**HN2800/5**

# The NZHF Home*Smart* Home: Occupants' experience of the home and comparison with NOW Homes®

**Final**

**A report prepared for Beacon Pathway Limited**
**June 2010**

The work reported here was funded by Beacon Pathway Limited and the Foundation for Research, Science and Technology

# About This Report

**Title**

The NZHF HomeSmart Home: Occupants' experience of the home and comparison with NOW Homes®

**Authors**

Rachael Trotman

**Reviewer**

Vicki Cowan and Lois Easton, Beacon Pathway

**Abstract**

Following on from its NOW Home® sustainable homes projects in Waitakere and Rotorua, Beacon partnered with the New Zealand Housing Foundation in 2009 to develop and monitor a sustainable Home*Smart* Home in Waitakere. This report presents feedback from a face to face interview in May 2010 of the adult male occupant of the Home*Smart* Home on how the family is experiencing the home, and compares this feedback with that from the Rotorua and Waitakere NOW Home® occupants. After nine months this family rates the home reasonably highly, especially for warmth, dryness, spaciousness, the hot water heat pump and other energy efficiency measures, cost savings and the double garage. A comparison of the homes reinforces the fundamental importance of warmth, natural light, ventilation and dryness that are the foundation of a sustainable home.

**Reference**

Trotman, R. June 2010. The NZHF HomeSmart Home: Occupants' experience of the home and comparison with NOW Homes®.Report HN2800/5 for Beacon Pathway Limited.

# Contents

# 1 Executive Summary

Beacon Pathway Limited is a research consortium with a goal to bring 90% of New Zealand's homes to a high standard of sustainability by 2012. To assess home sustainability Beacon led the development of the HSS High Standard of Sustainability® (HSS®); a set of benchmarks tested through the NOW Home® programme. This programme involved two demonstration sustainable homes, one each in Rotorua and Waitakere, which were lived in by families and monitored, as 'live' research projects aiming to show that sustainable homes can be achieved now with existing designs, materials and products.

Building on these two pilot projects, the Home*Smart* Home was developed by Beacon in partnership with the New Zealand Housing Foundation. This home was completed in 2009 and is located in Waitakere City. A family of five moved in to the house in September 2009.

This report presents feedback from a face to face interview in May 2010 of the adult male occupant of the Home*Smart* Home on how the family is experiencing the home, and compares this feedback with that from the Rotorua and Waitakere NOW Home® occupants. The Home*Smart* Home occupant is given the pseudonym James in this report.

The household comprises a Fijian family of five, with two teenage sons and a 15 month old boy. A 17 year old Fijian male student also came to live with the family in January 2010. Both adults commute long distances to work and extended family in the area visit daily.

The table below summarises key likes and dislikes regarding the home, as reported by James.

| Likes | Dislikes |
|---|---|
| ■ Warmth and insulation<br>■ Dryness (no damp, mould or condensation)<br>■ No-one gets sick any more<br>■ Hot water heat pump<br>■ Cost savings from energy efficiency features<br>■ Double garage (extra storage, rumpus room, place to keep things dry)<br>■ More bedrooms and space<br>■ Back yard and upstairs privacy<br>■ Strong neighbourhood relationships and sense of community<br>■ Extended family close by<br>■ Air flow and ventilation<br>■ Natural light | ■ Overheating in summer (compounded by security window catches upstairs and lounge doors not able to be opened)<br>■ Would like more open plan style<br>■ Need to keep downstairs front corner curtains shut for privacy<br>■ There was a break-in when they first arrived<br>■ Stove would be better on an outside wall with an extractor fan<br>■ More lighting needed on the stairs |

The features of the house most appreciated overall were the insulation, which made the house warm and cosy, followed by the heat pump for hot water, which saved the family a lot of money. The most negative features were a desire for a more open plan layout and moving the stove to the outer kitchen wall.

As well as addressing the dislikes above, suggestions for future houses included connecting the pathways outside of the house, raising the rainwater tank to sit on a higher base, not having carpet in the dining room, moving the toilet from being adjacent to the lounge, putting a split system hot water heat pump where the cylinder sits in the house and the fridge unit outside, and investing in small features such as stove splashbacks, which save money over the longer term.

