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Industry perspectives on exceeding the minimum

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Preface

This report is concerned with the issue of housing that exceeds the minimum standards as set out in the New Zealand Building Code. It is a part of the BRANZ research programme *Exceeding the minimum*.

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BRANZ Study Report SR385

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Abstract

This report seeks to evaluate the benefits of exceeding the minimum within the current New Zealand housing market. The report examines how exceeding the minimum is understood and its benefits are evaluated within the market. It also examines how the building and construction industry evaluates its own practices around exceeding the minimum. A nationwide industry survey was conducted to gain an understanding of current industry practices relating to exceeding the minimum. There are a number of barriers to exceeding Code minimum within the current market, such as a mismatch between real and perceived costs and benefits, but cost is the greatest barrier to exceed the minimum for consumers. Despite this, industry has been exceeding the minimum especially in relation to insulation, energy efficiency and material durability. It was found that, within industry, architects and designers were the main influencers in helping to exceed the minimum within building projects. Our building industry survey outlined that exceeding the minimum is something that certain parts of the industry are attempting to change because of a core belief in wanting to improve the health of New Zealanders. The report outlines some recommendations for targeted initiatives and future research to encourage exceeding the minimum within the residential housing market.

Keywords

Exceeding the minimum, sustainable buildings, building industry performance, New Zealand Building Code, health, housing markets.

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Executive summary

This report examines how the building and construction industry evaluates its practices around exceeding the minimum.

Exceeding the minimum refers to:

- new buildings that go beyond minimum performance levels set out in the New Zealand Building Code and standards
- new buildings that incorporate features and/or consider aspects that are not covered in the Building Code and standards such as access and environmental performance
- existing buildings that are brought up closer to current Building Code minimum performance levels and meeting or exceeding these
- existing buildings that incorporate features and/or consider aspects that are not covered in the Building Code and standards.

This research has sought to answer these questions within the current New Zealand new-build residential housing market:

- Where do stakeholders in the residential construction sector perceive they are incorporating features in their new house that go beyond Building Code requirements?
- What are the real or perceived barriers to the realisation of these benefits?

A nationwide industry survey (n=496 respondents) was undertaken to gain an understanding of current industry practices relating to exceeding the minimum.

There is a mismatch between real and perceived costs and benefits from exceeding the minimum within the market

- Buildings that exceed minimum standards have a number of benefits, such as improved thermal comfort and energy efficiency.
- Cost is one of greatest barriers to exceeding the minimum. We therefore need better cost-benefit methodologies for helping to align costs and benefits (both tangible and invisible) into a rigorous analysis at individual and public good levels.
- Attention should also be directed at consumers' understanding of financial risk – both real and perceived. This is because as costs rise, so does risk.
- To increase the uptake of exceeding the minimum across the market, consumer and industry risk needs to be mitigated. Our research suggests that, within the current residential housing market, there is a mismatch between what the industry thinks are higher-performing buildings and what buildings they are delivering as built.

Building professionals are part of the solution, and health and wellbeing is the common interest

- Our industry survey has helped to highlight that the main driver to exceed the minimum was for health reasons.
- Architects and designers are the main influencers in helping to exceed the minimum.
- Building professionals need to take a central role in educating consumers and by explaining more technical aspects of building performance to apprentices, consumers and so on. They should also be advocating for greater regulations or

just simply leading the way and using the Building Code as a minimum and constructing buildings that exceed that minimum.

Recommendations

- On-going training and support for building professionals to encourage the promotion and uptake of exceeding the minimum. This should involve greater grass-roots dialogue between designers, architects and builders as key influencers in getting the industry to exceed the minimum.
- Raise awareness amongst real estate agents, mortgage lenders, valuers and so on about buildings that exceed the minimum and their costs and benefits in terms of building quality, building performance and health benefits. A greater awareness is likely to have a flow-on effect in resale, as real estate agents could use the building's thermal performance as a selling point.
- More research is needed to identify how exceeding the minimum could be incorporated into financial systems, such as buildings that perform better having a mortgage discount of some kind, in order to redistribute the risk of constructing buildings that exceed the minimum until it becomes more normalised within the market.
- More research needs to be done to examine how the Building Code can be brought into line with international building codes and regulations in countries with similar climates to New Zealand.

1. Introduction

This report seeks to examine where stakeholders in the residential construction sector perceive they are incorporating features that go beyond New Zealand Building Code requirements into their constructions. Further, it seeks to examine the real and perceived barriers from going beyond the Building Code.

Buildings that go beyond the Building Code are considered higher-performing houses that incorporate low energy consumption and/or sustainable design features that help enhance and increase building performance, such as greater thermal comfort and energy efficiency. The increased popularity of higher-performing houses has seen industry-led initiatives such as the Superhome Movement, the Passive House Institute New Zealand, Homestar and smaller individual-led projects such as the Beacon NOW Home and Zero Energy House[1] project. These projects have made higher-performing buildings more visible within the New Zealand residential housing market. Initiatives such as the exemplar Superhome tour, which is held annually in Christchurch by the Superhome Movement, helps to show consumers and industry alike that higher-performing buildings that go beyond Building Code requirements or exceed the minimum are achievable within the current New Zealand market.

Recent research on consumer experiences of going beyond Building Code requirements has highlighted that many consumers see the Building Code as a quality assurance mechanism rather than the legally allowed minimum building standard (MacGregor & Donovan, 2018). Further, it has been highlighted that the relationship between consumers and building professionals is critical to consumer decision making and their choice to exceed the minimum or not. MacGregor and Donovan also suggest that it is important to change consumer expectations when considering cost versus quality, a house as an asset/commodity versus as a healthy home and Code minimum versus exceeding the minimum.

In the context of this report, benefits refer to an advantage or something good that comes from exceeding the Building Code minimum standards. Within building and construction, benefits will most likely be classified under environmental, economic and social benefits (Page, 2009). More specifically, indoor and external environmental benefits could include water conservation, reduced greenhouse gas emissions, temperature control, improved air quality and/or water quality and protecting the environment. Economic benefits could include reducing operating costs and increasing property value. Social benefits could include improving occupant health and wellbeing, creating a user-friendly space and increasing ontological security.

This research has sought to examine the following questions within the current New Zealand housing market:

- Where do stakeholders in the residential construction sector perceive they are incorporating features in their new house that go beyond Building Code requirements?
- What are the real or perceived barriers to the realisation of these benefits?

[1] www.zeroenergyhouse.co.nz

1.1 Defining exceeding the minimum

The Building Code sets out the minimum standards (the lowest legally permissible standard) that a new building must meet. Within our current housing market, new houses tend to just meet the minimum standards outlined in the Building Code rather than striving to exceed the minimum standards.

For this reason, BRANZ established the *Exceeding the minimum* research programme,[2] which seeks to help and encourage consumers and the building industry to understand that the Building Code is a minimum only and that there are real benefits to exceeding these standards. The research programme hopes that, with the benefit of better information and choices around design features and the benefits of these features, the opportunity to consider higher-performing buildings will be created for industry and consumers alike. Over time, it is expected that the research programme will help to create a more responsive housing market, with industry better able to meet consumer expectations, aspirations and needs and create higher-performing housing (James, Saville-Smith, Saville-Smith & Isaacs, 2018).

The *Exceeding the minimum* research programme seeks to ensure that:

- consumers and industry understand that the Building Code and standards are a minimum that must be met but can and should be exceeded
- the benefits of exceeding the minimum can be clearly articulated based on meaningful terms
- the barriers to exceeding the minimum have been addressed
- consumers expect and demand buildings and communities that perform to a higher standard
- the industry delivers buildings and communities that perform to a higher requirement in a cost-effective way.

Within this report, the terms 'exceeding the minimum' and 'higher-performing housing' are used interchangeably to refer to:

- new buildings that go beyond minimum performance levels set out in the Building Code and standards
- new buildings that incorporate features and/or consider aspects that are not covered in the Building Code and standards such as access and environmental performance
- existing buildings that are brought up closer to current Building Code minimum performance levels and meeting or exceeding these
- existing buildings that incorporate features and/or consider aspects that are not covered in the Building Code and standards.

1.2 Structure of report

This report should be read in conjunction with other papers within the *Exceeding the minimum* research programme. It is structured as follows:

- Section 2 examines the market basis for exceeding the minimum and how the market values houses that exceed the minimum.
- Section 3 describes a nationwide industry survey that was undertaken to gain an understanding of current industry practices relating to exceeding the minimum.

[2] www.branz.co.nz/social-economics-industry-research/etm

- Section 4 outlines the results of a survey of industry practices surrounding exceeding the minimum and industry experiences and views on exceeding the minimum.
- Section 5 discusses the overall findings from the study and outlines some recommendations for future research.

2. Background

This section seeks to outline the market basis for exceeding the minimum, which helps to frame industry perspectives and the benefits associated with going beyond Building Code requirements. A core focus of this section is to understand how the market values houses that exceed the minimum and also to understand how we can examine consumer and industry economic decision making in this area.

2.1 Market value of higher-performing houses

The construction industry covers general construction and construction trade services and is the fifth-largest sector of the New Zealand economy, contributing around 5% of gross domestic product (MBIE, BRANZ & Pacifecon, 2016; Statistics New Zealand, 2017). The construction sector employs about 130,000 people, approximately 44,000 workers are builders. The majority of builders, especially in the residential sector, are self-employed builders or work for small firms that build on average two or three houses a year and undertake repair work.

The National Construction Pipeline Report (MBIE et al., 2016) states that New Zealand continues to construct more by value than ever before, with current levels of recorded activity reaching $31 billion for 2015. Value increased by 4% in 2015 and was expected to grow another 20% to a peak of $37 billion towards the end of 2017. The annual value of all construction nationally is forecast to remain above current elevated levels until 2021. For example, the value of building work consented (including alterations) in the month of January 2017 was $1.1 billion, comprising $748 million of residential work and $338 million of non-residential work (Statistics New Zealand, 2017). There continues to be a lot of activity within the building construction industry. There is growth within the market especially for retrofitting existing houses to bring them up to high-performance levels.

At a national job summit in 2009, Beacon Pathway (n.d.b) outlined how retrofitting houses to help improve performance also has employment possibilities to help economic development. Beacon Pathway suggested that, if large-scale projects to improve New Zealand housing performance were initiated, "for every 1,000 homes renovated for improved performance, 151 full time equivalent jobs would be required on-site, and 392 full time equivalent jobs to provide related products and services". A similar effect was seen with increased work generated by the Government's Warm Up New Zealand scheme (Grimes et al., 2012). Such figures suggest there is potential for the market expansion of increased building and construction activity if a concerted effort is made to target particular issues, such as the Warm Up New Zealand scheme that focused on increasing insulation in house with no or substandard insulation.

Page (2009) considered the costs and benefits of a variety of energy and water interventions in three different climate zones across the country, finding that lower cost renovations were financially worthwhile throughout the country and the financial case for more expensive and extensive renovations improved the further south you went.

