BBS/9

Halswell 1: Build Back Smarter Case Study

A report prepared by Beacon Pathway Incorporated
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About This Report

Title

Halswell 1: Build Back Smarter Case Study

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Abstract

The Build Back Smarter Project aims to develop evidence that residential performance upgrades at the point of earthquake repair is able and worthwhile to be implemented as part of the Canterbury earthquakes recovery process. Using the case studies of ten homes, the project is exploring and demonstrating what is possible as part of the repairs. This report documents the second completed case study – the upgrade of a house known in the project as Halswell 1.

Reference

Easton, L. (August 2013). Halswell 1: Build Back Smarter Case Study. Report BBS/9 for Beacon Pathway Incorporated.

Disclaimer

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1 Introduction

Over the past 2 years Beacon Pathway Inc has been undertaking research into how energy and water efficiency and indoor environment quality improvements can be incorporated into earthquake repairs from the 2010 and 2011 Canterbury earthquakes. The research has involved the use of case studies to explore and demonstrate what is possible as part of the repairs. This report documents the second completed case study – a house known in the project as "Halswell 1".

2 Halswell 1

Figure 1: Halswell 1

Halswell 1 is a modest, late 1960s, brick clad house. The house consists of three bedrooms, a living room, dining room, kitchen, laundry and bathroom, with a separate garage. The exterior cladding of the house is brick and it has a suspended timber floor. The total dwelling area is 130m^2. The roof is clad with corrugated iron. Heating in the home was with two heat pumps and hot water is supplied by a brand new electric hot water cylinder installed as part of emergency earthquake repairs when the old one was damaged.

The house is owned by a single mother with three children under 16, one of whom has a heart condition and another has respiratory problems. The family has lived there for the last 6 years.

2.1 Earthquake damage

The house and grounds suffered from substantial liquefaction in several of the earthquakes, as well as the ground level dropping. There was also damage to exterior brick cladding (see Figure 2 below), ceiling damage in one room, as well as minor damage to wall linings, and some other fixtures.

Figure 2: Earthquake damage to Halswell 1 exterior cladding

Figure 3: Contaminated liquefaction under Halswell 1

The house was insured by IAG and the Project Management Office (PMO) was Hawkins.

In terms of the scope of the earthquake repairs:

- All of the brick cladding on the ground floor was replaced and building wrap installed
- Ceiling linings were replaced in 3 bedrooms, hallway and lounge
- Wall linings were repaired and redecorated
- Doors were eased and adjusted throughout
- Contaminated liquefaction was removed from the sub-floor
- The floor was levelled through pile repacking
- Ring foundation cracks were repaired and foundation re-plastered
- Driveway, paths and patio paving were replaced
- Additional stormwater drainage was installed

The total value of earthquake repairs is estimated at $150,000 excl. GST. Repairs were undertaken over a period from February 2013 to May 2013. Because of the nature of the repairs, no building consent was required.

2.2 House performance assessment and upgrade

The house was assessed using Beacon's Home Assessment and Prioritised Plan tool. The pre-upgrade condition and performance interventions undertaken are outlined in Table 1 below.

Table 1: Pre-upgrade condition and interventions

Halswell 1	Pre-upgrade condition	Interventions	Cost (excl GST)
Thermal	Thick blown-in insulation previously installed by homeowner.	None required.	
	No wall insulation	R 2.8 Wall insulation installed in whole house from the outside while cladding was replaced and building wrap installed.	$2034
	No underfloor insulation – ineffective ripped foil in place. Liquefaction and subsidence had increased an already damp underfloor – no vapour barrier	R1.6 underfloor insulation installed Polythene vapour barrier installed	$1489

