ASSESSING NEW ZEALAND HOUSEHOLDERS' HOME USE BEHAVIOURS: HOW ENERGY EFFICIENT ARE THEY?

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ABSTRACT
In New Zealand, the government has developed an energy strategy to respond to the challenges of climate change. One of the target areas is "Energywise Homes" aimed to make homes more energy efficient. This paper outlines results from research conducted in 2011 to examine householders' preferences in relation to the size of homes they live in, the appliances they buy and the way they use their homes. These factors help determine how energy efficient homes are. Further, as the NZ Green Building Council introduced a rating tool for homes, Homestar™, the paper investigates householders' awareness of the new tool and any experience they may have had in using it. The results help identify where energy inefficiencies occur within the home and what behavioural and policy changes are needed to increase the uptake of energy efficiency and sustainability practices in homes.

Keywords: sustainability, energy efficiency, greenhouse gas emissions, Homestar™ rating tool

BACKGROUND
Buildings in New Zealand account for 17% of the country's greenhouse gas emissions. By comparison, Australian buildings account for 23%, US buildings 38% of America's GHG emissions, while the figure for the UK is around 42%. While the building sector is not the largest contributor to greenhouse gas emissions it is one of the fastest-growing sources. Energy usage in residential buildings accounts for around 10% of total carbon dioxide (CO_2) emissions from all sources in New Zealand. In terms of source of greenhouse gas emissions in the residential sector, over half comes from electrical appliances, including lighting, selected by residents or persons outside the building sector, about a quarter comes from water heaters and a fifth from space heating and cooling. In terms of home energy use the figures are similar but more is used in space heating and cooling (34%), followed by water heating (29%), with just over a third coming from electrical appliances (refrigeration 10%, lighting 8%, cooking 6%, other appliance 13%), (BRANZ 2006).

It is not only the amount of energy used in homes that has an impact on the production of greenhouse gas emissions (GHGe) but also the type of energy. Householders could reduce the amount of greenhouse gases they emit by not only reducing the amount of energy they use in their homes but also by using energy from renewable and green sources. While New Zealand is fortunate that about three quarters of the electricity generated comes from renewable sources, predominantly hydropower, this percentage has been falling from a high of 91% in 1980 to 76.7% in 2011 (MED 2012a).

Despite efforts to reduce energy consumption in homes, household electricity use per person has being rising due in part to larger dwelling sizes, decreasing average household size, more appliances and IT equipment per household as well as the increased use of heaters and coolers. Further, despite improvements to the New Zealand Building Code and availability of subsidies and grants, existing New Zealand homes perform poorly in terms of energy and water efficiency. The research reported here investigates consumers' home choices, home use behaviours, level of motivation to act more sustainably and awareness of, or experience with, the new Homestar™ Rating Tool.

The following literature review outlines the energy efficiency of homes, government actions to help protect the environment and reduce GHGe and strategies introduced to achieve a more energy efficient housing sector.

LITERATURE REVIEW

The Energy Efficiency of Homes

The average size of new houses in many countries has grown significantly over the past twenty years. Until recently, the USA had the largest average size new home but this began dropping in 2008. Now Australia leads with the an average new house size of 214.6sqm, according to James (2009), followed by the USA at 201.5sqm, New Zealand (196.2sqm), Canada (181sqm), Japan (132sqm) and the UK (76sqm).

New Zealand house sizes, like the USA, have also started to shrink from an average of 205sqm (QV, 2011) but, by the end of June 2011, fell back for the first time in years to 196sqm according to Statistics New Zealand (2011). It was last 196sqm in 2009 and was 176sqm in 2003. At the same time, average household size decreased to 2.6 persons per household according to the 2006 Census and this likely to decrease to 2.4 by 2021 (Statistics New Zealand 2005). By comparison, Australia's household size was 2.56, the USA's 2.6 and the UK's, 2.1. Unfortunately, small households are less efficient as fewer people are sharing space and resources.

Both New Zealand and Australian houses have poor thermal insulation, especially homes built prior to the 1980's when requirements were introduced requiring insulation to be included in the construction of new houses. According to McChesney and Amitrano (2006), about 65% of the NZ housing stock (or about 0.9million dwellings) were estimated to have been built prior to any requirement for insulation. The two countries have varying climatic zoneswithin each of them. Australian houses have traditionally been built to cope with the hot weather, being wide, open, single storey, with a lot of windows designed to let the light in and the hot air out. In New Zealand, homes tend to be built using lighter, timber frames with weatherboard cladding to withstand earthquakes, rather than the brick that is more common in Australia. This stands in contrast to UK houses, which are generally small, two storey homes with solid internal walls, and small windows, to keep the heat in during winter. Although they are well insulated, British houses are commonly poorly ventilated, trapping summer heat.

Homes with limited insulation and poor ventilation tend to be cold, damp and expensive to heat in the cooler months (EECA 2007). According to Lloyd (2006), in 2001 between 10% and 14% of total households in New Zealand were in "fuel poverty". This figure could rise to possibly as much as 32% in Dunedin in the lower South Island. A household is considered to be in "fuel poverty" if it would need to spend more than 10% of the total household income on all household fuels to achieve a satisfactory indoor environment. A satisfactory indoor environment is defined as being at temperatures of at least 21°C in the living areas and 18°C in other parts of the house (WHO 1987, 1989).

Studies have shown that poor housing affects health. For example, a study by the Universities of Otago, Massey, Victoria and Auckland and BRANZ (Howden-Chapman et al 2007) showed that retrofitting low-income family homes with insulation had a positive impact on the health of the children and their families, as well as on the households' energy consumption. They found that indoor temperature increased during winter (0.5°C), relative humidity decreased (2.3%) and energy consumption was only 81% of that in un-insulated homes.

In New Zealand, EECA complete consumer surveys to track the nation's views on energy efficiency and renewable energy. The most current survey in 2010 indicates that 58% of respondents have ceiling insulation (12% didn't know), 26% have under floor insulation (11% didn't know) and 38% have wall insulation (20% didn't know). Under a third (31%) had hot water cylinder wraps, 42% use energy efficient light bulbs while 39% said some of their home had these. In terms of heating systems, 27% had heat pumps, 23% low emission wood burners, 19% flued gas heating and only 3% had pellet fires. Solar heating was installed in only 4% of homes and only 2% had solar panels. Respondents were most willing to install insulation of all types, including ceiling (30%), under floor (27%), and wall (24%) and least likely to install pellet fires (3%) and flued gas heaters (2%).

While the New Zealand Building Code has minimum requirements for ventilation that all the air in a home should be changed every three hours and air in kitchens and bathrooms should be changed more regularly (kitchens every hour; bathrooms every two hours), McChesney (2009) estimated that only 10% of New Zealand homes had some form of mechanical ventilation system installed. Positive pressure roof cavity systems made up the majority of these systems. Fitzgerald et al (2011) at Otago University carried out research for ECCA to investigate the heating and cooling potential of positive pressure ventilation systems. While they found that the potential heating and cooling benefits from pumping air from the roof space into the living areas of some New Zealand houses were not large enough to significantly alter the indoor air temperature, on average, they did not investigate the health and comfort benefits of using the roof space air as a means of household humidity control. Positive pressure ventilation systems can still assist heating by drying houses.

Boulic et al (2010) investigated the benefits of using positive pressure ventilation systems by assessing their efficiency during winter. They measured the indoor climate change in terms of humidity (RH), temperature, and pollutants (CO_2 and formaldehyde, HCHO). Measurements were taken in the living room and master bedroom of twenty intervention homes and compared to measurements taken in a control group of ten homes that did not have the ventilation system. Results indicated a statistically significant decrease in the weekly average level for both gases in the intervention homes whereas no significant differences were detected in the control group homes.