> [W]all insulation retrofit was cost-effective but the other measures were either not cost-effective (rainwater tanks, hot water heat pump), or were cost-effective only in the cooler parts of the country (curtains, secondary glazing). The net benefits [of retrofitting homes with sustainability features] were scaled up for the total housing stock to give total benefits of about $22 billion in net

> present value (NPV) terms, assuming retrofit of the total stock over the next 15 years. The investment required is about 12 billion in present value and the benefit-cost ratio (BCR) is approximately 2.8. (Page, 2009, p. 1)

There are benefits from increasing house performance, but it is limited to the climatic zone the house is located.

An often under-recognised benefit of higher-performing homes and their more sustainable features is the lower demand on stressed infrastructure. In terms of climate change resilience, reduced pressure on infrastructure is critical, as without reduced water demand, local government faces extensive infrastructure costs (KPMG, 2012). Indeed, there are a number of benefits for New Zealand to help improve its housing stock. In terms of benefits, more sustainable housing could enable energy efficiency by saving enough electricity to power 500,000 homes per year and recoup $52 million worth of tradable CO_2 emissions and save 130 million cubic metres of water (Beacon Pathway, n.d.a).

These financial arguments for higher-performing houses are often conflicting. A cost-benefit analysis may help make the financial benefits explicit. However, more than one approach is needed to understand who benefits from improved housing performance. A common measure when promoting higher-performing housing is the payback period and the operational cost savings. Both measures are the two biggest motivators to promote sustainable behaviour. It is important to ask whether the market recognises these benefits.

Research undertaken by Christie (2010) helps shed light onto the market perception and value of higher-performing houses. As part of her study, she compared print and online real estate advertising. Her results found that references to terms used for higher-performance housing, such as energy efficiency, were often dropped by 49% of advertisements when going from the online version to the print version. This finding is similar to that experienced in the UK, where it was found that being environmentally friendly ranked seventh out of 10 for overall priority (Green Building Press, 2007, cited in Christie, 2010). The most widely advertised high-performance features were solar water heating (59% of advertisements) closely followed by double glazing (48% of advertisements) and insulation (10% of advertisements). The high incidence of these terms within the advertising suggests these ideas are common and within homeowners' awareness and have a market presence in New Zealand. Christie's research also suggests that there is a disconnect between homeowners' stated preferences and the benefits of high-performance buildings, which are not accurately reflected in the market. As we have examined, there is great market benefit to make sure houses exceed the minimum building standards as they are healthier and more energy efficient. However, we have also shown that the market is not always receptive to housing that exceeds the minimum standards. Therefore, we need to understand how consumers value these houses and make their decisions about adopting higher-performing building innovations.

2.2 Understanding the behavioural economics of exceeding the minimum

In order to understand the value and benefits of exceeding the minimum within the existing housing market, we must understand the behavioural economic decision making of consumers. Christie (2010) and Salvi and Syz (2010) have found that willingness to incur the extra cost of exceeding the codes and standards are

predominantly related to income levels rather than environmental ideology. This suggests that economic decision making, especially with regard to the choice to build beyond Code, is strongly associated with private resources. As we have previously noted in this report, some benefits such as energy saving from better insulation may be relatively easy to quantify. The two main methods to quantify benefit to consumers have been the contingent valuation method and cost-benefit analysis. We will address each of these methods in turn.

2.3 Contingent valuation method

Contingent valuation (CV) is a method used for placing hypothetical monetary values on environmental goods and services not bought and sold in the market place (Carson, 2000). The method has a long history dating back to 1947 and refers to value that is contingent upon a constructed or simulated market (Portney, 1994). The method provides a way to understand the value individuals place on private or public goods. Portney suggests that there is no standard approach to the design of CV. Instead, there are several elements that have been adopted in multiple studies. First, a survey contains a scenario or description of an issue (hypothetical or real), such as a proposed policy change. The scenario is described in as much detail as needed but must give the respondent a clear picture of the good that the respondent is being asked to value. Second, the survey CV research must contain a mechanism for eliciting value or a choice from the respondent. For example, it could include open-ended questions, such as "What maximum amount would you be willing to pay…" or "The government is considering doing X. Your annual tax bill would go up by Y if this happens. How would you vote?" The final characteristic of CV is that it usually elicits information on the socio-economic characteristics of the respondents (age, ethnicity, income, education) as well as their attitudes or behaviour to the issues being discussed such as environmental attitudes.

One of the simplest and commonly used CV techniques is via a question format whereby the respondent or interviewee is offered a binary choice between two alternatives, one being the status quo and another alternative having a cost greater than maintaining the status quo (Carson, 2000). For example, the respondent would be told the government will impose a specific cost (such as an increased tax or higher service fee) if the status quo alternative is provided. Therefore, the key element in the CV is that the respondent provides a favour/not favour answer with respect to the specific alternative cost/policy change versus the status quo, where and what the alternative policy/cost will provide, how it will be provided and how much it will cost will have been clearly specified. Carson suggests that the random assignment of numbers to respondents allows the researcher to gain an understanding of the distribution of the willingness to pay for the good.

CV is an important and useful method where valuation is difficult due to the lack of a market to generate prices, as the topic may be issue driven such as pollution (Hanemann, 1994). CV is a useful method for non-market valuation and a useful way to gain insight into consumer behaviours on the choice to exceed minimum building standards. CV provides a way to examine a demand curve where one may not be observable, as there is no fixed market for the commodity or service. Therefore, CV can help explain the existence of a latent demand curve. Diamond and Hausmann (1994) argue that CV is unreliable due to credibility and bias issues. They suggest that CV is an anomaly due to the embedding effect – the tendency of willingness to pay responses to be highly similar across different surveys, even when a survey from different contexts and different issues would illicit different responses. An example of

embedding would be willingness to pay to clean up one lake, even when the cost was roughly equal to that of cleaning up five lakes. Thus, because of embedding effects, different CVs can obtain widely variable stated willingness to pay for the same public good.

Matthews, Gheorghiu and Callan (2016) suggest that, within studies of willingness to pay, people commonly overestimate how much others will be prepared to pay for products and that people's preparedness to pay is based upon their self-belief of their own affluence and sometimes (but not always) a belief that others are more better off than oneself. Therefore, people tend to overestimate others' willingness to pay, which is partly due to differing beliefs about the material circumstances of the target individuals and their affluence beliefs in some circumstances contributing to the net overestimate of people's willingness to pay. Interestingly for housing, Matthews et al. also suggest an endowment effect, which is the tendency for owners to value products more highly than non-owners. Therefore, in terms of housing, this could mean owner-occupiers, especially those directly involved in retrofitting or building a new house, are more likely to overestimate their willingness to pay, which is relevant for high-performance housing that exceeds the Building Code.

Following the 1989 *Exxon Valdez* oil spill in Prince William Sound, Alaska, CV was used as a method to gauge the economic impact of this vast environmental disaster. A panel was set up by the National Oceanic and Atmospheric Administration (NOAA) to enquire into the validity of CV as an assessment method (Arrow et al., 1993). The panel outlined a number of methodological recommendations that, when undertaking CV, researchers should incorporate to help the robustness of the method:

- Questions on prior knowledge and established attitudes towards the situation.
- Indication of how CV scenario will be implemented and paid for and an outline of the status quo.
- Questions on the participants' willingness to pay for the good.
- A debrief to establish how well the participants understood the scenario.
- Demographic questions.

To explore the validity of CV as a method to understand who benefits from high-performance housing, a case study has been examined.

2.3.1 Case study: Valuing warm homes – exploring New Zealanders' home heating choices

Vujcich (2008) undertook a research project into New Zealanders' home heating choices. Specifically, the research sought to understand how New Zealanders value energy-efficient heating and to explore how they made decisions about home heating. Vujcich's research highlighted the socio-economic and cultural factors that impact on New Zealanders' home heating choices. Her core finding was that a person's reluctance to adequately warm their home to recommended WHO levels (18–21°C) was in part due to the tight economic circumstances (personal income) of many individuals. She also suggested that reluctance to warm houses was tied to deeply held cultural beliefs such as the "stoic, tough New Zealand masculine identity" (Vujcich, 2008, p. 11). However, behavioural aspects alone were not the sole reason individuals may be reluctant to heat their home. There has also been a systematic failure of agencies to adequately inform consumers about the benefits associated with more energy-efficient heating. For example, in 2008, EECA admitted that no one had taken up their $500 subsidy for solar water heating during the last financial year.

Vujcich's mixed-methods study consisted of a Housing, Heating and Health Study (HHHS) contingent valuation survey followed by focus groups addressing consumers' willingness to pay for home heating choices. The object of the quantitative study was to establish how people value energy-efficient home heaters. This was conducted in two ways. First, data was gained from the HHHS undertaken by the He Kainga Oranga/Housing and Health research programme at the University of Otago, Wellington. The HHHS began in 2005 and sought to understand the role of home heating on childhood asthma. Households for this study were recruited from Porirua, Hutt Valley, Christchurch, Dunedin and Bluff. Key inclusion criteria for the study was a child aged 6–12 years with diagnosed asthma living in a home where the main form of heating was either a plug-in electric heater or unflued gas heater. The study recruited 412 households and was completed with 349 households – an 85% retention rate. In return for participation in the study, participants were offered the choice of the installation of either a flued gas heater, a heat pump or a wood pellet burner at no cost. In the course of the study, HHHS participants were given detailed information on the association of health outcomes and indoor air quality, particularly in relation to asthma, outdoor air pollution levels and the sustainability of different heaters. Within the context of the HHHS study, participants were informed about the potential health and environmental benefits. The CV study used data from 2005 and 2006.

The 2005 and 2006 willingness to pay data represented the valuation of all study members before heaters were installed. Participants were asked the following question:

> We would like to measure how much your household values your new heater. One way of doing this is to imagine how much you would pay for your new heater (in fact, the heater will be free to you – you will not be asked to pay). Would this be:
>
> - Nothing
> - $1–300
> - $301–1,000
> - $1,001–2,000
> - $2,001–5,000
> - Over $5,000

The 2005 willingness to pay survey found that nearly 50% of people were willing to pay less than $300 for their heater – the median being $533 in 2005 and $1,011 in 2006. While the 2006 survey suggested a wider willingness to pay, very few consumers were willing to pay above $5,000. The study found that a core factor in an individual's willingness to pay was personal income. Those with higher incomes were more willing to pay for a heater than those on lower incomes. For example, from the 2005 survey, those on lower incomes had a willingness to pay of $391, those on middle incomes $628 and those on high incomes $1,250. In the 2006 survey, willingness to pay was higher for all income groups: lower $681, middle $1,257 and higher $1,815. Interestingly, similar results were also expressed according to housing tenure, with those who owned their house willing to pay the most at $851, those in private rental housing $369 and those in social housing $283. Willingness to pay was also influenced by environmental factors. The two climatic zones within the North and South Island demonstrated a deferential in willingness to pay for home heating, with North Island study participants at $460 (2005) and $670 (2006) compared to the South Island at $708 (2005) and $1,391 (2006). Vujcich's CV study found that, despite the information provided on the benefits of energy-efficient heaters, participants tended to value

energy-efficient heaters below their actual market price. However, in the second year of the study, the CV increased. This was believed to be due to several factors such as a severe winter. Despite the willingness to pay variance, Vujcich's study demonstrates that New Zealanders continue to live in cold, unhealthy homes and lack the personal resources and capability to adequately heat them. This in turn impacts the ability of consumers to exceed minimum standards.