Halswell 1	Pre-upgrade condition	Interventions	Cost (excl GST)
	Draughty external door	Draught excluders installed on door	$10
	Poor condition draughty wooden frames single glazed. Very large north west windows creating overheating problems. Substantial condensation on all windows.	Homeowner funded standard double glazed windows in aluminium frames with glare tint for large north and west facing windows in lounge. BBS project funded additional cost for thermally broken frames with low emissivity argon filled glass.	Total cost $26464 = $6536 paid by BBS and + $19948 paid by the homeowner
Hot water	New (emergency earthquake repair) electric hot water cylinder. Unlagged hot water pipes.	Solar thermal system installed on existing hot water cylinder Pipe lagging installed on hot water pipes	$8440
Heating	Large heat pump in lounge. Poorly located heat pump in hallway; heat pump was installed in easiest location for installer but one which was ineffective for heating all the bedrooms.	No work undertaken as when additional costs (22%) of doing as part of earthquake repairs was considered too large. However the homeowner may relocate hallway heat pump herself in the future.	
Ventilation	Kitchen rangehood vented into ceiling. Ineffective bathroom extract vent, venting into ceiling.	Rangehood ducted to the outside. New bathroom extract ventilation installed and externally ducted.	$1103
Water	Efficient showerhead. High flow kitchen and bathroom taps. Full flush toilet	New dual flush toilet cistern	$600
Total BBS Upgrade Cost			**$40160 = $20,212 BBS + $19,948 paid by the homeowner**

Figure 4: Large draughty windows facing north and west causing overheating in Halswell 1

2.2.1 Homestar™ assessment

Prior to the repair and upgrade, the house was assessed by a Homestar™ Homecoach using the simplified online tool. The house was assessed as being 2 Star. Following the upgrade and repair, a reassessment indicated the house now meets a 5 Star on the online tool. A Certified Homestar™ assessment has not been undertaken. The Homestar™ Homecoach reports are attached in Appendix One.

3 Findings – Repair Process

Figure 5: Mid-repair – Wall insulation being installed from the outside prior to building wrap and recladding

3.1.1 Inclusion of Build Back Smarter upgrades

As with the previous Huntsbury 2 Case Study, inclusion of Build Back Smarter upgrades in the Halswell 1 repairs appears to have had no impact on the pace or difficulty of the repair process for the case study household, PMO or the insurer. As for Huntsbury 2 case study, the liaison was primarily with the builder as main contractor, rather than the PMO or insurer.

In this case study, it proved initially more difficult to get the builder to add additional (paid) work into the scope. This was largely because of the scale of this builder's earthquake repair programme and their priorities being focussed solely on this outcome - the work involved is a very small addition in terms of value to quite a large job. The volume of work available and a preference from PMOs to allocate work to a smaller number of larger main contractors can lead to some degree of over-commitment from those contractors. The builder's Preliminary and General percentage plus margin amounted to 22% on the cost of the additional work. Anecdotally, this size of margin is now common in the Christchurch rebuild, and it led to some items (a proposed rainwater tank and moving the badly located heat pump) from being excluded from the Build Back Smarter scope of works due to financial constraints. This issue of contractor's P & G percentage and its impact on repairs is discussed further in Section Six.

As in the Huntsbury 2 case study, the homeowner also sought additional work to be undertaken at the time of repair; however, this was not through the builder (and hence no additional margin was charged) – the homeowner organised the window replacement with the window company herself.

Figure 6: New windows installed while cladding was removed – a classic Build Back Smarter opportunity

Figure 7: Post completion flooding on the driveway during June 2013 floods
The combination of too much paving, absence of drainage systems and ground subsidence means this home will always have issues with stormwater during heavy rain events.

Figure 8: Ground vapour barrier and underfloor insulation
While the liquefaction was removed from under the house, substantial dampness remains. The ground vapour barrier is a critical intervention to prevent the return of mould and excessive moisture into this house.

Figure 9: Double glazing with thermally broken aluminium frames, low emissivity and argon filled glass with a glare tint in living areas

3.1.2 Homeowner-initiated window work

As part of the repairs, the homeowner was very keen to upgrade the windows to double glazing, and replace the wooden frames which were draughty and in poor condition. This was funded through an extension to her mortgage – although she indicated the approximately $20,000 was about the limit of what she could afford, and that the bank would allow. The homeowner was motivated by previous experience living in homes with double glazing, and was also keen to address glare and overheating issues in the main living room.