Indoor humidity levels not only affect when condensation will form on colder objects, but also affect the heat capacity of air, which changes the amount of energy required to heat a home. In general, the more moisture contained within the air, the harder it will be to heat. Thus, while the study by Fitzgerald et al (2011) does not support the use of positive pressure ventilation systems for their heating and cooling potential, the study by Boulic et al (2010) does, in terms of their use for controlling relative humidity that can make homes easier (and thus cheaper) to heat.

As much of the environmental impact of buildings is determined at the design stage, it is critical that these be considered early in the design process. To overcome "fuel poverty", ill health from poor housing and high energy consumption in homes, a number of Government initiatives have been implemented to improve the energy efficiency of homes.

Government Actions to Make Homes More Energy Efficient

Building Codes

Recognising the need to improve the energy efficiency of New Zealand homes and overcome "fuel poverty", new requirements were introduced in October 2007 for all new homes in the coldest climatic Zone first: the South Island and North Island Central Plateau. The new requirements, New Zealand Building Code Clause H1 (Energy efficiency), were phased in throughout the rest of New Zealand, in 2008 Climate Zone 2, North Island districts south of Franklin and Thames-Coromandel

Districts (excluding Central Plateau), in June and lastly Climate Zone 1, Districts north of Franklin and Thames-Coromandel Districts inclusive, in September.

The Building Code Clauses A2 and H1 3.2 changed to refine the definition of the building performance index (BPI) and to improve the thermal performance of houses. This effectively requires houses to use about 30% less heating energy than before and, in practice, means that most new houses will need better insulation (higher R-values, as outlined in NZS 4218: 2004). While double-glazing is not mandatory, it will likely be used extensively to meet the new H1 requirements. However, for some designs in some locations, the building performance index will not exceed 1.55 for a house with single glazing, making double glazing an optimal solution (Department of Building and Housing 2008).

Similarly in Australia, in the 2010 update of the Building Code of Australia, energy efficiency requirements for new residential buildings were increased to six stars, or equivalent, nationally (BCA), as well as introducing new efficiency requirements for hot-water systems and lighting. Building Codes generally, however, tend to focus on new works, including major renovations and refurbishments. Existing structures, that may not meet the new standards unless refurbishment is carried out, have been largely ignored.

Government Environmental Policies Relating to Homes

In the UK, the European Union Directive 2002/91/EC relating to the energy performance of buildings was transposed into British law by the Housing Act 2004 and The Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007. The Directive was inspired by the Kyoto Protocol which commits the EU to reduce CO_2 by 8% by 2010, to 5.2% below 1990 levels, and requires that every home in Europe have an energy efficiency rating by 2012. As part of the Directive, since August 2007 homeowners in England and Wales are required to obtain and present an energy efficiency rating (Energy Performance Certificate) to buyers or renters of their home and all new homes are required to be built to the Code for Sustainable Homes (RICS 2007). Energy Performance Certificates (EPCs) present the energy efficiency of dwellings on a scale of A to G. The most efficient homes – which should have the lowest fuel bills – are in band A. The certificate uses the same scale to define the impact a home has on the environment. The average property in the UK is in band D or E for both ratings. (Easy Energy Assessment (2008), "About Energy Performance Certificates", http://www.easyenergyassessments.co.uk/certificate.html [accessed 16 December 2012])

In New Zealand, the New Zealand Government introduced The New Zealand Energy Efficiency and Conservation Strategy (NZEECS) in 2001:

> "*The NZEECS is a detailed action plan for increasing the uptake of energy efficiency, conservation and renewable energy programmes across the economy and to make doing so part of the normal behaviour of New Zealanders," p.10.*

A target was set to address all pre 1978 homes with a "suite of cost effective energy efficiency measures". At that stage it was believed that about 0.6 million homes had no or inadequate insulation, with some 0.15 million low income households being the primary focus to achieve health and welfare improvements (EECA and MfE 2001).

The first five-year NZEEC Strategy was written in 2001, with a second version published in 2007. The 2007 NZEECS looked at the lessons learned under the previous Strategy. It outlined the barriers that prevent individuals and businesses from taking up energy efficiency and renewable energy that need addressing as being a lack of information about the benefits of energy efficiency,

conservation and renewable energy and how to realise them, weak price signals with energy prices too low to drive conservation behaviors and access to capital with some consumers unable to meet the initial costs of energy efficiency and renewable energy measures.

A further barrier is the split incentives between landlords, who are responsible for paying for building improvements, and tenants who get the benefits, such as lower energy bills and improved home comfort. As outlined in the EECA (2007):

> "Incentive programmes, such as assistance to landlords to insulate properties and the setting of minimum standards, can help overcome this", p.11.

To address these barriers and increase the uptake of energy efficient measures in homes, the New Zealand Government developed a number of grants, funding and rebates, under a scheme called Energywise Homes (and replaced by the Warm Up NZ - Heat Smart Programme in June 2009), that aims to achieve warm dry healthy homes, improved air quality and reduced energy costs (EECA 2007). From 2009 to 2013, more than 180,000 New Zealand homes will have access to grants for insulation and clean heating devices, such as heat pumps and approved wood burners, as part of a major investment in household energy efficiency. The scheme is open to owners and occupiers of houses built before 2000 and will provide grants up to $1,800, regardless of income.

According to the EECA (2007), by improving the performance of 162,000 existing homes, it is estimated that CO_2 emissions will be reduced by 0.3 metric tons (Mt) and there will be cost savings of $63.3million in energy and $97million in health per annum in 2025. For existing homes, emissions will be reduced by 0.37Mt and there will be $47 million energy savings per annum in 2012 (EECA, 2007, p.18 and 19). MED (2012b) indicates that 100,759 homes have been fitted with insulation and 23,985 with clean heating devices under the Warm Up NZ- Heat Smart programme since it began on 1 July 2009 to the end of June 2011.

A third edition of the NZEECS was released in 2011 and sets the Government's policies, objectives, and targets for the next five years (2011–2016). In terms of housing, the objective remains much the same as the previous NZEECS, but is simplified to insulating 188,500 by 2013. The Government has subsequently announced, as part of Budget 2012, that the programme will now aim to retrofit 230,000 homes, at no extra cost. The Strategy specifically avoids providing a full list of Government energy efficiency initiatives, as the previous editions did, but does state that Government will work with industry to identify and develop a range of market measures targeting the energy productivity of New Zealand's homes. It specifies the Homestar™ rating tool, launched in November 2010, as a good example of this (see below, for details).

Australia introduced a similar strategy in 2009, the National Strategy on Energy Efficiency that, in addition to making changes to the Building Code as outlined above, has proposed a new national Residential Mandatory Building Disclosure (RMBD) scheme. July 2011 saw the release of a consultation Regulation Impact Statement (RIS) for mandatory disclosure of residential building energy, greenhouse and water performance with a consultation period following for industry stakeholders, groups and individuals to comment on proposals. The latter half of 2011 involved the testing of various options to the RMBD of existing dwellings for regulatory implementation, consumer and market acceptance, as well as national and state level cost benefit analyses. The preliminary findings by the Allen Consulting Group (2011) indicate that there are regulatory and non-regulatory options for intervention where the community would be better off with intervention than without it. That is, on the basis of the modelling undertaken, the benefits exceed the costs, although the question of costs and benefits is contested.