2.4 Cost-benefit analysis

Cost-benefit analysis (CBA) is a tool that uses a quantitative approach to assess the merits of a project or plan. It evaluates the value of a project by assessing the costs and benefits to a community if the project is undertaken compared to not undertaking it (Leong & Lim, 2016). The core aspect of CBA is the economic valuation in terms of market prices, which is in contrast to CV.

For public investments and policy decisions, CBA is accepted as a core appraisal technique (Pearce, Atkinson & Mourato, 2006) providing a flexible, well-established framework for weighing relevant costs and benefits. Applications of CBA range from rudimentary to comprehensive, often drawing on diverse specialities of economics. The flexibility of the CBA framework enables the application of analytical rigour to be varied in proportion to the importance of the decision being made (The Treasury, 2015).

The body of CBA studies can be broadly categorised as private or social. Private CBA tends to consider only costs and benefits that are already captured in market prices for one or several representative buildings as they relate to specific persons or organisations (Mishan & Quah, 2007; Gjerde & Cairncross, 2012; Page, 2016; Smith, 2009). This can be considered as a form of cost accounting (National Institute of Building Sciences, 1982) and closely resembles the established practice of life-cycle costing whereby both capital and operational costs of a building are quantified to inform decision making in the design and construction process (Langston, 2013). Some studies, such as Page (2009), take a private CBA approach and aggregate the findings at a building level up to the national level, which is an economical way of applying CBA at a national scale as it uses internalised costs that are readily available. Additional detail is required to justify social investment (The Treasury, 2015).

Social CBA often requires an estimate of the monetary value where there is no established market price, applying techniques from welfare economics to consider the impact on the whole economy, modelling how the economy adapts and considering externalised costs as well as the internalised costs of a private CBA (Pearce et al., 2006; The Treasury, 2015). Revealed preference methods are one family of approaches to estimating market value without a market price, which instead use prices in related markets. One such method is hedonic pricing, which is a statistical technique to identify how a set of attributes each contribute towards the overall price of a good, such as the value ascribed to extra sunlight exposure on the overall value of a house (Fleming, Grimes, Lebreton, Mare & Nunns, 2017). Applying hedonic pricing to housing requires comprehensive and consistently coded data on all the features that contribute to house values, not just the features of interest (Malpezzi, 2003). Stated preference methods are another family of approaches that are used when there are no suitable direct or related market prices. This typically involves surveying individuals on how much they would hypothetically value non-market goods, although it can be challenging to establish the validity of these methods (Pearce et al., 2006). Comprehensive social CBA may also consider the impact of behavioural and market

changes in response to changing incentives – for example, the take-back effect across society (The Treasury, 2015).

In terms of a social CBA, the health benefits from improved indoor air quality associated with higher-performing houses are difficult to derive in New Zealand. Both public and private health benefits are difficult to provide as there is a lack of suitable life tables (Miller & Hurley, 2003). Whilst Grimes et al. (2012) noted that health benefits comprised 99% of the benefits from improved home insulation and heating, most of these accrued to society at large rather than specific households. Chapman, Howden-Chapman and O'Dea (2004) did quantify some of the direct health benefits to households, but these were conflated with benefits to society at large and were not comprehensive. Development of a methodology to quantify the impact of indoor air quality on occupant health and the financial costs associated with this impact should be investigated in future research.

While a range of methods can be used to estimate costs and benefits, it is important to note that they are all alternative methods of measuring the same value and therefore cannot be added together. However, contrasting the values derived from market prices, revealed preference and stated preference methods can yield insights into market perceptions and understanding, although this is rarely done. Jaques, Norman and Page (2015) noted that improved performance from sustainability features is often not reflected in house values in New Zealand due to a lack of understanding between households, the construction industry and the real estate industry. Dastrup, Zivin, Costa and Kahn (2012) found the opposite in the California housing market, applying hedonic pricing analysis to identify that houses with solar panels fetched a sale price premium of $22,554 over those without solar panels and that this premium was greater than the market cost of installing the panels ($20,892). The premium was even greater in areas with more highly educated residents, which points towards a greater level of acceptance and understanding of sustainability features compared to less-educated areas of California and New Zealand overall.

2.4.1 Cost-benefit analysis best practice

Drawing on The Treasury (2015) and Udvarhelyi, Colditz, Rai and Epstein (1992), best-practice CBA involves six core principles for the benefit of the researcher and subsequent readers regardless of analytical sophistication.

- CBA should be clear on which perspective is being analysed – for instance, an individual, local government or central government.
- It should be explicit on the scope of benefits of the proposed investment or policy.
- It should clearly specify which costs are being considered.
- Where costs and benefits occur through different points in time, they should be discounted to a common time period.
- Sensitivity analysis should be carried out on all assumptions.
- The CBA should be captured into a summary statistic such as a cost-benefit ratio.

The first three best-practice principles can be dealt with by the thorough application of a theoretical framework that makes explicit the relationship between costs, benefits and the analytical perspective. This can be developed from generic examples (for instance, The Treasury, 2015) or be field specific (discussed in section 2.4.2).

Sensitivity analysis establishes the sensitivity of results to input assumptions. Making assumptions is a practical approach to dealing with uncertainty or impracticality in establishing more authoritative information and is commonplace across CBA (The

Treasury, 2015). The subjectivity of assumptions presents a risk of artificial or manipulated results, so sensitivity analysis is ubiquitous across CBA studies for analysing how the choice of assumptions impacts on the findings. Pearce et al. (2006) suggested an analysis is considered robust if the sign of the net benefits does not change in response to an input parameter varying between its likely minima and maxima. The minima and maxima are a matter of judgement but typically represent 50% above and below the assumed value.

Most CBA involves a range of costs and benefits that occur at various points in time, which requires discounting to take account of the time value of money. This is dealt with by quantifying costs and benefits into monetary terms and applying the practice of net present value (NPV), which encapsulates the stream of future costs and benefits into a single NPV figure that considers the timing of costs and benefits and the relevant discount rate. The NPV figure indicates whether the benefits are sufficiently positive to proceed or not or which, out of an array of projects, offers the greatest net benefits (Mishan & Quah, 2007). Discount rates have long been subject to debate (Baumol, 1968; Mayo, 2007). However, the cost of borrowing from capital markets is generally appropriate (Mishan, 1971). This will depend on the perspective of analysis, as analysis at a household level should reflect the household cost of borrowing and social analysis should reflect the societal cost of borrowing. Page's (2016) household level analysis used 5%, the prevailing mortgage borrowing rate for New Zealand households. The Treasury (2015) recommended 6%, the long-run rate of return on the share market, for New Zealand social analyses. Regardless of the choice of discount rate, it often has a significant effect on the NPV and as such should be subject to sensitivity analysis.

Summary statistics for CBA typically draw upon NPV with a comparison of NPV itself across competing projects or a benefit-cost ratio based on the NPV of benefits and costs. Internal rate of return and payback period are referred to in some analyses (for example, Smith, 2009) but fail to account for the time value of money (Pearce et al., 2006).

2.4.2 Benefits

CBA of building projects typically avoided health, energy and environmental costs as benefits. The scope of benefits quantified is influenced by the feasibility of quantifying the benefits rather than a particular evidence base. Intangible or unquantifiable benefits are sometimes mentioned but not developed further, such as improved wellbeing from living in a better-maintained dwelling (Roys, Davidson, Nicol, Ormandy & Ambrose, 2010).

Health

Examining the health benefits within CBA often follows a similar methodology to traditional CBA, although the quantification of health impacts requires different methods. This can be considered in two parts – estimating the impact of an intervention on health outcomes and the conversion of health outcomes into dollar terms. As CBA requires all costs and benefits to be analysed in the same units, health impacts are converted into dollars using established approaches. This can sometimes be controversial, but the practice follows an established body of literature, commonly using value of statistical life year (VOSLY) for morbidity, the value of a statistical life (VOSL) for mortality and willingness to pay for mental health impacts (Pearce et al., 2006).

In New Zealand, standard values are provided for the VOSL ($3.85 million) but not the VOSLY, and the two cannot easily be equated as the value of a statistical life varies with age (Guria, 2010). There is a New Zealand standard cost of PM_{10} air pollution of $40 per person per year per microgram/m^3 (The Treasury, 2015), although this is based on a transport context and it is unclear how this relates to an indoor environment (New Zealand Transport Agency, 2013). Holt (2010) explores approaches to quantifying the cost of ill health focused on indirect costs of absenteeism and limitations to working, noting that the findings are highly sensitive to assumptions made.

Estimating the impact of a health intervention on health outcomes varies considerably depending on the type of intervention. Garrett, Roys, Burris and Nicol (2016) estimate the health benefits that accrue to the UK National Health Service (NHS) of a broad-ranging publicly funded house improvement programme. This is based on subjective assessment by building inspectors who categorise hazards into a harm-likelihood framework, where harms are placed in four categories based on the severity and multiplied by the likelihood. The estimated reduction in harms is multiplied by typical direct costs incurred by the NHS to derive the benefit of the intervention.

CBA of improving drinking water quality in New Zealand by Moore, Black, Valji and Tooth (2010) considered the health benefits in terms of avoided costs to society, grouped into healthcare costs, travel costs to access healthcare, lost productive time and death for those experiencing illness and lost productive time for caregivers looking after ill children. Cost of death is estimated based on remaining life expectancy and the market value of lost productive time.

Chapman et al. (2004) used an alternative approach in quantifying the health benefits of a house insulation retrofit programme. Instead of quantifying the health impacts, this study quantified the reduction in costs associated with improved health outcomes – the costs of a doctor visit and hospital admission and the labour costs associated with time off school and work. This is less intensive than other approaches and is relatively robust, but as the incidence of these costs is spread across individuals and the government, the link between conclusions and specific decision makers is unclear. Grimes et al. (2012) built on these costs to provide a comprehensive CBA of a retrofit insulation and heating programme. Applying the health costs of Chapman et al. (2004) required the health records of individuals living in homes subject to the retrofit programme to analyse how the use of health services had changed after the intervention.

The indoor air quality and health literature largely focuses on its impact on productivity in commercial buildings (Wyon, 2004) or on health with respect to heavily polluting biomass stoves in developing countries (Ezzati & Kammen, 2002; Fullerton, Bruce & Gordon, 2008). In discussing the health impact assessment of air quality, the World Health Organization (2006) indicated that information is needed on air pollution concentrations and exposure, the population groups exposed, background incidence of mortality and morbidity, and the concentration-response functions. It further mentioned that the composition of particulate matter varies considerably between indoor and outdoor environments as well as between and within cities, which makes locale-specific data even more important. Kay, Prüss and Corvalán (2000) developed a useful conceptual framework to relate a reduction in exposure to its impact on the burden of disease, considering unavoidable exposure that cannot be reduced.