Figure 10: Completed brick veneer replacement and new double glazed windows installed at homeowner's cost.
Note liquefaction has been cleared from the perimeter foundation, but still needs to be excavated from the adjacent area.

The homeowner had previously installed a good level of ceiling insulation, and two heat pumps, but it was interesting to note that she prioritised the window improvements ahead of other insulation (e.g. wall, underfloor) or dampness-reducing improvements in the house.

4 Builder experience of the upgrade process

The site foreman for Halswell 1 was interviewed about the builder's experience with the project and Build Back Smarter interventions. His role was to oversee construction, co-ordinate all subtrades on site and liaise with the homeowner through the repair process.

Generally the experience of the process was also a good one with the most measures installed with little problem or impact on the overall project.

Coordination was required with Community Energy Action over the installation of the wall insulation when the cladding was off and this was one of the more critical components in the time schedule as the builder was eager to get the building wrap on the house.

From the builder's perspective, the value of the competent (and accredited) wall insulation installer was not well understood. It is common in both new house builds and renovations for builders to install wall (and other) insulation, so having an additional contractor was seen as unnecessary and creating some extra hassle and minor delay in the process. The site foreman felt the building company would have easily been able to install the wall insulation, and that this would be preferable from their perspective.

Coordination with the window installer was also somewhat time-critical – although windows are installed after the building wrap, so this is less likely to be an absolute time pressure point for the builder.

Coordination with the solar hot water installer has proved to be the most significant issue with this project, largely arising from a conflict of personalities/ priorities. While the solar hot water installer was subcontracted by the building company, it was Beacon's choice of contractor, based on the type of solar hot water system chosen. The homeowner also provided negative feedback about the solar hot water contractor. The solar panels weren't able to be hooked up prior to completion of the repair because the (new) hot water cylinder had developed a leak and this needed to be dealt with by that installer under the warranty.

The builder also identified that supplying a physical drawing (even just a sketch) for work to be undertaken by subtrades such as electricians and plumbers would assist in the ease of implementation of the upgrades. In this house it was initially proposed to move the poorly located hallway heat pump. A quote was required from the electrician; however, without a drawing, he wasn't clear what work was required which added time to the process through clarifying this.

Some problems arose between the Halswell 1 homeowner and the building company around what were earthquake repair issues and what was an existing problem prior to the earthquake – in this case around drainage.

This is likely to be a common issue with earthquake repairs being done several years after the event. In this house, extensive paving draining to soakage existed prior to the earthquake, on what was already a low lying site. Drainage problems were exacerbated by the earthquake, with liquefaction and also the ground dropping further. While some new stormwater drainage was installed as part of the repair, the outcome of the repaving was very unsatisfactory from the homeowner perspective. From the builder's perspective, the homeowner was seeking betterment from the repairs that she was not entitled to.

Key recommendations forward which arise as a result of the interview with the building company site foreman are:

- Investigate whether builders would be willing to undergo the training and accreditation process for wall insulation retrofit installation.
- Ensure a drawing is provided where electrical or plumbing work specific to the upgrade is required –this suggests the need for architectural draughting expertise, or greater on-site overview by BBS case management.

5 Homeowner experience and willingness to pay

The owner of Halswell 1 was interviewed 7 weeks after her house was completed and immediately following the substantial floods of 13/14 June 2013 which had flooded large areas of Christchurch, including her property.

The main expectations she had around the project were that the house would become warm and dry. In this respect, despite the short post-repair timeframe, she felt that the upgrade had delivered a substantial improvement. Previously the house had been noted for its dampness and post-earthquakes this had led to very substantial mould growth in the southwest facing bedroom where two of the children slept.

