	**654.2**	**577.3**	**88%**
Frame colour (abs)	0.4	0.5			114%
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	4.0	3.7	95.9	87.7	92%
E area Day	3.2	2.9	75.7	69.8	92%
S area Day	3.0	2.5	72.4	60.6	84%
W area Day	3.5	3.0	83.9	72.3	86%
N area Night	3.5	3.4	84.7	81.4	96%
E area Night	2.7	2.5	64.2	61.1	95%
S area Night	3.0	2.6	72.3	63.4	88%
W area Night	3.4	2.6	80.4	62.7	78%

Total window area across all units was reduced by around 12%. There was a 28% reduction in the use in single clear glazing, and there was a corresponding increase in the use of double glazing. Slightly darker window frame colours were used. The proportion of high-performance windows increased from 3% to 20%.

6.2.3 Energy Bill Savings

The extent of improvement costs for individual units varied significantly. This variation is in part because a heterogeneous approach to rating was adopted, i.e. there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to the average benefits for all units in the development.

Table 154 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 1 : Financial Impacts	Reverse Cycle Heating & Reverse Cycle Cooling Whole House	Living Areas Only
Cost per unit	$537	$537
Energy-saving per unit Total	$53	$35
Energy-saving per unit Heating	$35	$27
Energy-saving per unit Cooling	$18	$8
Increase to annual mortgage payments	$31	$31
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$22	$5
Net Present Value @ 7%	$164	-$66
Net Present Value @ 5%	$365	$69
Net Present Value @ 3%	$678	$279

Table 155 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 2

Appliance Mix 2 : Financial Impact	Gas Space Heating & Reverse Cycle Cooling Whole House	Living Areas Only
Cost per unit	$537	$537
Energy-saving per unit Total	$74	$52
Energy-saving per unit Heating	$56	$44
Energy-saving per unit Cooling	$18	$8
Increase to annual mortgage payments	$31	$31
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$43	$21
Net Present Value @ 7%	$449	$156
Net Present Value @ 5%	$732	$355
Net Present Value @ 3%	$1,172	$665

Table 156 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 3

Appliance Mix 3 :	Resistive Electric Off-Peak rate Heating & Evaporative Cooling	
Financial Impact	**Whole House**	**Living Areas Only**
Cost per unit	$537	$537
Energy-saving per unit Total	$112	$86
Energy-saving per unit Heating	$106	$83
Energy-saving per unit Cooling	$6	$3
Increase to annual mortgage payments	$31	$31
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$82	$55
Net Present Value @ 7%	$960	$604
Net Present Value @ 5%	$1,390	$932
Net Present Value @ 3%	$2,059	$1,442

The most common appliance mix in high rise apartments is likely to be an electric reverse cycle due to the difficulty associated with distributing gas and installing flues in these buildings. In lower rise apartments, gas may be more common. Even if there is no installed heater in bedrooms, gas space heaters usually have sufficient capacity to heat bedrooms as well as heating the living area, or at least significantly increase temperatures in bedrooms, due to the smaller size of the apartment.

A small but significant proportion of the market in Melbourne uses off-peak electric resistive heating. Around 23% of the market in Victoria use Evaporative Cooling, but penetration in apartments is unclear. These two options were combined, more to cover all bases, than to provide information about a significant market segment.

The NPV at 7% discount rate is positive except for reverse cycle heating and cooling to living areas only. Household cash flow is improved by a small amount in all cases. NPV at 3% - the household alternative investment scenario – is positive in all cases.

6.2.4 Conclusion: Class 2, Melbourne

Adoption of a 7-star minimum fabric requirement in Class 1 dwellings in similar climates to Melbourne in Climate Zone 6 ***is recommended***:

- NPV at 7% is positive except where reverse cycle air-conditioning is not used in bedrooms,
- Even in those cases where the NPV is negative, analysis of annual household cash flow impact shows that this is generally positive,
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment for the household,
- Inclusion of Whole of Home measures will result in much larger benefits which will outweigh the cases reported above where the benefits are negative.
- Furthermore, not all benefits have been evaluated:
    - 7-star dwellings will have lower peak loads. Lower peak loads provide a saving to the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
    - 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
    - 7-star dwellings will provide greater resilience to climate change. The updated weather data in central Melbourne (NatHERS Climate 21) has significantly shifted the balance of heating and cooling loads toward cooling, which will help ensure greater resilience to climate change.

7 NCC Climate Zone 7

As shown in Table 3 above, the rating of dwellings which achieve 7.0 stars with the current weather and star bands in Hobart and Canberra is virtually unchanged with the updated weather data and star bands.

7.1 Class 1 Dwellings

7.1.1 Canberra Dwelling Costs

Table 157 Costs of improving building fabric from 6 to 7 stars in Class 1 in Climate

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost (/m2)
SBH01	Slab	Large	Two	Detached	$3,824	$13.66
SBH01	Timber	Large	Two	Detached	$4,058	$14.50
SBH02	Slab	Large	One	Detached	$3,428	$13.20
SBH02	Timber	Large	One	Detached	$3,385	$13.03
SBH03	Slab	Medium	Two	Detached	$3,935	$21.07
SBH03	Timber	Medium	Two	Detached	$3,116	$16.68
SBH04	Slab	Medium	One	Detached	$1,999	$14.83
SBH04	Timber	Medium	One	Detached	$3,656	$27.13
SBH05	Slab	Small	One	Detached	$1,872	$13.36
SBH05	Timber	Small	One	Detached	$2,548	$18.19
SBH06	Slab	Small	One	Detached	$1,496	$14.81
SBH06	Timber	Small	One	Detached	$1,321	$13.07
SBH11	Slab	Small	One	Passive Solar BV	$2,779	$10.39
SBH16	Slab	Small	One	Semi-detached	$1,418	$14.16
SBH16	Timber	Small	One	Semi-detached	$967	$9.66
SBH19	Slab	Small	One	Passive Solar BV	$456	$2.94

Table 158 Summary of dwelling upgrade costs for Class 1 in Climate

House Type	Cost (total)	Cost (per m2)
All	$2,516	$14.42
Non specialist	$2,650	$14.81
Specialist Designs	$1,452	$9.54

The cost of improving the NatHERS rating of a Class 1 dwelling from 6-stars with the current weather data to 7-stars with the new weather data varies from around $3 to $27 per square metre, depending on how well the design of the dwelling is suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $15/m^2. In contrast, specialist well-oriented designs (main living areas face south) which are well suited to the Darwin climate can achieve around $5/m^2 cost savings.

Two-storey and timber floored poorly oriented Class 1 dwellings have the highest costs.

7.1.2 Canberra, summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 159 Changes to Roof and Ceiling specifications needed to meet 7-stars in Canberra

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	3.4	4.7
Area ceiling 1	127.9	127.9
R-value ceiling 2	0.6	0.6
Area ceiling 2	17.4	17.4
Area roof insulated (Attic)	1.2	1.2
Area roof uninsulated (Attic)	197.0	197.0
R-value roof blanket	0.0	0.0
R-value ceiling 3	1.2	1.3
Area roof insulated (Flat)	24.6	24.6
Area roof uninsulated (Flat)	9.7	9.7
Foil under roof?	69%	81%
Ventilated roof?	0%	0%
Roof colour	0.50	0.69

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased ceiling R-values, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

Ceiling insulation levels used to obtain 7-stars were increased, on average, by around R1.3, and one dwelling was also required to install foil under the roof. At 7-stars there was a significant increase in the use of darker roof colours.

Table 160 Changes to External and Internal wall and floor specifications needed to meet 7-stars in Canberra

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	100%	100%
R-value walls	R 2.23	R 2.5
Proportion of walls insulated (insulated houses)	100%	100%
Area walls uninsulated	0.0	0.0
Area walls insulated (Garage and roof space)	6.8	6.8
Area walls uninsulated (Garage and roof space)	22.4	22.4
Foil layer walls?	94%	100%
If yes emissivity	0.1	0.1
Wall colour (Solar Abs)	0.54	0.71
Internal Walls		
No dwellings with insulated internal walls	16	16
R-value (if isnulated)	2.2	2.5
Insulated area	36.2	35.6
Floors		
Area floor insulated	135.9	124.1
Waffle pod?	100%	100%
R-value floor	5 Houses, R 1.8	5 Houses, R 3
Foil underfloor?	0%	0%
R-value subfloor walls	2 Houses Average R: 1	2 Houses Average R: 1.5
Area subfloor walls insulated	29.7	29.7
Area ceramic tile floor surface	21.8	21.8

All the dwellings used brick veneer walls. These walls were all insulated at both 6- and 7-stars and 7-star houses used slightly higher R-values. Reflective wall wrap was also needed for all dwellings at 7-stars. There was a significant increase in the use of darker coloured walls.

The wall to the garage was also required to be insulated all dwellings at 7-stars. A slightly higher insulation R-value was used in these walls than at 6-stars.

All but two dwellings required floors over enclosed subfloor spaces to be insulated, while the other dwelling insulated subfloor walls. Higher R-values for underfloor and subfloor wall insulation were needed. Note that fully insulating both subfloor walls and the floor itself is not required. All dwellings on a slab floor used a waffle pod slab.

Table 161 Changes to Ceiling fan and Window specifications needed to meet 7-stars in Canberra

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	0.3	0.0
No. 1200	0.0	0.0
No. 1400	0.0	0.3
Windows		
Area single glazed clear	37.0	25.7
Area single low e	0.0	0.1
Area single glazed tinted	0.0	0.0
Area single glazed heavy tinted	0.0	0.0
Area single low e tint	0.0	0.0
Area double glazed argon fill low e	3.7	12.0
Total Window Area	40.7	37.8
Frame colour (abs)	0.52	0.76
Area external Blinds	0.0	0.0
Highly openable windows louvre	NA	NA
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre tint H	NA	NA
Highly openable windows louvre low e	NA	NA
Highly openable windows louvre low e tint	NA	NA

The total window area at 7-stars was reduced by around 7%. The majority of windows in 6-star dwellings were able to use single clear glazing, with a small area of double glazing (9%). At 7-stars 32% of windows were required to be double glazed.

7.1.3 Canberra Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on Flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 162 Heating and cooling energy bill savings for various appliances and area of dwelling conditioned

		Heating Savings						Cooling Savings			
		Whole House			Living Areas only			Whole House		Living areas only	
House No	Floor-type	Gas Space	Gas Duct	AC Heat	Gas Space	Gas Duct	AC Heat	AC Cool	Evap Cool	AC Cool	Evap Cool
01	SLA	$300	$345	$113	$267	$307	$100	$43	$16	$37	$14
01	TIM	$364	$419	$137	$311	$358	$117	$22	$8	$23	$8
02	SLA	$278	$320	$105	$236	$271	$89	$36	$13	$30	$11
02	TIM	$361	$415	$136	$319	$367	$120	$12	$5	$16	$6
03	SLA	$250	$287	$94	$241	$277	$91	$28	$10	$26	$10
03	TIM	$289	$333	$109	$271	$311	$102	$17	$6	$18	$7
04	SLA	$191	$220	$72	$175	$201	$66	$15	$6	$14	$5
04	TIM	$215	$248	$81	$197	$227	$74	$7	$2	$8	$3
05	SLA	$161	$185	$61	$125	$143	$47	$14	$5	$13	$5
05	TIM	$211	$242	$79	$187	$215	$70	$10	$4	$10	$4
06	SLA	$135	$156	$51	$109	$125	$41	$8	$3	$7	$3
06	TIM	$154	$177	$58	$127	$146	$48	$3	$1	$7	$3
11	SLA	$152	$175	$57	$122	$140	$46	$45	$17	$38	$14
16	SLA	$118	$136	$44	$107	$123	$40	$15	$5	$13	$5
16	TIM	$150	$172	$56	$126	$145	$47	$9	$3	$13	$5
19	SLA	$161	$185	$61	$119	$137	$45	$22	$8	$15	$6

7.1.3.1 Energy Bill savings for common appliance combinations

The table below shows the combined heating and cooling annual energy savings using the most common appliance combinations:

- Gas space heating and reverse Cycle cooling to living areas,
- Reverse Cycle heating/cooling space conditioning to living areas only)
- Gas ducted heating to the whole house and Reverse Cycle cooling to living areas
- Gas ducted heating and evaporative cooling to the entire house

Table 163 Space conditioning energy bill savings for common space conditioning appliance combinations

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool	Gas ducted, Evaporative cool
SBH01	Slab	$304	$137	$383	$362
SBH01	Timber	$334	$140	$441	$426
SBH02	Slab	$266	$119	$350	$333
SBH02	Timber	$335	$136	$431	$420
SBH03	Slab	$267	$117	$313	$297
SBH03	Timber	$288	$120	$351	$339
SBH04	Slab	$189	$80	$234	$225
SBH04	Timber	$206	$82	$256	$250
SBH05	Slab	$138	$60	$198	$190
SBH05	Timber	$198	$81	$252	$246
SBH06	Slab	$116	$48	$163	$159
SBH06	Timber	$135	$55	$185	$178
SBH11	Slab	$160	$84	$212	$191
SBH16	Slab	$120	$53	$149	$141
SBH16	Timber	$139	$60	$185	$176
SBH19	Slab	$134	$60	$201	$194

7.1.3.2 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 164 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Canberra

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool	Gas ducted, Evaporative cool
SBH01	Slab	$85	-$82	$164	$142
SBH01	Timber	$101	-$93	$209	$194
SBH02	Slab	$70	-$78	$154	$137
SBH02	Timber	$141	-$58	$238	$226
SBH03	Slab	$41	-$109	$88	$72
SBH03	Timber	$110	-$59	$172	$161
SBH04	Slab	$74	-$35	$119	$111
SBH04	Timber	-$4	-$127	$46	$41
SBH05	Slab	$30	-$47	$91	$83
SBH05	Timber	$52	-$65	$106	$100
SBH06	Slab	$30	-$38	$77	$73
SBH06	Timber	$22	-$57	$72	$66
SBH11	Slab	$1	-$75	$53	$32
SBH16	Slab	$39	-$28	$68	$60
SBH16	Timber	$83	$5	$130	$120
SBH19	Slab	$108	$34	$174	$167

Cash flow impacts for building fabric improvements for the householder is positive for all cases except for dwellings using reverse cycle heating and cooling to living areas only. Gas is the dominant form of heating in the ACT with over 71% market penetration. Negative cash flow ranges from 50c to $2 per week for these households may be offset by other aspects of the Whole of Home measures.

7.1.3.3 The net present value of building fabric induced energy savings versus capital cost

The table below shows the Net Present Value of energy savings discounted at 7% over 40 years less the cost of building fabric improvements. Figures in red indicate that the net present value is negative, i.e., the discounted value of energy savings over 40 years is less than the value of the capital cost of improvements required to achieve 7-stars. A 7% real discount rate is the policy evaluation metric recommended for this project by the OBPR.

Table 165 Net Present Value of Cost and Benefits at 7% discount rate over 40 years, Class 1 in Canberra

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool	Gas ducted, Evaporative cool
SBH01	Slab	$227	-$1,991	$1,278	$996
SBH01	Timber	$390	-$2,197	$1,822	$1,628
SBH02	Slab	$117	-$1,843	$1,238	$1,012
SBH02	Timber	$1,083	-$1,571	$2,367	$2,213
SBH03	Slab	-$378	-$2,380	$237	$27
SBH03	Timber	$729	-$1,521	$1,560	$1,406
SBH04	Slab	$515	-$937	$1,117	$1,006
SBH04	Timber	-$916	-$2,558	-$247	-$322
SBH05	Slab	-$38	-$1,074	$766	$666
SBH05	Timber	$87	-$1,472	$816	$728
SBH06	Slab	$52	-$856	$674	$621
SBH06	Timber	-$171	-$1,230	$493	$409
SBH09	Slab	-$649	-$1,662	$54	-$232
SBH17	Slab	$180	-$708	$570	$467
SBH18	Timber	$880	-$168	$1,499	$1,375
SBH19	Slab	$1,334	$344	$2,218	$2,125

Net Present Value at a 7% discount rate for building fabric improvements for the householder is positive for 64% of the cases modelled. In those cases which are negative, this may be offset by other aspects of the Whole of Home measures. In terms of an industry-wide impact in the ACT, the dominance of gas heating means that positive outcomes will more than balance the negative outcomes for reverse cycle for gas heating.

7.1.3.4 The net present value of costs and benefits: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 166 Net Present Value of costs and benefits at 3% discount rate

		Space Conditioning			Ducted conditioning
House Number	Floor-type	Gas Space, RC Cool	Living areas only RC Space	Gas Ducted, RC Cool	Gas ducted, Evaporative cool
SBH01	Slab	$3,200	-$646	$5,021	$4,534
SBH01	Timber	$3,654	-$832	$6,137	$5,800
SBH02	Slab	$2,719	-$681	$4,661	$4,270
SBH02	Timber	$4,362	-$240	$6,588	$6,321
SBH03	Slab	$2,233	-$1,240	$3,299	$2,934
SBH03	Timber	$3,550	-$351	$4,991	$4,724
SBH04	Slab	$2,359	-$157	$3,403	$3,210
SBH04	Timber	$1,095	-$1,752	$2,255	$2,125
SBH05	Slab	$1,308	-$490	$2,702	$2,528
SBH05	Timber	$2,020	-$682	$3,285	$3,132
SBH06	Slab	$1,187	-$386	$2,267	$2,174
SBH06	Timber	$1,147	-$689	$2,298	$2,153
SBH09	Slab	$914	-$843	$2,132	$1,637
SBH17	Slab	$1,353	-$186	$2,029	$1,851
SBH18	Timber	$2,236	$419	$3,309	$3,093
SBH19	Slab	$2,648	$931	$4,179	$4,018

Net Present Value at 3% discount rate is positive, i.e. benefits exceed costs, in 78% of the cases reported above.

7.1.4 Conclusion: Class 1, Canberra

Adoption of a 7-star minimum fabric requirement in Class 1 dwellings in similar climates to Canberra in Climate Zone 7 ***is recommended***:

- NPV at 7% is strongly positive for the majority of dwellings,
- Because Canberra is a cold climate, in dwellings which only have fixed heating in living areas using reverse cycle, there may be significant use of electric day rate heating. The use of plug-in bedroom heating is not modelled and would easily offset the negative NPV in these dwellings.
- Gas is the dominant form of heating in Canberra, and all metrics reported above are strongly positive for this form of heating.
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment in almost all cases, and
- Not all benefits have been evaluated:
- 7-star dwellings will have lower peak loads. Lower peak loads provide a saving to the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
- 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
- 7-star dwellings will provide greater resilience to climate change.

7.1.5 Hobart Dwelling Costs

Table 167 Costs of improving building fabric from 6 to 7 stars in Class 1 in Hobart

House Number	Floor-type	Size	Storeys	Type	Cost (total)	
SBH01	Slab	Large	Two	Detached	$4,520	$16.15
SBH01	Timber	Large	Two	Detached	$3,411	$12.19
SBH02	Slab	Large	One	Detached	$2,443	$9.41
SBH02	Timber	Large	One	Detached	$4,347	$16.74
SBH03	Slab	Medium	Two	Detached	$2,902	$15.54
SBH03	Timber	Medium	Two	Detached	$2,653	$14.21
SBH04	Slab	Medium	One	Detached	$415	$3.90
SBH04	Timber	Medium	One	Detached	$1,639	$12.16
SBH05	Slab	Small	One	Detached	$1,620	$11.56
SBH05	Timber	Small	One	Detached	$1,698	$12.12
SBH06	Slab	Small	One	Detached	$670	$6.63
SBH06	Timber	Small	One	Detached	$399	$3.95
SBH11	Slab	Small	One	Passive Solar BV	$3,699	$13.83
SBH16	Slab	Small	One	Semi-detached	$1,469	$14.67
SBH16	Timber	Small	One	Semi-detached	$1,578	$15.75
SBH19	Slab	Small	One	Passive Solar BV	$1,486	$9.58

Table 168 Summary of dwelling upgrade costs for Class 1 in Hobart

House Type	Cost (total)	Cost (per m2)
All	$2,419	$13.46
Non specialist	$2,526	$13.51
Specialist Designs	$1,464	$9.95

The cost of improving the NatHERS rating of a Class 1 dwelling from 6-stars with the current weather data to 7-stars with the new weather data varies from around $4 to $17 per square metre, depending on how well the design of the dwelling is suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $14/m^2. In contrast, specialist well-oriented designs (main living areas face south) which are well suited to the Darwin climate can achieve around $4/m^2 cost savings.

Two-storey and timber floored poorly oriented Class 1 dwellings have the highest costs.

7.1.6 Hobart, summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 169 Changes to Roof and Ceiling specifications needed to meet 7-stars in Hobart

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	3.1	4.1
Area ceiling 1	127.9	127.9
R-value ceiling 2	0.6	0.6
Area ceiling 2	17.6	17.6
Area roof insulated (Attic)	1.2	1.2
Area roof uninsulated (Attic)	197.0	197.0
R-value roof blanket	0.0	0.0
R-value ceiling 3	1.3	1.6
Area roof insulated (Flat)	24.6	24.6
Area roof uninsulated (Flat)	9.7	9.7
Foil under roof?	81%	75%
Ventilated roof?	13%	6%
Roof colour	0.49	0.73

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased ceiling R values, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation,
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

Ceiling insulation levels used to obtain 7-stars were increased, on average, by around R1.0, and in one dwelling the higher ceiling R-value allowed under roof reflective insulation to be removed. At 7-stars there was a significant increase in the use of darker roof colours.

Table 170 Changes to External and Internal wall and floor specifications needed to meet 7-stars in Hobart

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	94%	100%
R-value walls	R 1.93	R 2.41
Proportion of walls insulated (insulated houses)	100%	100%
Area walls uninsulated	6.5	0.0
Area walls insulated (Garage and roof space)	6.8	6.8
Area walls uninsulated (Garage and roof space)	21.2	21.2
Foil layer walls?	88%	94%
If yes emissivity	0.1	0.1
Wall colour (Solar Abs)	0.54	0.70
Internal Walls		
No dwellings with insulated internal walls	16	16
R-value (if insulated)	2.1	2.4
Insulated area	36.2	36.2
Floors		
Area floor insulated	142.5	135.9
Waffle pod?	100%	100%
R-value floor	7 Houses, R 1.4	6 Houses, R 1.9
Foil underfloor?	0%	13%
R-value subfloor walls	Nil	1 Houses Average R: 1
Area subfloor walls insulated	29.7	29.7
Area ceramic tile floor surface	21.8	21.8

All the dwellings used brick veneer walls. These walls were all insulated at both 6- and 7-stars and 7-star houses used around higher R0.5 higher-insulation levels. Reflective wall wrap was also needed for all but one dwelling at 7-stars. There was a significant increase in the use of darker coloured walls.

The wall to the garage was required to be insulated in all dwellings at 7-stars. A slightly higher insulation R-value was used in these walls than at 6-stars.

All but one of the dwelling required floors over enclosed subfloor spaces to be insulated, while the other dwelling insulated subfloor walls. Higher R-values for underfloor and subfloor wall insulation were needed. Note that fully insulating both subfloor walls and the floor itself is not required. All dwellings on a slab floor used a waffle pod slab.

Table 171 Changes to Ceiling fan and Window specifications needed to meet 7-stars in Hobart

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	0.0	0.0
No. 1200	0.0	0.0
No. 1400	0.0	0.0
Windows		
Area single glazed clear	38.8	28.2
Area single low e	0.0	0.1
Area single glazed tinted	0.0	0.0
Area single glazed heavy tinted	0.0	0.0
Area single low e tint	0.0	0.0
Area double glazed argon fill low e	1.5	9.1
Total Window Area	40.4	37.4
Frame colour (abs)	0.52	0.70
Area external Blinds	0.0	0.0
Highly openable windows louvre	NA	NA
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre tint H	NA	NA
Highly openable windows louvre low e	NA	NA
Highly openable windows louvre low e tint	NA	NA

The total window area at 7-stars was reduced by around 9%. The majority of windows in 6-star dwellings were able to use single clear glazing, with a small area of double glazing (4%). At 7-stars 25% of windows were required to be double glazed.

7.1.7 Hobart Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on Flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 172 Heating and cooling energy bill savings for various appliances and area of dwelling conditioned

		Heating Savings						Cooling Savings			
		Whole House			Living Areas only			Whole House		Living areas only	
House No	Floor-type	Wood	AC Heat	Resistive Elec	Wood	AC Heat	Resistive Elec	AC Cool	Evap Cool	AC Cool	Evap Cool
01	SLA	$228	$118	$303	$216	$112	$287	$3	$1	$3	$1
01	TIM	$240	$124	$319	$223	$115	$296	$1	$0	$1	$1
02	SLA	$220	$114	$293	$196	$101	$261	$1	$1	$1	$1
02	TIM	$225	$117	$300	$188	$97	$251	-$0	-$0	-$0	-$0
03	SLA	$164	$85	$218	$156	$81	$207	$1	$0	$1	$1
03	TIM	$177	$92	$236	$164	$85	$219	$0	$0	$1	$0
04	SLA	$120	$62	$160	$109	$57	$146	$2	$1	$2	$1
04	TIM	$127	$66	$169	$102	$53	$135	$1	$0	$1	$0
05	SLA	$134	$69	$178	$113	$58	$150	$2	$1	$1	$1
05	TIM	$131	$68	$175	$109	$56	$145	$1	$0	$1	$0
06	SLA	$91	$47	$121	$73	$38	$96	$1	$0	$1	$0
06	TIM	$91	$47	$121	$72	$37	$96	$1	$0	$1	$0
11	SLA	$161	$83	$214	$129	$67	$171	$4	$2	$4	$2
16	SLA	$95	$49	$127	$90	$46	$119	$2	$1	$2	$1
16	TIM	$82	$42	$109	$71	$37	$94	$4	$1	$4	$1
19	SLA	$136	$70	$181	$124	$64	$165	$0	$0	$0	$0

The table above shows that heating energy savings dominate cooling savings in Hobart as would be expected in a cold climate.

7.1.7.1 Energy Bill savings for common appliance combinations

The table below shows the combined heating and cooling annual energy savings using the most common appliance combinations:

- Wood heating and Reverse Cycle cooling in living areas only,
- Off-Peak electric storage heating and Reverse Cycle cooling to living areas,
- Reverse Cycle heating and cooling to living areas, and
- Whole house Wood heating with reverse cycle cooling in living areas.

Note that wood heating is often capable of heating very large areas of a dwelling, so the area heated may be larger than only the living rooms.

Because Hobart is a cold climate, in dwellings which only heat and cool living areas using reverse cycle, there may be significant use of electric day rate heating. If this is the case, the energy savings for the reverse cycle heating case may be significantly underestimated.

Table 173 Space conditioning energy bill savings for common space conditioning appliance combinations

		Space Conditioning			Whole House
House Number	Floor-type	Wood Heating, RC cool	Off-Peak Heat and RC Cool	RC Heat and cool	Wood Heat and RC cool living
SBH01	Slab	$219	$306	$114	$231
SBH01	Timber	$224	$321	$117	$241
SBH02	Slab	$197	$294	$103	$222
SBH02	Timber	$188	$299	$97	$225
SBH03	Slab	$157	$219	$82	$165
SBH03	Timber	$165	$236	$86	$178
SBH04	Slab	$111	$162	$58	$122
SBH04	Timber	$103	$169	$53	$127
SBH05	Slab	$114	$179	$60	$135
SBH05	Timber	$110	$176	$58	$133
SBH06	Slab	$73	$122	$38	$92
SBH06	Timber	$73	$122	$38	$92
SBH11	Slab	$133	$219	$71	$165
SBH16	Slab	$92	$129	$48	$97
SBH16	Timber	$75	$113	$40	$86
SBH19	Slab	$125	$181	$65	$136

7.1.7.2 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 174 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Hobart

		Space Conditioning			Whole House
House Number	Floor-type	Wood Heating, RC cool	Off-Peak Heat and RC Cool	RC Heat and cool	Wood Heat and RC cool living
SBH01	Slab	-$40	$47	-$145	-$28
SBH01	Timber	$29	$125	-$79	$46
SBH02	Slab	$76	$173	-$19	$100
SBH02	Timber	-$66	$46	-$157	-$29
SBH03	Slab	-$9	$53	-$84	-$1
SBH03	Timber	$13	$84	-$66	$26
SBH04	Slab	$87	$138	$34	$98
SBH04	Timber	$9	$75	-$41	$34
SBH05	Slab	$21	$86	-$33	$42
SBH05	Timber	$13	$79	-$40	$35
SBH06	Slab	$35	$84	$0	$54
SBH06	Timber	$50	$99	$15	$69
SBH11	Slab	-$79	$7	-$141	-$46
SBH16	Slab	$7	$45	-$36	$13
SBH16	Timber	-$16	$23	-$50	-$4
SBH19	Slab	$66	$123	$6	$78

Cash flow impacts for building fabric improvements for the householder are positive for 66% of the cases modelled. The main negative cash flows occur where only living areas are heated using reverse cycle heating. As explained above, this may underestimate savings as there may be heating of bedrooms using plug-in heating which is four times more expensive than reverse cycle heating. In addition, any negative amount may be offset by other aspects of the Whole of Home measures.

7.1.7.3 Net present value of building fabric induced energy savings versus capital cost

The table below shows the Net Present Value of energy savings discounted at 7% over 40 years less the cost of building fabric improvements. Figures in red indicate that the net present value is negative, i.e., the discounted value of energy savings over 40 years is less than the value of the capital cost of improvements required to achieve 7-stars. A 7% real discount rate is the policy evaluation metric recommended for this project by the OBPR.

Table 175Net Present Value of Cost and Benefits at 7% discount rate over 40 years, Class 1 in Hobart

		Space Conditioning			Whole House
House Number	Floor-type	Wood Heating, RC cool	Off-Peak Heat and RC Cool	RC Heat and cool	Wood Heat and RC cool living
SBH01	Slab	-$1,605	-$443	-$2,995	-$1,446
SBH01	Timber	-$423	$864	-$1,856	-$193
SBH02	Slab	$510	$1,800	-$751	$831
SBH02	Timber	-$1,923	-$438	-$3,135	-$1,431
SBH03	Slab	-$808	$24	-$1,810	-$698
SBH03	Timber	-$455	$499	-$1,511	-$281
SBH04	Slab	$1,066	$1,739	$362	$1,209
SBH04	Timber	-$272	$618	-$927	$60
SBH05	Slab	-$100	$769	-$824	$181
SBH05	Timber	-$232	$647	-$931	$69
SBH06	Slab	$309	$956	-$157	$555
SBH06	Timber	$568	$1,226	$106	$825
SBH09	Slab	-$1,926	-$784	-$2,754	-$1,493
SBH17	Slab	-$248	$247	-$825	-$173
SBH18	Timber	-$582	-$70	-$1,038	-$432
SBH19	Slab	$639	$1,396	-$161	$796

Net Present Value at a 7% discount rate for building fabric improvements for the householder is positive for 42% of the cases modelled. As explained above, most of those cases which are negative use reverse cycle heating in living areas only. In a cold climate like Hobart, this may underestimate savings as there may be heating of bedrooms using plug-in heating which is four times more expensive than reverse cycle heating. Further, this negative outcome may be offset by other aspects of the Whole of Home measures.

7.1.7.4 Net Present Value: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 176 Net Present Value of costs and benefits at 3% discount rate

		Space Conditioning			Whole House
House Number	Floor-type	Wood Heating, RC cool	Off-Peak Heat and RC Cool	RC Heat and cool	Wood Heat and RC cool living
SBH01	Slab	$534	$2,549	-$1,875	$809
SBH01	Timber	$1,770	$4,002	-$714	$2,169
SBH02	Slab	$2,442	$4,679	$256	$2,999
SBH02	Timber	-$83	$2,491	-$2,184	$771
SBH03	Slab	$728	$2,171	-$1,009	$919
SBH03	Timber	$1,159	$2,813	-$673	$1,459
SBH04	Slab	$2,153	$3,320	$932	$2,402
SBH04	Timber	$731	$2,274	-$405	$1,307
SBH05	Slab	$1,015	$2,523	-$241	$1,502
SBH05	Timber	$844	$2,367	-$368	$1,365
SBH06	Slab	$1,028	$2,148	$219	$1,454
SBH06	Timber	$1,277	$2,418	$476	$1,723
SBH09	Slab	-$626	$1,355	-$2,060	$125
SBH17	Slab	$648	$1,505	-$353	$778
SBH18	Timber	$148	$1,036	-$642	$409
SBH19	Slab	$1,858	$3,170	$471	$2,131

Net Present Value at 7% discount rate for building fabric improvements for the householder is positive for 80% of the cases modelled.