Hamilton et al. (2015) developed a unique theoretical framework relating home energy interventions to indoor air quality and health outcomes. The link between indoor air quality and health outcomes draws upon the life tables developed in Miller and Hurley (2003) for the UK and quantifies the relationship between incremental exposure to air pollutants, temperature and mould growth to the risk of morbidity and mortality. The translation of this into economic impact is then straightforward, using standard values for VOSL and VOSLY. However, the underlying relationship is specific to the population of interest, so a New Zealand study would require New Zealand-specific life tables to be developed. In noting the difficulty in quantifying health impacts, these may be significant, as Grimes et al. (2012) found that health benefits comprised 99% of total benefits for a home heating and insulation CBA.

Environmental

Buildings have a wide range of impacts on the environment. However, the environmental benefits of buildings are typically expressed as the abated cost of greenhouse gas emissions associated with reduced or cleaner energy consumption (Kats, 2003; Preval, Chapman, Pierse & Howden-Chapman, 2010). Preval et al. (2010) established a cost for greenhouse gas emissions that are higher than New Zealand's market price (i.e. the price of carbon within the New Zealand Emissions Trading Scheme) on the basis that the market price fails to fully account for the costs associated with such emissions, that is, it is not fully internalised in market prices.

Energy

The benefit of reduced energy costs is quantified in many building cost-benefit studies. Page (2016) assumed constant electricity prices of 27 c/kWh across New Zealand, with annual growth of 2% drawing on residential retail electricity price data that shows spread across parts of the country and over time. Page (2009) derived average energy prices for electricity, solid fuel and gas from retailer websites.

Water

Benefits from reduced water consumption are easily quantified when there is a consumption-based water charge. However, in New Zealand, only some territorial authorities charge for water based on consumption (Bint, 2012).

2.5 Construction costs

The practice of establishing construction costs varies considerably in academic and governmental research reports and is likely to vary considerably between different countries owing to different local data sources. Within New Zealand, QV *costbuilder* (formerly Rawlinsons NZ Construction Handbook) is most commonly used for quantifying costs (Fung, 2010; Gjerde & Cairncross, 2012; Page, 2009, 2016), and *The New Zealand Building Economist* (Wilson, 2016) is somewhat less common (Mithraratne, Vale & Vale, 2007). Both resources provide a limited description of their proprietary data collection processes, with QV *costbuilder* FAQs stating that rates are obtained from "more than 70 different trade suppliers"[3] and Wilson (2016) indicating that rates are set by independent quantity surveyors. Rates are provided for different building elements and QV *costbuilder* breaks this down further into labour and material components of each element. Both appear to follow the cost analysis framework of New Zealand Institute of Quantity Surveyors (2012). Regardless of the rigour applied in deriving these proprietary datasets, the widespread use of these resources indicates

[3] https://qvcostbuilder.co.nz/app.html#/frequently-asked-questions

that they represent the most efficient means of obtaining construction cost data. QV *costbuilder* includes rates for waste disposal, which can be framed as a benefit (avoided cost).

There are several life-cycle costing standards that are relevant, providing a framework for categorising costs in a consistent way to enable comparison across projects – for example, ISO 15686-5:2017 *Buildings and constructed assets – Service life planning – Part 5: Life-cycle costing* and BS EN 16627:2015 *Sustainability of construction works. Assessment of economic performance of buildings. Calculation methods*. These are aimed at specific projects at the design or predesign stage and therefore require a high level of detail, which may not be appropriate when modelling a general intervention across the national building stock. Neither cover cost-benefit analysis nor collection of construction cost information.

2.6 Cost-benefit analysis of Homestar

The Homestar rating tool is a useful measure for promoting high-performance housing. There is a growing number of CBAs about Homestar. An e-Cubed Building Workshop (2013) CBA undertaken for Auckland Council suggested that houses with a rating of 5-Homestar to 7-Homestar were the most attainable for a standard New Zealand house. From a housing performance point of view, a homes with a rating of 5-Homestar above are more energy and water efficient and healthier to live in than a Code minimum constructed dwelling. However, in determining the CBA of higher-performance housing, e-Cubed Building Workshop included in their analysis increased insulation levels, low-flow fittings (which assist in reducing hot water use), a hot water heat pump and energy-efficient lighting (CFLs or LED). Excluded in the CBA were materials selection, site selection and ecology, home management features, waste minimisation and recycling features and accreditation costs to achieve the Homestar rating.

The e-Cubed Building Workshop CBA showed that for 5-Homestar and 6-Homestar rated houses, positive paybacks were expected in 3–6 years. The CBA recommended that Homestar become a formally adopted rating system used by the Council with houses set to meet a minimum target of 6-Homestar. A report by the Christchurch City Council (2013) has suggested that building to exceed the minimum (5-Homestar to 7-Homestar) can be widely achieved with products and materials currently available on the market and with current construction methods. The report states that the Homestar rating outlines some easy wins that can help the economic and environmental sustainability of the house. For example, water-saving technologies such as a rainwater tank or greywater system may be a low priority for the home buyers' market but would add huge value for the Council as it would help with consumer costs and demands on infrastructure. The report suggests it is likely that the "cost of more expensive upgrade items can be expected to fall over time as supply increases and specifications become standard practice" (Christchurch City Council, 2013, p. 17).

e-Cubed Building Workshop undertook an updated and expanded CBA of Homestar in 2018. The study focused on hard costs of energy and water only and did not address the costs of materials selection, site selection and ecology, home management features, waste minimisation and recycling features and accreditation costs (e-Cubed, 2018). The CBA focused on Homestar version 4 under which ratings of 6-Homestar to 8-Homestar were identified as being the most attainable for a standard New Zealand house (e-Cubed Building Workshop, 2018). The CBA focused on comparing building Code houses to 6-Homestar to 8-Homestar houses in Auckland, Wellington and Christchurch.

For 6-Homestar:

- the capital cost of investment was $1,142 for Auckland, $2,510 for Wellington and $2,370 for Christchurch
- the total hard cost savings per year were broadly the same across the three centres at approximately $465 to $471 above a Code-minimum house with a payback 2, 5 and 5 years respectively.

For 7-Homestar:

- the capital cost of investment was $14,955 for Auckland, $22,305 for Wellington and $19,290 for Christchurch
- the total hard cost saving per year were $2,115 for Auckland with a 7-year payback, $2,325 for Wellington) with a 10-year payback and $1,613 for Christchurch with a 12-year payback.

For 8-Homestar:

- the capital cost of investment was $21,055 for Auckland, $33,835 for Wellington and $34,810 for Christchurch
- the total hard cost saving per year were $2,094 for Auckland with a 10-year payback, $2,475 for Wellington with a 15-year payback and $1,768 for Christchurch with a 22-year payback.

A 2018 study sought to determine the additional capital cost of Homestar rated houses compared to a Building Code-compliant design (Ade, 2018). Based upon an analysis of 10 case study dwellings in Auckland's Hobsonville Point, the designs were compared against Homestar versions 2, 3 and 4. The report found that, for a 6-Homestar rating, a median additional cost of 3–5% was incurred, with a 7-Homestar rating attracting an additional 12% for Homestar versions 2 and 3 – but only an additional 4% for Homestar version 4 (see Table 1 for an outline of costs for Homestar versions 3 and 4). These results are higher than previous studies. Another interesting finding was the wide variation in the certification costs of Homestar, which varied from $380 to $3,800 per dwelling.

Table 1. Median additional costs to achieve 6-Homestar to 10-Homestar using Homestar versions 3 and 4 from a Building Code standard

	6-Homestar	7-Homestar	8-Homestar	9-Homestar	10-Homestar
v3	$18,813	$39,625	$65,901	$93,639	$110,279
v4	$13,238 (checklist) $11,677 (points with schedule method) $14,618 (points with calculation method)	$16,210 (schedule method) $13,896 (calculation method – option 1) $30,952 (calculation method – option 2) $37,726 (calculation method – option 3) $28,039 (energy modelling)	$47,372	$67,365	$85,446

Source: Ade, 2018, pp. 34–35.

The two 2018 CBAs on Homestar present some difference in numbers in terms of cost to exceed the minimum. The studies highlight that exceeding the minimum does cost more and that cost can take a while for payback. But what is less clear from these studies are the benefits from exceeding the minimum such as adopting Homestar, as

many of the benefits from better housing such as better health was not included. To fully realise these benefits, future research needs to undertake a full-scale CBA that factors in relevant components such as the cost of materials. The CBA would also ideally take into account the potential savings that could be expected from making energy and water efficiencies. Other costs prohibitions, especially when using rating tools such as Homestar, are the costs associated with direct fees for formal assessment and indirect costs associated with using designers, developers and builders to achieve beyond-Code housing. There may also be other factors such as site selection, shading, and orientation that greatly impact on a house's performance and its economic viability. However, there are some things that are hard to account for when assessing the economic benefits of higher-performing housing, such as perceptions of value and consumer motivations or barriers from doing so.

2.7 Value considerations of uptake of housing that exceeds the minimum

When considering economic decisions to build or retrofit housing that exceeds the minimum, a number of socio-economic technical factors are involved. A builder's reluctance to discuss higher-performing housing features may be due to the extra costs to bring houses up to the level desired (MacGregor & Donovan, 2018). A builder may see it as a market risk to suggest features that exceed the minimum, as consumers themselves run on tight budgets and it may increase costs. A more helpful question to ask is: What is a meaningful level of energy efficiency gain that would cause homeowners to take notice? McCabe (2011) suggests that 10% is too little and suggests that, at 20% savings, investors will take notice, but even at that level of saving, they still need to be convinced that the energy efficiency and savings are durable.

The perception of the value of higher-performing features that exceed the minimum and whether that comes from the builder or the consumer is important. Within the current New Zealand market, higher-performing housing that exceed the Building Code minimums are seen to be a risky option, mainly due to the costs and uncertainty over benefits – for example, people may see a health benefit in higher insulation, but they may not see an energy saving. Therefore, within a market where higher-performing houses are rare, a more level playing field like special housing areas would enable cultural change to take place and help make high-performance features more normative. Different sectors of the housing market may perceive different benefits from exceeding the minimum. For example, sections of the building and construction industry may only focus on the economic benefits or quality issues, while consumers may be more attracted to the health and social benefits of higher-performing housing. The costs of exceeding the minimum may be higher than conventional properties. However, if we examine the benefits over the lifespan of the house, higher-performing housing presents some real benefits. These benefits must also be seen in light of other indirect benefits, which could include the increased tenure of rental housing where tenants may want to stay longer due to the good and healthy conditions, thereby making renting the house easier. Other indirect benefits include the potential market value of future proofing against regulatory changes such as electricity price hikes, healthy homes legislation or stressed infrastructure due to the demands of climate change.