Prior to the earthquakes, the homeowner had taken some steps to improve the warmth and comfort in her home. With two children suffering from health problems (one with a heart condition and the other with a respiratory disorder), she had been aware of the need to keep the house warm and had topped up the ceiling insulation to a good level. A large heat pump was also installed in the main living area. Following the earthquakes, a second heat pump was installed in the hallway as part of an initiative to help low income households. This was intended to provide heating to the three bedrooms, but was poorly located for this purpose – instead it was located in the easiest place for the installer, anecdotally a common problem with emergency installations.

The family had lived in the house for about 4 years prior to the earthquakes, but prior to that, the homeowner had lived in a house with double glazing. When it came to funding additional improvements to the house at the time of repair, she prioritised this performance improvement initiative ahead of other, more cosmetic, improvements to the house.

Unsurprisingly perhaps, the most notable change for the homeowner post-repair and upgrade was the reduction in moisture in the home and the absence of surface moisture on the walls. The house was also noticeably easier to heat.

"Last year we had to set the heat pump on 25 degrees and it would never heat up the room. My bedroom was like an icebox and the walls of the kids' bedroom were wet. I couldn't have the beds against the walls because of the mould. Since moving back in, we've been running the heat pump at 19 degrees and it is really warm. We haven't needed to run the dehumidifiers or electric blankets and I can't feel the moisture on the walls now".

"When we first moved back in we'd come from a bitterly cold place – and we couldn't believe how warm and easy to heat the house was. We hardly use the second heat pump now – the one in the lounge is heating the whole house"

5.1 Experience of the repair and upgrade process

The delays experienced leading up to the repair process (which commenced 2 years following the earthquake damage occurring) were seen as a significant stress to the household. The subsequent massive increase in dampness as a result of the liquefaction and ground sinking may well have contributed to adverse health outcomes for the children in the home, although the homeowner made significant efforts to keep the house warm, with resultant high energy bills.

The homeowner had a number of complaints about the insurance repair process – particularly relating to the stormwater drainage issues as discussed in Section 4. She felt that the repair didn't address all the stormwater issues created by the earthquake – the builder felt she was trying to get betterment from the insurance company. This may well be a common issue in homes where liquefaction damage has occurred, and where several years have passed since the earthquakes. The homeowner wasn't well able to describe her experience of the house pre-earthquakes – the past 2 years had been spent in a miserable damp mouldy home, and unsurprisingly this was the major focus of her experience of the house.

The homeowner felt that, despite the fact that she had organised the window replacement herself, the role of the Beacon project manager in the process was critical. After 2 years in a damaged home, working part time and juggling her studies and parenting 3 children, and having to move out during the repair, she was at her capacity to deal with the situation. This emphasises the need for the role of project coordinator/facilitator as part of any Build Back Smarter roll out.

5.2 Build Back Smarter approach

The homeowner saw significant value in the Build Back Smarter approach, particularly the independent assessment and advice on priorities for upgrades. She felt there were a number of things included in the Upgrade Plan which she wouldn't have identified herself, and that the prioritisation process was useful. Despite the final BBS upgrade not including many water efficiency measures, the homeowner was interested in these, and in particular the potential benefits of a rainwater tank in helping mitigate stormwater problems.

5.3 Cost and willingness to pay

The homeowner spent approximately $19,500 + GST on the replacement and double glazing of the windows during the upgrade process, the maximum amount that she could afford being added to the existing mortgage. As a low income household (the homeowner is a solo mother, working part time and attending Christchurch Polytech), their capacity to fund improvements at the time of repair was very limited. She identified double glazing as a priority because of the performance improvements – reduced draughts, improved ventilation (many of the old windows wouldn't open), winter warmth, reduced condensation, and reduced glare in summer by including a tint. Additionally the window upgrade is also very visible, and the homeowner believed it was something that would add value to the home in any future resale.

If she had been able to afford it, the homeowner would have been prepared to pay for the insulation and dampness measures included in the house as part of the Build Back Smarter upgrade (insulation, extract vent, vapour barrier). At the time of interview, however, the solar hot water installation was not complete, and the problems and delays meant that this was not a particularly valued component of the upgrade. A further interview will be undertaken once the installation is complete to gauge the homeowner's perceptions of this component of the upgrade.