In terms of comparing the three homes, key likes and dislikes among them were as follows.

| | **Rotorua** | **Waitakere** | **HomeSmart** |
|---|---|---|---|
| Likes | Natural light<br>Ventilation<br>No step shower tray | Natural light<br>Warmth<br>Open plan and layout<br>Concrete floor<br>Cost savings | Warmth<br>Hot water heat pump<br>Energy efficiency features<br>Cost savings |
| Dislikes | Poor finishing<br>Lack of privacy<br>Lack of security | Lack of privacy<br>Lack of security<br>Range of minor issues all addressed | Desire for more open plan design<br>Move the stove to the outside kitchen wall |

The experiences of the three homes point to the unique nature of each household, but also to universal requirements for warmth, dryness, ventilation and natural light that form the foundation of a sustainable home. Cost savings, privacy, safety and security will also be important to most households.

The Home*Smart* Home occupants after nine months rate the home reasonably highly and have provided useful feedback for future housing development. James appeared to rate this home more favourably than did the Rotorua NOW Home® occupants, though not quite as favourably as the Waitakere NOW Home® occupants. Future housing projects would benefit from a standardised approach to surveying occupants and to overall monitoring and evaluation.

In terms of future NZHF housing, key implications from this Home*Smart* Home experience to date include the following.

- A high level of insulation, proper ventilation and lighting result in reported health benefits and are greatly appreciated by occupants.
- Proper ventilation is essential, including kitchen extraction to the outside.
- Cost savings from energy efficiency features will be valued by low income households.
- Open plan living is likely to facilitate family connection and this family's experience highlights the desirability of having ample storage and recreation space.
- High quality finishing is important, as well as attention to detail.
- Spending money on small features such as stove-top splashbacks can save money in the longer term.
- Do not put carpet in areas where eating commonly occurs, such as dining rooms.
- Consider other options for ventilation in upstairs rooms than safety catches on windows.
- Ensure stairways are well lit, with natural light if possible (for example via solatubes).
- Do not put toilets next to shared social spaces such as lounges, kitchens or dining rooms.

Findings that support lessons from other Beacon projects or that link to Beacon's goal are as follows.

- These home occupants' awareness of how to run the house to bring down bills grew through living in this home.
- Setting Beacon's water benchmark to cover household use at 125 litres per person per day is valid, but requires ensuring that outside water sources such as taps are rainwater-fed.
- A double garage is not part of Beacon's home specifications – this home occupants' experience implies the desirability for more internal storage and recreation space when building homes for families.
- Beacon's Homeowner Manual supports and reinforces the decisions this family are making.
- Lawn cover is not considered sustainable by Beacon, which recommends another form of garden cover.

# 2 Introduction

Beacon Pathway Limited is a research consortium that aims to enhance the sustainability of New Zealand homes and neighbourhoods. Beacon's vision is to 'create homes and neighbourhoods that work well into the future without costing the earth'.

To assess the sustainability of homes, Beacon Pathway collaboratively developed a set of benchmarks called the HSS High Standard of Sustainability® (HSS®)[1], which were tested through the NOW Home® programme. In this programme Beacon partnered with others to design and build two demonstration sustainable homes, which were lived in by families and monitored. These homes were 'live' research projects that aimed to show that sustainable, affordable and desirable homes can be built now using available design concepts, materials and products.

As pilot projects, the two NOW Homes® [2], one in Waitakere City and one in Rotorua, led the way for the Home*Smart* Homes project. Beacon initially sought in this project to partner with planners and developers to build 100 Home*Smart* Homes around New Zealand, each of which would be monitored and evaluated, to test whether it had performed to the HSS High Standard of Sustainability®. The intention was that this process inform a set of guidelines and procedures to assist the construction of more sustainable housing in New Zealand, and to engage the whole industry in making sustainable housing "business as usual".

This projected was derailed by the international credit crisis and tightening financial situation for the building industry, which made recruiting 100 homes a challenge. Time spent with developers, planners, designers and builders however resulted in the production of Home*Smart* Homes Procedures and Home*Smart* Homes Best Practice Guidelines, which seek to provide a strong and practical basis for building homes that meet the High Standard of Sustainability®.

During the Home*Smart* Homes project Beacon developed a partnership with the New Zealand Housing Foundation (NZHF), to test the procedures and guidelines above on the design of a new home as part of a NZHF subdivision in Glen Eden, Waitakere City (West Auckland).