2.7.1 Understanding consumer motivations towards high-performance innovations

Christie (2010) suggested there is a paradox at the heart of consumer decision making concerning higher-performing housing features such as energy efficiency – the current market can build houses that exceed the minimum that are warmer, drier and healthier than Code-minimum houses and the majority of homeowners (79%) are open to the idea of higher-performing house innovations but are not prepared to pay for it. Trotman (2007) suggested that monetary saving and 'getting a deal' was an important motivating factor for New Zealand consumers to adopt higher-performing innovations. However, Christie's research suggested that a consumer's unwillingness to pay was not due to the costs of the innovation or the energy savings they would receive. The unwillingness to pay is more a reflection of the risk (financial, functional and social). For consumers, their unwillingness to pay is better interpreted as an expression of their perception of financial risk. Christie outlined the main financial risks that concerned consumers have identified about higher-performing housing innovations, such as sustainability and energy efficiency features:

- They thought their house or household was 'different' (not similar to other houses) and would therefore not receive energy savings.
- They were averse to debt or committing to on-going payment for too long when there were unknown future variables.
- They thought they would be overcapitalising their initial investment, which they would not recoup if they moved.

The second kind of risk that concerned consumers and their decision to adopt higher-performing housing innovations was functional risk. Functional risk is the perception that a product or service will fail to deliver its promised functions or benefits (Lake, 2016). Christie outlined the key concerns of consumers that affected their perceptions of functional risk to adopt high-performance innovations were uncertainties:

- Reservations about the environmental innovations and their performance.
- The decision was too complex and included too many factors.
- Consumers felt they were lacking in knowledge about the innovations.

Bayne (2006, as cited in Christie 2010, p. 208) suggested that, despite a consumer's low confidence about things like housing that exceeds the minimum, "as more consumers become more knowledgeable about a product … the perception of risk will also decrease". This point provides critical insight into the motivations of consumers. If higher-performing housing innovations are unknown or their value is unclear, people are less likely to adopt these innovations. However, with more information, consumer understanding and perceptions about higher-performing housing innovations could change.

The third kind of risk that consumers perceive within Christie's research was social risk. Christie found that homeowners were reluctant to be seen as different from the average person (the social risk). Homeowners (59% of them in her study) felt that other homeowners were "just like them" and presented an unwillingness to act due to a sense of futility that, by themselves, their actions would make little difference. Therefore, social risk is important to a consumer's willingness to pay, as it may change when others' willingness to adopt high-performance housing innovations does, making it a collective norm.

It is therefore critical to balance the benefits and risks within the housing market when exceeding the minimum. Christie's research highlights how consumers are more disposed to discourses of risk, which are associated with adopting the innovations, as opposed to the benefits they stand to gain. This asymmetrical perception of risk related to the benefits could be conceived as an aversion to change or rather a preference to maintain the status quo.

Christie suggested that consumers who are uncertain about adopting housing innovations that exceed the minimum may seek the status quo, meaning that they require a discount – the difference between cost and willingness to pay for the innovation. This discount is an economic buffer to prevent this change or a form of compensation for the risks they perceive. Therefore, as the costs of higher-performing housing features increase, the amount of risk increases, meaning that homeowners need compensation to be increased in order to help motivate them to invest in these innovations.

Christie identified that a distinction needs to be made between real and perceived risks. For example, functional risks are not real barriers but rather a reflection of concern about the perceived benefits of the innovation. Functional risks can be contrasted with financial risks, whereby the market does not value high-performance innovations. This has been shown in real estate advertising and the cutting of high-performance features such as double glazing and energy efficiency from the advertisements as they were not valued in the current market. Overcapitalising is a real risk for consumers, especially if the market sees no value in it. Therefore, the balancing of risk is important in understanding consumer decision making. For consumers, wanting to follow the status quo, the cost (of purchasing and installing high-performance innovations) and their willingness to pay can be viewed as an economic buffer to prevent this change. Alternatively, it could be seen as a form of compensation for the risks they perceive. Put simply, as the cost of high-performance innovations increases, so does the level of risk and the increased need for compensation for the risks perceived by consumers.

3. Methodology

A methodology was undertaken that utilised quantitative and qualitative responses to a social survey.

3.1 Industry survey

An online electronic survey was undertaken in order to capture industry thoughts and experiences of exceeding the minimum. A random sample of 3,000 architects, builders, building officials, buildings consultants and designers were selected from Auckland, Waikato, Bay of Plenty, Wellington, Nelson, Canterbury and Otago.

An email invitation was sent out to participants that introduced BRANZ and the researcher, explained the purpose of the survey and confidentiality and provided a link to the survey. The email also offered participants the opportunity to go into a draw if they completed the survey to win an iPad for their participation and support. A follow-up reminder email to complete the survey and thank those who had completed the survey was sent 2 weeks after the initial email.

The survey contained 22 questions in relation to housing quality and building standards in New Zealand as well as participants' experiences and thoughts on exceeding the minimum and its benefits and some basic demographic information.

A total of 496 valid survey responses were recorded, with most responses coming from builders/installers (33%), designers (30%) and architects (20%). Survey responses were entered into SPSS software for analysis.

3.2 Ethics

A BRANZ human research ethics application was undertaken for this research project. The application gained ethical approval on 2 February 2017 after independent ethical review in line with BRANZ human research ethics policy. The ethical conduct of the research was maintained throughout the research process. All research participants consented to participate in this research.

4. Industry perspectives on exceeding the minimum

In order to help contextualise the New Zealand market for high-performance building that exceeds Code minimums, this section outlines the results of an industry-wide survey. The survey sought to examine industry views on exceeding the minimum and provides a snapshot of where the industry feels it is performing with regard to creating higher-performing houses that exceed minimum standards.

4.1 Profile of survey respondents

496 valid survey responses were received (Table 2). These participants worked predominantly as builders/installers (33%), designers (30%) and architects (20%).

Table 2. Profile of survey respondents by role.

Role	Respondents
Builder/installer	33%
Designer	30%
Architect	20%
Project manager	13%
Building consent/compliance	9%
Building surveyor/consultant	2%
Developer	2%
Engineer	2%
House owner/client	1%
Manufacturer/supplier	1%
Other	1%
Base count	489
Role not specified	11

The majority of participants lived in Auckland (25%), Canterbury (16%) or Wellington (14%) (Figure 1).

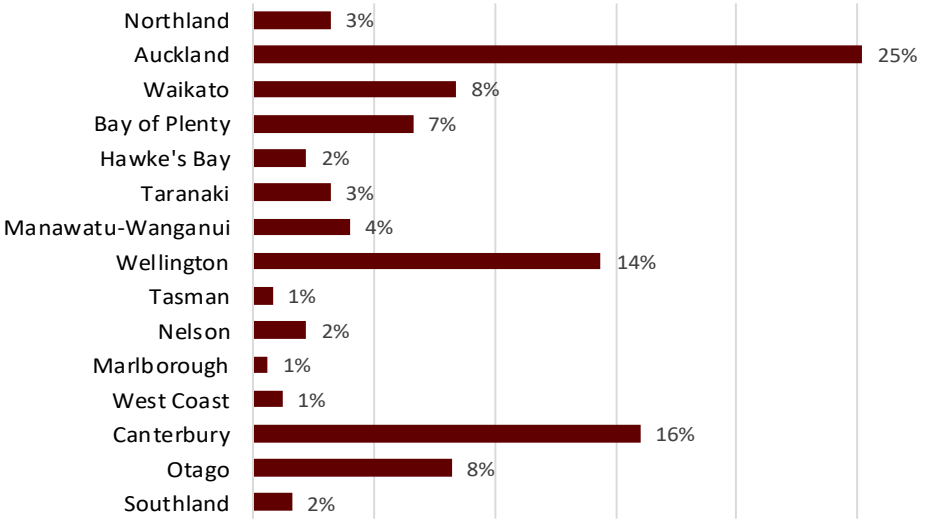

Figure 1. Home region of survey respondents.

The majority of respondents had more than 20 years' experience in the industry (Figure 2 – the base count for each category of respondent is shown in brackets).

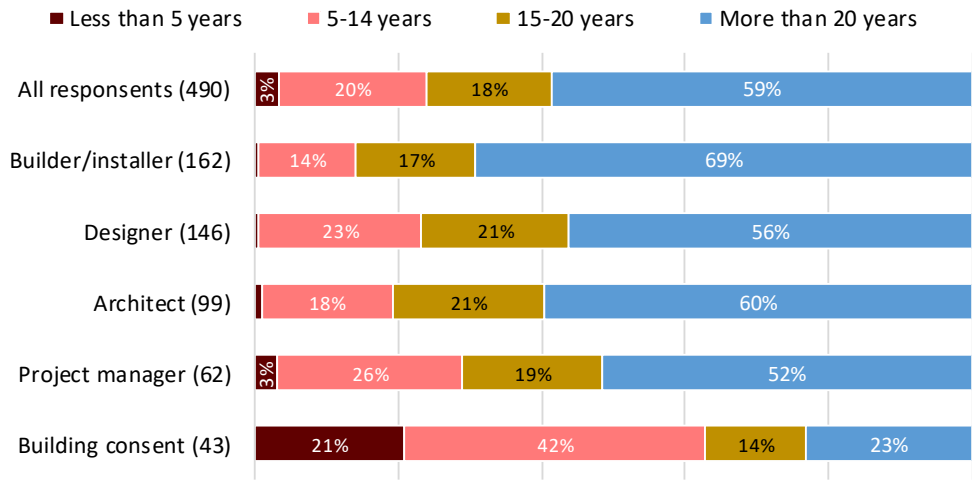

Figure 2. Years in role by profession.

4.2 Perception of housing quality and performance

Overall, roughly equal proportions (one-third) of respondents considered the quality of existing houses in New Zealand to be very poor or poor, neutral or good or excellent. Architects had the lowest perception of housing quality, with 46% considering it very poor or poor, while builders were more likely to rate the quality of existing housing as good (40%) or excellent (4%) (Figure 3).

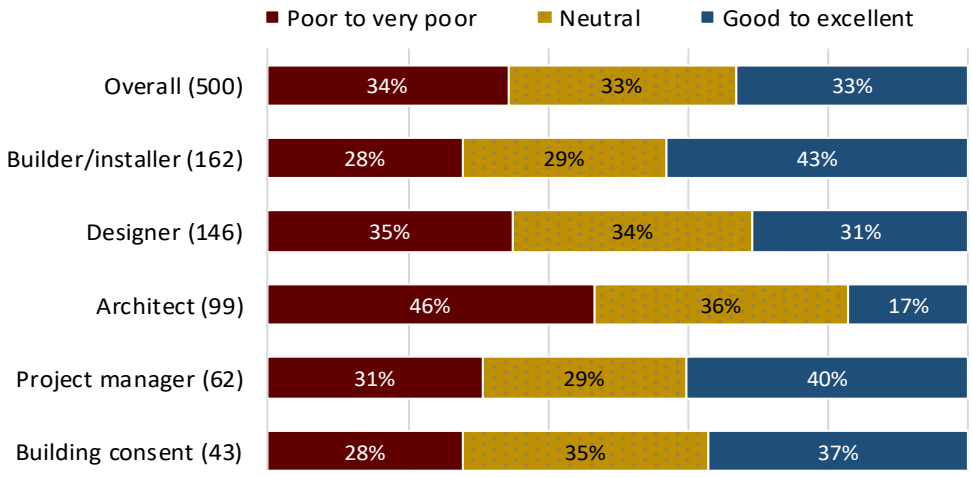

Figure 3. Perception of housing quality in New Zealand, overall and by role type.