At 3% discount rate the NPV shows significantly larger benefits and smaller disbenefits than at 7%. Note that if a 7% investment return was available after-tax and assuming a real growth in energy prices as shown in AEMO, 2015, NPV would be similar to the values shown above.

7.1.8 Conclusion: Class 1 Hobart

Adoption of a 7-star minimum fabric requirement in Class 1 dwellings in similar climates to Hobart in Climate Zone 7 ***is recommended***:

- NPV at 7% is strongly positive for the majority of dwellings,
- Because Hobart is a cold climate, in dwellings which only have fixed heating in living areas using reverse cycle, there may be significant use of plug-in electric day rate heating. Plug-in electric heating to bedrooms is not modelled and would easily offset the negative NPV in these dwellings.
- Gas is the dominant form of heating in Hobart, and all metrics reported above are strongly positive for this form of heating.
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment in almost all cases, and
- Not all benefits have been evaluated:
    - 7-star dwellings will have lower peak loads. Lower peak loads provide a saving to the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
    - 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
    - 7-star dwellings will provide greater resilience to climate change.

7.2 Class 2 dwellings

7.2.1 Canberra Dwelling Costs

Table 177 Costs of improving building fabric from 6 to 7 stars in Class 2 in Canberra

House Number	Floor-type	Position	Cost (total)	Cost (/m2)
SBA01	Slab	Corner	$1,036	10.84
SBA02	Slab	Middle	$678	7.58
SBA03	Slab	Corner	$174	1.82
SBA04	Slab	Middle	$699	7.81
SBA05*	Slab	Corner	$0	0.00
SBA06	Slab	Middle	$841	9.40
SBA07	Slab	Corner	$1,465	15.34
SBA08	Slab	Middle	$1,709	19.11
SBA11*	Slab	Corner	$0	0.00
SBA12*	Slab	Middle	$0	0.00
SBA13	Slab	Corner	$649	6.79
SBA14	Slab	Middle	$474	5.30
SBA15	Slab	Corner	$1,672	17.51
SBA16	Slab	Middle	$212	2.37
SBA17	Slab	Corner	$1,416	14.83
SBA18	Slab	Middle	$124	1.39
SBA21	Slab	Corner	$2,132	22.33
SBA22	Slab	Middle	$1,225	13.70
SBA23	Slab	Corner	$1,291	13.52
SBA24	Slab	Middle	$1,614	18.05
SBA25	Slab	Corner	$765	8.01
SBA26*	Slab	Middle	$0	0.00
SBA27	Slab	Corner	$1,904	19.94
SBA28	Slab	Middle	$1,828	20.44

* Note these units did not need to be altered to increase the rating to an average 7-stars

Table 178 Summary of dwelling upgrade costs for Class 2 in Canberra

Summary	Cost
Building-wide cost	$21,906
Cost per unit	$913
Cost per m^2	$9.87

The cost of improving the NatHERS ratings of a Class 2 dwelling from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the new weather data varies from around $2 to $20 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $10/$m^2$.

7.2.2 Canberra: Changes to design and specification Class 2

Table 179 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans in Canberra

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling 1	1.4	2.3			168%
Area ceiling 1	69.3	81.3	740	740	117%
External Walls	**Per unit**		**Whole Building**		
R-value walls	0.6	1.7			1.04
Area walls insulated	15.9	33.2	381	798	209%
Area walls uninsulated	22.1	4.7			21%
Wall colour	0.40	0.65			161%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.0	0.0			Nil
Insulated area	0.0	0.0			Nil
Floors	**Per unit**		**Whole Building**		
Area floor insulated	88.1	88.1	740	740	Nil
R-value floor	1.38	1.94			141%
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	0.0	0.0	0	0	0
No. 1200	0.0	0.0	0	0	0
No. 1400	0.0	0.0	0	0	0

Roof insulation was increased to achieve a 7-star average, 6-star minimum across the building by, on average, R0.9. Further increases insulation R-values will improve the rating; however, other methods of improving the rating were selected in preference to this.

Wall insulation R-values were increased by, on average, R1.1. The area of wall insulated also increased, and all units needed to have wall insulation for the building to achieve its minimum and average rating requirements.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show a significant increase over the current assumption.

All of the dwellings required floor insulation to achieve 7-stars. The level of insulation needed to be increased by around R0.5 compared to 6-stars. Note that the car park is assumed to be unenclosed. If the car park was enclosed, floor insulation R-values could likely be reduced, or other specifications lowered.

Table 180 Changes to building design and specification to increase stringency: Windows in Canberra

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	26.1	20.2	627.4	483.9	77%
Area single low e	0.0	0.4	0.0	10.1	Nil
Area single glazed tinted	0.0	0.0	0.0	0.0	Nil
Area single glazed heavy tinted	0.0	0.0	0.0	0.0	Nil
Area single low e tint	1.1	0.7	27.4	15.8	58%
Area double glazed argon fill low e	0.6	4.0	15.1	97.0	642%
Highly openable windows louvre	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e tint	0.0	0.0	0.0	0.0	Nil
Total Window Area	**27.9**	**25.3**	**669.8**	**606.8**	**91%**
Frame colour (abs)	0.4	0.7			188%
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	4.1	3.5	98.9	83.7	85%
E area Day	3.6	3.1	85.8	74.5	87%
S area Day	3.0	3.1	71.7	75.5	105%
W area Day	3.4	2.9	81.5	70.3	86%
N area Night	4.0	3.4	94.8	82.7	87%
E area Night	3.3	2.9	80.0	69.8	87%
S area Night	3.0	3.0	71.4	72.9	102%
W area Night	3.2	2.9	75.6	69.3	92%

Total window area across all units was reduced by around 9%. There was a 23% reduction in the use in single clear glazing, and there was a corresponding increase in the use of double glazing and some single low-e tinted glazing. Slightly darker window frame colours were used. The proportion of high-performance windows increased from 6% to 19%.

7.2.3 Canberra Energy Bill Savings

The extent of improvement costs for individual units varied significantly. This variation is in part because a heterogeneous approach to rating was adopted; i.e., there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to the average benefits for all units in the development.

Table 181 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 1 : Financial Impacts	Reverse Cycle Heating & Reverse Cycle Cooling Whole House	Living Areas Only
Cost per unit	$913	$913
Energy-saving per unit Total	$59	$39
Energy-saving per unit Heating	$38	$30
Energy-saving per unit Cooling	$21	$9
Increase to annual mortgage payments	$52	$52
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$7	-$13
Net Present Value @ 7%	-$127	-$392
Net Present Value @ 5%	$99	-$242
Net Present Value @ 3%	$450	-$10

Table 182 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 2

Appliance Mix 2 : Financial Impact	Reverse Cycle Ducted Heating &Cooling Whole House	Living Areas Only
Cost per unit	$913	$913
Energy-saving per unit Total	$81	$54
Energy-saving per unit Heating	$53	$41
Energy-saving per unit Cooling	$28	$13
Increase to annual mortgage payments	$52	$52
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$29	$1
Net Present Value @ 7%	$166	-$198
Net Present Value @ 5%	$476	$7
Net Present Value @ 3%	$958	$327

Table 183 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 3

Appliance Mix 3 : Financial Impact	Gas Space Heating & Evaporative Cooling	
	Whole House	Living Areas Only
Cost per unit	$920	$920
Energy-saving per unit Total	$110	$71
Energy-saving per unit Heating	$102	$67
Energy-saving per unit Cooling	$8	$3
Increase to annual mortgage payments	$53	$53
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$57	$18
Net Present Value @ 7%	$540	$23
Net Present Value @ 5%	$960	$293
Net Present Value @ 3%	$1,612	$715

The most common appliance mix in high rise apartments is likely to be an electric reverse cycle due to the difficulty associated with distributing gas and installing flues in these buildings. In lower rise apartments, gas may be more common.

Even if there is no installed heater in bedrooms, gas space heaters usually have sufficient capacity to heat bedrooms as well as heating the living area, or at least significantly increase temperatures in bedrooms, due to the smaller size of the apartment. Energy savings may therefore be underestimated for gas heating.

Because Canberra is a cold climate, in dwellings which only have fixed heating in living areas using reverse cycle, there may be significant use of electric day rate heating. Where this occurs, the energy savings will be underestimated. If 7-stars allows just 18 hours of heating using a 2kW fan heater each year to be avoided in bedrooms, the worst negative NPV in the tables above would be reduced to $0.

7.2.4 Conclusion: Class 2, Canberra

Adoption of a 7-star minimum fabric requirement in Class 1 dwellings in similar climates to Canberra in Climate Zone 7 ***is recommended***:

- NPV at 7% is positive except for reverse cycle heated dwellings which heat only the living area,
- Because Canberra is a cold climate, in dwellings which only have fixed heating in living areas using reverse cycle, there may be significant use of electric day rate heating. The use of electric plug-in heating in bedrooms is not modelled and would easily offset the negative NPV in these dwellings.
- Gas is the dominant form of heating in Canberra, and all metrics reported above are strongly positive for this form of heating. Gas appliances also have the capacity to heat larger areas than the living rooms in the apartments modelled, so the energy-saving for living area only may also be an underestimate.
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment in almost all cases, and
- Not all benefits have been evaluated:
    - 7-star dwellings will have lower peak loads. Lower peak loads provide a saving to the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
    - 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
    - 7-star dwellings will provide greater resilience to climate change.

7.2.5 Hobart Class 2 Dwelling Costs

Table 184 Costs of improving building fabric from 6 to 7 stars in Class 2 in Hobart

House Number	Floor-type	Position	Cost (total)	Cost (/m2)
SBA01*	Slab	Corner	$-	$-
SBA02	Slab	Middle	$507	$5.67
SBA03	Slab	Corner	$617	$6.46
SBA04*	Slab	Middle	$-	$-
SBA05	Slab	Corner	$316	$3.31
SBA06	Slab	Middle	$795	$8.89
SBA07**	Slab	Corner	-$28	-$0.29
SBA08	Slab	Middle	$800	$8.94
SBA11	Slab	Corner	$796	$8.33
SBA12*	Slab	Middle	$-	$-
SBA13	Slab	Corner	$103	$1.07
SBA14**	Slab	Middle	-$379	-$4.24
SBA15	Slab	Corner	$184	$1.93
SBA16	Slab	Middle	$918	$10.27
SBA17	Slab	Corner	$569	$5.96
SBA18	Slab	Middle	$547	$6.12
SBA21	Slab	Corner	$759	$7.95
SBA22	Slab	Middle	$680	$7.60
SBA23	Slab	Corner	$158	$1.65
SBA24	Slab	Middle	$979	$10.94
SBA25	Slab	Corner	$151	$1.58
SBA26	Slab	Middle	$361	$4.04
SBA27	Slab	Corner	$1,296	$13.57
SBA28	Slab	Middle	$764	$8.54

* Units marked with an asterisk have zero cost because these units did not need to be upgraded in moving from minimum 5-stars, average 6-stars to minimum 6-stars, average 7-stars.

** the negative costs arise from either a change to the rating, which was required for the unit, or trimming window size in a unit which already had large window areas

Table 185 Summary of dwelling upgrade costs for Class 2 in Hobart

Summary	Cost
Building-wide cost	$10,891.90
Cost per unit	$453.83
Cost per m2	$4.91

The cost of improving the NatHERS ratings of a Class 2 dwelling from 6-stars (minimum 5) with the current weather data to 7-stars (minimum 6) with the new weather data varies from around $1 to $11 per square metre, depending on the orientation of the unit and whether the individual unit rating was increased by 1 or 2 stars. The average across all units is $5/m^2.

7.2.6 Hobart: Changes to design and specification Class 2

Table 186 Changes to building design and specification to increase stringency: Roof, Walls, Floor and Ceiling Fans in Hobart

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Roof	**Per unit**		**Whole Building**		
R-value ceiling 1	1.9	3.0			160%
Area ceiling 1	92.5	92.5	739.7	739.7	100%
External Walls	**Per unit**		**Whole Building**		
R-value walls	0.6	1.1			0.50
Area walls insulated	12.3	22.9	295	551	187%
Area walls uninsulated	25.7	15.0			58%
Wall colour	0.39	0.47			121%
Internal Walls	**Per unit**		**Whole Building**		
R-value	0.0	0.0			Nil
Insulated area	0.0	0.0			Nil
Floors	**Per unit**		**Whole Building**		
Area floor insulated	92.5	92.5	740	740	Nil
R-value floor	1.25	1.81			145%
Ceiling fans	**Per unit**		**Whole Building**		
No. 900	0.0	0.0	0	0	0
No. 1200	0.0	0.0	0	0	0
No. 1400	0.0	0.0	0	0	0

Roof insulation was increased to achieve a 7-star average, 6-star minimum across the building by, on average, R01.1. Further increases insulation R-values will improve the rating; however, other methods of improving the rating were selected in preference to this.

Wall insulation R-values were increased by, on average, R0.5. The area of wall insulated also increased, and 80% of units needed to have wall insulation for the building to achieve its minimum and average rating requirements. Wall colours were made slightly darker.

NatHERS tools now have a separate thermal zone for enclosed car parks. The NatHERS ratings were based on the current assumption that floors above car parks are exposed to the outside air temperature. Ratings to units above enclosed car parks show a significant increase over the current assumption.

All of the dwellings required floor insulation to achieve 7-stars, and the level of insulation needed increased by around R0.5 compared to 6-stars. Note that the car park is assumed to be unenclosed. If the car park was enclosed, floor insulation R-values could likely be reduced or other specifications lowered.

Table 187 Changes to building design and specification to increase stringency: Windows in Hobart

Key specifications	6-star	7-star	6-star	7-star	Change 6 to 7
Windows	**Per unit**		**Whole Building**		
Area single glazed clear	30.8	25.1	738.8	603.2	82%
Area single low e	0.0	0.0	0.0	0.0	Nil
Area single glazed tinted	0.0	0.0	0.0	0.0	Nil
Area single glazed heavy tinted	0.0	0.0	0.0	0.0	Nil
Area single low e tint	1.2	0.5	28.0	12.2	43%
Area double glazed argon fill low e	0.0	3.6	0.0	87.0	
Highly openable windows louvre	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre tint H	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e	0.0	0.0	0.0	0.0	Nil
Highly openable windows louvre low e tint	0.0	0.0	0.0	0.0	Nil
Total Window Area	**31.9**	**29.3**	**766.8**	**702.4**	**92%**
Frame colour (abs)	0.4	0.6			160%
Area external Blinds	0.0	0.0	0.0	0.0	Nil
N area Day	4.6	4.3	109.4	104.2	95%
E area Day	4.3	3.9	102.4	94.6	92%
S area Day	3.4	3.1	81.7	74.9	92%
W area Day	3.8	3.5	90.8	84.8	93%
N area Night	4.6	4.2	110.5	100.1	91%
E area Night	3.9	3.5	94.1	84.8	90%
S area Night	3.3	3.1	79.8	74.2	93%
W area Night	3.7	3.2	87.6	76.2	87%

Total window area across all units was reduced by around 8%. There was an 18% reduction in the use in single clear glazing and there was a corresponding increase in the use of double glazing and some single low-e tinted glazing. Slightly darker window frame colours were used. The proportion of high-performance windows increased from 3% to 14%.

7.2.7 Hobart Energy Bill Savings – Class 2 Dwellings

The extent of improvement costs for individual units varied significantly. This variation is in part because a heterogeneous approach to rating was adopted, i.e. there is significant variation between window size and type between units. The averaging approach of the regulation itself also creates a diverse outcome. A more homogenous approach would smooth out costs and benefits across all units.

The tables below show the average costs compared to average benefits for all units in the development.

Table 188 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 1 : Financial Impacts	Reverse Cycle Heating & Cooling Whole House	Living Areas Only
Cost per unit	$454	$454
Energy-saving per unit Total	$47	$34
Energy-saving per unit Heating	$45	$34
Energy-saving per unit Cooling	$2	$0
Increase to annual mortgage payments	$26	$26
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$21	$8
Net Present Value @ 7%	$171	-$3
Net Present Value @ 5%	$351	$127
Net Present Value @ 3%	$630	$328

Table 189 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 2 : Financial Impact	Resistive Electric Off Peak rate Heating & Reverse Cycle Ducted Cooling Whole House	Living Areas Only
Cost per unit	$454	$454
Energy-saving per unit Total	$107	$78
Energy-saving per unit Heating	$105	$78
Energy-saving per unit Cooling	$2	$0
Increase to annual mortgage payments	$26	$26
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$81	$52
Net Present Value @ 7%	$974	$589
Net Present Value @ 5%	$1,383	$888
Net Present Value @ 3%	$2,021	$1,354

Table 190 Financial analysis of benefits and costs for Class 2 dwellings in Climate: Appliance Mix 1

Appliance Mix 3 : Financial Impact	Closed Combution Wood Heating & Evaporative Cooling	
	Whole House	Living Areas Only
Cost per unit	$454	$454
Energy-saving per unit Total	$88	$78
Energy-saving per unit Heating	$88	$78
Energy-saving per unit Cooling	$1	$0
Increase to annual mortgage payments	$26	$26
Annual Cash Flow: Total Annual Energy Bill Saving - Mortgage Increase	$62	$52
Net Present Value @ 7%	$723	$588
Net Present Value @ 5%	$1,061	$887
Net Present Value @ 3%	$1,586	$1,352

Reverse cycle heating is the most common form of heating in Tasmania (over 50%), but there is significant market penetration for resistive electric (10%) and wood (25%). In high rise apartments the use of wood is unlikely, but it may be provided in low rise developments. Off peak resistive electric heating may be a more practical alternative in apartments where installation of the split system fan unit is problematic.

The NPV at 7% discount rate is positive in all cases except where only the living area is heated where it is $-3. Impacts on annual cash flow are positive in all cases, and NPV at 3% discount rate is strongly positive.

7.2.8 Conclusion: Class 2, Hobart

Adoption of a 7-star minimum fabric requirement in Class 1 dwellings in similar climates to Hobart in Tasmania in Climate Zone 7 ***is recommended***:

- NPV at 7% is positive except for reverse cycle heated dwellings which heat only the living area using reverse cycle heating,
- Because Canberra is a cold climate, in dwellings which only have fixed heating in living areas using reverse cycle, there may be significant use of electric day rate heating. This is not modelled and would easily offset the negative NPV in these dwellings.
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment in all cases, and
- Not all benefits have been evaluated:
- 7-star dwellings will have lower peak loads. This results in a saving to both the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
- 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases,
- 7-star dwellings will provide greater resilience to climate change.

8 NCC Climate Zone 8: Alpine (Thredbo)

As shown in Table 3 above, changes to the star bands for the updated and improved weather data mean that houses that were formerly 7.0 stars now achieve a rating of around 7.4 stars in Thredbo. This increase in ratings has reduced the cost of achieving 7-stars. It has also reduced the energy-saving benefits. Both factors are accounted for in the results shown below.

8.1 Class 1 Dwellings

8.1.1 Dwelling Costs

Table 191 Costs of improving building fabric from 6 to 7 stars in Class 1 in Thredbo

House Number	Floor-type	Size	Storeys	Type	Cost (total)	Cost (/m2)
SBH01	Slab	Large	Two	Detached	$1,323	$4.73
SBH01	Timber	Large	Two	Detached	$2,212	$7.90
SBH02	Slab	Large	One	Detached	$2,786	$10.73
SBH02	Timber	Large	One	Detached	$2,430	$9.36
SBH03	Slab	Medium	Two	Detached	$2,166	$11.59
SBH03	Timber	Medium	Two	Detached	$2,248	$12.04
SBH04	Slab	Medium	One	Detached	$1,549	$11.50
SBH04	Timber	Medium	One	Detached	$1,945	$14.43
SBH05	Slab	Small	One	Detached	$1,138	$8.12
SBH05	Timber	Small	One	Detached	$1,343	$9.59
SBH06	Slab	Small	One	Detached	$1,175	$11.62
SBH06	Timber	Small	One	Detached	$1,431	$14.16
SBH11	Slab	Medium	One	Passive Solar FC sheet	$1,093	$4.09
SBH16	Slab	Small	One	Semi-detached	$563	$5.62
SBH16	Timber	Small	One	Semi-detached	$486	$4.85
SBH19	Slab	Small	One	Passive solar FC sheet	$1,085	$7.00

Table 192 Summary of dwelling upgrade costs for Class 1 in Thredbo

House Type	Cost	Cost/m2
All	$1,593	$9.21
Non specialist	$1,465	$9.59
Specialist Designs	$1,154	$6.81

The cost of improving the NatHERS rating of a Class 1 dwelling from 6-stars with the current weather data to 7-stars with the new weather data varies from around $5 to $14 per square metre, depending on how well the design of the dwelling is suited to the climate. The average across all non-specialist designed dwellings on less favourable orientations is around $10/m^2, while specialist well-oriented designs (main living areas face south) which are well suited to the Thredbo climate can achieve around a $3/m^2 cost savings.

8.1.2 Thredbo, summary of building fabric changes

Section 13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars shows the design and specification changes needed to increase the rating from 6 to 7 stars for each dwelling. The tables below summarise these changes for all the Class 1 dwellings rated:

Table 193 Changes to Roof and Ceiling specifications needed to meet 7-stars in Thredbo

Key specifications	6.0 stars Average	7.0 stars Average
Roof		
R-value ceiling 1	3.6	4.7
Area ceiling 1	127.9	127.9
R-value ceiling 2	0.7	0.7
Area ceiling 2	17.9	17.9
Area roof insulated (Attic)	2.8	2.8
Area roof uninsulated (Attic)	194.1	194.1
R-value roof blanket	0.0	0.0
R-value ceiling 3	1.4	1.7
Area roof insulated (Flat)	24.6	24.6
Area roof uninsulated (Flat)	9.7	9.7
Foil under roof?	75%	75%
Ventilated roof?	0%	0%
Roof colour	0.65	0.78

The figures in the table above show average data across all dwellings. Changes were not made across the board for all houses. Some may have only increased ceiling R-values, while others may have only changed the roof colour, and vice versa.

In each dwelling, there were several areas of ceiling and roof that contained insulation. The table above allows for all possible combinations:

- Ceiling 1 and 2 allow for the installation of different R-values over different areas of ceiling or a bulkhead to the attic space,
- Roof insulation allows for under roof bulk insulation,
- Flat shows the R-value of ceiling insulation installed in a flat/skillion roof.

Ceiling insulation levels used to obtain 7-stars were increased, on average, by around R1.1. At 7-stars there was an increase in the use of darker roof colours. Roof colours at 6-stars were already a medium-dark colour.

Table 194 Changes to External and Internal wall and floor specifications needed to meet 7-stars in Thredbo

Key specifications	6.0 stars Average	7.0 stars Average
External Walls		
Proportion of houses with wall insulation	100%	100%
R-value walls	R 2.19	R 2.41
Proportion of walls insulated (insulated houses)	100%	100%
Area walls uninsulated	0.0	0.0
Area walls insulated (Garage and roof space)	1.9	1.9
Area walls uninsulated (Garage and roof space)	31.9	31.9
Foil layer walls?	69%	69%
If yes emissivity	0.1	0.1
Wall colour (Solar Abs)	0.70	0.82
Internal Walls		
No dwellings with insulated internal walls	16	16
R-value (if insulated)	2.1	2.4
Insulated area	0.0	0.0
Floors		
Area floor insulated	142.5	135.9
Waffle pod?	56%	56%
R-value floor	0.7	0.9
Foil underfloor?	0%	13%
R-value subfloor walls	None	None
Area subfloor walls insulated	29.7	29.7
Area ceramic tile floor surface	16.6	21.3

All the dwellings used fibre-cement clad framed walls. These walls were all insulated at both 6- and 7-stars and 7-star houses used slightly higher R-values. There was no change in the use of reflective wall wrap. There was a significant increase in the use of darker coloured walls, but walls at 6-stars were already a medium-dark colour.

The wall to the garage was also required to be insulated in all of the dwellings at 6-stars and 7-stars. A slightly higher insulation R-value was used in these walls.

All of the dwellings required floors over enclosed subfloor spaces to be insulated. R-values for underfloor insulation increased by around R0.3 on average. All dwellings on a slab floor used a waffle pod slab.

Table 195 Changes to Ceiling fan and Window specifications needed to meet 7-stars in Thredbo

Key specifications	6.0 stars Average	7.0 stars Average
Ceiling fans		
No. 900	0.0	0.0
No. 1200	0.0	0.0
No. 1400	0.0	0.0
Windows		
Area single glazed clear	32.2	20.9
Area single low e	0.2	0.1
Area single glazed tinted	0.0	0.0
Area single glazed heavy tinted	0.0	0.0
Area single low e tint	0.0	0.0
Area double glazed argon fill low e	11.5	17.6
Total Window Area	43.9	38.6
Frame colour (abs)	0.65	0.85
Area external Blinds	0.0	0.0
Highly openable windows louvre	NA	NA
Highly openable windows louvre tint	NA	NA
Highly openable windows louvre tint H	NA	NA
Highly openable windows louvre low e	NA	NA
Highly openable windows louvre low e tint	NA	NA

Total window area across all units was reduced by around 12%. There was a 35% reduction in the use in single clear glazing, and there was a corresponding increase in the use of double glazing and some single low-e tinted glazing. Darker window frame colours were used for all dwellings, but widow frame colours at 6-stars were already medium-dark. The proportion of high-performance windows increased from 26% to 46%.

8.1.3 Energy Bill Savings

The table below shows the energy bill impact (excluding connection costs) for the upgrade from 6 to 7 stars. The energy bill savings are based on Flat-rate energy tariffs which generally result in slightly lower bills that the time of use tariff used for evaluating societal cost. For a detailed explanation of the societal cost metric, see the Whole-of-House Annexe report by EES. Energy bill savings are larger in larger dwellings and where a larger area of the dwelling is conditioned.

Table 196 Heating and cooling energy bill savings for various appliances and area of dwelling conditioned

		Heating Savings						Cooling Savings			
		Whole House			Living Areas only			Whole House		Living areas only	
House No	Floor-type	Wood	AC Heat	Resistive Elec (Off Peak)	Wood	AC Heat	Resistive Elec (Off Peak)	AC Cool	Evap Cool	AC Cool	Evap Cool
01	SLA	$384	$259	$499	$299	$201	$389	$4	$1	-$0	-$0
01	TIM	$383	$258	$498	$291	$196	$379	-$3	-$1	$0	$0
02	SLA	$357	$240	$464	$267	$180	$347	$2	$1	$1	$0
02	TIM	$355	$239	$461	$263	$177	$341	$2	$1	$0	$0
03	SLA	$285	$192	$370	$216	$146	$281	-$0	-$0	$0	$0
03	TIM	$261	$176	$340	$199	$134	$259	-$1	-$0	$1	$0
04	SLA	$179	$120	$233	$135	$91	$176	$2	$1	-$1	-$0
04	TIM	$211	$142	$274	$158	$106	$205	-$4	-$1	-$0	-$0
05	SLA	$228	$153	$296	$173	$116	$224	$1	$0	$0	$0
05	TIM	$200	$135	$261	$155	$104	$202	$1	$1	-$0	-$0
06	SLA	$199	$134	$259	$142	$96	$184	-$2	-$1	-$1	-$0
06	TIM	$162	$109	$211	$114	$77	$148	-$6	-$2	$2	$1
11	SLA	$172	$116	$224	$152	$102	$197	$10	$4	$0	$0
16	SLA	$184	$124	$239	$145	$97	$188	$2	$1	$1	$0
16	TIM	$142	$95	$184	$115	$78	$150	$2	$1	$0	$0
19	SLA	$310	$209	$403	$238	$161	$310	$1	$0	$0	$0

Note that in some cases the upgrade to 7-stars slightly increases the cooling energy bill. This increase in cooling occurs because the design and specification change required to achieve 7-stars focus on lowering heating energy.

8.1.4 Energy Bill savings for common appliance combinations

The table below shows the combined heating and cooling annual energy savings using the most common appliance combinations:

- Wood heating and Reverse Cycle cooling in living areas only
- Off-Peak electric heating and Reverse Cycle cooling to living areas only,
- Reverse Cycle heating and cooling to living areas only, and
- Whole house heating and cooling using a ducted reverse cycle system.

Table 197 Space conditioning energy bill savings for common space conditioning appliance combinations

		Space Conditioning			Whole House
House Number	Floor-type	Wood Heating, RC cool	Off-Peak Heat and RC Cool	RC Heat and cool	Wood Heat and RC cool living
SBH01	Slab	$298	$499	$201	$383
SBH01	Timber	$291	$498	$196	$383
SBH02	Slab	$268	$465	$181	$358
SBH02	Timber	$263	$461	$177	$355
SBH03	Slab	$216	$370	$146	$285
SBH03	Timber	$200	$341	$135	$262
SBH04	Slab	$135	$232	$90	$178
SBH04	Timber	$157	$273	$106	$210
SBH05	Slab	$173	$296	$116	$228
SBH05	Timber	$155	$260	$104	$200
SBH06	Slab	$141	$258	$94	$198
SBH06	Timber	$117	$213	$79	$165
SBH11	Slab	$152	$224	$103	$172
SBH16	Slab	$145	$240	$98	$185
SBH16	Timber	$115	$184	$78	$142
SBH19	Slab	$238	$403	$161	$310

8.1.5 Cash Flow Analysis

The following table shows the impact of the upgrade from 6 to 7 stars from a householder perspective by comparing annual energy bill savings with the annual increase to mortgage payments resulting from the higher capital cost of 7-star dwellings. Mortgage interest rate is assumed to be 4%, and the loan is assumed to be paid monthly over 30 years.

Table 198 Impact on Annual householder cash flow: Energy Savings - Mortgage Increase, Class 1 in Thredbo

		Space Conditioning			Whole House
House Number	Floor-type	Wood Heating, RC cool	Off-Peak Heat and RC Cool	RC Heat and cool	Wood Heat and RC cool living
SBH01	Slab	$223	$423	$125	$308
SBH01	Timber	$165	$371	$70	$256
SBH02	Slab	$108	$305	$21	$198
SBH02	Timber	$123	$322	$38	$215
SBH03	Slab	$92	$246	$22	$161
SBH03	Timber	$71	$212	$6	$133
SBH04	Slab	$46	$143	$2	$89
SBH04	Timber	$46	$162	-$6	$99
SBH05	Slab	$108	$231	$51	$163
SBH05	Timber	$78	$183	$27	$123
SBH06	Slab	$73	$190	$27	$131
SBH06	Timber	$35	$131	-$3	$83
SBH11	Slab	$89	$162	$40	$110
SBH16	Slab	$113	$208	$66	$152
SBH16	Timber	$87	$157	$50	$114
SBH19	Slab	$176	$341	$98	$248

Cash flow impacts for building fabric improvements for the householder are positive for 97% of the cases modelled. Thredbo is a very cold climate. Where dwellings which only have fixed heating in living areas there may be significant use of plug-in electric day rate heating. Plug-n electric heating is four times more expensive than reverse cycle heating and wood heating and twice as expensive as off-peak heating. Use of plug-in heating is not modelled and where it is used the figures above would significantly underestimate the actual improvement to cash flow.

8.1.6 Net present value of building fabric induced energy savings versus capital cost

The table below shows the Net Present Value of energy savings discounted at 7% over 40 years less the cost of building fabric improvements. Figures in red indicate that the net present value is negative, i.e., the discounted value of energy savings over 40 years is less than the value of the capital cost of improvements required to achieve 7-stars. A 7% real discount rate is the policy evaluation metric recommended for this project by the OBPR.