---

***[1] See for example Easton and Howell (2008), with a poster summary of the HSS®, accessible at www.beaconpathway.co.nz/images/uploads/SB08_poster_High_Standard_of_Sustainability_FINAL.pdf.***

***[2] See Beacon's website www.beaconpathway.co.nz/ for further information on NOW Homes®.***

This report presents the results of an interview with the adult male occupant of this NZHF Home*Smart* Home, on his own and his family's experience of living in the home and the neighbourhood, and compares this feedback with that from NOW Home® occupants. The research objective was to gain an understanding of the performance of the NZHF Home*Smart* Home from an occupancy perspective and determine any clear differences between the experience of these home occupiers and those who lived in the Waitakere and Rotorua NOW Homes®.

The report begins by providing some background on the NZHF Home*Smart* Home project in Glen Eden, followed by the method used to interview the adult male occupant of this home. The feedback from this interview is then presented and contrasted with feedback from the Waitakere and Rotorua NOW Home® occupants.

The report ends by presenting implications from this research moving forward. The findings will inform the Home*Smart* Homes Procedures and Home*Smart* Homes Best Practice Guidelines, as well as future housing development by the NZHF and other housing providers, designers and developers.

# 3 The NZHF Home*Smart* Home

As noted, during the Home*Smart* Homes project Beacon developed a partnership with the New Zealand Housing Foundation[3] (NZHF). The NZHF is a not-for-profit charitable trust that assists low income households to buy their own home through shared ownership[4] and home equity[5] programmes. With philanthropic funding, the NZHF builds housing for low income families, with one such development located off West Coast Road in Glen Eden, Waitakere, as pictured below.

The house was built by Goldsmith Developments Ltd. It has two storeys with four bedrooms, an overall area of 160m$^2$, and was valued at around $410,000 at the time of construction in 2009. It has a weatherboard and brick exterior with colour steel roofing, and aims to achieve high levels of energy, water and waste efficiencies while providing a comfortable and healthy house.

[3] ***See www.housingfoundation.co.nz for more information.***

[4] ***Shared ownership involves first home seekers purchasing around 75% of the value of the property with NZHF purchasing the remainder. The new home owner can choose when and if they wish to purchase more, or the house can be sold and the profit used to purchase their own home outright.***

[5] ***In home equity programmes a household occupies a NZHF home and pays a market rent, and the NZHF helps the household through advice and support to clear its debts. Over time, the household gets 75% of the property's increase in value to use to buy their own home.***

This home was designed and built in accordance with the Home*Smart* Home Procedures. The home's sustainability features include:

- good solar orientation and a PV solar power system
- a high standard of insulation, including ceiling and wall insulation, some north facing double glazing and thermal drapes for all windows and doors
- a passive solar powered low noise ventilation system, designed to minimise overheating in summer
- opening windows in all rooms and an extraction fan in the bathroom
- a HERS (Home Energy Rating System) thermal rating of 8.5 stars
- an external heat pump hot water system
- energy efficient appliances
- energy efficient lighting
- a greywater system
- a rainwater system and rain garden
- photovoltaic panels.

A detailed description of the house is attached at Appendix One, containing information provided to the public during an open day held for the home in August 2009.

A comparison was undertaken of the NZHF Home*Smart* Home with Beacon's Home*Smart* Home specification. Areas where the NZHF home complied with the specification were: thermal envelope (insulation), hot water system, lighting, outdoor clothesline, maximum dwelling size, passive ventilation, low flow shower, taps and toilet, water meter, 4 star rated washing machine, 3 star dishwasher, outside rainwater tank for the garden, kitchen composting, and space for recycling bins and composting.

Areas where the NZHF home varies from the Home*Smart* Home specification were: unlagged pipes for the heat water pump; no windows in the laundry located in the garage and no mechanical ventilation there; no uniform use of low toxicity products and materials and of environmental choice certified materials. The greywater system supplies the toilet but not the washing machine. This house also has a double garage which is not part of the Home*Smart* Home specification.

The house was occupied by a family in September 2009. Physical monitoring of the home is being undertaken by BRANZ to November 2010, of energy and water consumption, indoor temperatures and moisture levels. Alongside the physical monitoring of the home, as with other Beacon research the experience and behaviour of the occupants in the home are key to understanding its performance. As Beacon's Foundation for Science, Research and Technology funding ends in June 2010, this interview was Beacon's sole opportunity to capture the occupants' experience of this house.

# 4 Method

This research began with a preliminary analysis of the occupancy research findings from the Waitakere and Rotorua NOW Homes® and the background reports for the development of the NZHF Home*Smart* Home. This was used to inform the development of an interview question schedule for the home occupants, which incorporated issues covered in the NOW Homes® research. See Appendix B for the interview guide.