Respondents were asked to describe the performance of the last new house they worked on, using three possible categories (Figure 4):

- Meets the minimum Building Code standard.
- Exceeds the current minimum standard (incorporates selected high-performance aspects such as renewable energy but is not comprehensive across the whole house).
- Exemplifies best practice in the world, leading in design and efficiency standards (e.g. 10-Homestar).

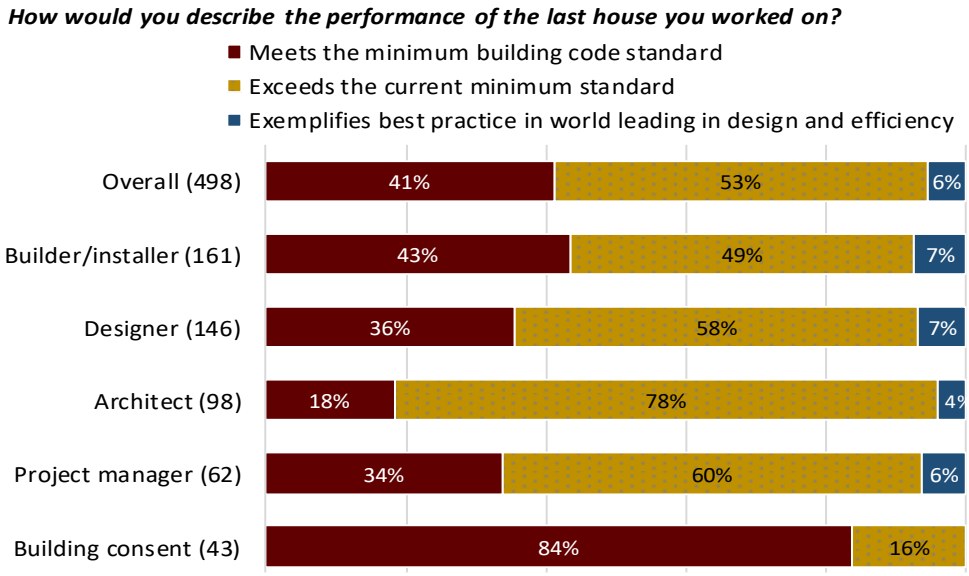

Figure 4. Respondent perceptions of the performance of the last house they worked on, overall and by role type.

Over half of respondents (53%) rated the last new house they worked on as exceeding current minimum standards. Very few (6% overall) fell into the best-practice category. Architects had a slightly more positive perception of performance, with 78% rating the last house they worked on as exceeding the current minimum standards. Conversely, only 16% of building consent officials selected this option, with the majority (84%) describing the house as meeting the minimum standard only.

4.3 Exceeding the minimum – common practices

Respondents were asked which features they currently used in the construction of new houses that exceed the minimum standards (Figure 5). The most commonly selected features were insulation (underfloor, wall and ceiling), energy efficiency (heat recovery, LED lights etc.) and material durability (cladding and wear surfaces for low maintenance). The least common features identified included renewable power generation, water efficiency (rainwater collection, greywater recycling) and external solar shading.

Practices appeared fairly consistent across the different roles (i.e. respondents tended to agree on the extent to which different features were being used in exceeding the minimum). The exceptions were external solar shading, use of environmentally friendly/sustainable materials – both more commonly specified by architects – and water efficiency, which was more commonly specified by both architects and designers.

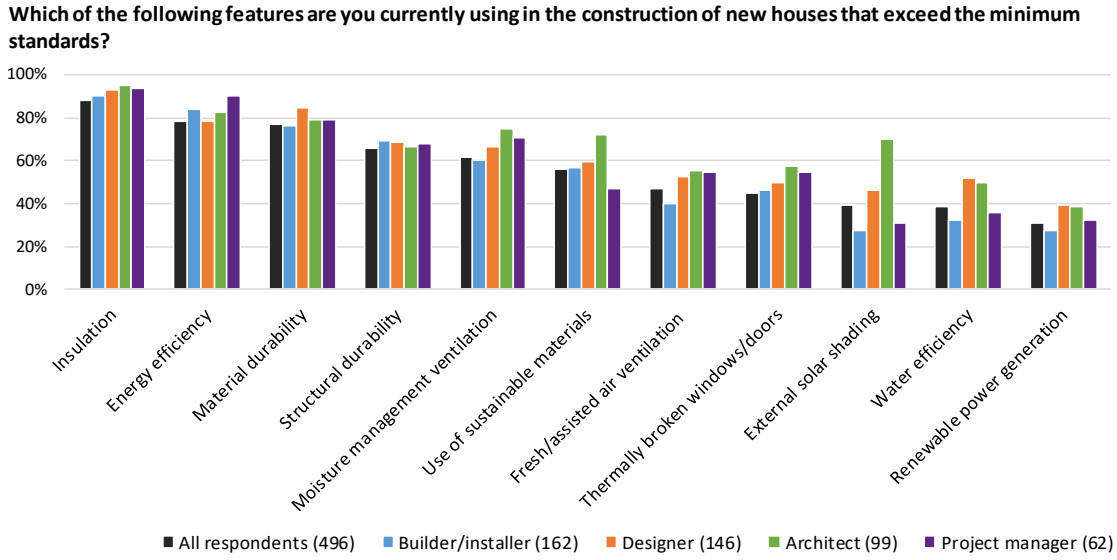

Figure 5. Features currently being used by survey respondents in the construction of new houses that exceed the minimum standards.

Compared to the features that respondents were currently using that exceeded the minimum (Figure 6), planned practices were generally very similar (Figure 7), with higher R-value insulation, energy efficiency and material durability again the most commonly selected features. However, a higher proportion said they were planning to use fresh air ventilation, renewable power generation and water efficiency than were currently using these features.[4]

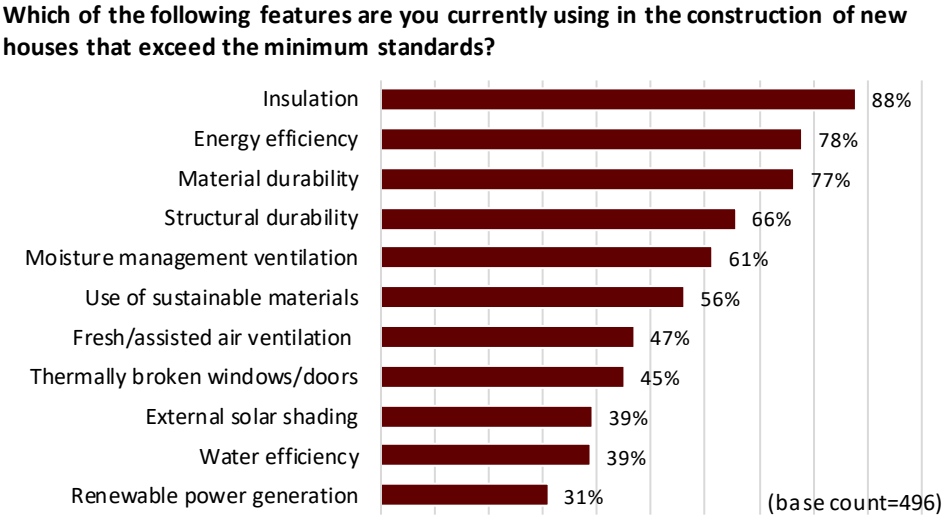

Figure 6. Features currently being used by survey respondents in the construction of new houses that exceed the minimum standards.

[4] Results from the two questions about current and planned use of different features to exceed the minimum differ slightly in the respondent base count and question phrasing/features listed.

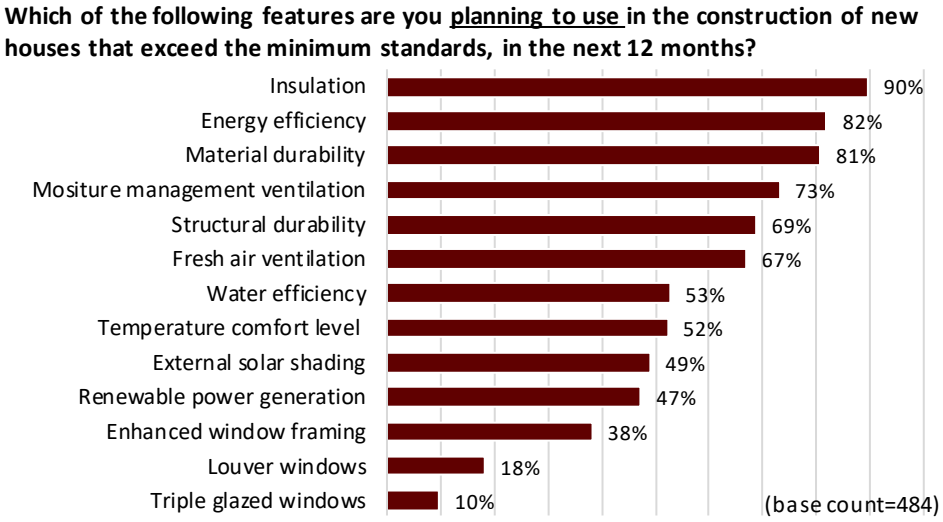

Figure 7. Features that survey respondents were planning to use in the construction of new houses that exceed the minimum standards in the next 12 months.

4.4 Perceived benefits, barriers and advocates of exceeding the minimum

4.4.1 Perceived benefits

Respondents were asked to rank four potential benefits of going beyond Code minimums, broadly categorised as environmental, economic, social and health benefits (Table 3). Three-fifths of respondents (61%) ranked health as the most important benefit. There was a relatively even spread of the rank of the other three categories, with economic benefits ranked marginally higher in importance and environmental of lower importance. Project managers placed slightly higher importance on economic benefits (26% ranked this as most important) while architects tended to rank this of lower importance – 11% of architects ranked economic benefits as the most important and 41% as the least important benefit. Otherwise, there was little difference between respondents' ranking by role type.

Table 3. Rank of perceived benefits of exceeding the minimum building standard.

	Benefit category			
Rank	Environmental	Economic	Social	Health
1 - Most important	13%	18%	11%	61%
2	21%	30%	36%	22%
3	29%	29%	32%	8%
4 - Least important	36%	23%	21%	9%
Base count	384	371	409	484

4.4.2 Barriers

Respondents were asked to select three barriers from a list of 12 that were most prohibitive to them to building beyond Code minimums (Table 4).

Table 4. Rank of barriers to exceeding the minimum building standard.

Barriers to exceeding the minimum	1 - Most significant	2	3 - Least significant
Built cost	43%	18%	10%
House owner not willing	11%	16%	15%
Developer not willing	10%	9%	4%
Lack of knowledge of owner	8%	9%	14%
Life-Cycle cost and payback	7%	14%	12%
Lack of knowledge of designer	5%	5%	7%
Features not included in design	4%	4%	7%
Time pressures	2%	4%	4%
Resale value	2%	5%	6%
Weather constraints	1%	1%	1%
Builder not willing	1%	2%	6%
Lack of knowledge of builder	1%	3%	5%

Built cost was most commonly selected as the most significant barrier (43% of respondents). Whilst this was consistently selected as the most significant barrier by different professions, there was some variation between them, with it being more commonly identified by architects and designers than builders.