In terms of actions which weren't taken but were recommended, the homeowner indicated that if she could afford it, she would like to relocate the hallway heat pump to the other end of the hall in the future.

6 Discussion

6.1 Wall insulation and repair – Installation at the time of cladding replacement

The Halswell 1 house had only a small amount of relining as part of the repair scope, but a full reclad. As such, installation of wall insulation from the outside, prior to the installation of building wrap, was the method used, and this enabled the entire house to have wall insulation installed. While a very effective method, this requires very timely action and better co-ordination between the on-site contractor and the specialist insulation installer. The builder wants to get the building wrap on the building as quickly as possible, in order to protect the framing from the weather. In the case of the Halswell 1 case study, some confusion did occur, and this did result in a small delay of work on site. As a result, it was the builder's view, that it would be better if the insulation could be installed by the builder, rather than a separate subcontractor.

It is worth noting that there are issues around finishing (building wrap left covering the subfloor vents, problems with drainage resulting in water ponding under the house) on this case study site, which have a direct adverse impact on the ongoing house performance. This tends to reinforce the wide experience of EECA and other auditors that insulation installation is a specialist job, requiring trained and accredited installers.

There is no reason, however, why builders could not be encouraged to take up this training and accreditation, although the volume and pace of work underway in Christchurch means this may not be something widely taken up, but should be considered. Certainly if builders were trained and accredited to install wall insulation it could make the process slightly easier and faster, and may result in a higher proportion of houses having this intervention included. It could also have positive long term benefits in improving the general skill base of insulation installation in the wider sector.

6.2 Builders' margins for work undertaken by contractors

This case study, and other Build Back Smarter houses currently under repair, have large builders' margins – both P&G and contractors' margins for work being undertaken by third party subcontractors. This has had the effect of substantially increasing (by 22% in this case) the cost of the interventions. This, combined with the need to use the electricians and plumbers already contracted by the building repairer, has resulted in some interventions (e.g. the moving of the heat pump in this case study, plumbing work in another currently under construction) being priced at a prohibitively high level for the work which was proposed.

In the case of the heat pump relocation, a decision was made, therefore, not to proceed with the work, as it could have been done at a later date. However, the high builders' margin does make a substantial difference to the cost of work that must be done at the time of repair, such as the wall insulation.

This raises the issue about whether the model adopted by Build Back Smarter for the pilot, of going through the PMO and subcontracting through the appointed builder, is one which is best for a wider roll out. The original intention of the BBS approach was to work in with the insurer and their PMO; however, it has become clear through the case studies, that the PMO is actually taking little or no role in relation to the BBS repairs, and that homeowners are often getting quotes and negotiating with contractors to undertake additional work at the time of repairs.

Now that the EQC have allowed wall insulation installs at the time of repair, it is worth examining how this is managed. In this case, EQC requires that the builder allow EQC accredited wall insulation installers access to install the insulation, but no extra builders' margin is provided for. The homeowner directly liaises with the wall insulation installer, and pays them directly.

This is a similar approach to that which the homeowner for the Halswell 1 case study used for her window replacement. She organised the window installers to give her a quote, and they liaised with the building company about the installation dates, but billed the homeowner directly. As a result, the BBS up-specification of the windows to thermally broken low e with argon gas did not incur any additional builders' margin – and the window company were paid directly.

If this kind of approach was taken with interventions not requiring the builder or their already engaged subcontractors (e.g. blocklayer, electrician, plumber, plasterer, painter) to undertake the work at the same time as repair, then this would, in particular, improve the affordability of the thermal improvements to the house. The issue of margins would remain with interventions such as ventilation improvements and heat transfer systems required to be undertaken by the builder's own subcontractors. Some of these types of interventions may be able to be deferred to the end of insurance repairs – in practice, sub-trades were often not taking advantage of the ceiling linings being removed and were not fitting these items until linings are replaced.