		Space Conditioning			Whole House
House Number	Floor-type	Wood Heating, RC cool	Off-Peak Heat and RC Cool	RC Heat and cool	Wood Heat and RC cool living
SBH01	Slab	$2,656	$5,325	$1,354	$3,788
SBH01	Timber	$1,673	$4,425	$406	$2,893
SBH02	Slab	$785	$3,411	-$377	$1,983
SBH02	Timber	$1,070	$3,717	-$73	$2,297
SBH03	Slab	$718	$2,772	-$224	$1,632
SBH03	Timber	$421	$2,292	-$448	$1,246
SBH04	Slab	$244	$1,542	-$344	$826
SBH04	Timber	$149	$1,701	-$536	$858
SBH05	Slab	$1,165	$2,810	$414	$1,899
SBH05	Timber	$718	$2,124	$43	$1,322
SBH06	Slab	$700	$2,260	$82	$1,463
SBH06	Timber	$122	$1,413	-$374	$764
SBH09	Slab	$934	$1,895	$274	$1,206
SBH17	Slab	$1,376	$2,636	$746	$1,899
SBH18	Timber	$1,051	$1,972	$550	$1,405
SBH19	Slab	$2,094	$4,286	$1,056	$3,046

Net Present Value at a 7% discount rate for building fabric improvements for the householder is positive for 89% of the cases modelled. In those cases which are negative, this may be offset by other aspects of the Whole of Home measures.

Because Thredbo is a very cold climate, in dwellings which only have fixed heating in living areas, there may be significant use of plug-in electric day rate heating. This form of heating is four times more expensive than reverse cycle heating and wood heating and twice as expensive as off-peak heating. Where plug-in electric heating is used in bedrooms, the figures above would underestimate the NPV. For example, if the upgrade to 7-stars allows 800 hours per year of a plug-in day rate electric fan heater to be avoided then in the worst case the NPV would be 0. This is equivalent to around 3.5 hours of use per day over the six coldest months, or approximately 1 hour per day per bedroom.

8.1.7 Net Present Value: the householder's perspective

The table below shows the Net Present Value of energy savings discounted at 3% over 40 years less the cost of building fabric improvements. Given the information discussed above, this ***may*** reflect the Net Present Value of costs and benefits for householders from the point of view of an alternative investment.

Table 199 Net Present Value of costs and benefits at 3% discount rate

		Space Conditioning			Whole House
House Number	Floor-type	Wood Heating, RC cool	Off-Peak Heat and RC Cool	RC Heat and cool	Wood Heat and RC cool living
SBH01	Slab	$5,575	$10,203	$3,319	$7,539
SBH01	Timber	$4,524	$9,296	$2,327	$6,639
SBH02	Slab	$3,405	$7,958	$1,391	$5,482
SBH02	Timber	$3,638	$8,228	$1,657	$5,767
SBH03	Slab	$2,834	$6,396	$1,202	$4,419
SBH03	Timber	$2,379	$5,624	$874	$3,810
SBH04	Slab	$1,561	$3,810	$540	$2,568
SBH04	Timber	$1,686	$4,376	$497	$2,914
SBH05	Slab	$2,855	$5,708	$1,553	$4,128
SBH05	Timber	$2,230	$4,669	$1,060	$3,278
SBH06	Slab	$2,075	$4,780	$1,005	$3,398
SBH06	Timber	$1,262	$3,500	$402	$2,374
SBH09	Slab	$2,422	$4,088	$1,277	$2,894
SBH17	Slab	$2,798	$4,983	$1,706	$3,706
SBH18	Timber	$2,179	$3,776	$1,310	$2,792
SBH19	Slab	$4,427	$8,228	$2,627	$6,077

Net Present Value at 3% discount rate is positive, i.e. benefits exceed costs, in all of the cases reported above. Where the energy bill savings are underestimated in dwellings which only heat living areas, the upgrade to 7-stars is a very good option from the householders' perspective.

At 3% discount rate the NPV shows significantly larger benefits and smaller disbenefits than at 7%. Note that if a 7% investment return was available after-tax and assuming a real growth in energy prices as shown in AEMO, 2015, NPV would be similar to the values shown above.

8.1.8 Conclusion: Class 1, Thredbo

Adoption of a 7-star minimum fabric requirement in Class 1 dwellings in similar climates to Darwin in Climate Zone 1 ***is recommended***:

- NPV at 7% is strongly positive for the majority of dwellings,
- If NPV is negative, better design and orientation of dwellings offer the scope to reduce costs and provide positive NPV values,
- Energy bill savings may be underestimated in dwellings which only have fixed heaters in the living area because bedrooms may be heated with plug-in day rate electric heating,
- Analysis of annual household cash flow impact shows that this is positive in 98% of cases,
- Analysis from a householder alternative investment point of view, i.e. NPV at 3%, shows that improving building fabric to 7-stars is a good investment in all cases, and
- Not all benefits have been evaluated:
    - 7-star dwellings will have lower peak loads. Lower Peak Loads provide a saving to both the electricity network, and the consumer in terms of a reduced appliance size and therefore cost,
    - 7-star dwellings are far more comfortable than the 2-star existing dwellings that they will replace over time. The improved comfort provided is likely to have significant health benefits. Avoiding just one doctor's visit per year would more than account for the negative impacts on household cash flow in most cases.

9 References

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10 Appendix 1 Unit Costs

Key specifications		Location					
Ceiling Insulation	Unit Cost for	Adelaide	Brisbane	Cairns	Canberra	Darwin	Hobart
0	0.0	$-	$-	$-	$-	$-	$-
1	1.0	$5.09	$5.09	$5.45	$5.09	$5.45	$5.09
1.5	1.5	$5.69	$5.69	$6.16	$5.69	$6.16	$5.69
2	2.0	$6.26	$6.26	$6.83	$6.26	$6.83	$6.26
2.5	2.5	$6.84	$6.84	$7.51	$6.84	$7.51	$6.84
3	3.0	$7.52	$7.52	$8.31	$7.52	$8.31	$7.52
3.5	3.5	$7.47	$8.01	$8.88	$8.01	$8.88	$8.01
4	4.0	$8.59	$8.59	$9.57	$8.59	$9.57	$8.59
4.5	4.5	$10.08	$10.08	$11.32	$10.08	$11.32	$10.08
5	5.0	$11.57	$11.57	$13.07	$11.57	$13.07	$11.57
Roof Insulation		Adelaide	Brisbane	Cairns	Canberra	Darwin	Hobart
	0	$-	$-	$-	$-	$-	$-
1.3	1.3	$3.58	$3.58	$3.85	$3.58	$3.85	$3.58
1.8	1.8	$4.66	$4.66	$5.12	$4.66	$5.12	$4.66
2.3	2.3	$6.05	$6.05	$6.76	$6.05	$6.76	$6.05
	N	$-	$-	$-	$-	$-	$-
Foil	Y	$4.49	$4.49	$4.89	$4.49	$4.89	$4.49
Ventilated Roof Cost per vent						$-	
N	N	$-	$-	$-	$-	$-	$-
Assumes 4 x Vents to provide ventilation	Y	$790.00	$782.00	$836.74	$899.20	$908.50	$802.00
External Walls and Insulation							
Brick Cavity	Brick Cavity	X	X	X	X	X	X
Brick Veneer	Brick Veneer	$205.65	$217.70	X	$233.35	X	$244.90
Concrete Block	Concrete block	$259.26	$218.71	$234.02	$216.84	$298.15	$213.89
Framed FC sheet Clad	Fibre-cement sheet	$129.15	$135.70	$145.20	$128.25	$148.52	$165.10

Key specifications		Location					
Ceiling Insulation	Unit Cost for	Adelaide	Brisbane	Cairns	Canberra	Darwin	Hobart
Framed Metal Clad	Metal clad	$136.65	$146.00	$156.22	$144.65	$157.15	$171.00
Framed Walls Insulation							
0.0	0.0	$-	$-	X	$-	X	$-
1.0	1.0	$5.37	$5.37	X	$5.37	X	$5.37
1.5	1.5	$5.54	$5.54	X	$5.54	X	$5.54
2.0	2.0	$6.11	$6.11	X	$6.11	X	$6.11
2.5	2.5	$9.40	$9.40	X	$9.40	X	$9.40
2.7	2.7	$15.64	$15.64	X	$15.64	X	$15.64
3.0	3.0	$17.57	$17.57	X	$17.57	X	$17.57
Double side foil							
N	N	$-	$-	$-	$-	$-	$-
Y	Y	$2.67	$2.67	$2.96	$2.67	X	$2.67
Concrete Block		$259.26	$218.71	$234.02	$216.84	$298.15	$213.89
	0	$-	$-	$-	$-	$-	$-
R1.0	1	$30.17	$24.87	$26.61	X	$34.70	X
R1.5	1.5	$30.34	$25.04	$26.80	X	$34.90	X
Foil	Foil	$27.47	$22.17	$23.72	X	$31.59	X
Brick Cavity cost		X	X	X	X	X	X
	0	$-	$-	$-	$-	$-	$-
1	1	X	X	X	X	X	X
2	2	X	X	X	X	X	X
Foil (Air Cell)	Foil	X	X	X	X	X	X
Internal Walls insulation costs							
Plasterboard (Insulation costs only, not wall)							
	0.0	$-	$-	$-	$-	X	$-
R1.0	1.0	$5.37	$5.37	X	$5.37	X	$5.37
R1.5	1.5	$5.54	$5.54	X	$5.54	X	$5.54
R2.0	2.0	$6.11	$6.11	X	$6.11	X	$6.11

Key specifications		Location					
Ceiling Insulation	Unit Cost for	Adelaide	Brisbane	Cairns	Canberra	Darwin	Hobart
R2.5	2.5	$9.40	$9.40	X	$9.40	X	$9.40
R2.7	2.7	$15.64	$15.64	X	$15.64	X	$15.64
Conc Block (Insulation costs only, not wall)				$-		$-	
	0	$-	$-	$-	X	$-	X
R1.0	1.0	$30.17	$24.87	$26.61	X	$34.70	X
R1.5	1.5	$30.34	$25.04	$26.80	X	$34.90	X
R2.0	2.0	$30.91	$25.61	$27.40	X	$35.55	X
Foil	Foil	$27.47	$22.17	$23.72	X	$31.59	X
Brick				$-		$-	
	0.0	$-	$-	$-	$-	$-	$-
R1.0	1.0	X	X	X	X	X	X
R1.5	1.5	X	X	X	X	X	X
R2.0	2.0	X	X	X	X	X	X
Foil	Foil	X	X	X	X	X	X
Floors and insulation				$-		$-	
Concrete Slab				$-		$-	
Waffle Pod: 375mm (vs Slab Class H soil)	N	$-	$-	$-	$-	$-	$-
	Y	$-	$-	$-	$-	$-	$-
	0.0	$-	$-	$-	$-	$-	$-
	1.0	$23.04	$22.04	$23.58	$22.04	$26.50	$22.04
R1.5 (under slab)	1.5	$28.00	$28.00	$29.96	$28.00	$32.20	$28.00
R2.0 (under slab)	2.0	$34.96	$34.96	$37.41	$34.96	$40.20	$34.96
	0.0	$-	$-	$-	$-	$-	$-
Slab edge R1.0	1.0	$22.04	$22.04	$23.58	$22.04	$25.35	$22.04
Slab edge R1.5	1.5	$28.00	$28.00	$29.96	$28.00	$32.20	$28.00
Timber				$-		$-	
	0	$-	$-	$-	$-	$-	$-
R1.5 (polyester)	1.5	$8.29	$8.29	$9.20	$8.29	$9.20	$8.29

Key specifications		Location					
Ceiling Insulation	Unit Cost for	Adelaide	Brisbane	Cairns	Canberra	Darwin	Hobart
R2.0 (polyester)	2.0	$9.20	$9.20	$9.40	$9.20	$9.40	$9.20
R2.5 (polyester)	2.5	$10.86	$10.86	$9.95	$10.86	$9.95	$10.86
R3.0 (polyester)	3.0	$12.02	$12.02	$10.27	$12.02	$10.27	$12.02
R3.5 (polyester)	3.5	$13.31	$13.31	$10.74	$13.31	$10.74	$13.31
DS foil underfloor joists	Foil	$4.89	$4.89	$4.89	$4.89	$4.89	$4.89
Subfloor walls				$-		$-	
	0.0	$-	$-	$-	$-	$-	$-
R1.0 (polystyrene board)	1.0	$21.25	$21.25	$22.74	$21.25	$24.44	$21.25
R1.5 (polystyrene board)	1.5	$27.25	$27.25	$29.16	$27.25	$31.34	$27.25
R2.0 (polystyrene board)	2.0	$33.25	$33.25	$35.58	$33.25	$38.24	$33.25
Floor coverings				$-		$-	
CSOG: Carpet		$85.70	$87.60	$93.73	$92.50	$98.56	$88.80
CSOG: Ceramic tile		$104.50	$126.00	$134.82	$115.50	$120.18	$131.50
		$18.80	$38.40	$41.09	$23.00	$21.62	$42.70
Ceiling fans (diameter mm)				$-		$-	
900	900	$210.00	$210.00	$224.70	$210.00	$241.50	$210.00
1200	1200	$240.00	$240.00	$256.80	$225.00	$276.00	$240.00
1400	1400	$270.00	$270.00	$288.90	$250.00	$310.50	$270.00
Windows				$-		$-	
Glazing Type				$-		$-	
Clear		$275.34	$275.34	$298.81	$260.00	$325.64	$275.34
Low e		$340.64	$340.64	$368.68	$340.00	$400.73	$340.64
Tint		$303.50	$303.50	$328.94	$295.00	$358.02	$303.50
Tint Heavy		$324.81	$324.81	$351.74	$305.00	$382.53	$324.81
Low e tint		$361.95	$361.95	$391.48	$355.00	$425.24	$361.95
Double low e argon filled		$466.70	$466.70	$503.57	$445.00	$545.71	$466.70
OPENABILITY				$-		$-	

Key specifications		Location					
Ceiling Insulation	Unit Cost for	Adelaide	Brisbane	Cairns	Canberra	Darwin	Hobart
Louvre windows (2100 high)		$471.94	$471.94	$495.41	$456.60	$522.24	$471.94
		$500.10	$500.10	$525.54	$491.60	$554.62	$500.10
		$510.10	$510.10	$535.54	$501.60	$564.62	$510.10
		$536.94	$536.94	$560.41	$521.60	$587.24	$536.94
		$551.94	$551.94	$575.41	$536.60	$602.24	$551.94
Stacker door (vs sliding)		$50.00	$61.00	$65.27	$46.00	$57.50	$30.00
SHADING				$-		$-	
External Blinds		$260.00	$260.00	$278.20	$260.00	$299.00	$260.00
Adjustable cover over pergola (not inc perg)				$-		$-	

Key specifications	Location					
Ceiling Insulation	Longreach	Mascot	Melbourne	Mildura	Perth	Richmond(WSyd)
0	$-	$-	$-	$-	$-	$-
1	$5.45	$5.09	$5.09	$5.45	$5.09	$5.09
1.5	$6.16	$5.69	$5.69	$6.16	$5.69	$5.69
2	$6.83	$6.26	$6.26	$6.83	$6.26	$6.26
2.5	$7.51	$6.84	$6.84	$7.51	$6.84	$6.84
3	$8.31	$7.52	$7.52	$8.31	$7.52	$7.52
3.5	$8.88	$8.01	$8.01	$8.88	$8.01	$8.01
4	$9.57	$8.59	$8.59	$9.57	$8.59	$8.59
4.5	$11.32	$10.08	$10.08	$11.32	$10.08	$10.08
5	$13.07	$11.57	$11.57	$13.07	$11.57	$11.57
Roof Insulation	Longreach	Mascot	Melbourne	Mildura	Perth	Richmond(WSyd)
	$-	$-	$-	$-	$-	$-
1.3	$3.85	$3.58	$3.58	$3.85	$3.58	$3.58
1.8	$5.12	$4.66	$4.66	$5.12	$4.66	$4.66
2.3	$6.76	$6.05	$6.05	$6.76	$6.05	$6.05
	$-	$-	$-	$-	$-	$-
Foil	$4.89	$4.49	$4.49	$4.89	$4.49	$4.49
Ventilated Roof Cost per vent						
N	$-	$-	$-	$-	$-	$-
Assumes 4 x Vents to provide ventilation	$1,094.80	$766.00	$784.00	$823.20	$822.00	$766.00
External Walls and Insulation						
Brick Cavity		X	X		$220.30	X
Brick Veneer	$304.78	$233.35	$200.55	$210.58	X	$233.15
Concrete Block	X	$216.84	$203.49	X	X	$216.84
Framed FC sheet Clad	$189.98	$128.25	$124.70	$130.94	X	$128.25
Framed Metal Clad	$204.40	$144.65	$126.55	$132.88	X	$144.65
Framed Walls Insulation						
0.0	$-	$-	$-	$-	X	$-

Key specifications	Location					
Ceiling Insulation	Longreach	Mascot	Melbourne	Mildura	Perth	Richmond(WSyd)
1.0	$5.81	$5.37	$5.37	$5.81	X	$5.37
1.5	$6.01	$5.54	$5.54	$6.01	X	$5.54
2.0	$6.68	$6.11	$6.11	$6.68	X	$6.11
2.5	$10.54	$9.40	$9.40	$10.54	X	$9.40
2.7	$14.28	$15.64	$15.64	$14.28	X	$15.64
3.0	$20.16	$17.57	$17.57	$20.16	X	$17.57
Double side foil						
N	$-	$-	$-	$-	$-	$-
Y	$2.96	$2.67	$2.67	$2.96	$2.67	$2.67
Concrete Block	X	$216.84	$203.49	X	$216.46	$216.84
	$-	$-	$-	$-	$-	$-
R1.0	X	X	X	X	X	X
R1.5	X	X	X	X	X	X
Foil	X	X	X	X	X	X
Brick Cavity cost		X	X		$220.30	X
	$-	$-	$-	$-	$-	$-
1	X	X	X	X		X
2	X	X	X	X		X
Foil (Air Cell)	X	X	X	X	$17.35	X
Internal Walls insulation costs						
Plasterboard (Insulation costs only, not wall)						
	$-	$-	$-	$-	$-	$-
R1.0	$5.81	$5.37	$5.37	$5.81	$5.37	$5.37
R1.5	$6.01	$5.54	$5.54	$6.01	$5.54	$5.54
R2.0	$6.68	$6.11	$6.11	$6.68	$6.11	$6.11
R2.5	$10.54	$9.40	$9.40	$10.54	$9.40	$9.40
R2.7	$14.28	$15.64	$15.64	$14.28	$15.64	$15.64
Conc Block (Insulation costs only, not wall)						

Key specifications	Location					
Ceiling Insulation	Longreach	Mascot	Melbourne	Mildura	Perth	Richmond(WSyd)
	X	X	X	X	X	X
R1.0	X	X	X	X	X	X
R1.5	X	X	X	X	X	X
R2.0	X	X	X	X	X	X
Foil	X	X	X	X	X	X
Brick						
	$-	$-	$-	$-	$-	$-
R1.0	X	X	X	X	$30.17	X
R1.5	X	X	X	X	$30.34	X
R2.0	X	X	X	X	$30.91	X
Foil	X	X	X	X	$20.02	X
Floors and insulation						
Concrete Slab						
Waffle Pod: 375mm (vs Slab Class H soil)	$-	$-	$-	$-	$-	$-
	$-	$-	$-	$-	$-	$-
	$-	$-	$-	$-	$-	$-
	$30.86	$22.04	$22.04	$23.14	$22.04	$22.04
R1.5 (under slab)	$39.20	$28.00	$28.00	$29.40	$28.00	$28.00
R2.0 (under slab)	$48.94	$34.96	$34.96	$36.71	$34.96	$34.96
	$-	$-	$-	$-	$-	$-
Slab edge R1.0	$30.86	$22.04	$22.04	$23.14	$22.04	$22.04
Slab edge R1.5	$39.20	$28.00	$28.00	$29.40	$28.00	$28.00
Timber	$-					
	$-	$-	$-	$-	$-	$-
R1.5 (polyester)	$9.20	$8.29	$8.29	$9.20	$8.29	$8.29
R2.0 (polyester)	$9.40	$9.20	$9.20	$9.40	$9.20	$9.20
R2.5 (polyester)	$9.95	$10.86	$10.86	$9.95	$10.86	$10.86
R3.0 (polyester)	$10.27	$12.02	$12.02	$10.27	$12.02	$12.02

Key specifications		Location				
Ceiling Insulation	Longreach	Mascot	Melbourne	Mildura	Perth	Richmond(WSyd)
R3.5 (polyester)	$10.74	$13.31	$13.31	$10.74	$13.31	$13.31
DS foil underfloor joinsts	$4.89	$4.89	$4.89	$4.89	$4.89	$4.89
Subfloor walls	$-					
	$-	$-	$-	$-	$-	$-
R1.0 (polystyrene board)	$29.75	$21.25	$21.25	$22.31	$21.25	$21.25
R1.5 (polystyrene board)	$38.15	$27.25	$27.25	$28.61	$27.25	$27.25
R2.0 (polystyrene board)	$46.55	$33.25	$33.25	$34.91	$33.25	$33.25
Floor coverings						
CSOG: Carpet	$122.64	$92.50	$86.30	$90.62	$88.50	$92.50
CSOG: Ceramic tile	$176.40	$115.50	$108.00	$113.40	$89.40	$115.50
	$53.76	$23.00	$21.70	$22.79	$0.90	$23.00
Ceiling fans (diameter mm)						
900	$294.00	$210.00	$210.00	$220.50	$210.00	$210.00
1200	$336.00	$240.00	$240.00	$252.00	$240.00	$240.00
1400	$378.00	$240.00	$270.00	$283.50	$270.00	$270.00
Windows						
Glazing Type						
Clear	$409.47	$275.34	$275.34	$292.11	$275.34	$275.34
Low e	$500.89	$340.64	$340.64	$360.67	$340.64	$340.64
Tint	$448.89	$303.50	$303.50	$321.67	$303.50	$303.50
Tint Heavy	$478.73	$324.81	$324.81	$344.05	$324.81	$324.81
Low e tint	$530.73	$361.95	$361.95	$383.04	$361.95	$361.95
Double low e argon filled	$677.39	$466.70	$466.70	$493.04	$466.70	$466.70
OPENABILITY						
Louvre windows (2100 high)	$606.07	$471.94	$471.94	$488.71	$471.94	$471.94
	$645.49	$500.10	$500.10	$518.27	$500.10	$500.10
	$655.49	$510.10	$510.10	$528.27	$510.10	$510.10

Key specifications	Location					
Ceiling Insulation	Longreach	Mascot	Melbourne	Mildura	Perth	Richmond(WSyd)
	$671.07	$536.94	$536.94	$553.71	$536.94	$536.94
	$686.07	$551.94	$551.94	$568.71	$551.94	$551.94
Stacker door (vs sliding)	$85.40	$46.00	$30.00	$31.50	$39.00	$46.00
SHADING						
External Blinds	$364.00	$260.00	$260.00	$273.00	$260.00	$260.00
Adjustable cover over pergola (not inc perg)	$-			$-		

10.1 Window unit costs Class 2

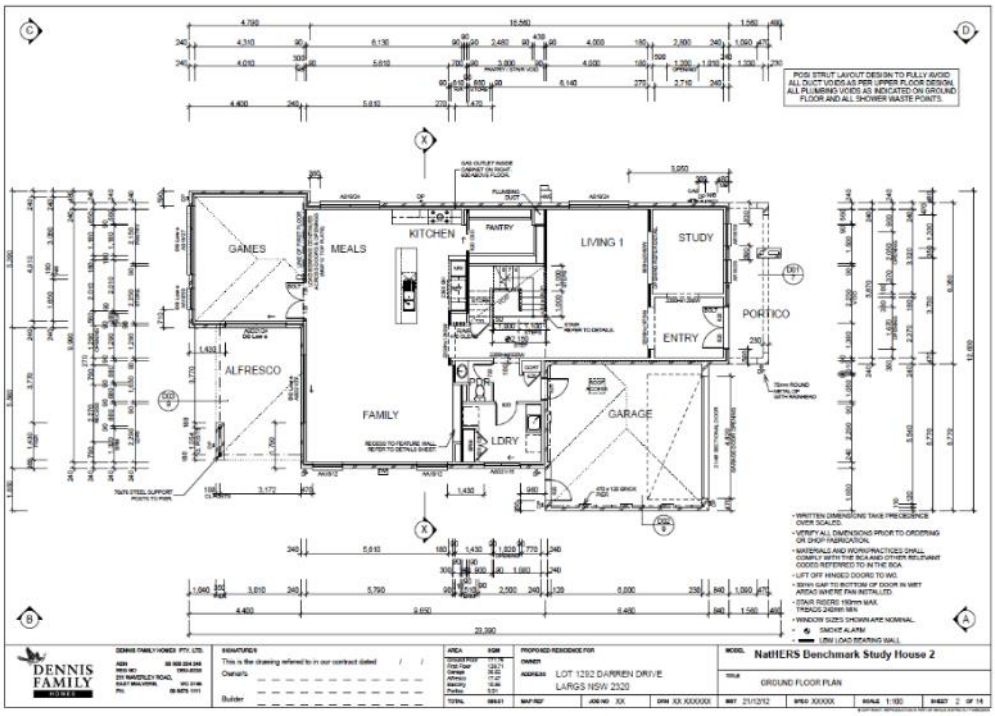
	Adelaide	Brisbane	Cairns	Canberra	Darwin	Hobart	Longreach
Windows			$-		$-		
Glazing Type			$-		$-		
Clear	v	$378.55	$408.55	$378.55	$442.83	$378.55	$549.97
Low e	$436.33	$436.33	$470.38	$436.33	$509.28	$436.33	$630.87
Tint	$407.35	$407.35	$439.36	$407.35	$475.95	$407.35	$590.29
Tint Heavy	$436.87	$436.87	$470.95	$436.87	$509.90	$436.87	$631.62
Low e tint	$488.33	$488.33	$526.01	$488.33	$569.08	$488.33	$703.66
Double low e argon filled	$583.41	$583.41	$627.75	$583.41	$678.42	$583.41	$836.77

	Mascot	Melbourne	Mildura	Perth	Richmond (W Syd)	Thredbo	Tullamarine
Windows							
Glazing Type							
Clear	$378.55	$378.55	$399.98	$378.55	$378.55	$485.69	$428.55
Low e	$436.33	$436.33	$460.65	$436.33	$436.33	$557.92	$486.33
Tint	$407.35	$407.35	$430.22	$407.35	$407.35	$521.69	$457.35
Tint Heavy	$436.87	$436.87	$461.22	$436.87	$436.87	$558.59	$486.87
Low e tint	$488.33	$488.33	$515.25	$488.33	$488.33	$622.91	$538.33
Double low e argon filled	$583.41	$583.41	$615.08	$583.41	$583.41	$741.76	$633.41

11 Appendix 2: Dwelling Plans

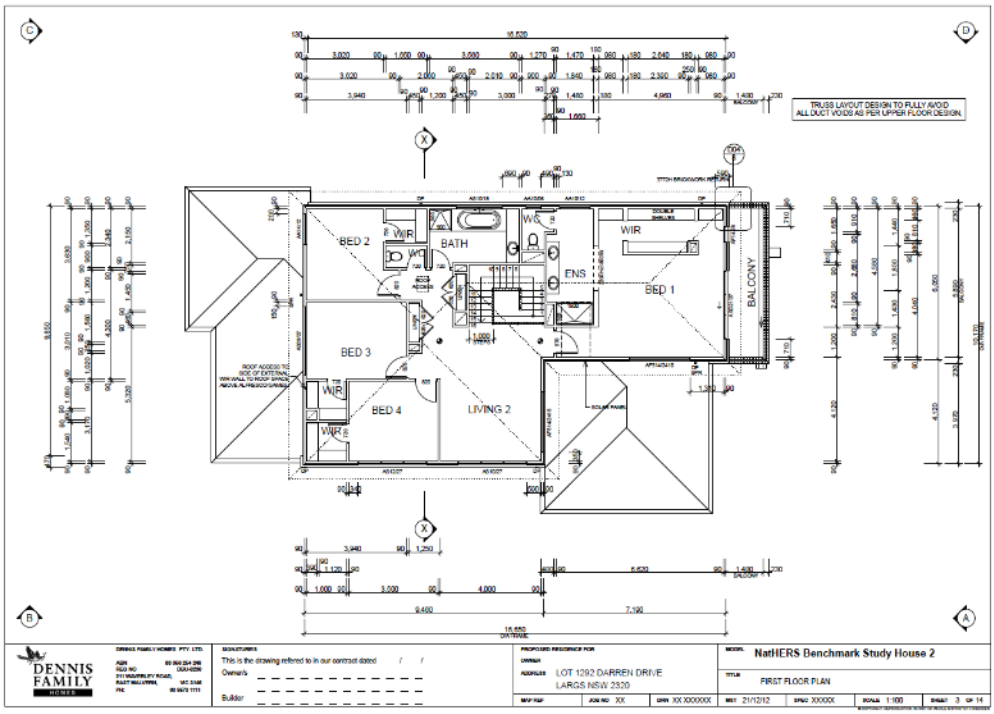
SBH01 Large detached 2 storey, NatHERS Benchmark study House No. 2

Ground Floor

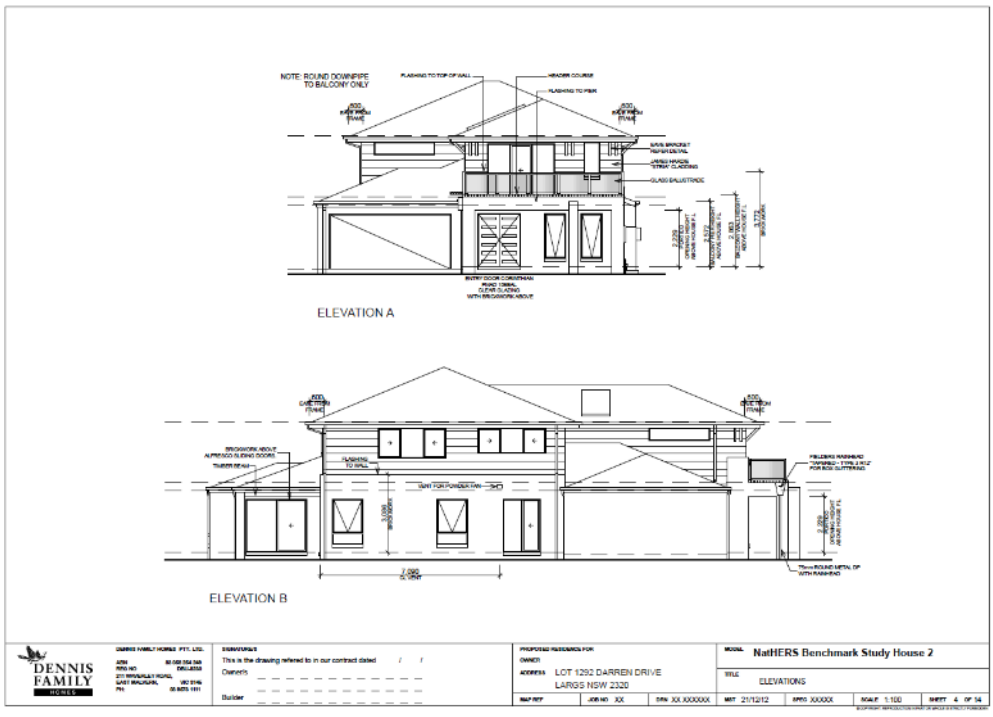


Source: Dennis Family

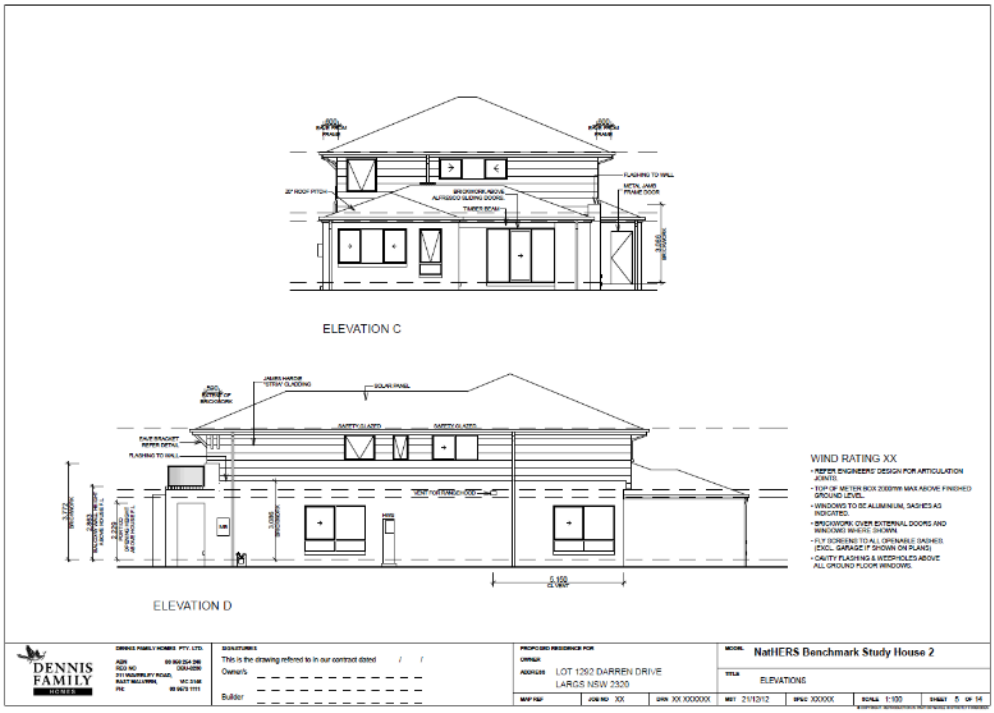
Upper floor



Elevations



Source: Dennis Family



Source: Dennis Family

SBH02 Large detached, 1 storey

View from Street

Plan

Source: The plans and specifications for this indicative house design used have been kindly provided by Henley Homes to assist with the consultation process on the draft NCC 2022 changes.