The Residential Development Council (2011), in its submission to the consultation RIS, believes any scheme requiring mandatory disclosure of energy, greenhouse and water performance should:

- include a public education program and publicity campaign to increase consumer awareness about the importance of improving the environmental performance of all residential buildings (existing and new);
- develop and adopt a single national rating tool (or similar) for residential assessment for new and existing residential dwellings;
- secure the national implementation of a single scheme with a consistent method of assessment and measurement;
- end consumer confusion and 'star overload' in the residential sector, especially regarding energy efficiency;
- enable comparisons of energy, greenhouse and water performance across all residential homes on a like-for-like basis; and
- establish a national database for the collection of information from the mandatory disclosure scheme, to provide a better understanding of the performance of the new and existing housing stock nationally.

Whilst the RMBD scheme is still in the development stage, individual jurisdictions, such as the Australian Capital Territory (ACT), have required disclosure. The ACT first introduced a scheme in 1999, later revised under the Civil Law (Sale of Residential Property) Act 2003 that has required existing homes to provide energy efficiency information to buyers and renters since 1999, using the NatHERS(Nationwide House Energy Rating Scheme). NatHERS is an initiative of Commonwealth, State and Territory Governments through the Ministerial Council on Energy to facilitate consistent and repeatable ratings irrespective of the commercial software tool selected and ensures that homes in all regions are treated fairly in their rating. (See Odams (2011), Martin (2009) "Home truths: Australia trumps US when it comes to McMansions", http://www.smh.com.au/national/home-truths-australia-trumps-us-when-it-comes-to-mcmansions-20091129-jyva.html and Infometrics New Zealand for latest building statistics for Australia and New Zealand http://www.infometrics.co.nz/top10/art1719.htm [accessed 16 December 2010].) The National Strategy on Energy Efficiency further sets out to develop a National Building Framework to deliver consistency in how building energy efficiency is assessed and rated throughout Australia.

Internationally, mandatory disclosure of the energy performance of homes has been criticized on the grounds of poor quality, lack of consistency, non-invasive style of inspections (ie: cannot check behind linings for insulation) and not driving the energy-conserving behaviour change they were designed for. Watts et al (2011) assessed the impact and effectiveness of EPSs in England by surveying 2000 homeowners in Southampton who bought their home in the first year of the scheme's introduction. With a response rate of 17%, they found that homeowners were aware of EPCs, but that they had little impact on decision-making or price negotiation. Further, energy efficiency was not found to be a priority for homebuyers.

The Building Performance Institute Europe (BPIE 2010) analysed the current status of implementation of EPC schemes across selected EU Member States and identified a number of challenges and issues and found that many individual EU Member States encounter difficulties in implementing EPCs within their national legal frameworks. For example, Member States have varying implementation solutions including chosen calculation methods, registration procedures, promotional activities undertaken, quality control mechanisms and enforcement systems. These differences lead to differences between countries in the effectiveness of EPCs to effect change and bring about energy efficiency improvements in residential buildings acrossEurope. The report

identifies a number of factors that could enhance the effectiveness of implementation such as involving multidisciplinary stakeholders in the design of the scheme,learning from the experience and knowledge of others, ensuring the implementation approach fits with everyday practice, developing a good registration system suitable for monitoring and evaluation,raising public awareness of the EPC through promotion and communication and designing a sound system for the enforcement of EPC obligations.

Bryant and Eves (2011) investigated the compliance of real estate professionals with the Queensland Government's 'sustainability declaration' introduced in 2010. According to O'Leary (2012), this is a somewhat less technically rigorous method of disclosing information on a property's energy systems than that adopted by the ACT. The declaration is a compulsory checklist that must be completed by the seller (vendor) when selling a home. The checklist is designed to identify the property's environmental and social sustainability features in key areas including energy, water, safety and access. A copy of the completed sustainability declaration must also be conspicuously displayed whenever a home is open for inspection by the seller, as it is the responsibility of the agent to disclose where a declaration can be obtained. The results from Bryant and Eves' survey showed that whilst a high level of compliance with the provision of declaration existed there was widespread disengagement with the sustainability declaration process from both sellers and buyers, with 98% of buyers not asking for a copy of the sustainability declaration at any time during the sales process.

Industry Initiatives

In the UK, as early as 1991, the National Energy Services (NES) had been offering home energy efficiency rating services, under the National Home Energy Rating Scheme (NHER) (National Energy Services 2012). The Building Research Establishment (BRE), owned by a charitable trust, developed the environmental rating scheme BREEAM for non-residential buildings and EcoHomes for homes. EcoHomes was first developed and used commercially in 2000. It was replaced by the Government-owned Code for Sustainable Homes in April 2008. Both the residential and non-residential versions of Green Star in Australia and New Zealand and LEED in the US produced by the respective Green Building Councils were based on these latter schemes. The calculation of the energy ratings on the Energy Performance Certificate (EPC) that are mandatory when selling or leasing a home in the UK (see above) are based on the Reduced Data Standard Assessment Procedure Version 3 (RDSAPv3) procedure, derived from BRE's Domestic Energy Model (BREDEM).

In New Zealand, Beacon Pathway, a consortium of the Building Research Association of New Zealand (BRANZ, similar to the UK's BRE), Fletcher Building, NZ Steel, Scion and Waitakere City Council, was formed in 2004 to fulfil a six year research contract with the Foundation for Research Science and Technology (FRST), to investigate issues related to New Zealand housing and its sustainability performance. Two aspirational goals, "to bring 90% of New Zealand houses to a high standard of sustainability by 2012", and "to ensure that existing or redevelopment subdivisions from 2008 onwards, is executed with reference to a nationally recognised sustainability framework" drove the establishment of an extensive programme of demonstration projects, collaboration and the development of practical solutions and tools. Subsequent to the ending of the six year contract, Beacon has since become an incorporated society (Beacon Pathway 2012).

In line with the goals of the NZEECS Strategy, a joint venture initiative was undertaken by the New Zealand Green Building Council, BRANZ and Beacon Pathway to empower consumers to act more sustainably. The free online Homestar™ Rating Tool (similar to EcoHomes in the UK) was launched in November 2010 and is independently administered by the New Zealand Green Building

Council. (The Australian Green Building Council does not currently have a rating tool for homes.) The development of the tool also had the support of the building industry and key Government agencies including the Department of Building and Housing and the Energy Efficiency and Conservation Authority (EECA). It allows owners to assess their home's performance in comfort, health and energy-efficiency. Further, it has an educational role as it provides valuable information to help householders make informed decisions to improve the performance of their homes. Since its introduction in October 2010, more than 8,000 New Zealand homes have gone through a voluntary online Homestar self-assessment and ten homes are independently certified.

The New Zealand Homestar™ rating is included in the study reported below to determine market knowledge of and level of engagement with the tool. The survey will raise awareness of the tool and the steps householders can take to act more sustainably. As mentioned by Shipworth (2000) in her handbook for the Australian Greenhouse Office titled "*Motivating Home Energy Action: A handbook of what works*":

> "Without householders taking energy actions, we cannot reduce home energy use", p. 1.

The author goes onto say:

> "Social scientists have done a great deal of research into what motivates people to take energy actions"

and the research reported below, is an attempt to find this out.

Previous research (for example, Shipworth 2010, Environment Victoria2010, Bond 2011) shows that factors affecting the willingness of householders to undertake sustainability improvements and to behave in more environmentally sensitive ways include the amount of time involved, effort required, level of comfort provided and the cost and long pay-back periods. Shipworth outlines a range of strategies to motivate home energy action and explains why others, including money, may not work. The author outlines when and what type of information motivates and a range of financial incentives that can be used. A useful checklist is provided that includes both marketing and delivery options.

This literature review has outlined a number of studies that have been undertaken about both public perceptions and consumer attitudes towards sustainability and the state of the housing sectors' in Australia, New Zealand and the UK in this regard. Generally, existing homes are still performing poorly in terms of energy and water efficiency, despite improvements to the Building Codes, the introduction of rating tools to measure energy efficiency (mandatory or voluntary) and the availability of subsidies and grants for energy efficient improvements to homes.