6.3 Measures included as part of Build Back Smarter upgrades

Following on from the issues discussed in 6.2 above, the case studies undertaken to date tend to indicate that there is a core group of interventions which are best (or can only be) undertaken at the time of repair – and a wider group which should be considered by the homeowner as part of the whole of house assessment and upgrade plan, but which could be undertaken at a later, post repair date.

From the case studies to date it is suggested that the following interventions should be undertaken at the time of repair:

- ceiling insulation retrofit to skillion and low pitched roofs where roofing or ceiling linings are being repaired
- underfloor insulation and ground vapour barrier installation under normally inaccessible suspended floors where foundation repairs are occurring – often these involve lifting the house creating a unique access opportunity to the underfloor
- wall insulation retrofit where recladding or wall linings are being replaced
- increasing specification of windows being repaired/replaced (double glazing, advanced glazing such as low emissivity/argon filled, thermally broken aluminium frames);
- cutting hatches to access “hard to insulate” places – these are common in roof extensions and “popped tops”
- installing externally vented extract ventilation systems in kitchens and bathrooms.
- installing heat transfer systems where ceilings are being repaired
- replacing downlights with surface mounted fittings
- relocating or replacing poorly located/sized/ performing heating systems such as heat pumps and wood burners – it is worth noting that poorly located and sized heat pumps has been a common feature of Build Back Smarter houses.

7 Conclusions

The conclusions of the Huntsbury 2 case study[1] are supported by the Halswell 1 case study. A number of additional conclusions can also be drawn:

- While inclusion of Build Back Smarter upgrades was easily incorporated into the repair process, good communication and co-ordination between the builder and insulation installer are needed where the walls are insulated from the exterior as the need to install building wrap and keep weather off the interior creates a strong time pressure
- Where electrical or plumbing work is required as part of the upgrade, a drawing is needed to assist with the quoting process
- The independent assessment and prioritised recommendations, including a written report, are important for the homeowner.
- An independent facilitator/coordinator role will be key to helping homeowners in any upscaling of the Build Back Smarter approach.
- Extending the Build Back Smarter concept beyond the pilot project will require consideration of how lower income homeowners will be able to fund improvement works.
- Builders’ margins have a significant impact on the cost of the work, and the implementation model for the scale up might be better to follow the EQC rather than Build Back Smarter pilot approach of the homeowner contracting the work separately.

[1] ***Easton (2013)***

8 References

Easton, L. (2013) Huntsbury 2: Build Back Smarter Case Study. Report BBS/6 for Beacon Pathway Incorporated.

Appendix One: Homestar™ Homecoach Pre-Upgrade Report

Homestar™ report

Homecoach assessed

Your Homestar rating

2

Analysis

Congratulations, on completing the Homestar™ rating.

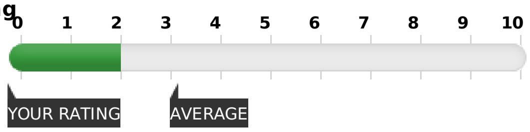
This house has achieved a rating of 2 stars under the Homestar Residential Rating Scheme.

It is possible for this home to achieve a higher star rating, except that it is currently being held back by a mandatory minimum performance level in the core issue of overall warmth and comfort (specifically the ability for the house to achieve healthy winter-time temperatures without using excessive energy). To gain a higher star rating address this core issue first, and then reassess the house once the changes have been made.

A small part of the rating tool rewards non-permanent fixtures of the home such as fridges, freezers, dishwashers, compost facilities etc. If these are removed (for instance when the house changes occupancy) this could affect the star rating of the house.

Compare your rating

The average score for your type of house (Detached State house/mass housing 1960–1970) is 3



Your house has been identified as a type of state or mass housing built in the 1960's. Typically, houses from this era have 'good bones', good orientation and good levels of access to renovation areas which means you have a high chance of success in renovating these houses to perform well. Cavities both in the ceiling and under the floor give relatively easy access to add better insulation and resolve dampness issues. In some cases, the small room sizes of this housing type mean that you may need to choose your heating options quite carefully. Often the pitch of the roof in this type of house makes it easier to install solar hot water systems, and the main living areas are well-orientated to the sun, providing good opportunity to maximise the amount of warmth coming in from the sun.