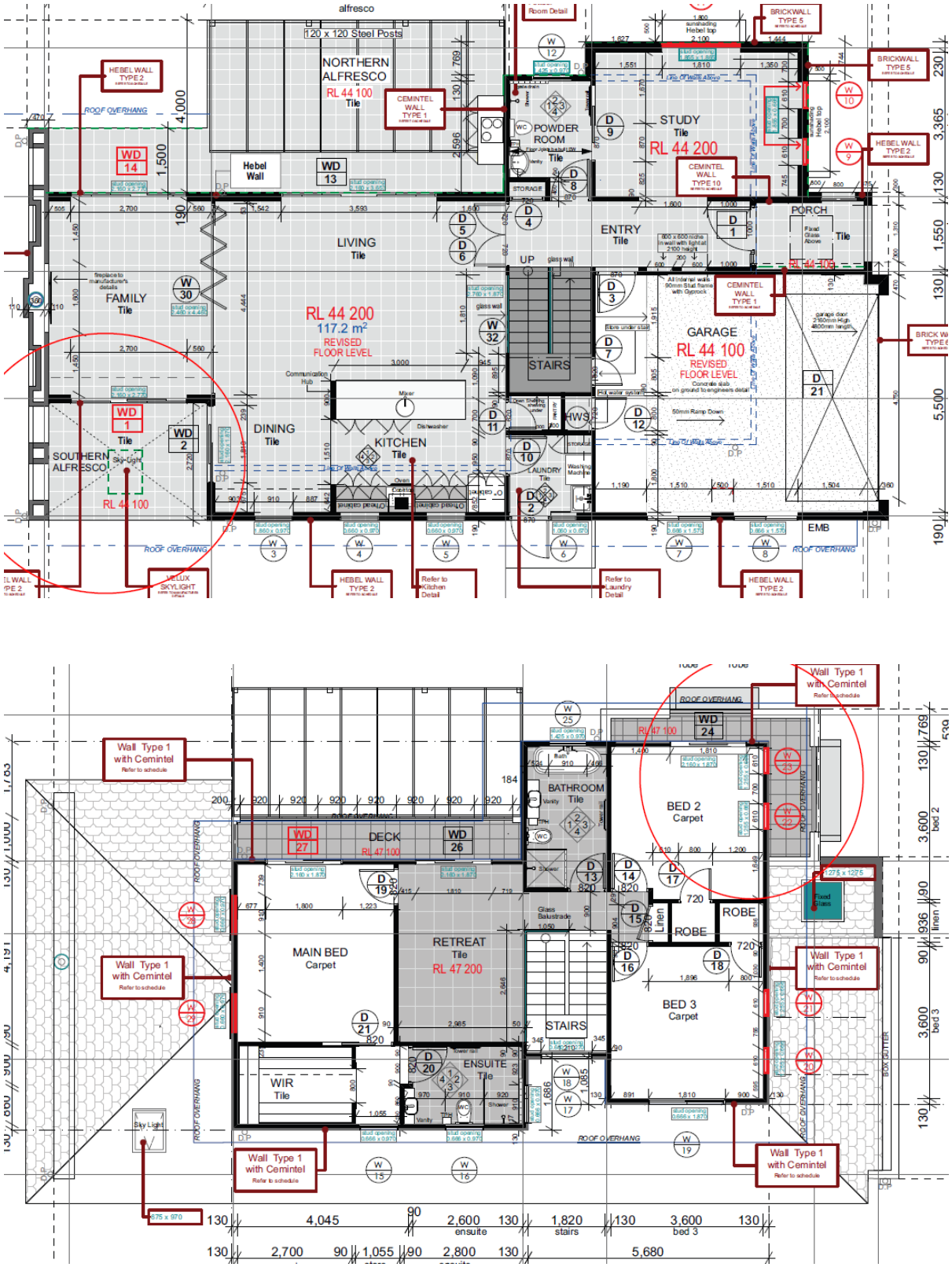
SBH03 Medium Detached, 2 storey

View from street

Double story design the lower level comprising double garage, entry hall, study, powder room, laundry open plan kitchen/living/dining and family room, upper level of parents retreat, master bedroom with an attached WIR and ensuite, bathroom and 2 bedrooms.

Total floor area of 241.2m^2. Net conditioned floor area 162.0 m^2

Source: CSR


alfresco
120 x 120 Steel Posts
NORTHERN ALFRESCO
RL 44 100
Tile
HEBEL WALL TYPE 2
ROOF OVERHANG
CEMINTEL WALL TYPE 1
Hebel Wall
WD 14
WD 13
POWDER ROOM
Tile
STUDY
Tile
RL 44 200
CEMINTEL WALL TYPE 10
BRICKWALL TYPE 5
HEBEL WALL TYPE 2
STORAGE
ENTRY
Tile
PORCH
Tile
LIVING
Tile
FAMILY
Tile
RL 44 200
117.2 m²
REVISED FLOOR LEVEL
UP
STAIRS
GARAGE
RL 44 100
REVISED FLOOR LEVEL
DINING
Tile
KITCHEN
Tile
HWS
LAUNDRY
Tile
SOUTHERN ALFRESCO
Sky Light
RL 44 100
EMB
ROOF OVERHANG
VELUX SKYLIGHT
Refer to Kitchen Detail
Refer to Laundry Detail
Wall Type 1 with Cemintel
Refer to schedule
ROOF OVERHANG
WD 24
RL 47 100
BATHROOM
Tile
BED 2
Carpet
DECK
WD 27
WD 26
RL 47 100
MAIN BED
Carpet
RETREAT
Tile
RL 47 200
STAIRS
ENSUITE
Tile
WIR
Tile
ROBE
ROBE
BED 3
Carpet
Sky Light
Wall Type 1 with Cemintel
Refer to schedule
4,045
2,600
ensuite
1,820
stairs
3,600
bed 3
2,700
1,055
2,800
5,680

Source: CSR

SBH04 Medium Detached, 1 storey

View from Street

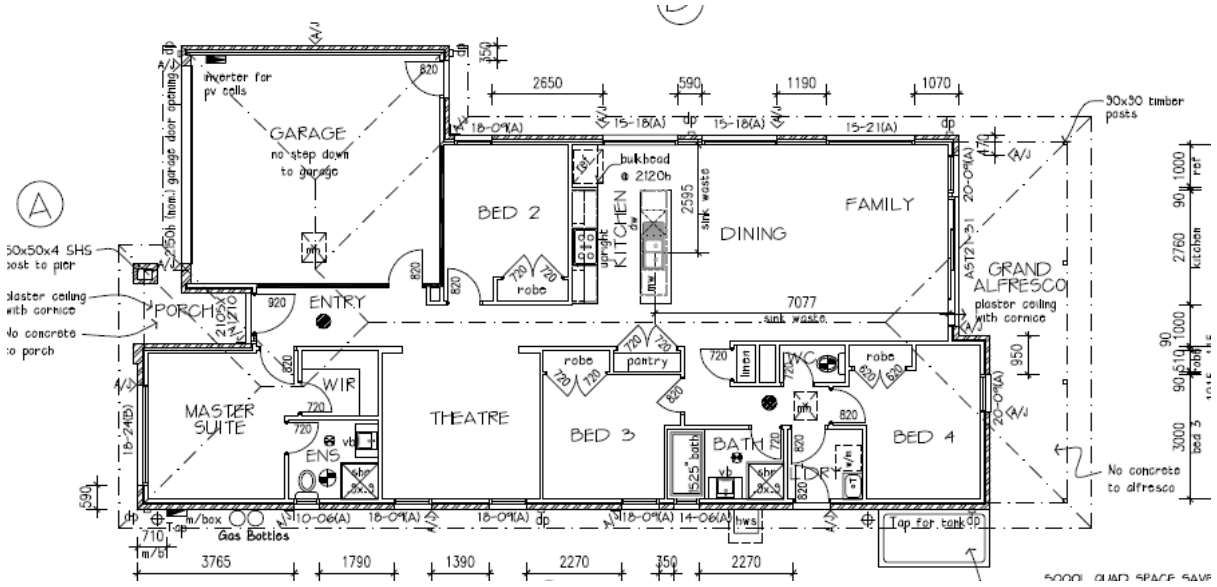
Single storey residence. Consisting of Master bedroom with ensuite and WIR, Bed 2, 3 and 4, Bath, laundry, WC, 2 circulation areas, Kitchen/living/family area, home theatre and double garage.

External alfresco area

Floor area 188.40 m^2. Conditioned floor area of 122.9 m^2

Source: The plans and specifications for this indicative house design used have been kindly provided by Henley Homes to assist with the consultation process on the draft NCC 2022 changes.

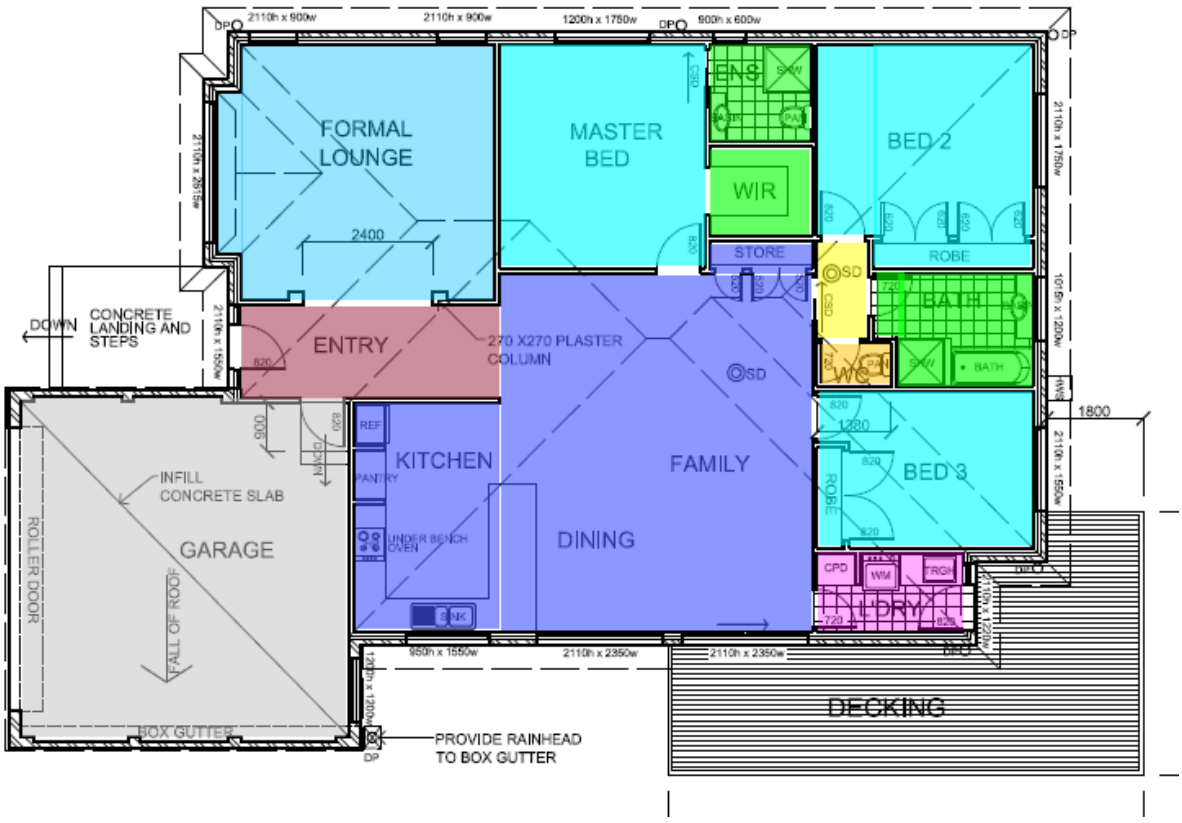
Floor Plan

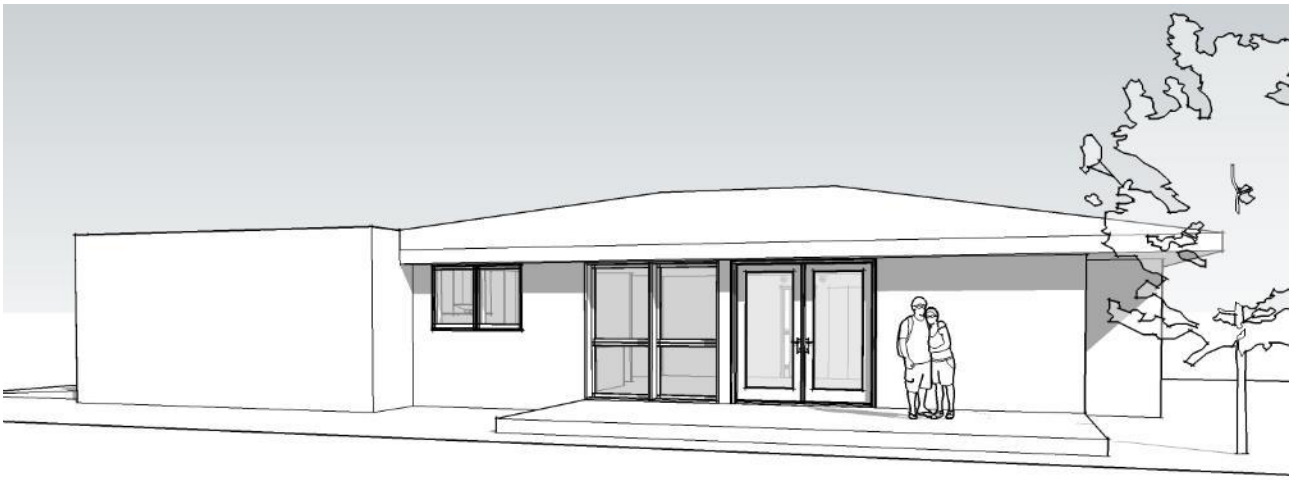


Source: The plans and specifications for this indicative house design used have been kindly provided by Henley Homes to assist with the consultation process on the draft NCC 2022 changes.

SBH05 Small Detached A, small house

Floor Plan



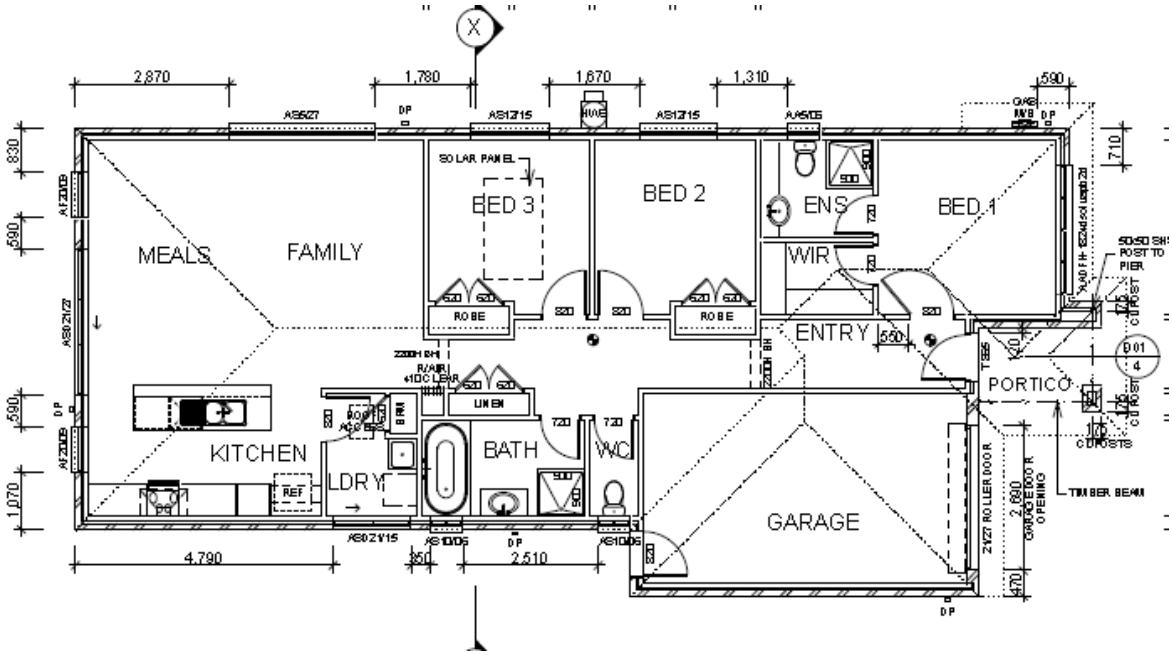


Source: This dwelling plan and specifications for this indicative house design have been kindly provided to ABCB by the Housing Industry Association (HIA) to assist with the consultation process on the draft NCC 2022 changes.

SBH06 Small Detached B

View from Street

Floor Plan



Source: Dennis Family

SBH07 Medium elevated well-ventilated house, hot climate

Perspective

Floor Plan

SBH08 Small elevated well-ventilated house, hot climate,

Simplified roof design, based on Troppo Architects

Perspective

Upper Floor

SBH09 Medium Hybrid Passive Solar/Ventilated & SBH 11 Passive Solar Perspective

Floor Plan

SBH15 & 16, Medium Semi-detached House

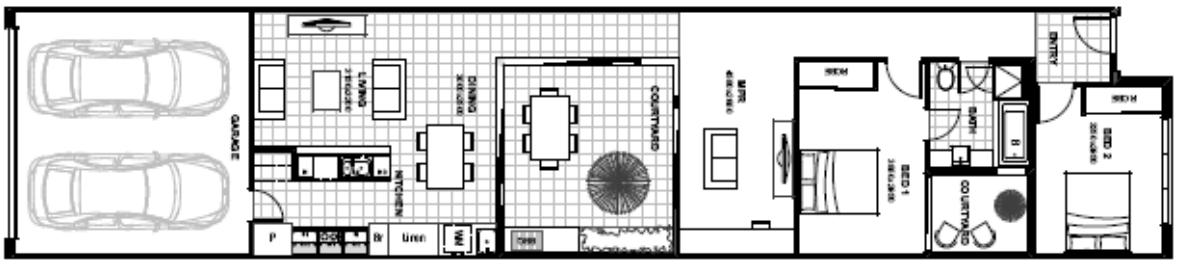
Configured so only 1 side with shared wall

View from Street

Medium density single storey terrace house, with neighbours on either side. Solar access to front elevation and 2 internal courtyards. The design has 2 bedrooms, bathroom, 2 internal hallways, Multi-purpose room, open plan living/dining/kitchen/laundry, garage with rear access.

Floor area 141.20 m^2. Conditioned floor area of 93.6 m^2

Floor Plan



Source: AV Jennings

SBH17 & 18 Small Semi-detached

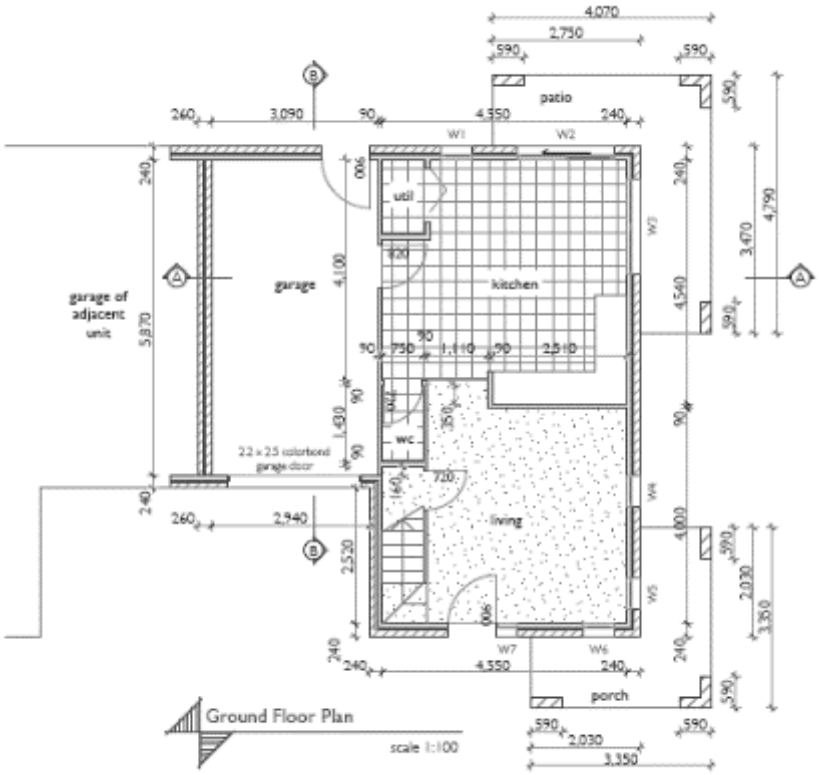
NatHERS software accreditation House 2

View from Street

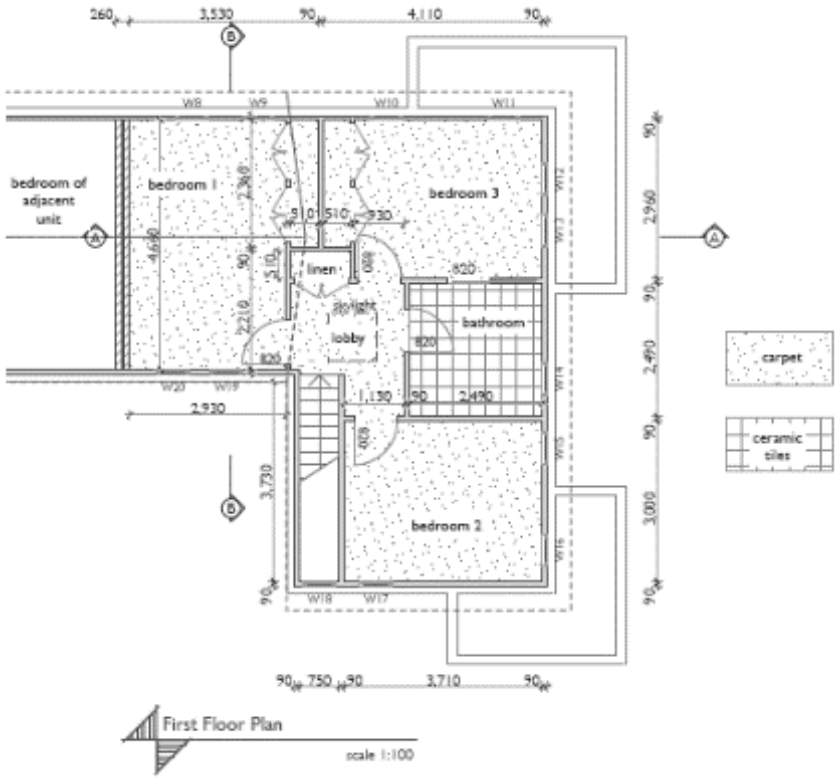
This design is NatHERS Software accreditation House 2. It is a double storey town house containing single garage, 3 bedrooms, living room, kitchen/ family, circulation area/hallway, separate WC, bath and laundry.