> The bespoke nature of housing construction in NZ and its high cost is a barrier to ticking additional 'nice to have' options. [Builder]

Willingness of the house owner and developer to go beyond Code minimums were identified as the next most significant barriers, followed by lack of knowledge of the owner and life-cycle costs and payback.

Other barriers to exceeding the minimum building standard identified by respondents included the building consent/compliance process (longer, more complex and/or more expensive for non-standard construction), existing Code standards being too low and availability of products and materials and documentation.

> Building consents are harder to achieve for non-standard systems of construction or performance. [Architect]

4.4.3 Advocates of going beyond building Code

Architects were considered the most likely to advocate going beyond Code minimums during the building process (44%), followed by designers (31%) (Figure 8).

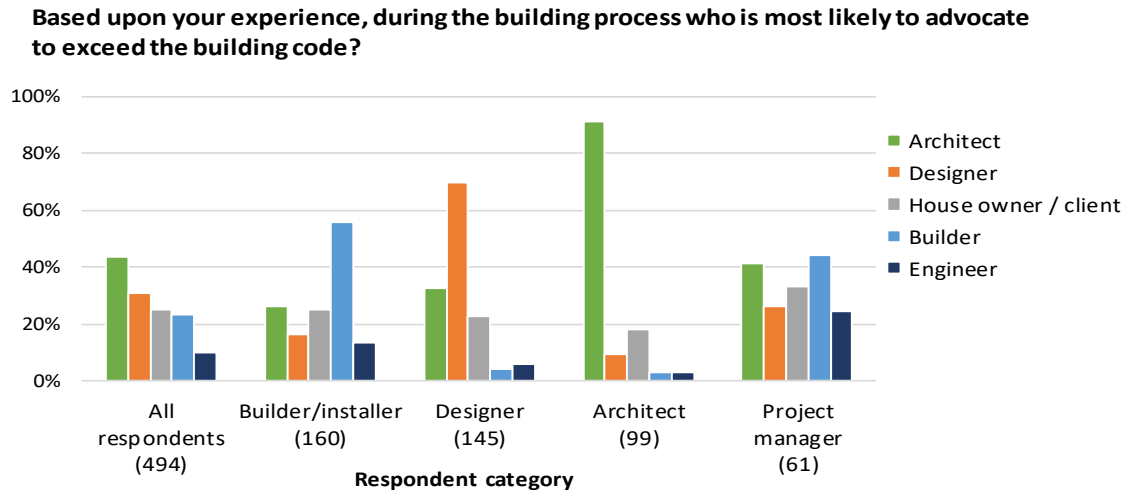

Figure 8. Person most likely to advocate going beyond Code minimums.

It should be noted that responses to this question show a tendency for self-selection – 90% of architects selected architects, 70% of designers selected designers and 56% of builders selected builders – and respondents could select more than one option.

Respondents were consistent in considering it the responsibility of the architect (67%) or designer (56%) to initiate discussion about exceeding the minimum (if it is not already discussed) (Table 5) and it being the house owner/client who makes the ultimate final decision to build beyond Code (73%) (

Table 6).

Table 5. If, during the construction of a new house, choosing to go beyond Code minimums is not discussed, who should raise this issue?

	All respondents	Builder/installer	Designer	Architect	Project manager	Building consent
Architect	67%	61%	57%	96%	64%	62%
Engineer	17%	25%	15%	13%	18%	19%
Designer	56%	46%	87%	27%	56%	69%
House owner/client	33%	32%	32%	29%	38%	45%
Developer	15%	14%	15%	16%	10%	17%
Other	5%	4%	2%	7%	2%	10%
Total	495	161	144	99	61	42

Table 6. From your experience, who makes the ultimate final decision to build beyond Code?

	All respondents	Builder/installer	Designer	Architect	Project manager	Building consent
Builder	6%	12%	3%	0%	10%	7%
Architect	8%	6%	3%	16%	8%	5%
Engineer	1%	1%	1%	0%	0%	2%
Designer	7%	5%	14%	0%	7%	5%
House owner/client	73%	71%	71%	82%	72%	71%
BCA	1%	2%	1%	0%	0%	2%
Total	497	161	146	99	61	

4.5 Willingness to pay for high-performance features

Based on their industry experience, 30% of respondents said clients were willing to pay over $10,000 on average to incorporate high-performance features into their new house (Figure 9). There was some variation in experience of clients' willingness to pay by respondent role type, with builders tending slightly towards the lower end and project managers to the upper payment bracket.

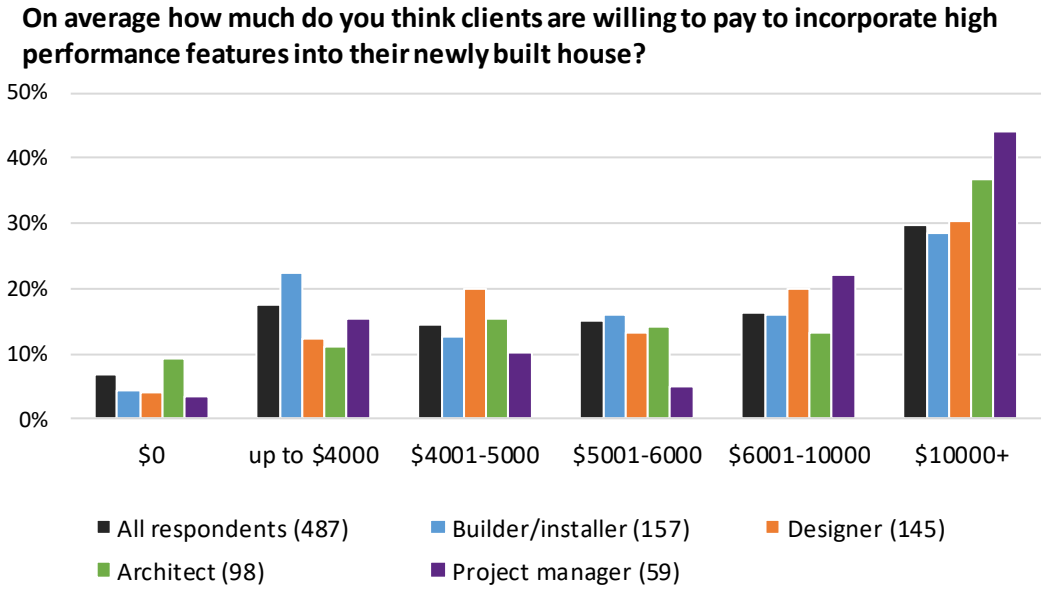

Figure 9. Experience of clients' willingness to pay for high-performance features, by respondent role type.

4.6 Information sources

BRANZ or Level was the most common source of information used by survey respondents to find out about building beyond Code minimums (Figure 10 and Table 7). Seeking information from colleagues was also common practice for over half. There was some variation between respondents by role type, with the New Zealand Green Building Council, Homestar and EECA being more commonly used by designers and architects than builders.

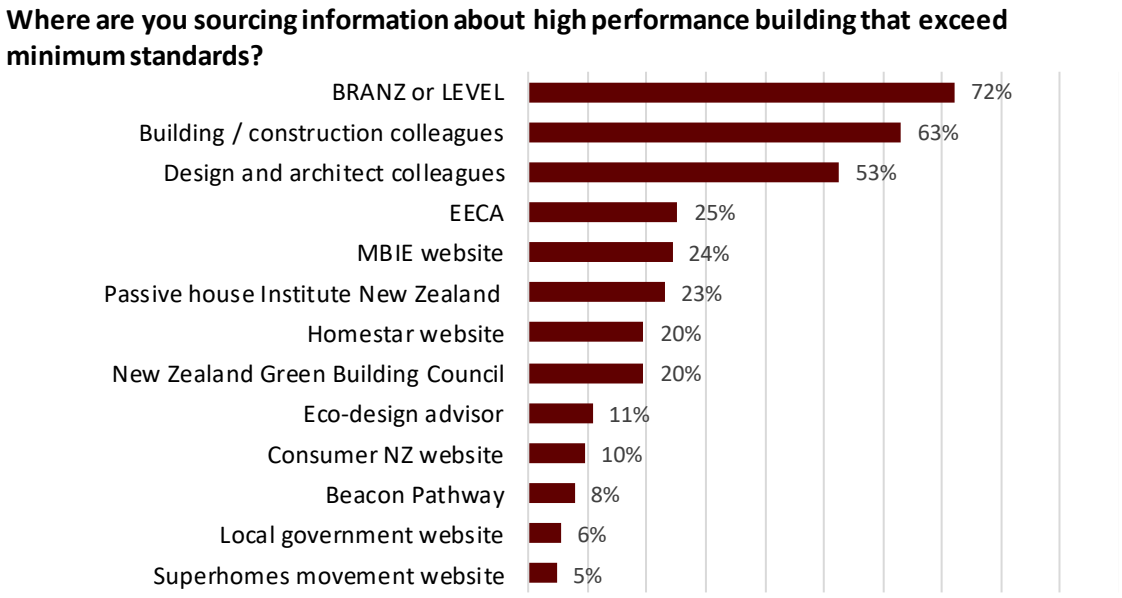

Figure 10. Sources of information used by survey respondents on building to exceed minimum standards.

Table 7. Where do you source information from about high-performance building that exceed minimum standards?

	All respondents	Builder/installer	Designer	Architect
BRANZ or LEVEL	72%	68%	77%	65%
Building/construction colleagues	63%	62%	60%	62%
Design and architect colleagues	53%	38%	59%	83%
EECA	25%	15%	29%	31%
MBIE website	24%	18%	29%	26%
Passive House Institute NZ	23%	22%	31%	29%
NZ Green Building Council	20%	9%	26%	33%
Homestar website	20%	10%	23%	35%
Eco Design Advisor	11%	10%	11%	10%
Consumer NZ website	10%	9%	15%	10%
Beacon Pathway	8%	4%	9%	12%
Local government website	6%	7%	5%	3%
Superhome Movement website	5%	4%	9%	4%
Total respondents	400	141	111	78

4.7 Going beyond Code minimums

The survey asked respondents what advice or messages the industry should give consumers about high-performance houses that go beyond Code minimums (see Appendix A). A number of comments were provided (353), from which there were some clear and recurring themes.

The importance of considering long-term cost benefit (life-cycle costs) was the most common message from survey respondents. Whilst acknowledging upfront costs may be higher for a high-performance house that goes beyond Code minimums, respondents emphasised the need for consumers to consider the longer-term benefits. Reference was made to the concepts of life-cycle costs and payback.

> Consumers need to distinguish between cost/price and value – they need to understand the life-cycle cost/s and long-term value of their asset. [Designer]

Several subthemes emerged, strongly associated with or embedded within the concept of life-cycle costs.