The face to face interview took place at the occupants' home at 5pm on Monday 31 May 2010 (Queen's Birthday weekend public holiday). The interview was held solely with the adult male occupant of the household, as the adult female householder was still at work for most of the interview and then busy with childcare and preparing food upon arriving home. Children and extended family members came and went during the interview.

Thus a key qualification of this research is that it is based solely on one interview, and on the perceptions of the adult male householder, who is given the pseudonym James in this report. Also no physical monitoring data is available as yet to compare with occupants' reported experience and use of the home. As such this report focuses solely on the adult male occupant's reported experience of the home, and his perceptions of his family's experience.

The focus of the interview was on the family's experience of the home and its features; their experience of the local neighbourhood; any changes in attitudes and behaviour since living in the home and suggestions for future homes.

The interview was undertaken by the author of this report.

# 5 Results

The first part of the interview focused on the context of the household and what this means for how they used it. The interview then progressed along the following structure:

- Perceptions of specific features of the house
- Overall experience of the house
- Experience of the neighbourhood
- Description of behaviour/use of the house, including any perceived changes to their behaviour and attitudes over time
- Perceived impact of monitoring and research undertaken
- Suggestions for future homes.

## 5.1 Occupant household context

The household is made up of a Fijian family of two married adults and three male children, aged 14 years, 12 years and 15 months. In late January 2010 a 17 year old male Fijian student also came to live with the family, to complete his schooling in New Zealand.

As noted this household began their occupancy at the end of September 2009. In terms of main factors affecting how they use the house, key factors are:

- Both adults undertake paid work and commute long distances to work in South Auckland. On week days James leaves early in the morning by 6.30am and is generally home by 5.30pm.
- There are three teenage boys and one toddler in the house.
- Extended family visit daily (for example James' parents look after the toddler while his parents work).

Regarding their use of the house, James reported no major changes since they arrived other than the student arriving to live there in January and the baby moving from an infant to toddler stage. James noted that extended family members live close by (his parents and siblings) and visit all the time.

## 5.2 Perceptions of specific features of the house

### *5.2.1 Temperature*

James noted that when they first arrived the baby was very young and had been born prematurely, and that initially they used some extra heating via an oil heater in the bedroom to keep him warm, and they had the inset heater on in the lounge when the baby was in the room. This inset heater in the lounge and extra heating in general had not been used, however, since the first few months of their arrival, when temperatures got warmer. The house was considered very warm.

The family experienced some overheating in the house during the summer months. They had left the solar powered vent on at the top of the stairs all summer and upstairs windows had been left open all summer as well to combat overheating. Upstairs windows, however, can only open partially due to security catches, so there was some difficulty cooling the house. James noted that it got so hot upstairs that his wife and their baby moved downstairs to sleep. He also noted that they intended to purchase a shade cloth for the lounge in summer to reduce overheating.

Overheating was also compounded downstairs in the lounge as the keys for one of the lounge doors went missing and snagging was happening with the other lounge door, so neither door was opened.

The heat pump hot water system was described as "fantastic", with hot water never running out, except for once when a tap was left on. James commented that "six people use a lot of energy" and that the teenage boys tend to use more water, but that he asked them to be mindful of their hot water use.

A big difference was noted to the power bill due to the solar panel and hot water systems and James expressed an interest in seeing what their level of energy use is over the winter. Their last house was described as "a fridge box", with this house being hugely different in terms of warmth.

### *5.2.2 Water use*

James noted that their first water bill was $20 and the following one was $200. This was due to there being no lawn when they moved in, with no grass having been sown. No grass emerged after the first sowing either so re-sowing occurred and they were told to water the lawn a lot if they wanted to have a lawn. They did this and given the dryness of the 2009/2010 summer quickly exhausted the rain water tank, thus leading to the higher water bill.

After receiving the high water bill, James sat the teenage boys down and asked them to keep their water use down. He considered that the family's water use would be considerable with six people in the house, but that there had been a gradual reduction in water use over time by his family. James also encouraged the boys to watch the water and energy meters in the house – he noted that the energy meter jumped when the electric jug was switched on, for example.

In terms of the greywater system, James reported that it worked fine as long as it received weekly doses of chlorine, though it had developed a leak at one stage which was fixed.

### 5.2.3 House layout and aesthetics

When asked to comment on the double garage, James responded that they "love it!" In their previous house they only had a carport, and now they can put in the boys' bikes, weights set and so on, and can keep things dry in there. He commented that "you can never have enough storage space" and that it was a major plus for their family having a big garage. Last Christmas they put a table tennis table in the garage, which doubles as a rumpus room and was reportedly great for the boys.