Total floor area of 95.5 m^2. Net conditioned floor area 81.1 m^2

Ground Floor Plan

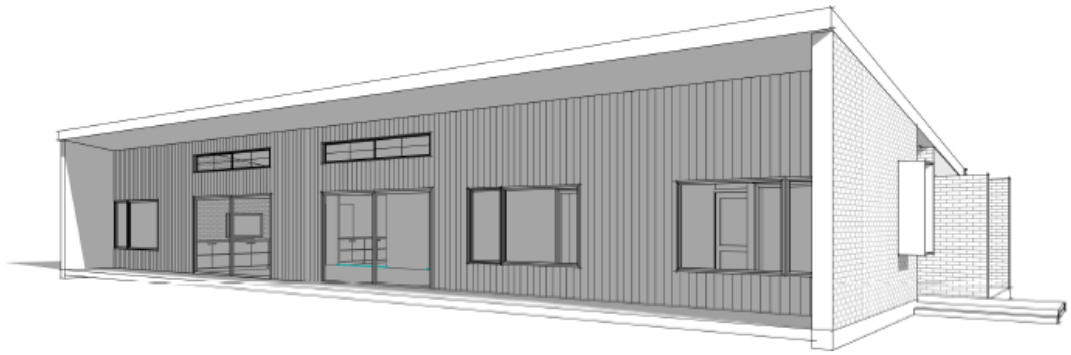


Upper Floor Plan

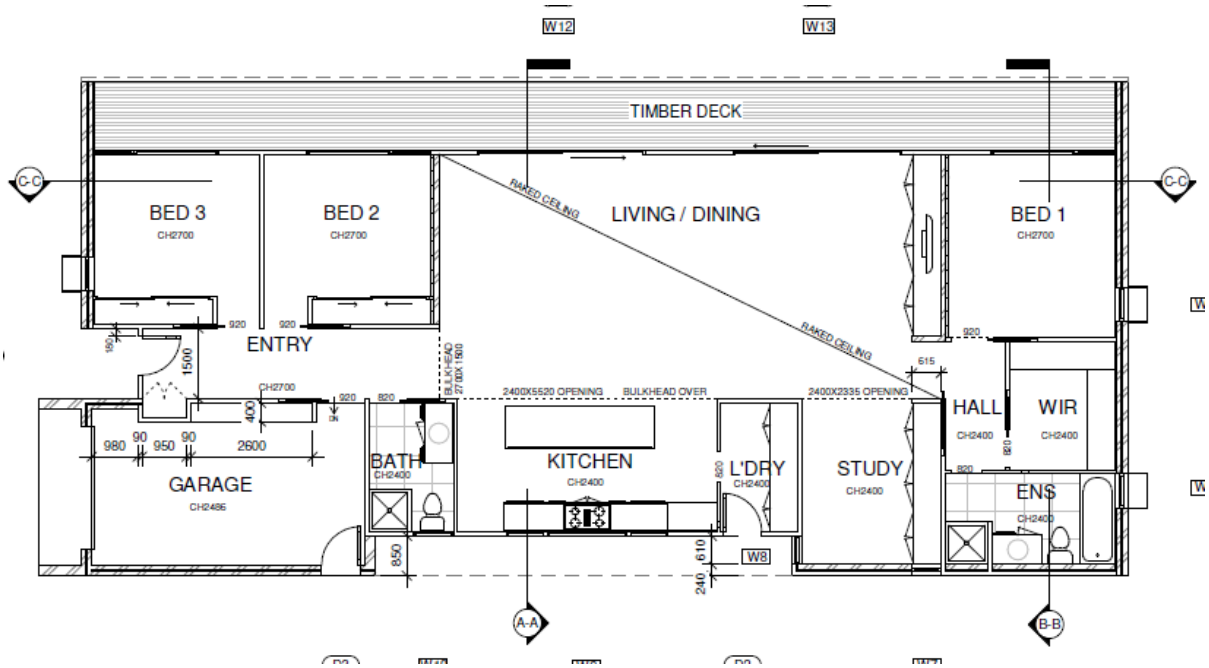


SBH19 Passive Solar, Design for Place

View from north



Plan

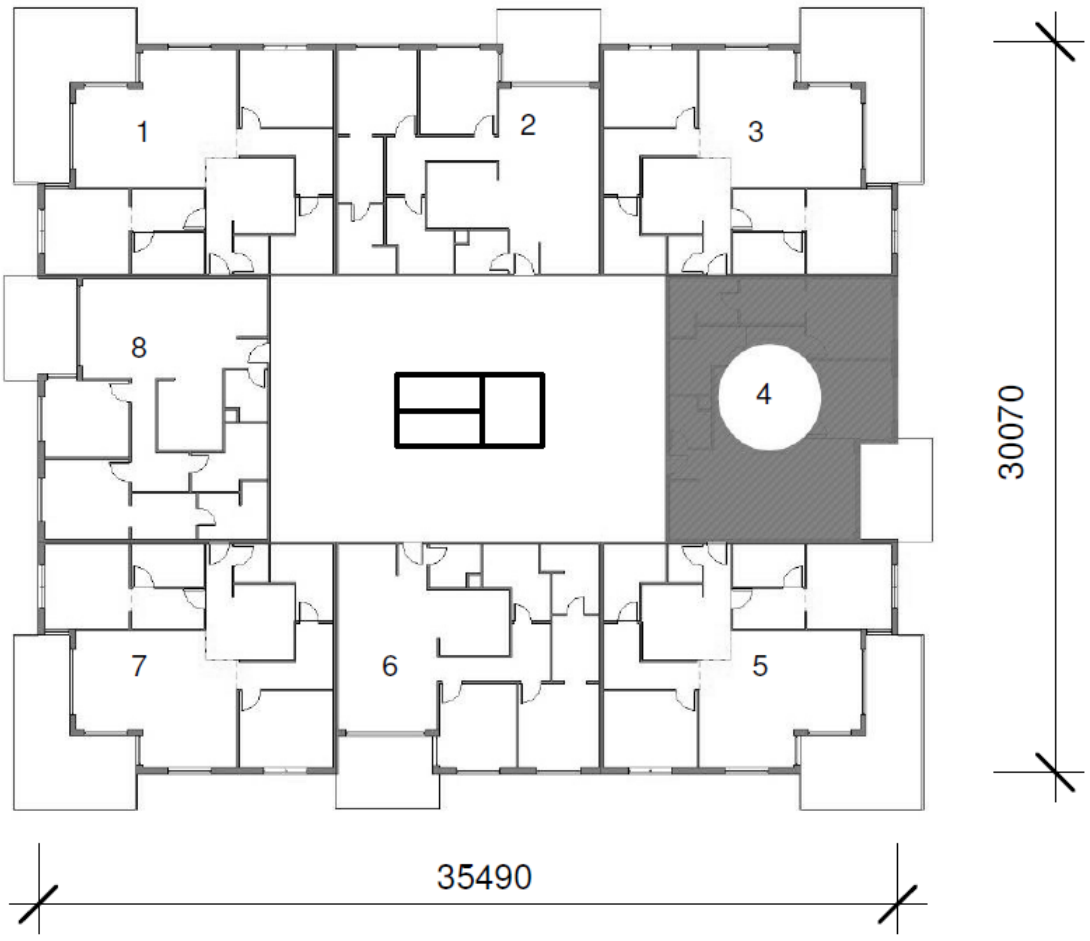


SBA01-28 Apartments

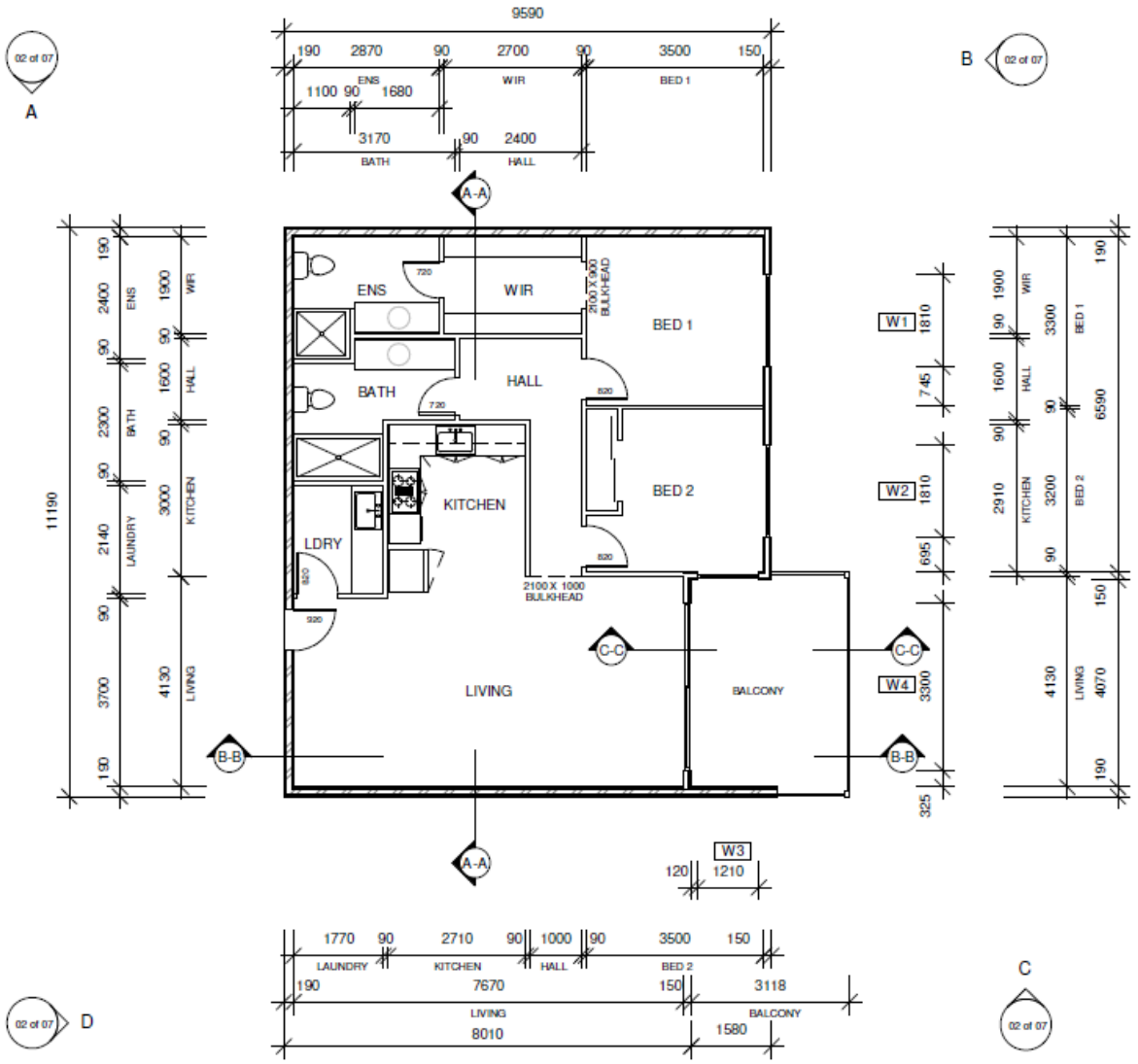
Perspective

ɔM UNIT

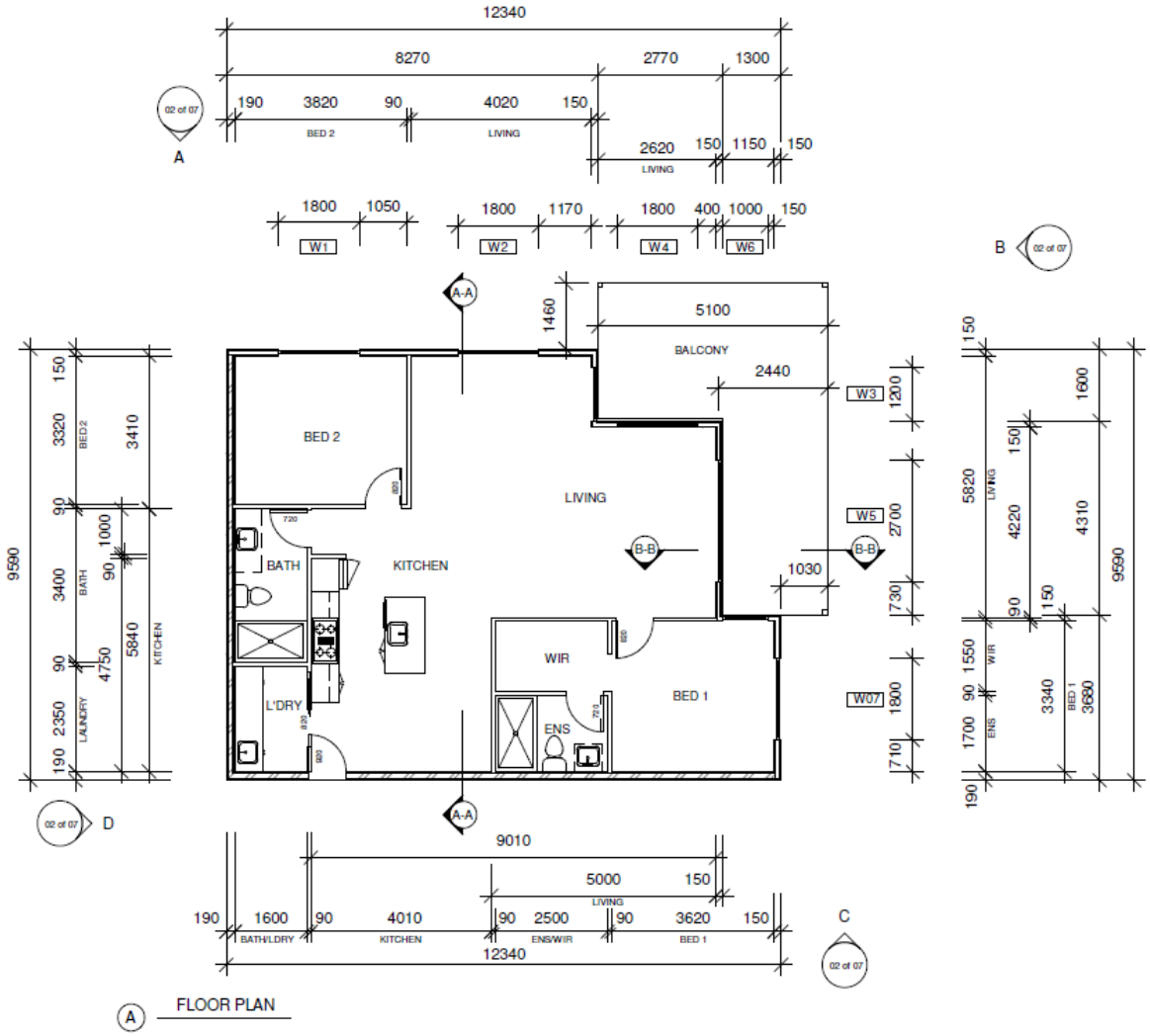
Floor plate



Middle Unit Plan

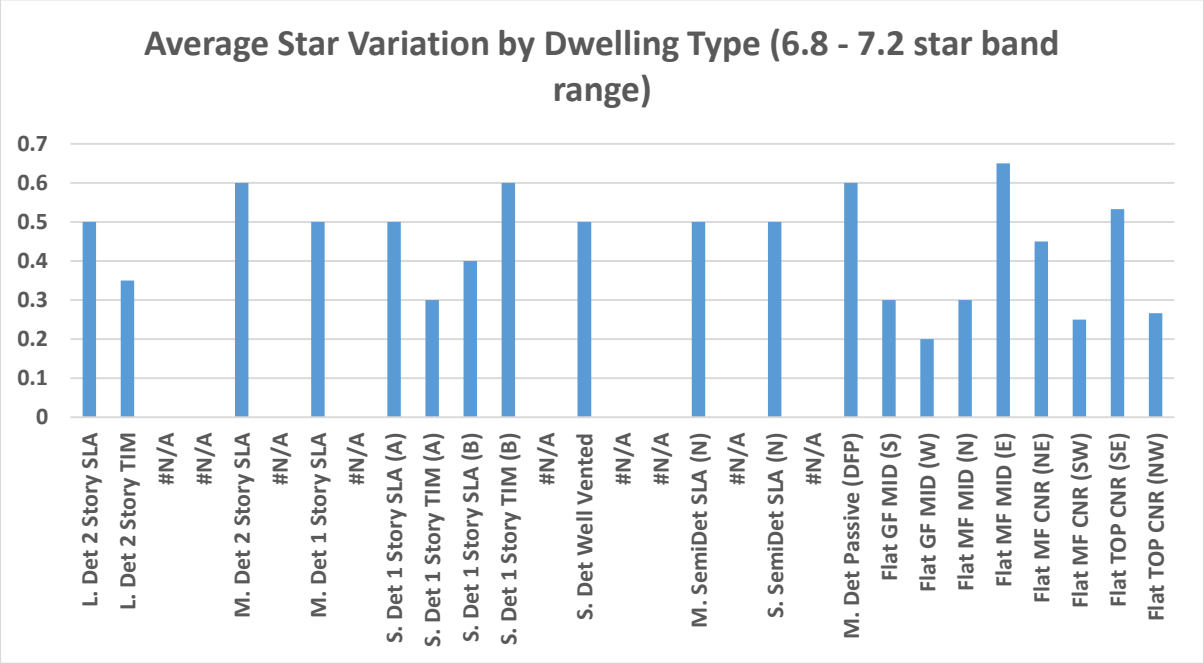


Corner Unit Plan

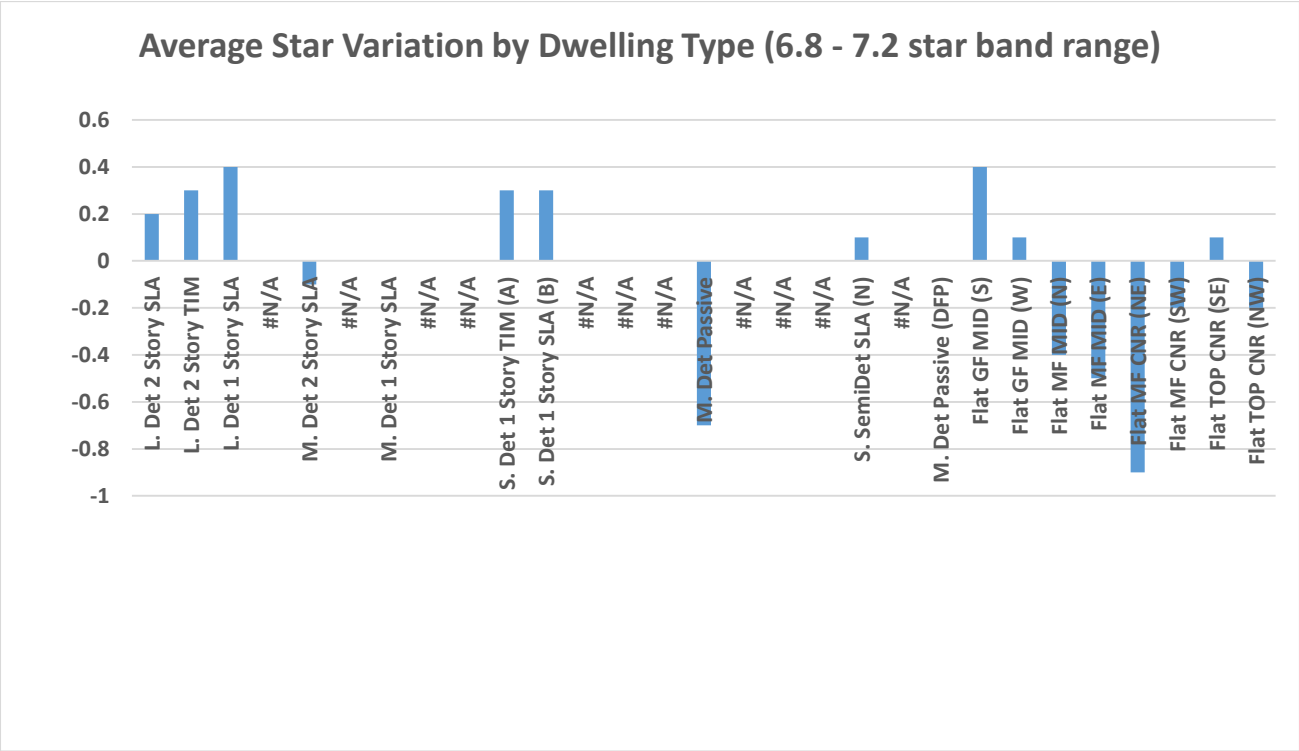


12 Appendix 3 Impact of new weather data on ratings at 7-stars

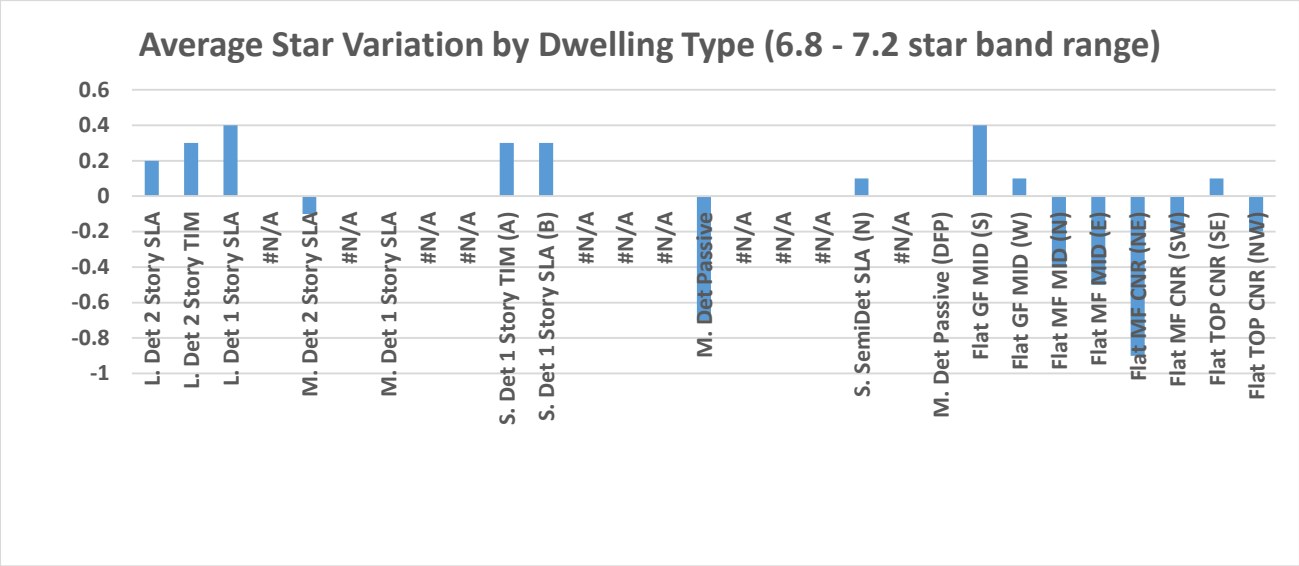
12.1 NCC Climate Zone 1: Darwin



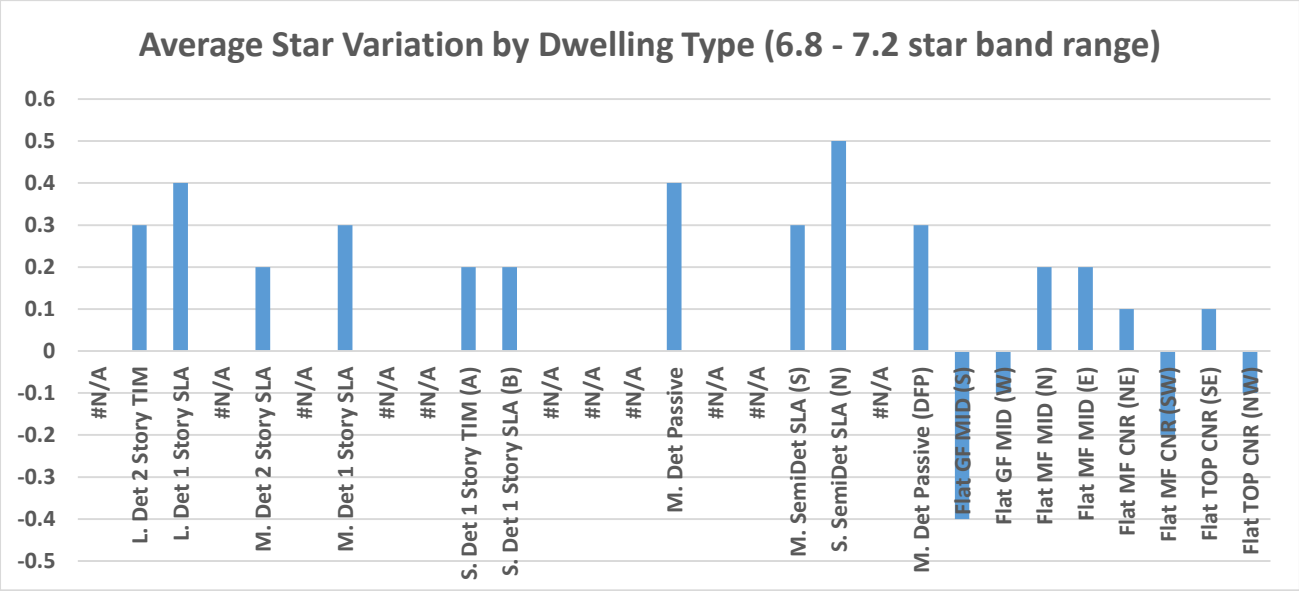
12.2 NCC Climate Zone 1: Cairns



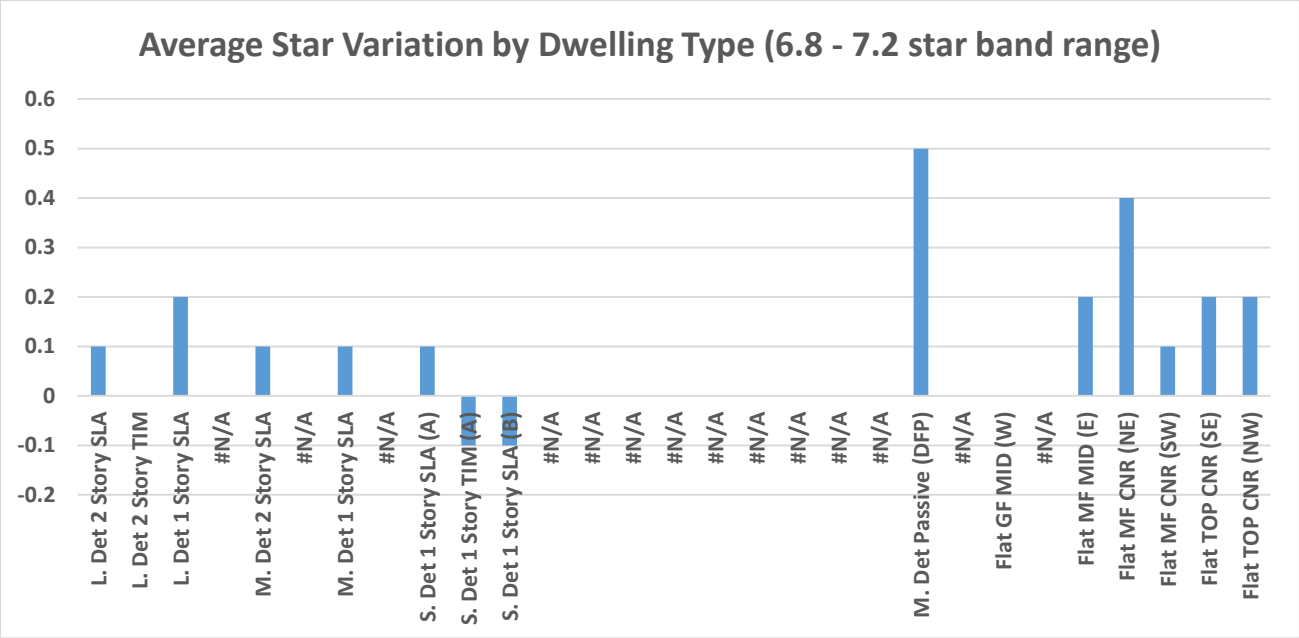
12.3 NCC Climate Zone 2: Brisbane



12.4 NCC Climate Zone 3: Longreach

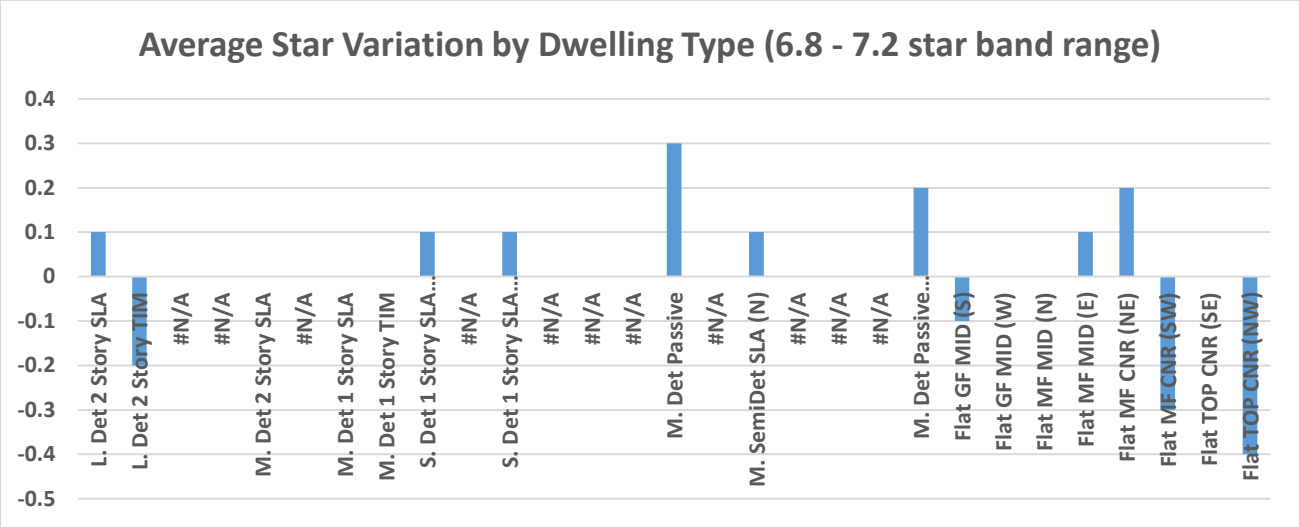


12.5 NCC Climate Zone 4: Mildura

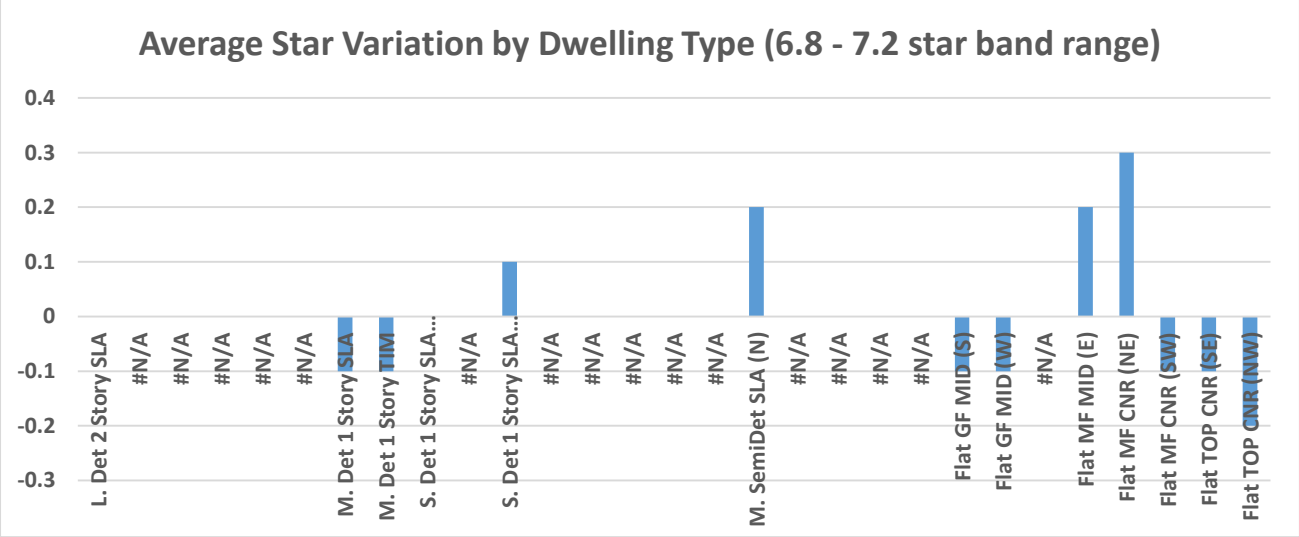


12.6 NCC Climate Zone 5: Sydney

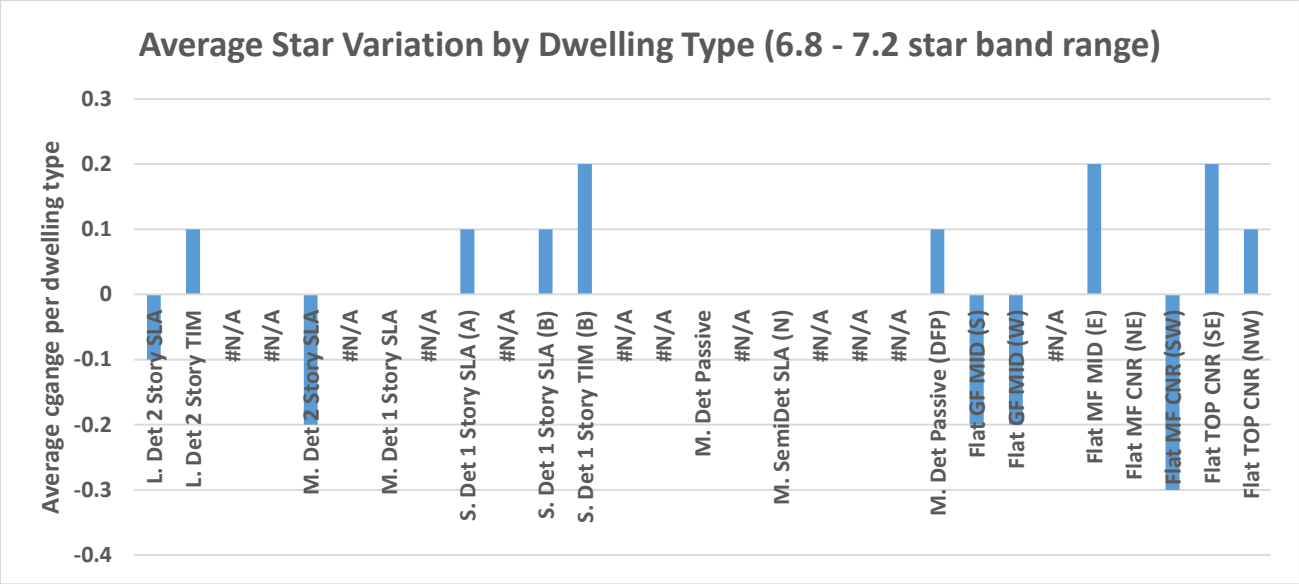
12.6.1 Mascot (used for Class 2)



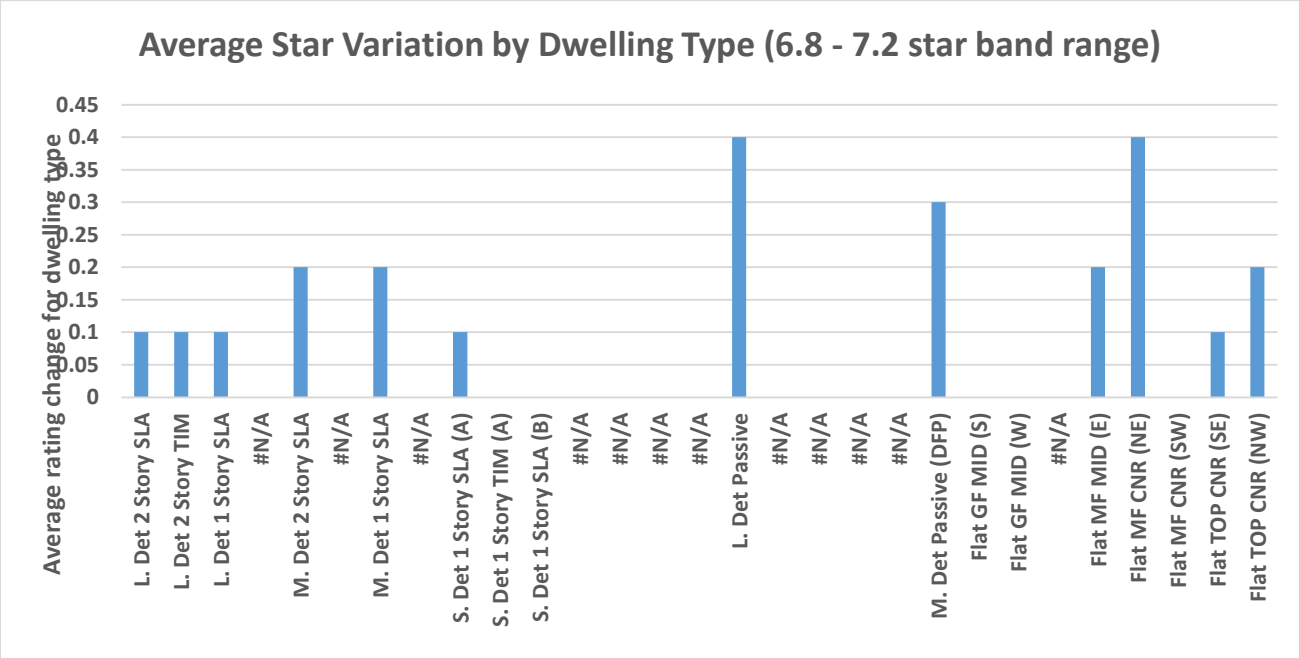
12.6.2 Richmond (West Sydney, used for Class 1)