The research reported here will investigate consumers home use behaviours and their level of motivation to act more sustainably, but will also assess the market knowledge of and level of engagement with the Homestar™ Rating Tool in its first year of operation. The research aligns with and contributes to the goals of various governments' energy strategies, outlined above, to meet energy and climate change transformation.

RESEARCH

According to the EECA (2007), the energy used in homes is affected by the appliances used, householder behaviors and building design. The broad aims of this research were to identify and explain user behaviour in residential buildings in relation to the energy consumed and to evaluate

the awareness and success of the Homestar™ rating tool in empowering householders to make their homes healthier and more energy efficient. The results from this survey help to identify the methods needed to aid communication of sustainability measures that encourage behaviour change and increase the uptake of sustainability practices in homes that reduce greenhouse gas emissions from residential buildings.

Methodology

A postal survey was adopted as the quickest and most cost effective way of surveying a large sample of householders across New Zealand. The survey was distributed by registered mail to a random sample of 4,000 householders throughout New Zealand. A covering letter describing the survey, the questionnaire and a self-addressed prepaid envelope, to aid collection and help improve the response rate, was included. To get a wide geographical spread of respondents, respondents were randomly selected from each of the seventy general electorates on the New Zealand Electoral rolls. The number of electors registered on the general electoral roll for each electorate varied from 30,400 to 48,000. Using the Excel random number generator, respondents were selected from the New Zealand Electoral roll for each electorate. These were weighted by the number of electors in each electorate to the total number of electors: 41 to 65 electors were chosen from each electorate. The responses were individually coded, entered into a computerised database and analysed. Frequencies and percentages were reported for all categorical variables. To determine if there were variances in responses based on demographic data, comparisons of categorical variables between groups were made using the one-way ANOVA test. A significance level of P-value ≤ 0.05 was used to define statistical significance.

Survey Instrument

The questionnaire commenced by asking respondents about the home they live in including size, number and types of rooms, construction details and household composition. They were then asked about the appliances in their home including whether they consider the energy efficiency and water rating of these, their age and whether they are energy/water rated or not and whether they have sourced information on the sustainability of their home or energy/water efficiency measures. Next they were given a range of actions that have been identified as having a significant effect on household climate change emissions and asked to indicate the likelihood of them adopting the listed behaviours or actions in the next 12 months, together with reasons for not undertaking them, if they have not already done so.

Questions in the second half of the survey related to the new Homestar™ residential rating tool. Respondents were asked if they knew about the tool, how they found out about it, whether they had used it and, if so, what the results were and whether they made changes based on this. If they made changes to their home, respondents were asked what difference the changes made to their energy/gas bill and comfort and whether they took advantage of available grants or subsidies. Respondents were asked to identify from a range of options what they considered to be the most important benefits of incorporating energy efficient features within a home, what were the barriers in doing so and what more can be done to improve the uptake of sustainable features. Finally, demographic questions were included at the end of the survey.

Pilot Testing

The survey was tested for its legibility by a convenience sample of industry professionals who were attending a New Zealand Green Building Council event, "Homestar™ Industry Forum", launching the new Homestar™ residential rating tool. The first event was held in Christchurch on the 1st June 2011 and the second in Wellington on the 7th June 2011. The written survey was distributed by hand to this targeted group. As half the survey questions relate to the Homestar™ Rating tool and it was considered this group would have an interest in answering it, a high response rate was

anticipated. Of the 48 questionnaires distributed to Christchurch NZGBC event attendees, 31.25% (15) were completed and returned. Of the 47 questionnaires distributed to the Wellington group 21.28% (10) were completed and returned.

Results from the pilot survey indicate that the survey was well understood and easy to follow. Nearly three quarters (72%) of respondents live in a home they own or are paying off. The responses indicate that the main barriers to energy efficiency in homes are the perceived cost and the lack of consumer information about benefits and savings from incorporating energy efficient and water saving devices and features.

Less than half (48%, n=12) of the respondents had used the Homestar™ rating tool and of those that had, they had all completed the online self-assessment (rather than using a HomeCoach™ or Homestar™ Assessor). Of the respondents that had conducted the Homestar™ assessment, three quarters (9) of them had not made any changes. The remaining 25% (3) of those that assessed their home only made three types of changes, beingadded/topped up insulation in the ceiling, installed energy efficient compact fluorescent or LED lights and draught seal around windows and doors. The next section outlines a summary of the results, indicating valid percentages (excluding missing data).

SURVEY RESULTS

Initially, from 4,000 surveys mailed out, 511 responses were received (12.78% response rate), then an additional 247 responses were received after a reminder letter was sent out to 2,000 of the respondents. Overall, 758 responses were completed and returned indicating a response rate of 18.95%. Demographic questions revealed that 67.3% of respondents came from the North Island, with 55% being female. While the cities/towns that respondents came from varies widely (see Appendix I for a breakdown of respondents by electorate), there was a concentration from the Bay of Plenty, Northland and New Plymouth in the North Island and West Coast-Tasman, Ilam (Christchurch), and Dunedin South in the South Island.

The majority of respondents (82.3%) were 40 years of age or older. 37.6% were 60 years or older, 24.1% were between 50-59 years and 20.6% were between 40-49 years of age. In terms of household income, 27% earned between $60,000 and $100,000, 23.9% earned $30,000 - $60,000, 22.5% earned less than $30,000, while 21% earned between $100,000 and $200,000.

Tenure, Size of Home, Household Composition and House Construction

Over three quarters (79.3%, n=598, missing data=4) of respondents live in a home they own or are paying off. The size of respondents' homes varied a lot as can be seen in Table 1, with 20.6% having a home between 101-150sqm, 18% between 151-200sqm, and 14.1% between 201-250sqm.

Nearly three quarters of respondents' homes have either three bedrooms (43.6%, n=328) or four bedrooms (30%, n=226), despite 45.7% (n=344) of households having only two persons living in them. Half of the homes have only one bathroom (52.5%, n=394) and over a third of homes have two (36.8%, n=276). Similarly, half of homes have one living room (50.3%, n=377). This number of rooms appears to be in line with data from QV (2011) that shows that the average home has grown to 205sqm. This trend to smaller household sizes and larger homes presents a barrier to reducing impacts on the environment.

Size (sqm)	Frequency	Percent (%)	Valid Percent (%)
Less than 100	75	9.9	10.3
101 – 150	149	19.7	20.6
151 – 200	130	17.2	17.9
201 – 250	102	13.5	14.1
251 – 300	83	10.9	11.4
Over 300	51	6.7	7.0
I do not know how big my home is/ No idea	135	17.8	18.6
Missing Data	33	4.4	0
Total	**758**	**100**	**100**

Size of the Respondent's House
Source: Author
Table 1

Nearly half (49.4%, n=373) of the homes were constructed of weatherboard (timber or composite materials) and 37.9% (n=286) were constructed of masonry veneer, 45.8% (n=345) were on a concrete slab foundation, 29.8% (n=225) were on timber floor with timber piles and 26% of homes had timber flooring on brick or stone footings. Over half (58.4%, n=431) of the respondents' homes had no air-conditioning, while 30.8% (n=227) had a heat pump/air conditioner. A question on heating types was not included as this has been well covered in previous studies, (see for example EECA 2010).