Energy	29%
Health & Comfort	39%
Water	13%
Waste	33%
Home Management	30%
Site	31%

Recommendation information

Use the recommendations in this report to prepare a plan for your whole house. This will guide you through the process of making your home cosy, warm, healthy, cheaper to run and with a higher rating. Some recommendations involve simple actions you can take at little or no cost. Others involve investments that will pay for themselves through lower running costs or other benefits like making your home more comfortable.

The recommendations are provided in order of priority for improving your overall health and comfort in the home, but you can re-prioritise based on the potential to improve your star rating, the operational cost savings, or whether the recommendation will be kinder on the environment – simply click on the headings to change the order.

Costs and improvement potential

$ $1 - $150	Some improvement
$$ $150 - $500	Modest improvement
$$$ $500 - $1000	Good improvement
$$$$ $1000 - $2500	Great improvement
$$$$$ $2500 plus	Huge improvement

The costs are just a guide – they will vary by location, complexity of your house and individual situation. The

Appendix Two: Homestar™ Post-Upgrade Report

Homestar™ report

Homecoach assessed

Your Homestar rating

5

Analysis

Congratulations, on completing the Homestar™ rating.

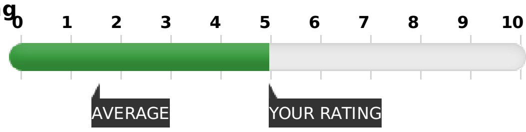
This house has achieved a rating of 5 stars out of 10 under the Homestar™ Residential Rating Scheme. Most New Zealand houses currently score between 2 and 4 stars.

The Homestar™ rating system rates houses on a variety of categories which look at health, comfort, resource use and environmental effects of residential dwellings. Individual Category scores are provided below.

A small part of the rating tool rewards non-permanent fixtures of the home such as fridges, freezers, dishwashers, compost facilities etc. If these are removed (for instance when the house changes occupancy) this could affect the star rating of the house.

Compare your rating

The average score for your type of house (Detached State house/mass housing 1960–1970) is 3



Your house has been identified as a type of state or mass housing built in the 1960's. Typically, houses from this era have ‘good bones’, good orientation and good levels of access to renovation areas which means you have a high chance of success in renovating these houses to perform well. Cavities both in the ceiling and under the floor give relatively easy access to add better insulation and resolve dampness issues. In some cases, the small room sizes of this housing type mean that you may need to choose your heating options quite carefully. Often the pitch of the roof in this type of house makes it easier to install solar hot water systems, and the main living areas are well-orientated to the sun, providing good opportunity to maximise the amount of warmth coming in from the sun.

Energy	37%
Health & Comfort	78%
Water	27%
Waste	33%
Home Management	44%
Site	31%

Recommendation information

Use the recommendations in this report to prepare a plan for your whole house. This will guide you through the process of making your home cosy, warm, healthy, cheaper to run and with a higher rating. Some recommendations involve simple actions you can take at little or no cost. Others involve investments that will pay for themselves through lower running costs or other benefits like making your home more comfortable.

The recommendations are provided in order of priority for improving your overall health and comfort in the home, but you can re-prioritise based on the potential to improve your star rating, the operational cost savings, or whether the recommendation will be kinder on the environment – simply click on the headings to change the order.

Costs and improvement potential

$ $1 - $150	Some improvement
$$ $150 - $500	Modest improvement
$$$ $500 - $1000	Good improvement
$$$$ $1000 - $2500	Great improvement
$$$$$ $2500 plus	Huge improvement

The costs are just a guide – they will vary by location, complexity of your house and individual situation. The house icons indicate how much the recommendation contributes to the priority selected – the more the better (for instance 5 house icons for environment means that the recommendation will be very beneficial to the environment).