Lower running costs

Reference was made to lower running costs in general of high-performance houses and specifically to reduced energy and (less commonly) water use.

The message was that there are longer-term financial and environmental benefits of investing in high-performance housing and consumers should consider these rather than just focusing on capital upfront costs.

> These houses perform better for the additional cost. The gains are the use of less water and energy. [Architect]

Resale value

Several respondents suggested the enhanced resale value of a high-performance home is a key message that needs conveying to consumers. Again, this was about taking a longer-term perspective in assessing the costs and benefits of investing in a high-performance home.

There was some debate evident in responses as to whether a higher value was achievable now and whether education and market change was needed to ensure sufficient demand for and understanding of the benefits of high-performance homes.

> Should enhance the saleability of the property. [Designer]

> Once the industry is more educated it will help the value of the property. [Architect]

Health benefits

Emphasising the health benefits of high-performance houses that go beyond Code minimums was frequently referenced by survey respondents as a key message for consumers.

This was both in isolation (high-performance houses provide a warmer, drier, healthier living environment) and within the context of lower running costs (cheaper to heat, more energy efficient and therefore a healthier indoor environment) and cost-benefit analysis/life-cycle costs (benefits to health should be considered as part of the CBA).

> It will be to their benefit as more are built and homeowners realise the resale value of energy-efficient homes. [Builder]

> The higher-performance house will reduce running costs and provide a warmer and healthier home. [Designer]

Comfort

Linked to the health benefits, respondents referred to the benefits associated with increased comfort in the home and an overall improved quality of life that high-performance housing offers.

> A healthy dry home provides the homeowner with a better quality of life. [Builder]

Environmental benefits

Often part and parcel of the whole life-cycle analysis concept and the importance of adopting a long-term perspective in housing choice, survey respondents referenced the need for consumers to recognise the environmental benefits and sustainability of high-performance housing.

> We have limited resources, build durably, consider the environment with materials used. [Builder]

Durability and lower maintenance

Linked to the sustainability argument, respondents identified enhanced durability and lower maintenance requirements as two further important key messages in promoting high-performance houses to consumers.

Code is a minimum, not a target

This message was frequently raised by survey respondents, who considered it important to communicate to consumers that the Building Code is the minimum requirement and "everyone should want to exceed it". There were some mixed feelings as to whether the current Building Code was sufficient to provide a reasonable quality house versus those who considered the Building Code too low even as a minimum requirement.

> That the Code is the legal minimum and should generally be exceeded in order to achieve a comfortable, draught-free, energy-efficient home. The message would be unless you accept the minimum standard in other areas of your life (income, food, clothing, cars, education, holiday accommodation etc.), why would you want only minimum standard for your most important investment, your home? [Architect]

Other messages that survey respondents considered important to convey to consumers about high-performance houses included the benefits of incorporating features at the design stage (easier and more cost-effective than later or through retrofitting) and that costs do not have to be excessive – some simple features can make a big difference.

4.8 What else would help?

In addition to messages for consumers, the survey asked respondents what else could be done to help them deliver high-performance houses that exceed the minimum standard (see Appendix A). Again, a high response rate was received (n=359) and some detailed feedback provided. The most common and recurring themes evident in their responses are outlined below.

The need for **education/awareness raising** came through strongly in survey responses. In some instances, respondents alluded to a widespread cultural/attitudinal shift required in New Zealand around housing quality in general. Others made reference to the need for education targeted at specific stakeholder groups:

- Raising awareness amongst consumers, with impartial independent information and education campaigns to enhance understanding of Code requirements and options available and to promote the benefits of high-performance homes (such as through advertising/ television).
- Education and training of industry professionals to encourage promotion and uptake of higher-performance products and features.
- Training for real estate agents/valuers to support recognition of the benefits of high-performance housing through sale price.

> Better homeowner awareness as to building codes and what can be achieved above and beyond these. [Building Consent Authority]

> It would be great to see more education in our universities, our polytechs, etc. so that professionals and tradespeople are learning how to question the standard and push to making better buildings and not just following trends. [Designer]

Linked to the need for better education and awareness amongst consumers was the call for more readily available **information on life-cycle costs**. A need for a **cost-benefit analysis reporting tool** to help calculate and communicate the concept of life-cycle costs was identified. This was entrenched within the admission that building high-performance housing does typically cost more and homeowners are typically

driven/constrained by price. Ensuring a good understanding of the full range of benefits over the lifetime of the dwelling was considered critical to the uptake of high-performance homes. This links back to the most important message to consumers identified in the previous questions.

> Simplify and demystify high-performance housing. Provide good, meaningful information on upfront costs, potential value added to a home and realistic payback timeframes. [Designer]

Survey respondents did not just consider consumers to be the ones in need of better information, but developers also needed access to better information to enable easier and more transparent **product comparisons**. There was a sense that lots of information exists but a **central repository and clearer guidance** to follow would be beneficial. The importance of this being impartial and independent was also emphasised. Being able to provide clear and accurate information on the relative merits of different options to consumers was considered a critical barrier in promoting high-performance homes.

> There is so much info from so many sources available, it would be great to formalise this into one manual for trade, the use of which may be within an advanced trade qualifications, so that everyone within the industry has the basics and the information path to follow. [Builder/Project Manager)

The lack of a standardised **home performance rating system** was raised as a barrier to communicating and selling the benefits of high-performance homes to consumers. It was suggested by some respondents that having such a system should be mandatory. This links to the resale value and ensuring high-performance features (more energy efficient, lower running costs) are reflected in the price of the dwelling.

> Savings in running cost should be a required rating component of selling properties. [Designer]

Cost associated with high-performance houses and indeed building in general was raised repeatedly by survey respondents as something that needed to be addressed. The **cost of materials and land** in general in New Zealand was considered prohibitively high. There were many pleas to lower costs and make materials more affordable, although practical solutions as to how this could be achieved were less forthcoming. Some pointed to the need for increased competition/more competitive pricing and better information to consumers to enable more-informed choices.

Incentives, subsidies or rebates for high-performance houses incorporating high-performance features or building beyond Code were also suggested as one way to help address the financial barriers. There were a range of suggestions for how such an incentive scheme might work or what form it might take from direct grants, tax incentives/rebates, low-cost finance or priority status and/or lower fees in the consent process.

Compliance/consent costs were pinpointed as one area where cost savings could be achieved (address inefficiencies, improve the process and reduce the cost). Linked to this and the cost of materials was the frustration raised by some with the **compliance process**, which impacts on product availability and affordability.

The issue of **existing Code and minimum standards** being inadequate was again highlighted by a number of survey respondents. Changing the Building Code was

suggested as needed to "raise the bar" such that higher standards would be the minimum and mandatory. Reference was made to overseas examples, in particular Europe, where minimum requirements are higher.

> If you set the Code as the guide, you will never get this to happen as it becomes optional. Refer to other countries where this has been done – we are too far behind the times here. [Architect]

Other suggestions from survey respondents of measures that could help professionals deliver high-performance houses included having show homes or case studies to help demonstrate and communicate the benefits to consumers and more research/funding into materials and testing of high-performance features.

5. Conclusion and recommendations

This research report has sought to answer the following questions within the current New Zealand housing market:

- Where do stakeholders in the residential construction sector perceive they are incorporating features in their new house that go beyond Building Code requirements?
- What are the real or perceived barriers to the realisation of these benefits?

There is a mismatch between real and perceived costs and benefits from exceeding the minimum within the market

Buildings that exceed minimum standards have a number of benefits, such as enhanced insulation that improves thermal comfort and energy efficiency. While some sustainability measures such as renewable energy may have a more tangible benefit to consumers such as lower energy bills, 'invisible' benefits such as reduced hospital admissions, reduced mortality etc. from greater insulation are perhaps less tangible but equally important when advocating to exceed the minimum.

Cost is one of greatest barriers to exceeding the minimum. We therefore need better cost-benefit methodologies for helping to capture costs and benefits (both tangible and invisible) into a rigorous analysis. We need to align individual costs and benefits with the greater public good – health, environmental, energy, carbon impact and water are all aspects that should be addressed in any cost-benefit analysis. This is especially true for health benefits related to exceeding the minimum, as going beyond Code minimum will likely mean there are health benefits that accrue to the individual.

In addition to individual and more public costs and benefits, attention should also be directed at consumers' perceptions of financial risk, both real and perceived. This is because, as costs rise, so does risk. Therefore, if we are to increase the uptake of exceeding the minimum across the market, consumer and industry risk needs to be mitigated. However, risk can only be mitigated once industry recognises that many of the buildings being built are not exceeding the minimum, despite a perception in industry that they are. This perception in industry helps to provide a context in which consumer decisions are made. From the industry survey, we observed that 78% of architects and 49% of builders thought that the last house they worked on exceeded minimum standards, yet 84% of building consent officials thought that the last house they worked on only met Building Code and did not exceed the minimum. Such insights tell us that there is a disjunction between what the industry thinks and what buildings they are delivering.

Building professionals are part of the solution and health and wellbeing is the common interest

Our industry survey has helped to highlight that the main driver to exceed the minimum is health. As has been shown by MacGregor and Donovan (2018), health is also a major driver of consumers in considering whether to exceed the minimum. The main areas in which industry has been concerned with exceeding the minimum are insulation, energy efficiency and material durability. Architects and designers are deemed to be the main influencers in helping to exceed the minimum in these areas. These insights from our industry survey outline that exceeding the minimum is something that certain parts of the market are attempting to change because of a core belief in wanting to improve the health of New Zealanders. This common interest in

health is important if the uptake of exceeding the minimum is going to become more normative.

Some core limitations of the current report need to be acknowledged. More research is needed in a number of areas if we are to create cultural change in the New Zealand building and construction industry. A more detailed framework of how to enact behavioural change is important for consumers so that current industry practices can be changed. We also need to ask what the macro-economic benefits in exceeding the minimum are for the New Zealand economy, especially with regard to real estate, banking and investment. We also need baseline quantitative data from higher-performing houses to further illustrate and quantify the benefit of these houses for occupants and also the wider climate impact. Each of these aspects of exceeding the minimum need to be addressed within the current market so that the benefits of exceeding the minimum can be provided to all New Zealanders to help enhance public health and wellbeing.

Recommendations

- On-going training and support for building professionals to encourage the promotion and uptake of exceeding the minimum. This should involve greater grass-roots dialogue between designers, architects and builders as key influencers in getting the industry to exceed the minimum.
- Raise awareness amongst real estate agents, mortgage lenders, valuers and so on about buildings that exceed the minimum and their costs and benefits in terms of building quality, building performance and health benefits. A greater awareness is likely to have a flow-on effect in resale, as real estate agents could use the building's thermal performance as a selling point.
- More research is needed to identify how exceeding the minimum could be incorporated into financial systems, such as buildings that perform better having a mortgage discount of some kind, in order to redistribute the risk of constructing buildings that exceed the minimum until it becomes more normalised within the market.
- More research needs to be done to examine how the Building Code can be brought into line with international building codes and regulations in countries with similar climates to New Zealand.

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Appendix A: Consumer advice and support for industry