12.7 NCC Climate Zone 5: Perth

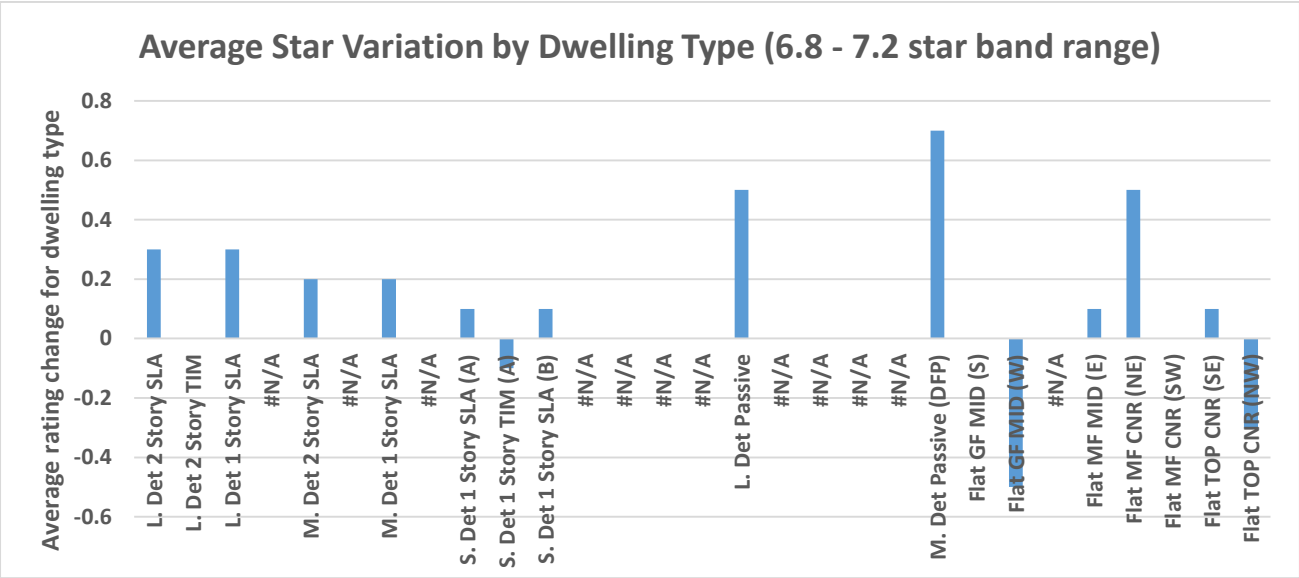


12.8 NCC Climate Zone 5: Adelaide

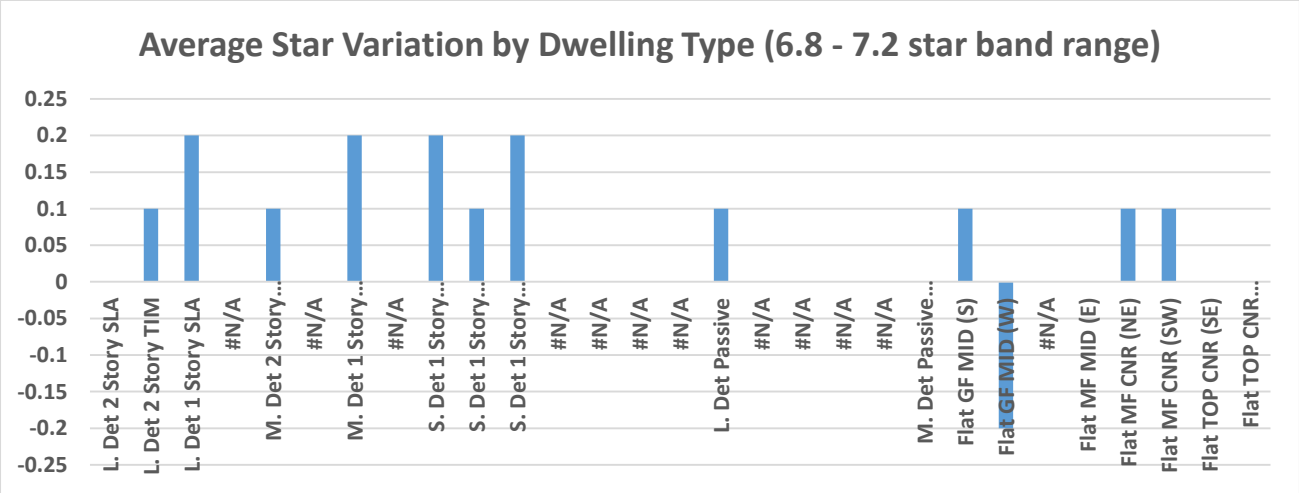


12.9 NCC Climate Zone 6: Melbourne

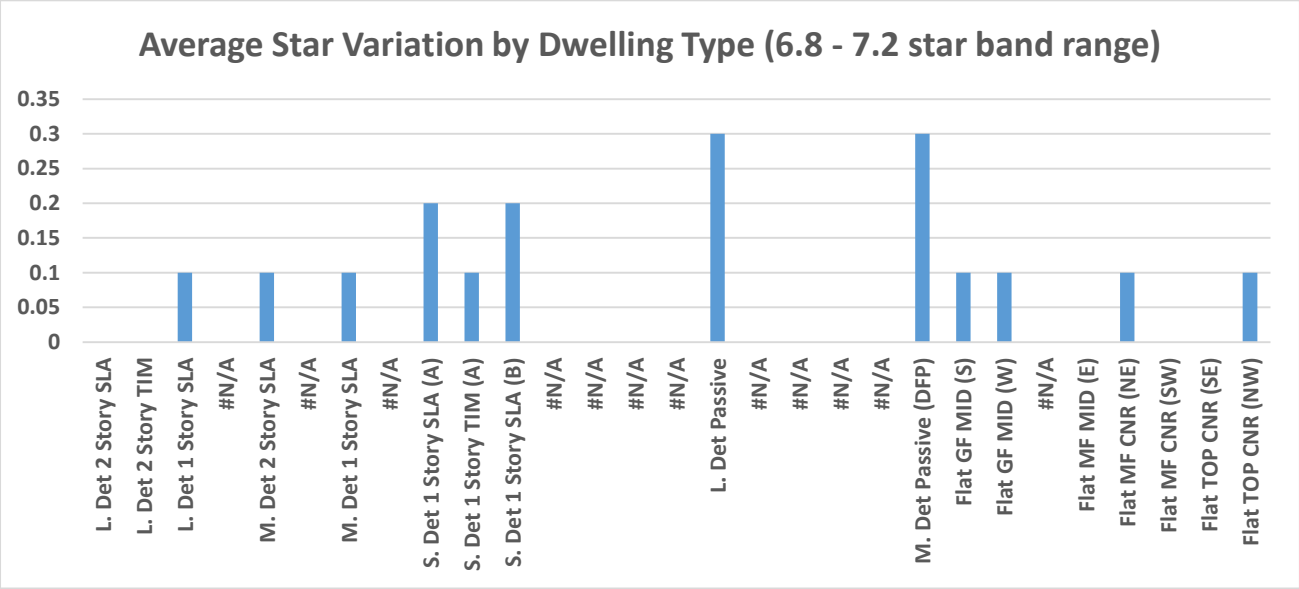
12.9.1 Melbourne (Central used for Class 2)



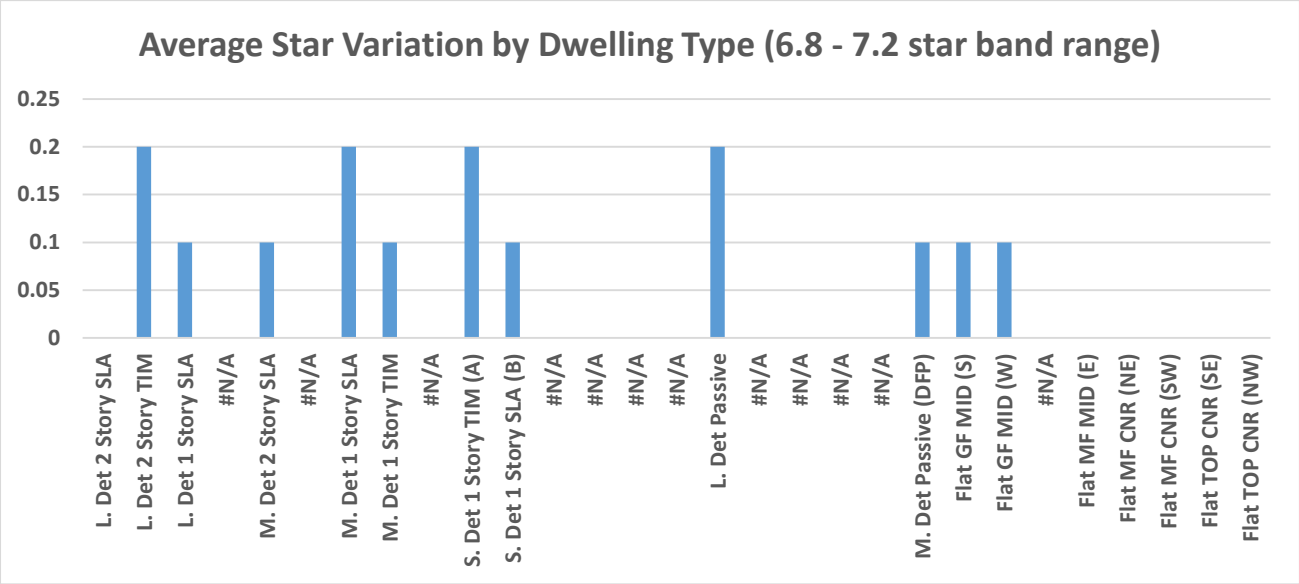
12.9.2 Tullamarine (used for Class 1)



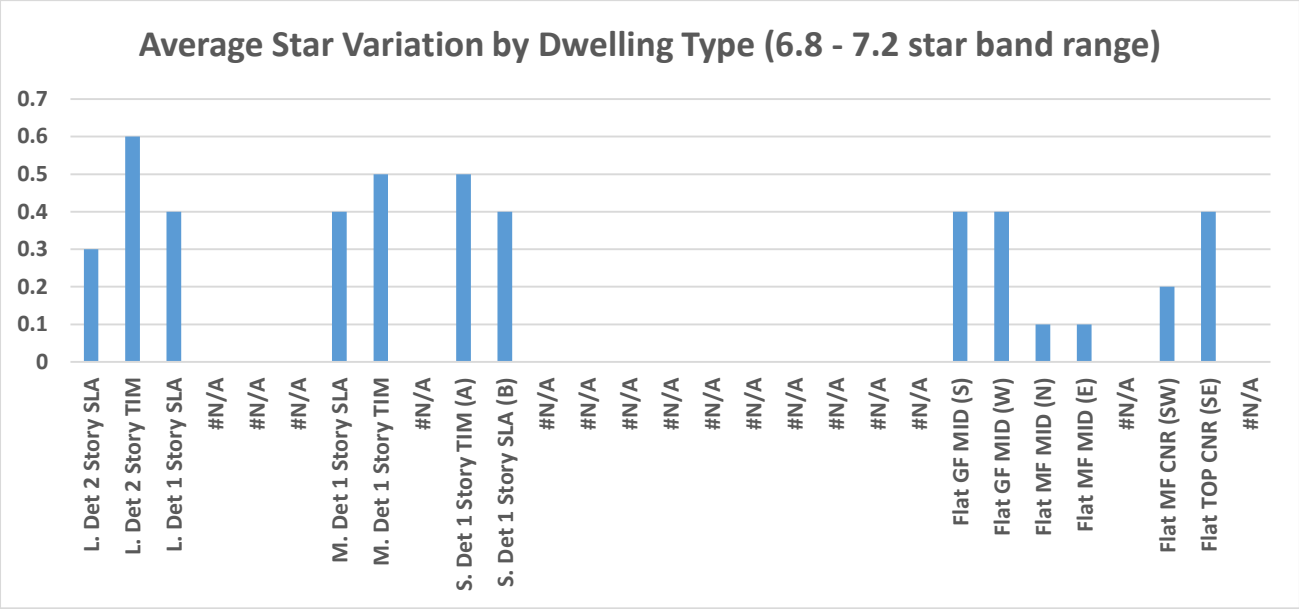
12.10 NCC Climate Zone 7: Canberra



12.11 NCC Climate Zone 7: Hobart



12.12 NCC Climate Zone 8: Thredbo



13 Appendix 4 Detailed changes to design and specification of Class 1 dwelling to improve from 6 to 7 stars

13.1 NCC Climate Zone 1: Darwin and Cairns

13.1.1 Darwin

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	No change R4	No change R0	From R2.5 to R3	From R2.5 to R3
Area ceiling 1	From 58.7 to 184.4	From 201.9 to 33.2	No change	No change
R-value ceiling 2	No change R3	From R3.5 to R3	No change R0	No change R0
Area ceiling 2	From 143.2 to 17.5	From 0 to 168.7	No change	No change
Area roof insulated	No change	No change	No change	No change
R-value roof blanket	No change R0	No change R0	No change R0	No change R0
R-value ceiling Flat	No change R0	No change R0	No change R0	No change R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: Y	No change: Y
Roof colour	No change: 0.3	From 0.7 to 0.3	No change: 0.3	No change: 0.3
External Walls				
R-value walls	From R1 to R1.5	No change R0	No change R0	No change R0
Area walls insulated	From 41.9 to 59.1	No change	No change	No change
Area walls uninsulated	From 223.5 to 206.3	From 292.9 to 262.9	No change	No change
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.3	From 0.85 to 0.3	From 0.5 to 0.3	No change: 0.5
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change	No change	No change	No change
Floors				
Area floor insulated	No change	No change	No change	No change
R-value floor	No change R0	No change R0	No change R0	No change R0
Foil underfloor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change R0	From R0 to R1	No change R0	No change R0

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Area subfloor walls insulated	No change	From 0 to 30	From 31.9 to 0	No change
Area ceramic tile floor surface	No change	From 29.4 to 69.9	From 106.7 to 91.7	From 106.7 to 42.8
Ceiling fans				
No. 900	From 4 to 0	No change	No change	No change
No. 1200	From 9 to 3	From 0 to 5	From 7 to 3	From 7 to 3
No. 1400	From 0 to 11	From 0 to 10	From 0 to 5	From 0 to 5
Windows				
Area single glazed clear	From 23.7 to 5.4	From 63.5 to 5.4	From 23.1 to 35.6	From 23.1 to 29.3
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	From 7.6 to 5.1	From 7.6 to 0
Area single glazed heavy tinted	From 0 to 44.9	From 0 to 42.9	No change	From 0 to 11.4
Area single low e tint	From 29.5 to 0	No change	From 12.6 to 0	From 12.6 to 0
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 53.1 to 50.3	From 63.5 to 48.3	From 43.2 to 40.6	From 43.2 to 40.6
Frame colour (abs)	No change: 0.3	From 0.5 to 0.3	From 0.5 to 0.3	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	No change R3	No change R3	No change R2	No change R1
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change R0	No change R0	No change R0	No change R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated	No change	No change	No change	No change
R-value roof blanket	No change R0	No change R0	No change R0	No change R0
R-value ceiling Flat	No change R2	No change R2	No change R0	No change R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: Y	No change: Y	No change: N	No change: N
Roof colour	No change: 0.3	No change: 0.3	No change: 0.3	No change: 0.3
External Walls				
R-value walls	No change R0	No change R0	No change R0	No change R0
Area walls insulated	No change	No change	No change	No change
Area walls uninsulated	No change	No change	No change	No change
Foil layer walls	No change	No change	No change	No change
Wall colour	From 0.3 to 0.37	From 0.27 to 0.36	From 0.4 to 0.3	No change: 0.3
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change	No change	No change	No change
Floors				
Area floor insulated	No change	No change	No change	No change
R-value floor	No change R0	No change R0	No change R0	No change R0
Foil underfloor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change R0	No change R1	No change R0	No change R1
Area subfloor walls insulated	No change	No change	No change	No change
Area ceramic tile floor surface	No change	No change	No change	No change
Ceiling fans				
No. 900	No change	No change	From 1 to 5	No change
No. 1200	No change	No change	From 2 to 0	From 7 to 4
No. 1400	No change	No change	From 0 to 1	From 0 to 3

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Windows				
Area single glazed clear	From 47.9 to 42.5	From 32.1 to 18.4	No change	From 29.4 to 14.5
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	From 0 to 12.2
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	From 15.8 to 24.1	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 51.8 to 49.1	From 51.8 to 49.1	No change	From 29.4 to 26.7
Frame colour (abs)	No change: 0.23	No change: 0.26	From 0.5 to 0.3	No change: 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	From 0.7 to 6.6	From 0.7 to 6.6	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	From 3.2 to 0	From 3.2 to 0	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R2 to R3	From R2 to R3	From R1 to R3	From R2 to R3
Area ceiling 1	No change	No change	From 52.7 to 101.1	No change
R-value ceiling 2	No change R0	No change R0	No change R0	No change R0
Area ceiling 2	No change	No change	From 69.6 to 21.2	No change
Area roof insulated	No change	No change	No change	No change
R-value roof blanket	No change R0	No change R0	No change R0	No change R0
R-value ceiling Flat	No change R0	No change R0	No change R0	No change R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: Y	No change: Y
Roof colour	No change: 0.3	No change: 0.3	No change: 0.3	No change: 0.3
External Walls				
R-value walls	From R0 to R1	From R0 to R1	No change R0	No change R0
Area walls insulated	From 0 to 20.1	From 0 to 11	No change	No change
Area walls uninsulated	From 104.4 to 84.3	From 147 to 136	No change	No change
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.3	No change: 0.3	From 0.45 to 0.3	From 0.3 to 0.3
Internal Walls				
R-value	No change: R1.5	No change: R1.5	From 1.5 to 0	No change: R0
Insulated area	No change	No change	From 15 to 0	No change
Floors				
Area floor insulated	No change	No change	No change	No change
R-value floor	No change R0	No change R0	No change R0	No change R0
Foil underfloor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change R0	No change R0	No change R0	No change R0
Area subfloor walls insulated	No change	No change	No change	No change
Area ceramic tile floor surface	No change	No change	No change	No change
Ceiling fans				
No. 900	From 3 to 0	From 3 to 0	No change	From 2 to 0
No. 1200	From 4 to 3	From 4 to 3	From 1 to 3	No change
No. 1400	From 0 to 4	From 0 to 4	From 0 to 4	From 0 to 3

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Windows				
Area single glazed clear	From 32.7 to 28.8	From 17.4 to 7.4	From 20.6 to 19.2	From 20.6 to 6.4
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	From 0 to 14.2
Area single low e tint	No change	From 15.3 to 21.3	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 32.7 to 29.7	From 32.7 to 29.7	From 20.6 to 19.2	No change
Frame colour (abs)	From 0.5 to 0.3	From 0.5 to 0.3	From 0.5 to 0.3	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	From 0 to 0.9	From 0 to 0.9	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH08 and 15

Key specifications	SBH08 TIMBER	SBH15 SLAB	SBH15 TIMBER
Roof			
R-value ceiling 1	No change R4	No change R4	No change R4
Area ceiling 1	No change	From 116 to 56	No change
R-value ceiling 2	No change R0	No change R0	No change R0
Area ceiling 2	No change	No change	No change
Area roof insulated	No change	No change	No change
R-value roof blanket	No change R0	No change R0	No change R0
R-value ceiling Flat	No change R0	From 0 to 4	No change R4
Area roof insulated (Flat)	No change	From 0 to 37.6	No change
Area roof uninsulated (Flat)	No change	From 116 to 31.4	No change
Foil under roof?	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	From N to Y	From Y to N
Roof colour	No change: 0.3	From 0.3 to 0.3	No change: 0.26
External Walls			
R-value walls	No change R2	From R2 to R1	No change R1
Area walls insulated	No change	From 139.2 to 29.5	From 29.5 to 13.9
Area walls uninsulated	No change	From 61 to 84.1	From 84.1 to 90.5
Foil layer walls	No change	No change	No change
Wall colour	No change: 0.3	No change: 0.3	No change: 0.3
Internal Walls			
R-value	No change: R0	From 0 to 1	No change: R1
Insulated area	No change	From 0 to 15.6	No change
Floors			
Area floor insulated	No change	No change	No change
R-value floor	No change R0	No change R0	No change R0
Foil underfloor	No change: N	No change: N	No change: N
R-value subfloor walls	No change R0	No change R0	From 0 to 1
Area subfloor walls insulated	No change	No change	From 0 to 75.5
Area ceramic tile floor surface	No change	From 0 to 68.3	No change
Ceiling fans			
No. 900	No change	No change	No change
No. 1200	From 6 to 0	No change	No change
No. 1400	From 0 to 6	From 6 to 5	From 5 to 6

Key specifications	SBH08 TIMBER	SBH15 SLAB	SBH15 TIMBER
Windows			
Area single glazed clear	From 5 to 10.1	From 10.1 to 0.5	No change
Area single low e	No change	No change	No change
Area single glazed tinted	No change	No change	From 0 to 4.4
Area single glazed heavy tinted	No change	From 0 to 23.8	From 23.8 to 15.6
Area single low e tint	From 5 to 0	No change	No change
Area double glazed argon fill low e	No change	No change	No change
Total Window Area	No change	From 39.5 to 24.3	From 24.3 to 20.5
Frame colour (abs)	No change: 0.23	No change: 0.23	No change: 0.23
Area external Blinds	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	From 29.4 to 24.3	From 24.3 to 0	No change
Highly openable windows louvre tint	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	From 0 to 4.5
Highly openable windows louvre low e	No change	No change	No change
Highly openable windows louvre low e tint	From 0 to 5.1	From 5.1 to 0	No change

House SBH19

Key specifications	SBH19 SLAB	SBH19 TIMBER
Roof		
R-value ceiling 1	No change R3.5	No change R3.5
Area ceiling 1	No change	No change
R-value ceiling 2	No change R0	No change R0
Area ceiling 2	No change	No change
Area roof insulated	No change	No change
R-value roof blanket	No change R1.3	No change R1.3
R-value ceiling Flat	No change R3.5	No change R3.5
Area roof insulated (Flat)	No change	No change
Area roof uninsulated (Flat)	No change	No change
Foil under roof?	No change: Y	No change: Y
Ventilated roof?	No change: Y	No change: N
Roof colour	No change: 0.3	No change: 0.3
External Walls		
R-value walls	No change R2.5	No change R2.5
Area walls insulated	No change	No change
Area walls uninsulated	No change	No change
Foil layer walls	No change	No change
Wall colour	From 0.5 to 0.3	From 0.5 to 0.3
Internal Walls		
R-value	No change: R0	No change: R0
Insulated area	No change	No change
Floors		
Area floor insulated	No change	No change
R-value floor	No change R0	No change R0
Foil underfloor	No change: N	No change: N
R-value subfloor walls	No change R0	From 2.5 to 1
Area subfloor walls insulated	No change	No change
Area ceramic tile floor surface	No change	No change
Ceiling fans		
No. 900	From 2 to 0	From 2 to 0
No. 1200	From 0 to 3	From 1 to 2
No. 1400	From 3 to 4	From 2 to 4

Key specifications	SBH19 SLAB	SBH19 TIMBER
Windows		
Area single glazed clear	From 43.7 to 22.1	From 38.2 to 20.1
Area single low e	No change	No change
Area single glazed tinted	No change	No change
Area single glazed heavy tinted	From 0 to 21.6	From 0 to 17.6
Area single low e tint	No change	No change
Area double glazed argon fill low e	No change	No change
Total Window Area	No change	From 52.1 to 51.5
Frame colour (abs)	From 0.5 to 0.3	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0
Highly openable windows louvre	No change	From 13.9 to 5.9
Highly openable windows louvre tint	No change	No change
Highly openable windows louvre tint H	No change	From 0 to 7.8
Highly openable windows lovure low e	No change	No change
Highly openable windows louvre low e tint	No change	No change

13.1.2 Cairns

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	No change: R3	No change: R3	From R1 to R1.5	No change: R1.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R1	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	From 33.9 to 0	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: Y	No change: Y	No change: N	No change: N
Roof colour	No change: 0.3	No change: 0.3	From 0.5 to 0.4	No change: 0.5
External Walls				
R-value walls	From R2 to R0	No change: R0	No change: R0	No change: R0
Area walls insulated	No change: 0	No change: 0	No change: 0	No change: 0
Area walls uninsulated	From 233.1 to 230.1	No change: 230.07	No change: 159.14	No change: 159.14
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.3	From 0.4 to 0.3	No change: 0.5	From 0.5 to 0.4
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change: 0	No change: 0	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 30.01	No change: 0	No change: 40.75
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Ceiling fans				
No. 900	No change: 0	From 3 to 0	No change: 3	From 3 to 0
No. 1200	From 6 to 8	From 11 to 4	From 2 to 3	From 2 to 3
No. 1400	From 0 to 3	From 0 to 10	From 1 to 3	From 1 to 5
Windows				
Area single glazed clear	From 53.1 to 36.3	From 21 to 12.9	From 43.9 to 41.7	From 43.9 to 26.1
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	From 32.1 to 18.9	No change	From 0 to 14.8
Area single glazed heavy tinted	From 0 to 12	From 0 to 19.2	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 53.1 to 48.3	From 53.1 to 50.9	From 43.9 to 41.7	From 43.9 to 40.9
Frame colour (abs)	From 0.5 to 0.3	No change: 0.3	From 0.5 to 0.3	From 0.9 to 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	No change: R1	From R1 to R1.5	No change: R1.5	No change: R3
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R1	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R2	No change: R2	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: Y	No change: Y	No change: N	No change: N
Roof colour	From 0.3 to 0.5	No change: 0.5	No change: 0.5	No change: 0.3
External Walls				
R-value walls	No change: R0	No change: R0	No change: R0	No change: R0
Area walls insulated	No change: 0	No change: 0	No change: 0	No change: 122.12
Area walls uninsulated	No change: 221.27	From 221.3 to 221.3	No change: 122.12	No change: 0
Foil layer walls	From N to Y	No change	From Y to N	No change
Wall colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.3
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change: 0	No change: 0	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 37.2	No change: 0	No change: 27.78
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	No change: 0	From 3 to 0	From 4 to 0	From 3 to 0
No. 1200	From 2 to 7	From 6 to 3	From 3 to 4	From 1 to 4
No. 1400	No change: 0	From 0 to 6	From 0 to 4	No change: 3
Windows				
Area single glazed clear	From 54.2 to 49.5	From 52.3 to 32.3	From 31.9 to 31.2	From 23.7 to 20
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	From 0 to 19.6	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	From 5.7 to 6.9
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 54.2 to 49.5	From 52.3 to 51.9	From 31.9 to 31.2	From 29.4 to 28.7
Frame colour (abs)	No change: 0.3	No change: 0.5	No change: 0.3	From 0.3 to 0.2
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	From 0 to 1.8

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R2 to R2.5	From R1 to R2	No change: R1	From R1 to R2.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	From 0 to 37.6	No change	No change
Area roof uninsulated (Flat)	No change	From 37.6 to 0	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: Y	No change: Y	No change: Y	No change: Y
Roof colour	From 0.5 to 0.3	No change: 0.3	From 0.9 to 0.3	From 0.5 to 0.3
External Walls				
R-value walls	No change: R0	No change: R0	No change: R0	No change: R0
Area walls insulated	No change: 0	No change: 0	No change: 0	From 99.4 to 0
Area walls uninsulated	No change: 104.38	No change: 104.38	No change: 99.36	From 0 to 99.4
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	No change: 0.3	From 0.7 to 0.5	No change: 0.5
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change: 0	No change: 0	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 0	No change: 0	From 0 to 101.1	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R1	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 26.85	No change: 0	No change: 25.71
Area ceramic tile floor surface	From 97.6 to 97.6	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	From 3 to 0	From 3 to 0	From 1 to 0	From 3 to 0
No. 1200	No change: 3	No change: 3	From 1 to 2	From 2 to 3
No. 1400	From 0 to 4	From 0 to 4	From 0 to 1	From 0 to 1
Windows				
Area single glazed clear	From 32.7 to 22.4	From 31.3 to 27	From 21.2 to 21	From 20.6 to 15.4
Area single low e	No change	No change	No change	No change
Area single glazed tinted	From 0 to 9.1	No change	No change	No change
Area single glazed heavy tinted	No change	From 1.5 to 4.4	No change	No change
Area single low e tint	No change	No change	No change	From 0 to 5.1
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 32.7 to 31.5	From 32.7 to 31.5	From 21.2 to 21	From 20.6 to 20.4
Frame colour (abs)	From 0.5 to 0.4	No change: 0.3	No change: 0.5	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH07, 15, 18 and 19

Key specifications	SBH07 SLAB	SBH15 SLAB	SBH18 TIMBER	SBH19 SLAB
Roof				
R-value ceiling 1	No change: R3.5	From R1.5 to R2.5	No change: R3.5	No change: R1.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R1.5
R-value ceiling 3	No change: R3.5	No change: R4	No change: R3.5	No change: R1.5
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: N	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: Y	No change: Y	No change: N
Roof colour	No change: 0.3	No change: 0.3	No change: 0.3	No change: 0.3
External Walls				
R-value walls	No change: R0	No change: R0	No change: R0	No change: R0
Area walls insulated	No change: 0	No change: 0	No change: 113.69	No change: 0
Area walls uninsulated	No change: 225.36	No change: 134.99	No change: 0	No change: 153.6
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.3	No change: 0.3	No change: 0.3	No change: 0.5
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change: 0	No change: 0	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 12.44	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH07 SLAB	SBH15 SLAB	SBH18 TIMBER	SBH19 SLAB
Ceiling fans				
No. 900	No change: 0	From 2 to 0	From 0 to 1	No change: 0
No. 1200	From 12 to 0	From 3 to 0	No change: 0	From 7 to 4
No. 1400	From 0 to 13	From 0 to 5	From 1 to 3	From 0 to 3
Windows				
Area single glazed clear	From 24.6 to 21.4	From 13.9 to 13.6	No change	From 38.3 to 32.3
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	From 12.6 to 15.8	From 17 to 17.3	No change	From 7.2 to 6.1
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 65.6 to 60.9	No change	From 21.1 to 20.7	From 57.6 to 52.1
Frame colour (abs)	From 0.2 to 0.3	No change: 0.23	No change: 0.5	From 0.5 to 0.2
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	From 28.4 to 12.1	No change	No change	From 12.1 to 0
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	From 0 to 11.6	No change	From 16.4 to 16.1	From 0 to 13.7

13.2 NCC Climate Zone 2 Brisbane

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	No change: R3	No change: R4	From R1.5 to R2	No change: R3.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R2	No change: R4	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.3	No change: 0.3	No change: 0.5
External Walls				
R-value walls	No change: R2	No change: R2.5	No change: R1.5	No change: R2.5
Area walls insulated	From 233.1 to 230.1	From 232.5 to 230.3	No change: 159.14	No change: 159.14
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	From 0.5 to 0.3	No change: 0.5	No change: 0.5
Internal Walls				
R-value	From 2 to 2.5	No change: R2.5	From 0 to 1	No change: R2.5
Insulated area	No change: 55.84	No change: 32.51	No change: 54.58	No change: 54.58
Floors				
Area floor insulated	No change: 152.32	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	From 0 to 1
Area subfloor walls	No change: 0	No change: 30.01	No change: 0	No change: 43.19
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 2
No. 1200	From 4 to 6	No change: 4	No change: 0	No change: 0
No. 1400	From 0 to 4	No change: 6	From 0 to 2	No change: 0
Windows				
Area single glazed clear	From 53.1 to 48.9	From 21.9 to 10.7	From 43.9 to 39.3	From 43.9 to 35.2
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	From 27.5 to 23.1	No change	No change
Area double glazed argon fill low e	No change	No change	No change	From 0 to 3.8
Total Window Area	From 53.1 to 48.9	From 53.1 to 48.7	From 43.9 to 39.3	From 43.9 to 39
Frame colour (abs)	No change: 0.5	No change: 0.3	No change: 0.5	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	From 3.6 to 14.9	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	No change: R1.5	No change: R4	From R2 to R2.5	From R4 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R2.5	No change: R2.5	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	From 1.5 to 2	No change: R4	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: N	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.3
External Walls				
R-value walls	From R0 to R1.5	No change: R2.5	From R0 to R1.5	No change: R2
Area walls insulated	No change: 0	No change: 226.57	From 0 to 122.1	No change: 122.12
Area walls uninsulated	No change: 221.27	No change: 0	From 122.1 to 0	No change: 0
Foil layer walls	From N to Y	No change	From Y to N	No change
Wall colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.4
Internal Walls				
R-value	No change: R2.5	No change: R2.5	No change: R2.5	No change: R2.5
Insulated area	No change: 61.11	No change: 61.11	No change: 40.48	No change: 40.48
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	From 0 to 1
Area subfloor walls	No change: 0	No change: 39.07	No change: 0	No change: 27.78
Area ceramic tile floor surface	No change	No change	From 87.5 to 72.4	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	From 0 to 1	From 2 to 0	From 2 to 1	No change: 0
No. 1200	From 5 to 1	From 8 to 3	No change: 1	From 8 to 3
No. 1400	From 0 to 5	From 0 to 7	From 0 to 2	From 0 to 5
Windows				
Area single glazed clear	From 58.2 to 51.4	From 46.5 to 29.7	From 29.4 to 28.8	From 12 to 15.9
Area single low e	No change	No change	No change	From 17.4 to 12.2
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	From 3.8 to 20.3	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 58.2 to 51.4	From 50.3 to 50	From 29.4 to 28.8	From 29.4 to 28
Frame colour (abs)	No change: 0.5	No change: 0.3	No change: 0.5	No change: 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R3 to R4	No change: R4	From R2 to R3.5	From R4.5 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	From 0 to 37.6	No change	No change
Area roof uninsulated (Flat)	No change	From 37.6 to 0	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: Y	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.3	No change: 0.5	No change: 0.5
External Walls				
R-value walls	From R1.5 to R2	No change: R2	From R1.5 to R2	From R2 to R2.5
Area walls insulated	No change: 104.38	No change: 104.38	No change: 0	No change: 99.36
Area walls uninsulated	No change: 0	No change: 0	No change: 99.36	No change: 9.19
Foil layer walls	No change	No change	No change	No change
Wall colour	From 0.3 to 0.5	No change: 0.3	No change: 0.5	No change: 0.5
Internal Walls				
R-value	From 2 to 2.5	No change: R2.5	No change: R1	No change: R1
Insulated area	No change: 14.99	No change: 17.47	No change: 14.68	No change: 14.68
Floors				
Area floor insulated	No change: 145.98	No change: 0	From 0 to 101.1	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R1	No change: R0	No change: R1
Area subfloor walls	No change: 0	No change: 50.6	No change: 0	No change: 26.05
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	From 1 to 0	No change: 0	From 3 to 0	No change: 0
No. 1200	No change: 2	From 0 to 2	From 2 to 3	From 5 to 3
No. 1400	From 0 to 4	No change: 4	From 0 to 2	From 0 to 2
Windows				
Area single glazed clear	From 28.3 to 30.9	From 28.3 to 15.9	No change	From 13.8 to 12.4
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	From 4.4 to 0	From 4.4 to 16.8	No change	From 9.2 to 8.8
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 32.7 to 30.9	No change	No change	From 23 to 21.3
Frame colour (abs)	No change: 0.23	No change: 0.3	No change: 0.5	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH09, 17, 18 and 19