As appliances make up about 40% of the average household's electricity bill (EECA, 2009), questions relating to choice and use of these were included in the survey. Further, as Energy Star is the global mark of energy efficiency, typically awarded to the top 25% most energy efficient products by category, respondents were asked whether they consider the energy efficiency or water star rating of appliances before purchasing them and nearly two-thirds (63.6%, n=472) said they did, while 24.8% (n=184) said they did only sometimes. In terms of the age of appliances and heating systems used in respondents' homes, respondents indicated that the systems that are commonly added to the house when it is built (hot water cylinder (HWC) and ceiling insulation) were generally older than five years, perhaps reflecting the age of the homes. However, appliances which tend to have a shorter life span and do not form part of the real estate were generally less than five years old. As older appliances tend to be less energy efficient, it is a concern that over half of respondents' fridges (59%, n=441) and washing machines (55%, n=414), and 39% (n=265) of dishwashers are more than five years old as outlined in Table 2.

Responses to the energy or water rating of respondents' appliances were generally low. Only 7.4% of respondents indicated the energy rating for their fridge, 7.1% for their washing machine, 1.8% for their dishwasher, 1.6% for their ceiling insulation and only 0.9% for their hot water system. This low awareness by respondents of energy ratings of appliances in their homes is unfortunate given the cost and energy saving benefits of buying energy efficient, star rated appliances. According to ECCA, a modern family fridge/freezer with a 3½ star energy rating label costs around $100 per year to run. A 10-year-old fridge of the same size could cost twice as much to run. Energy Star-qualified washing machines can be about 50% more efficient than nonqualified models. They also use less energy and water (EECA 2009).

Years	HWC	Ceiling Insulation	Fridge	Washing Machine	Dishwasher
Less than 5 years old	23%	28%	38%	42%	38%
More than 5 years old	63%	56%	59%	55%	39%
Unsure of age	13%	12%	2%	2%	2%
Not applicable	0.9%	5%	0.5%	0.5%	20%

The Age of Appliances and Heating Systems
Source: Author
Table 2

Less than half (45.6%, n=346) of respondents have sourced information on the sustainability of their home, including energy and water efficiency measures or rebates, in the last twelve months. Of those that had, most had obtained information from more than one source. 23% had obtained it from a government website such as EECA or the Ministry for the Environment's sustainability section and 20% had sourced it from a sales person in store or from a brochure delivered to their home.

When asked how motivated respondents are to reduce their personal climate change emissions, only 14% (n=103) said they were highly motivated, with nearly half (47%, n=350) moderately and 23% (n=172) slightly motivated.

Likelihood of Adopting No to Low Cost Energy Efficient Behaviours

EECA provides a number of information sheets for consumers. One of these outlines the energy saving tips for the home (EECA 2009A). Simple actions suggested include stopping draughts around doors and windows with draught stoppers, using thermostats and timers so heaters only come on when needed and switching appliances off at the wall when not in use as they draw energy even when on standby. EECA (2007) and EECA (2009) include the typical savings of taking some simple no cost or low cost actions, as outlined in Table 3.

From a range of no/low cost actions, such as those outlined in Table 3, that have been identified as having a significant effect on household greenhouse gas emissions, respondents were asked to indicate the likelihood of them adopting the listed behaviours or actions in the next 12 months (already taking, most likely to take, unlikely to take). Many respondents were already taking action for over half of the nineteen listed no/low cost options. The most common actions already taken were turning lights off when not in the room and using natural light where possible, drying clothes on a clothesline rather than in an electric clothes dryer, using the washing machine or dishwasher only when full, using a warmer blanket when sleeping rather than warming the whole house andwashing clothes in cold water.

The no/low cost actions respondents were most likely to take included seal around external doors and windows with sealing strips to reduce draughts, dress appropriately rather than cooling/warming the whole room/house and reduce showering time to less than 4 minutes.

The actions they were most unlikely to take were install timers on appliances to turn them off when not in use, reducing showering time to less than four minutes and installing a water efficient shower head and tap fittings. Given that all the listed actions are low or no cost, it was surprising that more people would not take these actions.

Actions	Typical savings per annum
Using the sun to dry clothes, rather than a dryer	$200
Switching off or getting rid of a spare fridge	$100 - $300
Use heated towel rail for just a few hours day instead of leaving on permanently	$90
Replacing four most used light bulbs with energy efficient ones	$85
Wrap electric hot water cylinder so it stays warmer for longer. If cylinder is older (i.e. pre-1987)	$140
Turn appliance off rather than leaving them on standby	$75
Install good thermal backed curtains	$100
Install an efficient shower head	$200 - $720 (depending on flow rate of old one)
Turn down the hot water heating setting – it should be at 55 °C.	Turning down 10°C: $20 - $30
Use cold water for washing your clothes	4 loads/week: $50-$75

Simple Energy Saving Actions and Savings
Source: EECA (2007) and EECA (2009)
Table 3

Reasons for Not Taking No to Low Cost Actions

A question was included to determine the reasons why respondents do not take action. The reasons given depended on the action. For example, some respondents said they did not turn off appliances as they had timers and clocks on them (would require resetting each time they turned them back on) or that they were difficult to reach. The reason given most commonly for not reducing showering times was simply that they like hot showers, or it was habit. Reasons given for not using a warmer blanket while sleeping rather than warming the whole room/house, or for not dressing appropriately rather than cooling/warming the whole room/house, was the need to keep the house warm to reduce the chance of illness, to maintain the home temperature in line with WHO (1989) guidelines of 18ºC and to keep the home comfortable for young children. Other reasons were cost, inconvenience, laziness, not used to thinking about it, switches are hard to reach, or that they are too busy. This information can provide useful clues for what is needed to help people act, such as automating some actions where possible or making actions mandatory such as requiring homes to have water efficient shower heads.

Likelihood of Adopting Low to Medium Cost Energy Efficient Behaviours

Next respondents were asked to indicate the likelihood of them adopting behaviours or actions in the next 12 months from a range of low to medium cost actions that have been identified as reducing greenhouse gas emissions produced by households. Not surprisingly fewer of the respondents were already taking action on the low/medium cost listed items compared to the no/low cost actions.

The most common actions already taken were replacing single flush toilet with dual system, installing or topping-up ceiling insulation, replacing the old fridge with a high Energy Star rated one and replacing the old washing machine with a more energy and water efficient one.

Given that 42% of heat escapes through the roof and that heating and cooling consume the most amount of energy in a home (38%), installing or topping up insulation is one of the more cost-effective ways of reducing energy consumption in homes and saving money. Not surprisingly, with rebates available for installing insulation, over a third of respondents (37%, n=257) had already done this.

Similarly, water heating uses 25% of energy in homes but consumes the most greenhouse gas emissions and installing instantaneous gas or solar hot water heaters is another cost-effective way of reducing both energy consumption and greenhouse gas emissions while saving money. Only 22% (n=152) had already taken measures to make heating water more energy efficient.

The low/medium cost actions that respondents were most likely to take included replacing the old fridge and old washing machine with a high Energy Star rated one and installing or topping-up ceiling insulation. The actions they were most unlikely to take were installing a photovoltaic system, a grey water system, a HRV home ventilation system and double glazing.

Reasons for Not Taking Low to Medium Cost Actions

The most common reasons for not acting on the various listed options were predominantly due to the cost of the item/s and the poor pay back on them, that the items do not need replacing yet or that the respondent does not own the property. For installing HRV home ventilation systems, respondents felt that they were overpriced, not effective or that their house is not suitable due to a lack of roof space. Certainly, given the results of recent studies (for example Fitzgerald et al 2011, and Boulic et al 2010), it is not surprising there is some confusion about the benefits or effectiveness of HRV home ventilation systems.

Homestar™ Residential Rating Tool Use

The next part of the survey asked respondents questions about the new Homestar™ residential rating tool. Respondents were asked if they were aware of the tool. Even though it has been mentioned on home product advertisements on television, only 9.2% (n=68) of respondents knew about it. When asked how they found out about the Homestar™ rating tool, the main source options selected were television, newspaper, and "other" sources (BRANZ building magazine, relatives, property-related associations).

Of the 9.2% of the respondents that knew about the Homestar™ rating tool, only eight (12.3% of 68, or 1.1% of the total number of respondents) had used the tool and did so using the online self-assessment (rather than using a HomeCoach™ or Homestar™ Assessor) and only three of these made any changes. Those respondents who had not used the rating tool were directed to a later general question not relating to the tool's use. In terms of their rating, 57% had a 3-Star (out of 10), 28.5% had a 1-Star and 14.2% had a 2-Star. These results are consistent with the findings of the NZGBC that the average New Zealand house is between a two or three-star ranking, but with basic insulation can instantly be upgraded to a four or five star rating (Radio NZ, 2011).

The low level of awareness of the Homestar™ residential rating tool may be as a result of it being so new on the market. Although it was launched on 8 November 2010 by the Minister of Building and Construction, the Hon. Maurice Williamson, it was not formally launched to industry until the June 2011 NZGBC forums, so it is not surprising that householders may not have known about it. It will be interesting to resurvey householders in the future to determine whether marketing efforts by the NZGBC and others to increase awareness of Homestar™ have been worthwhile.

Benefits for Acting Environmentally

It is recognised that many of the energy and water saving features in homes cost money, so all respondents to the survey were directed to answer the question seeking them to rank from a list of financial and non-financial benefits what they considered to be the most important and that might motivate them to act. Full results are detailed in Appendix II.

Respondents' ranked reduced home running costs as the most important followed by comfortable home temperature, healthy indoor air quality, reduced environmental impact, increased property value with decreased obsolescence ranked last. Certainly it is the cost savings benefits that are reported most widely in the media in relation to acting in a more energy conserving way. Further, with so much media-attention to the need to combat climate change, this has no doubt raised awareness amongst the public of the need to act in a more environmentally sensitive way.

Barriers to Incorporating Sustainable Features and Suggestions to Improve Uptake

All respondents to the survey were directed to rank a list of potential barriers to the incorporation of sustainable features into homes, from 1 most important to 9 least important. Full results are detailed in Appendix III and a summary of the results is outlined in Table 4.

Rank	Barriers
1	High cost/low benefit of features
2	Unwillingness to pay additional cost
3	Lack of owner/occupier awareness
4	Poor access to information
5	Unreliable or unproven technology;
6	Limited availability to new technology
7	Lack of developer awareness
8	Difficulty getting local authority approval
9	Other

Barriers to Incorporating Sustainable Features
Source: Author
Table 4

Respondents felt that the high cost/low benefit of features was the main barrier, followed by unwillingness to pay additional costs. Given that respondents that made changes after using the Homestar™ rating tool had either no change, or an increase, in their energy or gas bills such perceptions are understandable. It does seem from the results of the last two questions that respondents are cost-focused.

In terms of incentives to encourage the uptake of energy or water saving features in the design of new and retrofitted homes, respondents ranked the listed options, from 1 most important to 7 least important. Full results are detailed in Appendix IV, with a summary of the results in Table 5.

The respondents felt that more rebates and subsidies would have the strongest influence. This result is consistent with the feedback from the previous question, which found that unwillingness to pay additional cost is a primary barrier for incorporating sustainable features. Building Code changes were ranked second most important. Certainly, from the literature review, Building Code changes have aided the improvement in the performance of new homes, however such changes do little to help the performance of existing homes. The least important item for encouraging sustainable features in new homes was mandatory energy efficiency reporting. This latter incentive was

probably unpopular due to the perceived additional burden on the homeowner in terms of the additional time and cost of compliance.

Rank	Incentives
1	More rebates/subsidies
2	Building code changes
3	Changes to legislation
4	Availability of products
5	Building certification
4	Better advertising
6	Mandatory energy efficiency reporting
7	Other

Incentives to Encourage the Uptake of Sustainable Features
Source: Author
Table 5

The Australian Government has considered mandatory energy efficiency reporting as important in their energy efficiency strategies and are introducing it for homes in 2012 (it was introduced for commercial buildings in 2010, under the *Building Energy Efficiency Disclosure Act 2010*, Department of Climate Change and Energy Efficiency 2010). If introduced in New Zealand, mandatory energy performance reporting, while an additional cost to the homeowner, is likely to become a major driver for greater energy efficiency in homes.

Statistical Analysis of the Results

To determine if there were significant variances in responses based on demographic data (gender, age, income and location), comparisons of categorical variables between groups were made using the one-way ANOVA test. The house size that respondents live in had a statistically significant impact on their responses to obvious variables such as number of bedrooms and bathrooms, but more specifically, smaller homes less than 150sqm tend to have older hot water systems (5 years or older) and larger homes over 300sqm have older insulation (5 years or older). Respondents with homes in the 101-150sqm and 201-250sqm ranges were more likely to source information on sustainability for their home than respondents with homes in the other size categories.

There was no statistically significant difference in the distribution of attitude between respondents across age groups, income or location for levels of motivation to act sustainably. However, female respondents and respondents with homes between 101-150sqm were more highly motivated to reduce their personal climate change emissions than male respondents or respondents with homes in the other size categories. However, more female respondents were unwilling to pay additional cost compared to male respondents for incorporating sustainable features into homes.

Not surprisingly, the respondents from the warmer north island were more likely to have air conditioning than respondents from the cooler south island. Further, respondents from the south were more likely to have a wall mounted heat pump/air conditioner than those from the north.

SUMMARY AND CONCLUSIONS

This paper outlines the results of a survey of householders in 2011 to identify householders' lifestyle choices within homes that impact on energy use and their motivation to conserve energy. Barriers to energy efficiency in homes are larger homes and smaller households, initial costs, long payback periods for sustainable features and a lack of credible information to make energy efficient choices. The same barriers were indicated by respondents to this survey, particularly those relating

to cost and lack of consumer information about benefits and savings from incorporating energy efficient and water saving devices and features. There was low awareness by respondents of energy ratings of appliances in their homes and less than half of respondents have sourced information on sustainability.

Given that water heating and heating and cooling of homes use the most energy and produce the most greenhouse gas emissions these areas should be focused on. The greater uptake of available rebates for ceiling insulation and clean heating devices would aid in reducing greenhouse gas emissions.Further, to encourage people to act in more sustainable ways, automating some activities in homes, or making actions mandatory, such as requiring homes to have water efficient shower heads, would aid this.

Further research of users of the Homestar™ rating tool will provide insights into the motivations of householders using the tool and how successful the tool has been in driving change. The introduction of the voluntary Homestar™ rating tool, that provides relevant and credible information to help householders make better environmental choices, is just one step towards empowering householders to act more sustainably. Given the issues that other countries have faced with mandatory reporting regimes for the provision of energy, greenhouse and water performance information to buyers and renters, it is not recommended that the New Zealand Government take this action until there is solid evidence that such an approach can successfully drive behaviour change.

REFERENCES

Allen Consulting Group2011, *Mandatory Disclosure of Residential Building Energy, Greenhouse and Water Performance: Consultation Regulation Impact Statement*, fourth draft report to the National Framework for Energy Efficiency Building Implementation Committee, July.http://www.propertyoz.com.au/library/AttachmentA2-CRIS-Res-Buildings-Man-Disclosure.pdf(accessed 20 December 2012).

Department of Climate Change and Energy Efficiency 2011, *National Strategy on Energy Efficiency, 2011*,http://www.climatechange.gov.au/what-you-need-to-know/buildings.aspx(Accessed 17 September, 2011).