Key specifications	SBH09 SLAB	SBH17 SLAB	SBH18 TIMBER	SBH19 SLAB
Roof				
R-value ceiling 1	From R3 to R4	From R1.5 to R4	No change: R3.5	From R3.5 to R2.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	From R3 to R4	No change: R0	No change: R0	No change: R1
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R1.3
R-value ceiling 3	From 3 to 4	From 2 to 4	No change: R3.5	No change: R2.5
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: N	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: Y	No change: N
Roof colour	No change: 0.5	No change: 0.3	No change: 0.3	No change: 0.3
External Walls				
R-value walls	No change: R2	From R0 to R2	No change: R2.5	No change: R1.5
Area walls insulated	No change: 228.27	No change: 113.69	No change: 113.69	No change: 106.35
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 52.26
Foil layer walls	No change	From Y to N	No change	No change
Wall colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.3
Internal Walls				
R-value	No change: R2	No change: R1	No change: R1	No change: R1
Insulated area	No change: 23.63	No change: 13.66	No change: 13.66	No change: 24.6
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R1	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 12.44	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH09 SLAB	SBH17 SLAB	SBH18 TIMBER	SBH19 SLAB
Ceiling fans				
No. 900	No change: 0	No change: 0	From 0 to 1	From 2 to 0
No. 1200	From 5 to 0	From 1 to 2	No change: 0	From 0 to 4
No. 1400	From 0 to 5	No change: 0	From 1 to 2	No change: 0
Windows				
Area single glazed clear	No change	No change	No change	No change
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	No change	No change	No change	No change
Frame colour (abs)	No change: 0.5	No change: 0.5	No change: 0.5	From 0.5 to 0.2
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

13.3 NCC Climate Zone 3 Longreach

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	No change: R2	From R2 to R4	From R1 to R2	No change: R3
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R1	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: Y	No change: Y
Roof colour	No change: 0.3	No change: 0.3	From 0.3 to 0.4	From 0.5 to 0.3
External Walls				
R-value walls	No change: R0	No change: R1	No change: R0	No change: R0
Area walls insulated	No change: 0	No change: 74.92	No change: 0	No change: 0
Area walls uninsulated	No change: 262.94	No change: 188.02	No change: 170.98	No change: 170.98
Foil layer walls?	No change	No change	No change	No change
Wall colour (Solar Abs)	No change: 0.4	From 0.4 to 0.3	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change: 0	No change: 0	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil underfloor?	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	From 0 to 1
Area subfloor walls insulated	No change: 0	No change: 30.01	No change: 0	From 31.9 to 40.8
Area ceramic tile floor surface	From 106.2 to 127.5	No change	No change	No change

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 3
No. 1200	No change: 10	From 10 to 4	No change: 3	No change: 4
No. 1400	No change: 0	From 0 to 6	No change: 0	No change: 0
Windows				
Area single glazed clear	From 22 to 20.9	From 8.4 to 6.6	From 23.8 to 24.9	From 35.7 to 33.5
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	From 7.6 to 6.8
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	From 31.1 to 29.5	From 44.7 to 46.5	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 53.1 to 50.5	From 53.1 to 53.1	From 46.6 to 47.7	From 43.2 to 40.4
Frame colour (abs)	No change: 0.3	No change: 0.3	No change: 0.5	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	No change: R4	No change: R4	From R2 to R3	No change: R3
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R4	No change: R4	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: Y	No change: Y	No change: N	No change: N
Roof colour	No change: 0.3	No change: 0.3	No change: 0.3	No change: 0.3
External Walls				
R-value walls	No change: R0	From R0 to R1	No change: R0	No change: R0
Area walls insulated	No change: 0	From 0 to 34.8	No change: 0	No change: 0
Area walls uninsulated	No change: 260.34	From 229.5 to 194.7	No change: 160.38	No change: 160.38
Foil layer walls?	No change	No change	No change	No change
Wall colour (Solar Abs)	No change: 0.3	No change: 0.3	From 0.5 to 0.4	No change: 0.4
Internal Walls				
R-value	No change: R1	No change: R1	No change: R0	No change: R0
Insulated area	No change: 18.13	No change: 18.13	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil underfloor?	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	From 1 to 1.5	No change: R0	From 0 to 1
Area subfloor walls insulated	No change: 0	No change: 29.63	No change: 0	No change: 27.6
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	From 7 to 2	From 6 to 2	From 3 to 1	From 4 to 1
No. 1400	From 1 to 8	From 1 to 8	From 0 to 3	From 0 to 3
Windows				
Area single glazed clear	From 48.8 to 17.9	From 31.8 to 18.6	From 22.5 to 23	From 21.5 to 21.3
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	From 0 to 24.9	No change	From 6.9 to 5.9	From 6.9 to 7.2
Area single low e tint	From 5.7 to 8.9	From 21.6 to 31.4	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 54.5 to 51.6	From 53.3 to 50	From 29.4 to 28.9	No change
Frame colour (abs)	No change: 0.23	No change: 0.23	From 0.5 to 0.3	No change: 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R2 to R2.5	From R2.5 to R4	From R3 to R4.1	From R4.1 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: Y	No change: N
Roof colour	No change: 0.3	No change: 0.3	No change: 0.3	No change: 0.3
External Walls				
R-value walls	No change: R0	No change: R0	No change: R0	No change: R0
Area walls insulated	No change: 0	No change: 0	No change: 0	No change: 0
Area walls uninsulated	No change: 104.38	No change: 104.38	No change: 125.56	No change: 125.56
Foil layer walls?	No change	No change	No change	No change
Wall colour (Solar Abs)	No change: 0.3	No change: 0.3	From 0.5 to 0.5	From 0.5 to 0.3
Internal Walls				
R-value	No change: R1.5	No change: R1.5	No change: R0	No change: R0
Insulated area	No change: 14.99	No change: 14.99	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil underfloor?	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	From 0 to 1	No change: R0	From 1 to 1.5
Area subfloor walls insulated	No change: 0	From 40.3 to 26.8	No change: 0	No change: 26.05
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	From 2 to 0	From 3 to 0	From 2 to 0	From 2 to 5
No. 1400	From 0 to 3	From 0 to 3	From 0 to 3	No change: 0
Windows				
Area single glazed clear	From 32.7 to 33	From 17.4 to 16.6	No change	From 20.6 to 4.6
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	From 15.3 to 14.9	No change	From 0 to 14.8
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 32.7 to 33	From 32.7 to 31.5	No change	From 20.6 to 19.4
Frame colour (abs)	No change: 0.5	From 0.5 to 0.2	No change: 0.5	No change: 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH09, 15 and 19

Key specifications	SBH09 SLAB	SBH15 SLAB	SBH15 TIMBER	SBH19 SLAB
Roof				
R-value ceiling 1	From R1.5 to R3.5	No change: R3	No change: R4	From R2.5 to R3.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R1.3	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R1.3	No change: R0	No change: R0	No change: R1.5
R-value ceiling 3	From 1.5 to 3.5	No change: R3	No change: R3	From 2.5 to 3.5
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: Y	No change: Y	No change: Y
Roof colour	From 0.5 to 0.3	No change: 0.3	No change: 0.3	No change: 0.3
External Walls				
R-value walls	No change: R0	No change: R0	No change: R1	No change: R2
Area walls insulated	No change: 0	No change: 0	No change: 29.46	No change: 97.8
Area walls uninsulated	No change: 198.12	No change: 113.53	No change: 71.39	No change: 77.26
Foil layer walls?	No change	No change	No change	No change
Wall colour (Solar Abs)	No change: 0.3	No change: 0.3	No change: 0.3	From 0.5 to 0.3
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change: 0	No change: 0	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil underfloor?	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R1	No change: R0
Area subfloor walls insulated	No change: 0	No change: 0	No change: 29.46	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH09 SLAB	SBH15 SLAB	SBH15 TIMBER	SBH19 SLAB
Ceiling fans				
No. 900	No change: 0	No change: 0	From 2 to 3	No change: 0
No. 1200	From 5 to 0	No change: 2	No change: 0	From 2 to 0
No. 1400	From 0 to 5	No change: 3	No change: 3	From 0 to 3
Windows				
Area single glazed clear	No change	From 23.2 to 13.7	From 14.6 to 8	From 57.9 to 52.5
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	From 0 to 4.3
Area single low e tint	From 20.2 to 19.5	From 8.3 to 15.2	From 15.7 to 19.4	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 55.8 to 55.2	From 31.5 to 28.9	From 30.2 to 27.5	From 57.9 to 56.9
Frame colour (abs)	From 0.5 to 0.3	No change: 0.23	No change: 0.23	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

13.4 NCC Climate Zone 4 Mildura

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	From R3.5 to R4	From R5 to R6	From R2.7 to R3	From R4 to R5
Area ceiling 1	No change	From 151.2 to 184.4	No change	No change
R-value ceiling 2	From R2 to R2.5	From R2.5 to R2.7	No change: R0	No change: R2.5
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: N	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	From 0.4 to 0.3	No change: 0.3	No change: 0.5	From 0.3 to 0.5
External Walls				
R-value walls	No change: R2.5	No change: R2.5	No change: R2.5	No change: R2.5
Area walls insulated	No change: 232.53	No change: 232.53	No change: 159.14	No change: 159.14
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	From 0.5 to 0.3	No change: 0.5	No change: 0.5
Internal Walls				
R-value	From 2 to 2.5	From 2.5 to 2.7	No change: R2	No change: R2.5
Insulated area	No change: 55.84	No change: 55.84	No change: 54.58	No change: 54.58
Floors				
Area floor insulated	No change: 185.52	From 0 to 152.3	No change: 293.57	No change: 0
R-value floor	No change: R0	From 0 to 3.6	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	From 1 to 1.5
Area subfloor walls	No change: 0	No change: 30	No change: 0	No change: 43.19
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	From 3 to 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	From 3 to 1
No. 1400	No change: 0	No change: 0	From 0 to 4	From 0 to 4
Windows				
Area single glazed clear	From 39.9 to 24.8	From 15.9 to 5.4	From 43.9 to 36.3	From 42.1 to 25.4
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 13.2 to 26.5	From 37.4 to 43.5	From 0 to 5	From 6.3 to 14.2
Total Window Area	From 53.1 to 51.3	From 53.3 to 48.9	From 43.9 to 41.3	From 48.4 to 39.5
Frame colour (abs)	No change: 0.5	From 0.5 to 0.3	No change: 0.5	From 0.3 to 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	From R4 to R5	No change: R5	From R3 to R5	No change: R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R2.5	No change: R2.5	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	From 4 to 5	No change: R5	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	From 0.5 to 0.3	From 0.5 to 0.3	From 0.5 to 0.3
External Walls				
R-value walls	No change: R2.5	No change: R2.5	No change: R2	No change: R2.5
Area walls insulated	No change: 231.25	No change: 231.25	No change: 122.12	No change: 122.12
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	From 0.5 to 0.3	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R2.5	No change: R2.5	From 2 to 2.5	From 0 to 2
Insulated area	From 61.1 to 41.5	No change: 61.11	From 40.5 to 20.1	From 40.5 to 31.7
Floors				
Area floor insulated	No change: 105.01	From 0 to 105	No change: 134.82	No change: 0
R-value floor	No change: R0	From 0 to 2.5	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	From 1 to 0	No change: R0	From 1 to 1.5
Area subfloor walls	No change: 0	No change: 28.83	No change: 0	No change: 29.18
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	From 2 to 0
No. 1200	From 2 to 0	From 3 to 0	No change: 0	No change: 0
No. 1400	From 0 to 2	From 0 to 3	No change: 0	From 0 to 2
Windows				
Area single glazed clear	From 53 to 29.1	From 20.1 to 7.8	From 29.4 to 21.7	From 19.6 to 5.9
Area single low e	No change	No change	No change	From 0 to 2.6
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	From 0 to 7.6	No change	No change	No change
Area double glazed argon fill low e	From 5.1 to 12	From 30.1 to 39.7	From 0 to 5.7	From 9.8 to 17.7
Total Window Area	From 58.1 to 48.7	From 50.2 to 47.6	From 29.4 to 27.4	From 29.4 to 26.2
Frame colour (abs)	No change: 0.5	From 0.5 to 0.3	No change: 0.5	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R3 to R4	From R2.5 to R5	From R2.5 to R5	From R3.5 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: Y	No change: N
Roof colour	From 0.3 to 0.5	From 0.5 to 0.3	From 0.5 to 0.3	No change: 0.3
External Walls				
R-value walls	No change: R2.5	From R2 to R2.5	No change: R2.5	No change: R2.5
Area walls insulated	No change: 104.38	No change: 104.38	No change: 99.36	No change: 99.36
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	From 0.5 to 0.3	No change: 0.5	From 0.5 to 0.3
Internal Walls				
R-value	No change: R2.5	No change: R2.5	From 2 to 2.5	From 1.5 to 2.5
Insulated area	No change: 14.99	No change: 14.99	From 19.6 to 40	From 19.6 to 40
Floors				
Area floor insulated	No change: 145.98	No change: 145.98	No change: 0	From 0 to 101.1
R-value floor	No change: R0	No change: R2.5	No change: R0	From 0 to 2
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	From 1 to 1.5	No change: R0	No change: R1
Area subfloor walls	No change: 0	No change: 50.6	No change: 0	No change: 26.05
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	From 2 to 0	From 3 to 1	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	From 1 to 0	From 1 to 0
No. 1400	From 0 to 2	From 3 to 4	No change: 0	From 0 to 1
Windows				
Area single glazed clear	From 37.1 to 27.1	From 17.4 to 10.4	From 20.6 to 13.3	From 11.9 to 11.3
Area single low e	No change	No change	From 0 to 5.1	No change
Area single glazed tinted	No change	From 0 to 1.2	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	From 1.1 to 0
Area double glazed argon fill low e	From 0 to 5.9	From 15.3 to 18.2	From 0 to 1	From 7.6 to 7.9
Total Window Area	From 37.1 to 33	From 32.7 to 29.7	From 20.6 to 19.4	From 20.6 to 19.2
Frame colour (abs)	No change: 0.5	From 0.5 to 0.3	No change: 0.5	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH11, 16 and 19

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Roof				
R-value ceiling 1	From R3 to R5	From R3.5 to R5	From R4 to R5	From R2.5 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R3	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	From 0 to 19.7
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	From 3 to 5	From 3.5 to 5	No change: R5	From 2.5 to 5
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	From N to Y	From N to Y	From N to Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.5	No change: 0.3	No change: 0.5
External Walls				
R-value walls	From R2 to R2.5	From R2 to R2.5	From R2.5 to R2.7	From R2 to R2.5
Area walls insulated	No change: 204.59	No change: 134.99	No change: 134.99	No change: 150.07
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R1.5	From 2 to 2.5	From 2.5 to 2.7	From 0 to 2
Insulated area	From 23.6 to 21	No change: 15.56	From 35.4 to 15.6	From 0 to 18.7
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 93.59	No change: 0
R-value floor	From 0 to 4	No change: R0	No change: R2.5	No change: R0
Foil floor	No change: N	No change: N	From N to Y	No change: N
R-value subfloor walls	From 0 to 2	No change: R0	From 1 to 1.5	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 23.82	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	From 1 to 0	From 1 to 0	From 1 to 0
No. 1400	No change: 0	From 0 to 1	From 0 to 2	No change: 0
Windows				
Area single glazed clear	From 46.3 to 46.4	From 17 to 15	From 8.6 to 12.4	From 48.5 to 46
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 3.2 to 3.6	From 14.9 to 14.4	From 23.3 to 17.3	From 5.4 to 6.3
Total Window Area	From 49.6 to 50	From 31.9 to 29.4	From 31.9 to 29.7	From 53.9 to 52.3
Frame colour (abs)	No change: 0.5	No change: 0.5	No change: 0.3	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

13.5 NCC Climate Zone 5: Sydney, Perth and Adelaide

13.5.1 Sydney

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	From R3.5 to R5	No change: R5	From R2.7 to R4	From R3 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	From R2 to R2.5	No change: R2.5	No change: R0	No change: R2.5
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: N	No change: N	No change: N	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.3	No change: 0.5	From 0.5 to 0.3
External Walls				
R-value walls	No change: R2.5	No change: R2.5	From R2 to R2.5	From R2 to R2.5
Area walls insulated	No change: 232.53	From 232.5 to 230.3	No change: 159.14	No change: 159.14
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	From 0.5 to 0.3	No change: 0.5	From 0.5 to 0.3
Internal Walls				
R-value	From 2 to 2.5	No change: R2.5	From 2 to 2.5	No change: R2.5
Insulated area	No change: 55.84	From 23.2 to 50.3	No change: 54.58	No change: 54.58
Floors				
Area floor insulated	No change: 185.52	No change: 0	No change: 259.72	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	From 1 to 2	No change: R0	No change: R1
Area subfloor walls	No change: 0	No change: 30.01	No change: 0	No change: 43.19
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	From 3 to 0	No change: 0	From 3 to 0
No. 1400	From 0 to 4	From 0 to 5	No change: 0	From 0 to 3
Windows				
Area single glazed clear	From 53.1 to 42.9	From 32.2 to 19.7	No change	From 42.1 to 35.2
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	From 0 to 3.8
Area double glazed argon fill low e	From 0 to 5.3	From 21.1 to 29	No change	No change
Total Window Area	From 53.1 to 48.3	From 53.3 to 48.7	No change	From 42.1 to 39
Frame colour (abs)	From 0.5 to 0.3	From 0.5 to 0.3	No change: 0.5	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	From R3.5 to R4	From R4 to R5	From R3 to R4	From R4 to R4.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	From R2.5 to R4	From R2.5 to R4	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R4	No change: R4	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: N	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.5	No change: 0.5	From 0.5 to 0.3
External Walls				
R-value walls	From R2 to R2.5	From R2.5 to R2.7	No change: R2	No change: R2.5
Area walls insulated	No change: 221.27	No change: 226.57	No change: 122.12	No change: 122.12
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R2.5	No change: R2.5	From 2 to 2.5	No change: R2.5
Insulated area	No change: 35.81	From 61.1 to 44.5	No change: 40.48	From 20.1 to 40.5
Floors				
Area floor insulated	No change: 105.01	From 0 to 105	From 134.8 to 146.8	No change: 134.82
R-value floor	No change: R0	From 0 to 3	No change: R0	No change: R2
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R1	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 37.2	No change: 0	No change: 29.18
Area ceramic tile floor surface	No change	No change	From 58.6 to 70.6	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	From 2 to 0	From 0 to 2	No change: 0	No change: 0
No. 1400	From 0 to 4	From 4 to 5	No change: 0	No change: 3
Windows				
Area single glazed clear	From 54 to 28.6	From 27.7 to 16.6	From 30.1 to 20.6	From 22.5 to 6.6
Area single low e	From 0 to 22.8	From 0 to 5.2	No change	From 6.9 to 19.1
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	No change	From 19.7 to 26	From 0 to 7.5	No change
Total Window Area	From 54 to 51.4	From 47.3 to 47.7	From 30.1 to 28	From 29.4 to 25.7
Frame colour (abs)	No change: 0.5	From 0.5 to 0.3	No change: 0.5	From 0.5 to 0.4
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R3.5 to R4	From R3 to R4	From R2.5 to R4	From R4 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	From 0 to 37.6	No change	No change
Area roof uninsulated (Flat)	No change	From 37.6 to 0	No change	No change
Foil under roof?	From N to Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.3	No change: 0.3	No change: 0.3
External Walls				
R-value walls	No change: R2.5	No change: R2.5	No change: R2	From R2.5 to R2.7
Area walls insulated	No change: 104.38	No change: 104.38	No change: 99.36	No change: 99.36
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	From N to Y
Wall colour	No change: 0.5	From 0.5 to 0.3	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R2.5	No change: R2.5	No change: R2	No change: R2
Insulated area	No change: 14.99	From 15 to 37.9	No change: 19.59	No change: 19.59
Floors				
Area floor insulated	No change: 145.98	No change: 145.98	From 0 to 101.1	From 0 to 101.1
R-value floor	No change: R0	No change: R2	No change: R0	From 0 to 2.5
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	From 0 to 1	No change: R0	From 1 to 0
Area subfloor walls	No change: 0	No change: 26.85	No change: 0	From 26.1 to 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	From 2 to 0	From 2 to 0	From 1 to 0	From 1 to 0
No. 1400	From 0 to 2	From 1 to 3	From 0 to 1	From 0 to 1
Windows				
Area single glazed clear	From 32.7 to 22.1	From 15.9 to 10.7	From 20.6 to 13.2	From 13 to 4.6
Area single low e	From 0 to 8.9	No change	No change	From 7.6 to 0
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	From 16.5 to 18.6	From 0 to 6.6	From 0 to 10.9
Area double glazed argon fill low e	No change	No change	No change	From 0 to 4.4
Total Window Area	From 32.7 to 30.9	From 32.4 to 29.3	From 20.6 to 19.8	From 20.6 to 19.9
Frame colour (abs)	No change: 0.5	From 0.5 to 0.3	No change: 0.5	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH09, 16 and 19

Key specifications	SBH09 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Roof				
R-value ceiling 1	No change: R4	No change: R4	No change: R4	No change: R3.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R2.5	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R1.3	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R3	No change: R4	No change: R4	No change: R3.5
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	From N to Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.3
External Walls				
R-value walls	No change: R2	No change: R2.5	No change: R2.5	No change: R2.5
Area walls insulated	No change: 228.27	No change: 134.99	No change: 134.99	No change: 150.07
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	From N to Y	No change	From Y to N
Wall colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R0	No change: R2.5	No change: R2.5	From 0 to 2.5
Insulated area	No change: 0	No change: 35.44	From 15.6 to 19.9	From 0 to 24
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 93.59	No change: 0
R-value floor	No change: R0	No change: R0	From 2 to 3	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 23.82	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH09 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	From 3 to 1	From 2 to 0	From 2 to 0	No change: 1
No. 1400	From 0 to 4	From 0 to 2	From 0 to 3	No change: 0
Windows				
Area single glazed clear	From 48.5 to 32.5	From 19.4 to 0	From 9.8 to 1.4	From 42.6 to 30.4
Area single low e	From 0 to 13.9	From 12.6 to 30	From 21.5 to 26	From 6.3 to 18.5
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 63.1 to 58.7	From 32 to 30	From 31.4 to 27.5	No change
Frame colour (abs)	No change: 0.5	No change: 0.5	From 0.5 to 0.3	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	From 14.6 to 12.3	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

13.5.2 Perth

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	From R2.5 to R3.5	No change: R4	No change: R2.7	From R3 to R4
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: N	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.3	From 0.5 to 0.3	No change: 0.5	No change: 0.5
External Walls				
R-value walls	From R0.3 to R0.5	From R0.4 to R0.1	From R0 to R0.3	From R0 to R0.3
Area walls insulated	No change: 232.53	From 232.5 to 230.1	From 0 to 159.1	From 0 to 159.1
Area walls uninsulated	No change: 0	No change: 0	From 159.1 to 0	From 159.1 to 0
Foil layer walls	From N to Y	No change	From N to Y	No change
Wall colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change: 0	No change: 0	No change: 0	No change: 0
Floors				
Area floor insulated	From 0 to 185.5	No change: 0	No change: 0	No change: 0
R-value floor	No change: R0	No change: R0	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R1
Area subfloor walls	No change: 0	No change: 0	No change: 0	No change: 43.19
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 3
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Window				
Area single glazed clear	From 53.1 to 42.9	From 53.3 to 48.7	From 43.9 to 43.6	From 42.1 to 39
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 0 to 5.3	No change	No change	No change
Total Window Area	From 53.1 to 48.3	From 53.3 to 48.7	From 43.9 to 43.6	From 42.1 to 39
Frame colour (abs)	No change: 0.5	No change: 0.5	No change: 0.5	From 0.5 to 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	From R2.5 to R5	From R4 to R5	From R4 to R4.5	No change: R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	From 4 to 5	From 4 to 5	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: N	From Y to N	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	From N to Y	No change: N
Roof colour	No change: 0.5	No change: 0.5	From 0.5 to 0.9	From 0.5 to 0.9
External Walls				
R-value walls	From R0.3 to R0.5	From R0.4 to R1.2	No change: R0	No change: R0
Area walls insulated	No change: 221.27	No change: 226.57	No change: 0	No change: 0
Area walls uninsulated	No change: 0	No change: 0	No change: 122.12	No change: 122.12
Foil layer walls	No change	From N to Y	No change	No change
Wall colour	No change: 0.5	No change: 0.5	From 0.5 to 0.9	No change: 0.9
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change: 0	No change: 0	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 105.01	No change: 105.01	No change: 0	No change: 134.82
R-value floor	No change: R0	From 2.5 to 3	No change: R0	From 2 to 2.5
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 0	No change: 29.18
Area ceramic tile floor surface	No change	No change	From 58.6 to 70.6	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	From 0 to 2	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 4	From 1 to 3	From 1 to 5
Window				
Area single glazed clear	From 54 to 48.7	From 47.3 to 49	From 29.4 to 26.5	From 21.9 to 19.7
Area single low e	No change	No change	No change	From 7.5 to 6.8
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 54 to 48.7	From 47.3 to 49	From 29.4 to 26.5	From 29.4 to 26.5
Frame colour (abs)	No change: 0.5	From 0.5 to 0.3	From 0.5 to 0.9	From 0.5 to 0.9
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R2.7 to R4	From R3.5 to R4	From R2.2 to R4	No change: R4
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	From 0 to 37.6	No change	No change
Area roof uninsulated (Flat)	No change	From 37.6 to 0	No change	No change
Foil under roof?	No change: N	No change: N	No change: N	From N to Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	From 0.3 to 0.5	No change: 0.3	No change: 0.5	No change: 0.5
External Walls				
R-value walls	No change: R0	From R0.3 to R0.5	From R0.3 to R0.7	From R0.1 to R1.9
Area walls insulated	No change: 0	No change: 104.38	No change: 99.36	No change: 99.36
Area walls uninsulated	No change: 104.38	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	From N to Y	No change	No change
Wall colour	No change: 0.5	No change: 0.3	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change: 0	No change: 0	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 0	No change: 145.98	From 0 to 101.1	No change: 101.09
R-value floor	No change: R0	No change: R2	No change: R0	No change: R1.2
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 26.85	No change: 0	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	From 0 to 2	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Window				
Area single glazed clear	From 32.7 to 22.1	From 32.4 to 27.7	From 20.6 to 18.7	From 20.6 to 14.3
Area single low e	From 0 to 7.6	No change	No change	From 0 to 4.4
Area single glazed tinted	No change	From 0 to 3.8	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 32.7 to 29.7	From 32.4 to 31.5	From 20.6 to 18.7	From 20.6 to 18.7
Frame colour (abs)	No change: 0.5	No change: 0.3	No change: 0.5	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH09, 15 and 19

Key specifications	SBH09 SLAB	SBH15 SLAB	SBH15 TIMBER	SBH19 SLAB
Roof				
R-value ceiling 1	No change: R4	From R3 to R4	No change: R4	From R2 to R4
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R2	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R4	From 3 to 4	No change: R4	From 2 to 4
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	From N to Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.3
External Walls				
R-value walls	From R0.4 to R0.5	From R0.3 to R0.5	From R0.1 to R0.7	From R0 to R0.3
Area walls insulated	No change: 222.88	No change: 134.99	No change: 134.99	From 0 to 52.3
Area walls uninsulated	No change: 0	No change: 0	No change: 0	From 150.1 to 97.8
Foil layer walls	No change	From N to Y	No change	No change
Wall colour	No change: 0.5	No change: 0.5	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R0	No change: R0	No change: R0	No change: R0
Insulated area	No change: 0	No change: 0	No change: 0	No change: 0
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 93.59	No change: 0
R-value floor	No change: R0	No change: R0	From 2 to 3	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 31.09	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH09 SLAB	SBH15 SLAB	SBH15 TIMBER	SBH19 SLAB
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	From 0 to 1	From 2 to 0	No change: 0
No. 1400	No change: 0	From 0 to 1	From 0 to 2	No change: 0
Window				
Area single glazed clear	From 71.5 to 51.8	From 31.5 to 30	From 30.2 to 21.2	No change
Area single low e	From 0 to 15.1	No change	From 0 to 5.7	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	No change	No change	No change	No change
Total Window Area	From 71.5 to 67	From 31.5 to 30	From 30.2 to 26.8	No change
Frame colour (abs)	No change: 0.5	No change: 0.5	From 0.5 to 0.3	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