Beacon Pathway 2012, *Beacon – Our History*, http://www.beaconpathway.co.nz/about-us(accessed 14 August 2012).

Buildings Performance Institute Europe (BPIE)2010, *Energy Performance Certificates across Europe: From design to implementation*, http://www.buildup.eu/system/files/content/BPIE_EPC%20report%202010.pdf(accessed 20 December 2010).

Bond, SG 2011, 'Residential property development professionals attitudes towards sustainable development in Australia',*International Journal of Sustainable Development and Planning*, Vol. 6, No. 4, pp. 474-486.

Boulic, M, Hosie, I, Phipps, R 2010*Effects on indoor environment in 30 Auckland homes from the installation of a positive pressure ventilation unit*,paper given at SB10, New Zealand Sustainable Building Conference, 26-28 May 2010, Te Papa, Wellington, New Zealand. http://www.cmsl.co.nz/assets/sm/5933/61/10.PN031PhippsandHosie.pdf (Accessed 22 September, 20110.

BRANZ 2006,*Energy use in New Zealand houses: report on the ten year analysis of the household energy end-use project [HEEP]*, Study Report, Number SR 155, 2006. http://www.branz.co.nz/cms_show_download.php?id=b1ab61dd06f50e83e6a184b29b68a989472502ed(Accessed 23 September, 2011).

Bryant, L and Eves, C 2011, *Sustainability and mandatory disclosure in Queensland: an assessment of the impact on home buyer patterns*, paper presented at the 17th Pacific Rim Real Estate Society Conference, 16-19 January 2011, Gold Coast, Australia, http://eprints.qut.edu.au/39990/1/c39990.pdf, (accessed 20 December 2012).

Department of Building and Housing 2008, *New H1 requirements for houses - Q and A*, 2008 http://www.dbh.govt.nz/codewords-26-8(Accessed 17 September, 2011).

Department of Building and Housing 2008,*Domestic ventilation systems*, Codewords Issue 29, 2008: http://www.tenancy.govt.nz/codewords-29-5(Accessed 17 September, 2011).

Department of Climate Change and Energy Efficiency 2010,*National strategy on energy efficiency*, 2010.*http://www.climatechange.gov.au/what-you-need-to-know/buildings.aspx*(Accessed 17 September, 2011).

Easy Energy Assessment 2008, *Aboutenergy performance certificates*, http://www.easyenergyassessments.co.uk/certificate.html(Accessed 16 December 2012).

Energy Efficiency and Conservation Authority (EECA) and the Ministry for the Environment (MfE) 2001,*National energy efficiency and conservation strategy*, Energy Efficiency and Conservation Authority, Wellington. 24, pp. 2001.

EECA 2007,*The New Zealand energy efficiency and conservation strategy (NZEECS): making it happen*, http://www.eeca.govt.nz/sites/all/files/nzeecs-07.pdf(Accessed 23 September, 20110.

EECA 2009,*Actionsheet 4:choosing and using your appliances*, http://www.energywise.govt.nz/sites/all/files/action-sheet-4-choosing-and-using-appliances-11-09.pdfhttp://www.eeca.govt.nz/node/9209(Accessed 22 September, 2011).

EECA 2009A,*Action sheet 1:energy saving tips for your home*, 2009. http://www.energywise.govt.nz/sites/all/files/action-sheet-1-energy-saving-tips-10-09.pdf(Accessed 22 September, 2011).

EECA 2010,*January-March 2010 consumer marketing research*, 2010.http://www.eeca.govt.nz/node/9209(Accessed 22 September, 2011).

EECA 2011,*About the warm up New Zealand: heat smart programme*, 2011. http://www.energywise.govt.nz/funding-available/insulation-and-clean-heating/about (Accessed 22 September, 2011).

Environment Victoria2010,*Towards climate safe homes: the case for zero emissions and water saving homes and neighbourhoods*, September, available at http://www.apo.org.au/node/19020(Accessed 5 June 2010).

Fitzgerald W, Smith I, and Fahmy M. 2011, *Heating and cooling potential of roof space air: implications for ventilation systems*, report prepared for the Energy Efficiency and Conservation Authority (EECA), May 2011, https://www.energywise.govt.nz/sites/all/files/heating-potential-ventilation-systems-may-2011.pdf(Accessed 22 September, 2011).

Howden-Chapman P 2007,*Housing, heating and health study: preliminary results May 2007*, Universities of Otago, Massey, Victoria and Auckland and BRANZ, 2007. http://www.healthyhousing.org.nz/wp-content/uploads/2010/01/HeatingStudyOnePager.pdf(Accessed 22 September, 2011).

Howden-Chapman P 2007,'Effect of insulating existing houses on health inequality: cluster randomised study in the community', *British Medicine Journal*, BMJ. 2007 Mar 3; 334 (7591):460.

James C 2009, *Economic insights: Australian homes are biggest in the world*, a report produced by Commonwealth Research for ComSec (Commonwealth Securities Limited), a wholly owned subsidiary of the Commonwealth Bank of Australia, 20 November, 2009. http://images.comsec.com.au/ipo/UploadedImages/craigjames3f6189175551497fada1a4769f74d09c.pdf(Accessed 15 December 2012).

Lloyd B 2006,'Fuel poverty in New Zealand', *Social Policy Journal of New Zealand*, 2006, Issue 27, March, pp. 142-155.

McChesney I and Amitrano L 2006,*Sustainability options for retrofitting New Zealand houses – energy report*, TE106/4 for Beacon Pathway Limited, August, 2006.

McChesney I 2009, *Home ventilation system assessment",* Report to the Energy Efficiency and Conservation Authority (EECA), 2009. http://www.eeca.govt.nz/sites/all/files/home-ventilation-report-06-09.pdf, (Accessed 22nd February 2010).

Ministry of Economic Development (MED) 2012, *New Zealand energy data File 2012*, p.108.http://www.med.govt.nz/sectors-industries/energy/pdf-docs-library/energy-data-and-modelling/publications/energy-data-file/energydatafile-2011.pdf(Accessed 14 July 012).

Ministry of Economic Development (MED) 2012b, *Cost benefit analysis of the warm up New Zealand: heat smart programme*, http://www.med.govt.nz/sectors-industries/energy/pdf-docs-library/energy-efficiency/nzif-cba-report.pdf(Accessed 14 August 2012).

National Energy Services 2012, *Heritage*,http://www.nesltd.co.uk/content/heritage(Accessed 20 December 2012).

Odams G 2011,*Residential building costs and the modal house*, PINZ Lincoln Mainland Seminar, 2-3 September, Lincoln University, Christchurch, 2011.

O'Leary T 2012,*Residential energy efficiency and mandatory disclosure practices*,paper presented at the Pacific-Rim Real Estate Society Conference, Adelaide, Australia, 15-18 January 2012.

QV 2011,*Property information:average house size by age*, 2011,http://www.qv.co.nz/propertyinformation/KnowledgeCentre/Average+house+size+by+age10052011.htm(Accessed 23 September, 2011).

Radio NZ 2011,*New energy-efficiency ranking for homes*, 2011, 7 July. *http://www.radionz.co.nz/news/national/79438/new-energy-efficiency-ranking-for-homes*(Accessed 23 September, 2011).

Residential Development Council 2011,*RDC – RMBD regulation impact statement submission*, 12th Sept., Residential Development Council, division of Property Council of Australia.*http://www.ret.gov.au/Documents/mce/_documents/quicklinks/Submission2011/126Submission_CarolineSpeed_PCA_110914.pdf*(Accessed 20 December, 2012).

RICS 2007,*Energy Performance of buildings Directive (EPBD): the facts you need to know*, http://neupc.procureweb.ac.uk/estates/files/EPBD-the-facts-you-need-to-know.pdf(Accessed 16 December 2012).

Shipworth M2000, *Motivating home energy action: ahandbook of what works*, produced for the Australian Greenhouse Office,http://www.reading.ac.uk/web/FILES/energy/Shipworth_2000_Motivating_Home_Energy_Action_-_A_Handbook_of_What_Works.pdf

Statistics NZ 2011,*QuickStats About New Zealand*. http://www.stats.govt.nz/Census/2006CensusHomePage/QuickStats/AboutAPlace/SnapShot.aspx?type=region&tab=Households&id=9999999(Accessed 23 September, 2011).

Statistics NZ 2005,*National family and household projections: 2001 (base) - 2021 update*,http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalFamilyAndHouseholdProjections_HOTP01-21projections/Commentary.aspx(Accessed 23 September, 2011).

Watts C, Jentsch MF and James PAB 2011, 'Evaluation of domestic energy performance certificates in use', *Building Serv Eng Res Technol*,November,Vol. 32 No. 4,pps.361-376.

World Health Organization (WHO) 1985,*Health impact of low indoor temperatures*, Report on a WHO meeting, Copenhagen, 11-14 November 1985, World Health Organization Regional Office for Europe, 1987.http://whqlibdoc.who.int/euro/ehs/EURO_EHS_16.pdf(Accessed 23 September, 2011).

World Health Organisation (WHO) 1989,*Health principles for housing*, WHO, Geneva, 1989.

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Appendix I

Respondents by Electorate

	Frequency	Percent	Valid Percent	Cumulative Percent
Auckland Central	9	1.2	1.2	1.2
Bay of Plenty	15	2	2	3.2
Botany (Howick)	6	0.8	0.8	4
Christchurch Central	11	1.5	1.5	5.4
Christchurch East	11	1.5	1.5	6.9
Clutha-Southland	16	2.1	2.1	9
Coromandel	10	1.3	1.3	10.3
Dunedin North	9	1.2	1.2	11.5
Dunedin South	17	2.2	2.2	13.7
East Coast	9	1.2	1.2	14.9
East Coast Bays	4	0.5	0.5	15.4
Epsom	12	1.6	1.6	17
Hamilton East	10	1.3	1.3	18.3
Hamilton West	14	1.8	1.8	20.2
Helensville	9	1.2	1.2	21.4
Hunua	10	1.3	1.3	22.7
Hutt South	10	1.3	1.3	24
Ilam	18	2.4	2.4	26.4
Invercargill	11	1.5	1.5	27.8
Kaikoura	14	1.8	1.8	29.7
Mana	12	1.6	1.6	31.3
Mangere	3	0.4	0.4	31.7
Manukau East	2	0.3	0.3	31.9
Manurewa	4	0.5	0.5	32.5
Maungakiekie	7	0.9	0.9	33.4
Mt Albert	7	0.9	0.9	34.3
Mt Roskill	5	0.7	0.7	35
Napier	13	1.7	1.7	36.7
Nelson	10	1.3	1.3	38
New Lynn	7	0.9	0.9	38.9
New Plymouth	17	2.2	2.2	41.2
North Shore	12	1.6	1.6	42.7
North Cote	6	0.8	0.8	43.5
Northland	18	2.4	2.4	45.9
Ohariu	9	1.2	1.2	47.1
Otaki	12	1.6	1.6	48.7
Pakuranga	12	1.6	1.6	50.3

Palmerston North	11	1.5	1.5	51.7
Papakura	6	0.8	0.8	52.5
Port Hills (Banks Peninsula)	12	1.6	1.6	54.1
Rangitata	9	1.2	1.2	55.3
Rangitikei	15	2	2	57.3
Rimutaka	13	1.7	1.7	59
Rodney	12	1.6	1.6	60.6
Rongotai	7	0.9	0.9	61.5
Rotorua	10	1.3	1.3	62.8
Selwyn	15	2	2	64.8
Tamaki	9	1.2	1.2	66
Taranaki-King Country	10	1.3	1.3	67.3
Taupo	7	0.9	0.9	68.2
Tauranga	11	1.5	1.5	69.7
Te Atatu	7	0.9	0.9	70.6
Tukituki	11	1.5	1.5	72
Waikato (Piako)	9	1.2	1.2	73.2
Waimakariri	14	1.8	1.8	75.1
Wairarapa	13	1.7	1.7	76.8
Waitakere	7	0.9	0.9	77.7
Waitaki	15	2	2	79.7
Wellington Central	11	1.5	1.5	81.1
West Coast-Tasman	21	2.8	2.8	83.9
Whanganui	7	0.9	0.9	84.8
Whangarei	11	1.5	1.5	86.3
Wigram	13	1.7	1.7	88
Hauraki-Waikato	7	0.9	0.9	88.9
Ikaroa-Rawhiti	3	0.4	0.4	89.3
Tamaki Makaurau	1	0.1	0.1	89.4
Te Tai Hauauru	2	0.3	0.3	89.7
Te Tai Tokerau	3	0.4	0.4	90.1
Te Tai Tonga	6	0.8	0.8	90.9
Waiariki	2	0.3	0.3	91.2
Unknown, coded as AA for first mailing respondents	8	1.1	1.1	92.2
Unknown, coded as BB for reminders	59	7.8	7.8	100
Total	758	100	100	

Appendix II

Details of the Ranking of Important Financial and Non-Financial Benefits

Benefits	**Rank 1**	**Rank 2**	**Rank 3**	**Rank 4**	**Rank 5**	**Rank 6**	**Rank 7**	**MissingD**	**Tota l**
Reduced home running costs	329	126	107	42	11	7	3	133	**758**
Increased property value	48	78	71	92	172	117	34	146	**758**
Decreased obsolescence	16	31	28	53	162	245	23	200	**758**
Comfortable home temperature	141	181	158	87	28	17	7	139	**758**
Healthy indoor air quality	136	137	139	119	53	23	11	140	**758**
Reducing environmental impact	100	73	84	148	99	88	19	147	**758**
Other	10	5	1	3	6	8	436	289	**758**

Appendix III

Details of the Ranking of Main Barriers

Barriers	Rank 1	Rank 2	Ra 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	MissingD	Total
Poor access to information	54	45	92	70	95	56	36	63	17	230	**758**
Unreliable or unproven technology	29	50	81	71	80	60	80	60	10	237	**758**
Limited availability to new technology	28	39	78	86	78	86	69	40	16	238	**758**
Difficulty getting local authority approval	31	40	54	46	63	69	70	102	17	266	**758**
High cost/low benefit of features	231	124	64	47	43	26	18	8	3	194	**758**
Unwillingness to pay additional cost	193	183	62	47	44	28	15	10	2	174	**758**
Lack of developer awareness	21	35	51	73	63	64	100	69	9	273	**758**
Lack of owner/occupier awareness	68	63	90	71	37	52	52	71	14	240	**758**
Other	18	7	7	6	5	5	3	3	331	373	**758**

Appendix IV

Details of the Ranking of Main Motivators for Changes

Motivators	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	MissingD	Tota
Building code changes	135	125	96	65	54	34	17	13	219	**758**
More rebates/subsidies	292	89	69	51	30	21	14	5	187	**758**
Better advertising	65	92	51	59	85	102	71	13	220	**758**
Changes to legislation	81	92	106	82	71	47	33	11	235	**758**
Building certification	47	51	70	129	89	80	39	11	242	**758**
Availability of products	63	83	92	67	84	103	38	7	221	**758**
Mandatory energy efficiency reporting	44	49	45	44	50	48	188	23	267	**758**
Other	20	3	3	2	3	2	4	346	375	**758**