13.5.3 Adelaide

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	From R4 to R5	From R5 to R6	From R2 to R3.5	From R3 to R6
Area ceiling 1	No change	From 151.2 to 184.4	No change	No change
R-value ceiling 2	No change: R0	From R2.5 to R2.7	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: N	No change: N	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.3	No change: 0.3	No change: 0.5	From 0.5 to 0.3
External Walls				
R-value walls	No change: R2.5	No change: R2.5	From R1.5 to R2.5	No change: R2.5
Area walls insulated	No change: 232.53	No change: 232.53	No change: 159.14	No change: 159.14
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	From 0.5 to 0.3	No change: 0.5	From 0.5 to 0.3
Internal Walls				
R-value	From 2 to 2.5	From 2.5 to 2.7	No change: R2.5	No change: R2.5
Insulated area	No change: 67.82	No change: 55.84	No change: 54.58	No change: 54.58
Floors				
Area floor insulated	From 0 to 152.3	From 0 to 152.3	No change: 259.72	From 0 to 259.7
R-value floor	No change: R0	From 0 to 3.6	No change: R0	No change: R0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R1
Area subfloor walls	No change: 0	No change: 30	No change: 0	No change: 43.19
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 3
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 40.9 to 21.8	From 15.9 to 5.4	No change	From 43.9 to 28.9
Area single low e	From 0 to 1.6	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 12.2 to 24.9	From 37.4 to 43.5	No change	From 0 to 10.1
Total Window Area	From 53.1 to 48.3	From 53.3 to 48.9	No change	From 43.9 to 39
Frame colour (abs)	From 0.5 to 0.9	From 0.5 to 0.3	No change: 0.5	No change: 0.3
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	From R3 to R5	From R4.1 to R5	From R3.5 to R4	No change: R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R2.5	From R2.5 to R5	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	From 4 to 5	No change: R5	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	From 0.5 to 0.3	No change: 0.3	No change: 0.5
External Walls				
R-value walls	No change: R2.5	From R2.5 to R2.7	From R2 to R2.5	No change: R2.5
Area walls insulated	No change: 195.25	No change: 195.25	No change: 122.12	No change: 122.12
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	From 0.5 to 0.3	From 0.5 to 0.3	No change: 0.5
Internal Walls				
R-value	No change: R2.5	No change: R2.5	From 2 to 2.5	From 2 to 2.5
Insulated area	No change: 61.11	No change: 61.11	From 40.5 to 29.1	No change: 40.48
Floors				
Area floor insulated	From 105 to 0	No change: 0	No change: 134.82	From 134.8 to 0
R-value floor	No change: R0	No change: R0	No change: R0	From 2 to 0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R1	No change: R0	No change: R1
Area subfloor walls	No change: 0	No change: 28.83	No change: 0	No change: 29.18
Area ceramic tile floor surface	No change	No change	From 13.3 to 56.6	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	From 5 to 0	No change: 0
No. 1400	No change: 0	No change: 0	From 0 to 3	From 0 to 3
Windows				
Area single glazed clear	From 44 to 26.2	From 40.9 to 23.4	From 29.4 to 21.7	From 21.9 to 12
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 10.1 to 22.4	From 9 to 26.4	From 0 to 5.7	From 7.5 to 15.4
Total Window Area	From 54 to 48.7	No change	From 29.4 to 27.4	From 29.4 to 27.4
Frame colour (abs)	No change: 0.5	No change: 0.5	From 0.5 to 0.3	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R2.5 to R4	From R4 to R5	From R2.5 to R4	From R3 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: Y	No change: N
Roof colour	From 0.8 to 0.5	From 0.5 to 0.3	No change: 0.5	No change: 0.5
External Walls				
R-value walls	No change: R2.5	No change: R2.5	From R1.5 to R2.5	From R2.5 to R2.7
Area walls insulated	No change: 104.38	No change: 104.38	No change: 99.36	No change: 99.36
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	From 0.5 to 0.3	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R2.5	No change: R2	From 1.5 to 2.5	From 1.5 to 2.5
Insulated area	No change: 14.99	No change: 14.99	From 19.6 to 40	From 19.6 to 40
Floors				
Area floor insulated	No change: 145.98	No change: 145.98	No change: 0	From 0 to 101.1
R-value floor	No change: R0	No change: R2.5	No change: R0	From 0 to 2
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	From 0 to 1.5	No change: R0	No change: R1
Area subfloor walls	No change: 0	No change: 50.6	No change: 0	No change: 26.05
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	From 1 to 0
No. 1400	From 0 to 2	From 2 to 3	No change: 0	From 0 to 1
Windows				
Area single glazed clear	From 32.7 to 25.9	From 22.4 to 21.1	From 20.6 to 13.8	From 20.6 to 18.2
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 0 to 3.8	From 10.3 to 9.1	From 0 to 6	From 0 to 0.9
Total Window Area	From 32.7 to 29.7	From 32.7 to 30.2	From 20.6 to 19.8	From 20.6 to 19.2
Frame colour (abs)	No change: 0.5	From 0.5 to 0.3	No change: 0.5	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH11, 16 and 19

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Roof				
R-value ceiling 1	From R4 to R4.5	From R3.5 to R5	From R5 to R6	No change: R3.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	From R4 to R4.1	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	From 0 to 19.7
R-value roof blanket	No change: R0	No change: R0	No change: R0	From 0 to 1.3
R-value ceiling 3	No change: R0	From 3 to 5	No change: R5	No change: R3.5
Area roof insulated (Flat)	From 187.2 to 228.3	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	From N to Y	From N to Y	From N to Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.5	From 0.5 to 0.3	No change: 0.5
External Walls				
R-value walls	From R2 to R2.5	From R2 to R2.5	From R2.5 to R2.7	No change: R2.5
Area walls insulated	No change: 228.27	No change: 134.99	No change: 134.99	No change: 150.07
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	From N to Y	No change	No change	No change
Wall colour	No change: 0.5	No change: 0.5	From 0.9 to 0.5	No change: 0.5
Internal Walls				
R-value	From 1.5 to 2.5	From 2 to 2.5	From 2.5 to 2.7	From 0 to 1.5
Insulated area	No change: 23.63	No change: 15.56	From 35.4 to 15.6	From 0 to 18.7
Floors				
Area floor insulated	No change: 0	No change: 0	No change: 93.59	No change: 0
R-value floor	No change: R0	No change: R0	From 1.5 to 2	No change: R0
Foil floor	No change: N	No change: N	From N to Y	No change: N
R-value subfloor walls	No change: R0	No change: R0	From 1 to 2	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 23.82	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	From 0 to 1	No change: 0
No. 1400	No change: 0	No change: 0	From 0 to 3	No change: 0
Windows				
Area single glazed clear	From 51.5 to 33.1	From 11.4 to 9.6	No change	From 60.6 to 52.9
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 0 to 14.5	From 25.2 to 22.9	From 36.1 to 30.1	From 0 to 6.6
Total Window Area	From 51.5 to 47.6	From 36.6 to 32.4	From 36.6 to 30.6	From 60.6 to 59.5
Frame colour (abs)	No change: 0.5	No change: 0.5	No change: 0.3	No change: 0.5
Area external Blinds	From 4.3 to 0	No change: 0	From 0 to 1.7	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

13.6 NCC Climate Zone 6 Melbourne

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	From R3.5 to R4.1	From R4.1 to R5	From R3 to R3.5	From R3.5 to R4
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: N	No change: N	No change: N	No change: N
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
External Walls				
R-value walls	From R2.5 to R2.7	From R2.5 to R2.7	No change: R2	From R2.5 to R2
Area walls insulated	From 238.6 to 238.6	No change: 232.53	No change: 159.14	No change: 159.14
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	From Y to N	No change
Wall colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Internal Walls				
R-value	From 2.5 to 2.7	No change: R2.5	From 2.5 to 2	From 2.5 to 2
Insulated area	No change: 35.21	No change: 35.21	No change: 54.58	No change: 54.58
Floors				
Area floor insulated	From 0 to 152.3	No change: 152.32	No change: 259.72	No change: 259.72
R-value floor	No change: R0	No change: R2.5	No change: R0	From 1.5 to 3
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 30	No change: 0	No change: 43.19
Area ceramic tile floor surface	From 29.4 to 9.2	No change	No change	No change

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	From 3 to 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	From 0 to 3
Windows				
Area single glazed clear	From 45.9 to 23.9	From 39.3 to 22.7	From 46 to 28.9	From 45 to 28.9
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 7.1 to 24.3	From 13.8 to 25.6	From 0 to 10.1	From 0 to 10.1
Total Window Area	From 53.1 to 48.3	From 53.1 to 48.3	From 46 to 39	From 45 to 39
Frame colour (abs)	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	From R4 to R5	From R4 to R5	From R4 to R5	From R4 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R4	No change: R0	No change: R0
Area roof insulated (Flat)	From 0 to 5.1	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: N	No change: N	No change: N
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	From 0.5 to 0.9	From 0.5 to 0.9	No change: 0.5	No change: 0.5
External Walls				
R-value walls	No change: R2.5	No change: R2.5	From R2.5 to R2.7	No change: R2.5
Area walls insulated	No change: 221.27	No change: 221.27	No change: 122.12	No change: 122.12
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	From Y to N	No change	No change
Wall colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Internal Walls				
R-value	No change: R2.5	No change: R2.5	No change: R2.5	No change: R2.5
Insulated area	No change: 81.77	No change: 81.77	No change: 40.48	No change: 40.48
Floors				
Area floor insulated	No change: 0	No change: 105.01	No change: 0	No change: 134.82
R-value floor	No change: R0	From 2 to 3	No change: R0	From 2 to 2.5
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 28.52	No change: 0	No change: 29.18
Area ceramic tile floor surface	From 144.3 to 83.4	No change	No change	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 46 to 23.5	From 42.3 to 22.9	From 21.4 to 16.5	From 27.6 to 14.3
Area single low e	From 2.7 to 0	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 5.7 to 25.2	From 9.5 to 26.1	From 8 to 11.8	From 1.8 to 14.5
Total Window Area	From 54.5 to 48.7	From 51.8 to 49.1	From 29.4 to 28.3	From 29.4 to 28.8
Frame colour (abs)	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R3.5 to R4.1	From R3.5 to R5	From R2 to R3.5	From R3 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	From R0 to R21.2
Area ceiling 2	No change	No change	No change	From 21.2 to 0
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: N	No change: N	No change: N	From N to Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
External Walls				
R-value walls	From R2 to R2.7	No change: R2.5	From R1.5 to R2	From R2.5 to R2.7
Area walls insulated	No change: 104.38	No change: 104.38	No change: 99.36	No change: 99.36
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	From Y to 7.0 stars	No change
Wall colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Internal Walls				
R-value	No change: R2	No change: R2.5	From 2 to 2.5	From 2 to 2.7
Insulated area	No change: 14.99	No change: 14.99	No change: 34.26	No change: 34.26
Floors				
Area floor insulated	No change: 0	No change: 145.98	No change: 0	From 100.9 to 101.1
R-value floor	From 0 to 2	From 2 to 2.5	No change: R0	From 1.5 to 2.5
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	From 1 to 0	No change: R0	No change: R0
Area subfloor walls	No change: 0	From 50.6 to 0	No change: 0	No change: 26.05
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 32.7 to 29.7	From 32.7 to 19.1	From 20.6 to 15.8	From 20.6 to 19.2
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	No change	From 0 to 11.1	From 0 to 5.1	No change
Total Window Area	From 32.7 to 29.7	From 32.7 to 30.2	From 20.6 to 20.8	From 20.6 to 19.2
Frame colour (abs)	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH11, 16 and 19

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Roof				
R-value ceiling 1	From R2.5 to R4	From R4.1 to R5	From R4.1 to R5	From R2 to R3.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R1.3
R-value ceiling 3	No change: R0	From 4.1 to 5	From 4.1 to 5	From 3 to 4
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	From Y to N	From N to Y	From N to Y	No change: N
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
External Walls				
R-value walls	From R1.5 to R2.5	From R2 to R2.5	From R2.5 to R2.7	From R1 to R2.5
Area walls insulated	No change: 253.03	No change: 134.99	No change: 134.99	No change: 150.07
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	From N to Y	No change	No change	No change
Wall colour	From 0.5 to 0.9	No change: 0.9	No change: 0.9	From 0.5 to 0.9
Internal Walls				
R-value	From 2 to 2.5	No change: R2	From 2.5 to 2.7	From 1.5 to 2.5
Insulated area	No change: 26.47	No change: 15.56	No change: 15.56	No change: 48.55
Floors				
Area floor insulated	No change: 0	No change: 93.59	No change: 93.59	No change: 0
R-value floor	No change: R0	No change: R0	From 1.5 to 2.5	No change: R0
Foil floor	No change: N	No change: N	From N to Y	No change: N
R-value subfloor walls	No change: R0	No change: R0	From 0 to 1	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 23.82	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 69.6 to 61.2	From 18.8 to 10.3	From 10.3 to 9	From 57.6 to 47.3
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 0 to 4.1	From 17.8 to 21.6	From 26.3 to 20.8	From 0 to 6.9
Total Window Area	From 69.6 to 65.3	From 36.6 to 31.9	From 36.6 to 29.7	From 57.6 to 54.2
Frame colour (abs)	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

13.7 NCC Climate Zone 7: Canberra and Hobart

13.7.1 Canberra

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	From R4 to R5	From R4 to R5	From R2.5 to R4	From R2.5 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: N	No change: N	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
External Walls				
R-value walls	No change: R2.5	No change: R2.5	From R2.2 to R2.7	No change: R2.5
Area walls insulated	No change: 238.61	No change: 232.53	No change: 159.14	No change: 159.14
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	From 0.5 to 0.9	From 0.5 to 0.9	No change: 0.5	From 0.5 to 0.9
Internal Walls				
R-value	No change: R2.5	No change: R2.5	From 1.5 to 2.5	No change: R2.5
Insulated area	No change: 32.51	No change: 35.21	No change: 54.58	No change: 54.58
Floors				
Area floor insulated	No change: 152.32	No change: 152.32	No change: 259.72	No change: 259.72
R-value floor	No change: R0	From 2.5 to 3.5	No change: R0	From 2 to 3
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 30	No change: 0	No change: 43.19
Area ceramic tile floor surface	No change	No change	No change	No change
Ceiling fans				

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
No. 900	No change: 0	No change: 0	From 3 to 0	From 2 to 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	From 0 to 3	From 0 to 2
Windows				
Area single glazed clear	From 53.1 to 29.3	From 48.7 to 24.5	From 43.9 to 34	From 43.9 to 34.4
Area single low e	No change	From 0 to 0.8	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 0 to 18.9	From 4.4 to 22.3	From 0 to 7.6	From 0 to 7.6
Total Window Area	From 53.1 to 48.3	From 53.1 to 47.6	From 43.9 to 41.6	From 43.9 to 41.9
Frame colour (abs)	From 0.5 to 0.9	No change: 0.5	From 0.5 to 0.9	From 0.5 to 0.9
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	From R4 to R5	From R4 to R6	From R3 to R5	From R4 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	From R2.5 to R4	No change: R2.5	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R4	No change: R4	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	From Y to N	No change: N
Roof colour	No change: 0.85	From 0.5 to 0.9	From 0.5 to 0.9	No change: 0.5
External Walls				
R-value walls	From R2 to R2.5	No change: R2.5	From R2 to R2.7	No change: R2.5
Area walls insulated	No change: 221.27	No change: 221.27	No change: 122.12	No change: 122.12
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	From 0.9 to 0.5	From 0.5 to 0.3	From 0.5 to 0.9	From 0.5 to 0.9
Internal Walls				
R-value	No change: R2.5	No change: R2.5	From 2.5 to 2.7	No change: R2.5
Insulated area	From 63.6 to 54	No change: 61.11	No change: 40.48	No change: 40.48
Floors				
Area floor insulated	No change: 0	No change: 105.01	No change: 134.82	No change: 134.82
R-value floor	No change: R0	From 0 to 3	No change: R0	From 1.5 to 3.5
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	From 1 to 0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 28.52	No change: 0	No change: 29.18
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 45.6 to 25.4	From 45.5 to 27.9	From 29.4 to 19.9	From 27.6 to 13.7
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 8.2 to 23.3	From 8.3 to 20.2	From 0 to 6.8	From 1.8 to 15.7
Total Window Area	From 53.7 to 48.7	From 53.7 to 48.1	From 29.4 to 26.7	No change
Frame colour (abs)	From 0.9 to 0.5	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R2.5 to R4	From R3 to R5	From R3 to R4	From R3 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	From N to Y	From N to Y
Ventilated roof?	No change: N	No change: N	No change: Y	No change: N
Roof colour	No change: 0.5	From 0.5 to 0.3	From 0.3 to 0.9	From 0.5 to 0.9
External Walls				
R-value walls	From R2 to R2.7	No change: R2.5	From R2 to R2.5	From R2.5 to R2.7
Area walls insulated	No change: 104.38	No change: 104.38	No change: 101.09	No change: 101.09
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Internal Walls				
R-value	From 1.5 to 2.5	From 2.5 to 2	From 1.5 to 2.5	From 2 to 2.7
Insulated area	No change: 14.99	No change: 14.99	No change: 34.26	No change: 34.26
Floors				
Area floor insulated	No change: 145.98	No change: 145.98	No change: 0	No change: 101.09
R-value floor	No change: R0	From 2 to 2.5	No change: R0	From 1.5 to 0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	From 0 to 1
Area subfloor walls	No change: 0	No change: 26.88	No change: 0	No change: 26.05
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 32.7 to 25.9	From 32.7 to 20.6	From 20.6 to 17.9	From 20.6 to 17.9
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 0 to 3.8	From 0 to 9.6	From 0 to 2	From 0 to 2.6
Total Window Area	From 32.7 to 29.7	From 32.7 to 30.2	From 20.6 to 19.9	From 20.6 to 20.4
Frame colour (abs)	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH11, 16 and 19

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Roof				
R-value ceiling 1	From R4 to R5	From R4 to R5	From R4 to R5	No change: R2.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	From R4 to R3	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	From 0 to 1.3
R-value ceiling 3	No change: R0	From 4 to 5	From 4 to 5	No change: R2.5
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: N
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	From 0.5 to 0.9	No change: 0.3	No change: 0.5
External Walls				
R-value walls	From R2 to R2.5	No change: R2.5	From R2.5 to R2.7	From R1 to R1.5
Area walls insulated	No change: 213.12	No change: 134.99	No change: 134.99	No change: 150.07
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	From N to Y	No change	No change	No change
Wall colour	No change: 0.5	No change: 0.9	No change: 0.5	No change: 0.5
Internal Walls				
R-value	No change: R2	No change: R2.5	No change: R2.7	From 1.5 to 2.5
Insulated area	No change: 23.63	No change: 15.56	No change: 15.56	No change: 43.25
Floors				
Area floor insulated	From 189.8 to 0	No change: 125	No change: 93.59	No change: 174.77
R-value floor	No change: R0	No change: R0	From 1.5 to 2.5	No change: R0
Foil floor	No change: N	No change: N	From N to Y	No change: N
R-value subfloor walls	No change: R0	No change: R0	From 1 to 2	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 23.82	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 52.8 to 38	From 25.2 to 17.1	From 11.4 to 12.4	From 57.6 to 52.2
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 9.4 to 20.9	From 5 to 11.4	From 22.4 to 16.1	From 0 to 3.6
Total Window Area	From 62.1 to 58.9	From 30.2 to 28.4	From 33.8 to 28.4	From 57.6 to 55.8
Frame colour (abs)	No change: 0.5	From 0.5 to 0.9	From 0.5 to 0.9	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

13.7.2 Hobart

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	From R3 to R4	No change: R4	From R2.7 to R4	From R2 to R4
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
External Walls				
R-value walls	From R2 to R2.5	From R2 to R2.5	From R1.5 to R2.5	No change: R2.5
Area walls insulated	No change: 238.61	No change: 232.53	No change: 159.14	No change: 159.14
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	No change: 0.5	No change: 0.5	From 0.5 to 0.9
Internal Walls				
R-value	No change: R2.5	From 2.5 to 2.7	From 1.5 to 2.5	From 1.5 to 2
Insulated area	No change: 32.51	No change: 35.21	No change: 54.58	No change: 54.58
Floors				
Area floor insulated	No change: 152.32	No change: 152.32	No change: 259.72	No change: 259.72
R-value floor	No change: R0	From 1.2 to 1	No change: R0	From 1.2 to 2
Foil floor	No change: N	No change: N	No change: N	From N to Y
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 30	No change: 0	No change: 43.19
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 53.1 to 28.8	From 53.1 to 33.1	From 43.9 to 32.7	No change
Area single low e	No change	From 0 to 0.8	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 0 to 19.4	From 0 to 14.3	From 0 to 6.3	No change
Total Window Area	From 53.1 to 48.3	From 53.1 to 48.3	From 43.9 to 39	No change
Frame colour (abs)	No change: 0.5	No change: 0.5	From 0.5 to 0.9	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	From R3 to R4	From R3.5 to R4	From R3 to R4	From R3.5 to R4
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R2.5	No change: R2.5	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	From 3.5 to 4	From 3.5 to 4	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: N	From Y to N	No change: Y
Ventilated roof?	No change: N	No change: N	From Y to N	No change: N
Roof colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	No change: 0.5
External Walls				
R-value walls	No change: R2.5	No change: R2.5	From R2 to R2.5	From R2 to R2.5
Area walls insulated	No change: 221.27	No change: 221.27	No change: 122.12	No change: 122.12
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Internal Walls				
R-value	No change: R2.5	No change: R2.5	From 2 to 2.5	From 2.5 to 2.7
Insulated area	No change: 63.64	No change: 61.11	No change: 40.48	No change: 40.48
Floors				
Area floor insulated	From 105 to 0	No change: 105.01	No change: 134.82	No change: 134.82
R-value floor	No change: R0	From 2 to 2.5	No change: R0	From 1.2 to 2
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 28.52	No change: 0	No change: 29.18
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 53.7 to 33.4	From 53.7 to 34.7	From 29.4 to 19.8	From 29.4 to 26.7
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 0 to 15.2	From 0 to 13.4	From 0 to 9.6	No change
Total Window Area	From 53.7 to 48.7	From 53.7 to 48.1	No change	From 29.4 to 26.7
Frame colour (abs)	No change: 0.5	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R2.5 to R3.5	From R2.7 to R4	From R2.5 to R3.5	From R2.7 to R3.5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: Y	No change: N
Roof colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	No change: 0.5
External Walls				
R-value walls	From R0 to R2	From R1.5 to R2.5	From R1.5 to R2	From R1.5 to R2
Area walls insulated	From 0 to 104.4	No change: 104.38	No change: 101.09	No change: 101.09
Area walls uninsulated	From 104.4 to 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	From N to 7.0 stars	No change
Wall colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	No change: 0.5
Internal Walls				
R-value	From 1.5 to 2	From 2.5 to 2	From 1.5 to 2.5	From 1.5 to 2
Insulated area	No change: 14.99	No change: 14.99	No change: 34.26	No change: 34.26
Floors				
Area floor insulated	No change: 145.98	No change: 145.98	No change: 0	No change: 101.09
R-value floor	No change: R0	From 1 to 1.2	No change: R0	From 1.5 to 0
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	From 0 to 1
Area subfloor walls	No change: 0	No change: 26.88	No change: 0	No change: 26.05
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 32.7 to 27.1	From 32.7 to 24.4	From 20.6 to 17.9	From 20.6 to 18.3
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 0 to 4.4	From 0 to 5.8	From 0 to 2.6	From 0 to 2.6
Total Window Area	From 32.7 to 31.5	From 32.7 to 30.2	From 20.6 to 20.4	From 20.6 to 20.9
Frame colour (abs)	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH11,16 and 19

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 TIMBER
Roof				
R-value ceiling 1	From R4 to R5	From R4 to R5	From R4 to R5	From R2.5 to R4
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	From R4 to R5	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	From 0 to 1.3
R-value ceiling 3	From 4 to 5	From 4 to 5	From 4 to 5	No change: R2.5
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: N	No change: Y	No change: Y	No change: N
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	From 0.5 to 0.9	No change: 0.3	No change: 0.5
External Walls				
R-value walls	From R2 to R2.5	From R2 to R2.5	No change: R2.5	From R1 to R2.5
Area walls insulated	No change: 228.27	No change: 134.99	No change: 134.99	No change: 150.07
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	No change: 0.9	No change: 0.9	No change: 0.5
Internal Walls				
R-value	No change: R2.5	No change: R2	From 2.5 to 2.7	From 1.5 to 2.5
Insulated area	No change: 23.63	No change: 15.56	No change: 15.56	No change: 43.25
Floors				
Area floor insulated	No change: 189.81	No change: 125	No change: 93.59	No change: 174.77
R-value floor	No change: R0	No change: R0	From 2 to 2.5	No change: R0
Foil floor	No change: N	No change: N	From N to Y	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 23.82	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 59.1 to 42.9	From 18.7 to 12.7	From 19.1 to 17.3	From 57.6 to 38.1
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 0 to 12.4	From 13.9 to 18	From 10.5 to 13	From 0 to 8.1
Total Window Area	From 59.1 to 55.3	From 32.5 to 30.6	From 29.6 to 30.3	From 57.6 to 46.2
Frame colour (abs)	No change: 0.5	From 0.5 to 0.9	No change: 0.85	No change: 0.5
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

13.8 NCC Climate Zone 8 Thredbo

Houses SBH01 and 02

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Roof				
R-value ceiling 1	From R3.5 to R5	From R4 to R5	From R4 to R5	From R4.5 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.85	No change: 0.85	No change: 0.85	No change: 0.85
External Walls				
R-value walls	No change: R2.5	No change: R2.5	From R2 to R2.5	No change: R2.5
Area walls insulated	No change: 238.61	No change: 232.53	No change: 159.14	No change: 159.14
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.9	No change: 0.9	No change: 0.9	No change: 0.9
Internal Walls				
R-value	From 2 to 2.5	No change: R2.5	No change: R2.5	No change: R2.5
Insulated area	No change: 32.51	No change: 35.21	No change: 54.58	No change: 54.58
Floors				
Area floor insulated	No change: 152.32	No change: 152.32	No change: 259.72	No change: 259.72
R-value floor	No change: R0	From 1 to 2.5	No change: R0	No change: R2.5
Foil floor	No change: N	No change: N	No change: N	From N to Y
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 30	No change: 0	No change: 43.19
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH01 SLAB	SBH01 TIMBER	SBH02 SLAB	SBH02 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 44.3 to 20.7	From 53.1 to 43	From 31.5 to 12.2	From 35.7 to 19.8
Area single low e	No change	From 0 to 0.8	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 16.4 to 28.7	From 0 to 4.4	From 20.8 to 32.4	From 13.9 to 19.1
Total Window Area	From 60.6 to 49.4	From 53.1 to 48.3	From 52.3 to 44.6	From 49.6 to 39
Frame colour (abs)	From 0.5 to 0.9	No change: 0.85	No change: 0.85	No change: 0.85
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH03 and 04

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Roof				
R-value ceiling 1	From R4 to R5	From R3.5 to R4	From R3.5 to R5	From R3.5 to R4
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R4	No change: R2.5	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R3.5	From 3.5 to 4	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: Y	No change: N	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	From Y to N	No change: N
Roof colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.7	From 0.5 to 0.9
External Walls				
R-value walls	No change: R2.5	No change: R2.5	From R2 to R2.5	From R2 to R2.5
Area walls insulated	No change: 221.27	No change: 221.27	No change: 122.12	No change: 122.12
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.9 to 0.7	No change: 0.9
Internal Walls				
R-value	No change: R2.5	No change: R2.5	From 2 to 2.5	No change: R2.5
Insulated area	No change: 63.64	No change: 61.11	No change: 40.48	From 20.3 to 20.1
Floors				
Area floor insulated	From 105 to 0	No change: 105.01	No change: 134.82	No change: 134.82
R-value floor	No change: R0	From 2 to 2.5	No change: R0	No change: R1.5
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 28.52	No change: 0	No change: 29.18
Area ceramic tile floor surface	No change	No change	From 13.3 to 88.2	No change

Key specifications	SBH03 SLAB	SBH03 TIMBER	SBH04 SLAB	SBH04 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 36.6 to 24	From 53.7 to 34.7	From 21.9 to 19.9	From 25.5 to 15.7
Area single low e	No change	No change	No change	From 0 to 1
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 21.5 to 31.2	From 0 to 13.4	From 7.5 to 6.8	From 5.7 to 12.6
Total Window Area	From 58.2 to 55.1	From 53.7 to 48.1	From 29.4 to 26.7	From 31.2 to 29.4
Frame colour (abs)	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH05 and 06

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Roof				
R-value ceiling 1	From R2 to R3.5	From R3 to R3.5	From R2.5 to R5	From R3 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R0	No change: R0	No change: R0	No change: R0
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R0
R-value ceiling 3	No change: R0	No change: R0	No change: R0	No change: R0
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	From N to Y	From N to Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: Y	No change: N
Roof colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
External Walls				
R-value walls	From R1 to R2	From R1.5 to R2.5	No change: R2	No change: R2
Area walls insulated	No change: 104.38	No change: 104.38	No change: 101.09	No change: 101.09
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	From Y to N	No change	From N to 7.0 stars	No change
Wall colour	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Internal Walls				
R-value	From 1.5 to 2	From 1.5 to 2	From 1.5 to 2.5	No change: R2
Insulated area	No change: 14.99	No change: 14.99	No change: 34.26	No change: 34.26
Floors				
Area floor insulated	No change: 145.98	No change: 145.98	No change: 0	No change: 101.09
R-value floor	No change: R0	From 1 to 1.2	No change: R0	From 1 to 2
Foil floor	No change: N	No change: N	No change: N	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 26.82	No change: 0	No change: 26.05
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH05 SLAB	SBH05 TIMBER	SBH06 SLAB	SBH06 TIMBER
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 30.5 to 20.6	From 32.7 to 30.2	From 20.6 to 18	No change
Area single low e	No change	No change	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 5.1 to 9.1	No change	From 0 to 2.6	No change
Total Window Area	From 35.5 to 29.7	From 32.7 to 30.2	No change	No change
Frame colour (abs)	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9	From 0.5 to 0.9
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change

Houses SBH11, 16 and 19

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Roof				
R-value ceiling 1	From R4 to R4.5	From R4 to R5	From R4 to R5	From R4 to R5
Area ceiling 1	No change	No change	No change	No change
R-value ceiling 2	No change: R2.5	No change: R0	No change: R0	No change: R2
Area ceiling 2	No change	No change	No change	No change
Area roof insulated (Attic)	No change	No change	No change	No change
R-value roof blanket	No change: R0	No change: R0	No change: R0	No change: R1.3
R-value ceiling 3	From 4 to 4.5	From 4 to 5	From 4 to 5	From 4 to 5
Area roof insulated (Flat)	No change	No change	No change	No change
Area roof uninsulated (Flat)	No change	No change	No change	No change
Foil under roof?	No change: N	No change: Y	No change: Y	No change: Y
Ventilated roof?	No change: N	No change: N	No change: N	No change: N
Roof colour	No change: 0.5	No change: 0.85	From 0.9 to 0.3	No change: 0.85
External Walls				
R-value walls	No change: R2.5	No change: R2.5	No change: R2.5	No change: R2.5
Area walls insulated	No change: 253.03	No change: 104.36	No change: 104.36	No change: 150.07
Area walls uninsulated	No change: 0	No change: 0	No change: 0	No change: 0
Foil layer walls	No change	No change	No change	No change
Wall colour	No change: 0.5	No change: 0.9	No change: 0.9	No change: 0.9
Internal Walls				
R-value	From 1.5 to 2.5	No change: R2.5	No change: R2.5	From 2 to 2.5
Insulated area	No change: 23.63	No change: 15.56	No change: 15.56	No change: 43.25
Floors				
Area floor insulated	No change: 189.81	No change: 125	No change: 93.59	No change: 174.77
R-value floor	No change: R0	No change: R0	No change: R2.5	No change: R0
Foil floor	No change: N	No change: N	From N to Y	No change: N
R-value subfloor walls	No change: R0	No change: R0	No change: R0	No change: R0
Area subfloor walls	No change: 0	No change: 0	No change: 23.82	No change: 0
Area ceramic tile floor surface	No change	No change	No change	No change

Key specifications	SBH11 SLAB	SBH16 SLAB	SBH16 TIMBER	SBH19 SLAB
Ceiling fans				
No. 900	No change: 0	No change: 0	No change: 0	No change: 0
No. 1200	No change: 0	No change: 0	No change: 0	No change: 0
No. 1400	No change: 0	No change: 0	No change: 0	No change: 0
Windows				
Area single glazed clear	From 27.5 to 11	From 17.7 to 6.5	From 14.5 to 14.7	From 48 to 22.4
Area single low e	From 1.9 to 0	From 1.1 to 0	No change	No change
Area single glazed tinted	No change	No change	No change	No change
Area single glazed heavy tinted	No change	No change	No change	No change
Area single low e tint	No change	No change	No change	No change
Area double glazed argon fill low e	From 41.8 to 52.4	From 17.8 to 24.2	From 16.7 to 15.7	From 17.3 to 30
Total Window Area	From 71.2 to 63.4	From 36.6 to 30.6	From 31.2 to 30.3	From 65.3 to 52.3
Frame colour (abs)	No change: 0.85	No change: 0.85	No change: 0.85	No change: 0.85
Area external Blinds	No change: 0	No change: 0	No change: 0	No change: 0
Highly openable windows louvre	No change	No change	No change	No change
Highly openable windows louvre tint	No change	No change	No change	No change
Highly openable windows louvre tint H	No change	No change	No change	No change
Highly openable windows louvre low e	No change	No change	No change	No change
Highly openable windows louvre low e tint	No change	No change	No change	No change