In terms of the internal layout of the house, James noted that it had quite a bit of space but he would like it to be more open plan. The current design felt a bit "boxy" and separated the family, especially downstairs (note that the dining room is separate from the kitchen and lounge, which are reasonably small and adjacent to each other).

James stated that the bedrooms were a good size ("not too cramped"), with four bedrooms upstairs, though none could take a king sized bed and the main bedroom was only slightly bigger than the others. All of the rooms had closets, which was appreciated.

Indoor/outdoor flow in the house was described as good once the lounge doors were opening properly. These doors cannot open all the way out; only 90% from a closed position and James would like to have seen this changed.

The back yard was considered to be a good size, especially compared to the neighbours. In terms of the look of the house from the outside, James considered that it "looks ok" and there is nothing he would change. He had not been able to get uniform growth in the lawn however, with not enough topsoil used to create the lawn. He planned to plant some vegetables in boxes in the garden.

In terms of how the house looked from the inside, James and his wife chose the internal colour scheme after looking at other houses. James liked the thicker architraves in the house and the LED lighting, though he noted that this could have been better positioned over the work area in the kitchen.

James commented that the stove would have been better placed on an outside kitchen wall so that an extractor fan could blow the air outside.

### 5.2.4 Ventilation and lighting

James stated that there had been no issues with mould or condensation in the house, and that there was a good extraction fan in the bathroom and good air flow around the house.

He noted that there was a lot of natural light downstairs and upstairs, but there was a need to switch on stair lighting. James felt that a skylight or solar tube light would have been ideal for the stair area as it is dark and that this is a big issue for the children in terms of safety.

### 5.2.5 Energy use

James noted that the family had no dryer. He considered that overall the family's energy use would be low to medium, with hot water their biggest use of energy, plus they do a lot of ironing of work clothes and school uniforms.

### 5.2.6 Waste

James stated that the family plans to grow some of their own food in the garden and that they do compost their kitchen waste. He said that they use the rainwater tank water to water the garden, when it has enough water in it.

### 5.2.7 Privacy, noise, safety and security

James noted a good level of back yard privacy and privacy upstairs, but that they usually kept the curtains on the lower front corner of their house shut for privacy (the house is on a corner site).

In terms of noise, the house was considered to be very quiet.

Regarding safety and security, the family experienced a break-in several weeks after they arrived in the house, when they left a downstairs latch open on the toilet window. A local teenager was caught for the offence, and perversely the incident had several positive effects. Firstly, it forced the family to get to know their neighbours quickly and well, and together they organised a Neighbourhood Watch system. Secondly, their son's Playstation was stolen and the family considered that he did much better at school as a consequence.

James stated that, despite the break-in, the family do feel safe and secure in the home, mainly as there is generally always someone home.

### 5.2.8 Overall positive and negative features

When asked which features of the house really stood out for him, positively and negatively, James stated that the best thing in the house was the level of insulation, making it warm and cosy, followed by the heat pump for hot water, which he considered saved them a lot of money.

James noted that their first power bill was an estimate at $400, which went down to $80 after negotiation and an actual reading. He said the family liked all the energy saving features of the house.

Regarding negative features, James commented that he would like the house to be more open plan and for the stove to be on the outer kitchen wall.

### 5.3 Experience of the house

James was asked which aspects of the house were most positive and how among a range of domains. His responses were as follows.

| Domain affected | Aspects rated most positive |
|---|---|
| Children | Level of insulation (don't need to heat the rooms)<br>Kids don't get sick any more ("they were always getting sick in the last place which was damp and cold) |
| General comfort | Insulation |
| Awareness raising (of their environmental impact and features that made them think most about their behaviour) | The energy efficiency features |
| Cost savings/household expenditure | Insulation<br>Hot water pump<br>Energy efficiency features, including solar power |
| Health | Insulation |
| Interfamily relationships | Having extended family close by ("the kids love having family close, they can play close by") |

## 5.4 Comparison with previous houses

In terms of thinking about the house and living in it overall, James was asked on a scale of one to ten, where one is "not at all different" and ten is "extremely different", how living in this house compared to other houses he had lived in overall. James gave this a difference rating of 8-9.

On the same scale of one to ten he was asked how much better or worse is it living in this house? James gave the same score of 8-9 in terms of being better than previous houses they had lived in. In terms of what specifically is better about this house, James noted warmth, dryness, more room, more bedrooms, more living room and the garage.

He also noted that in previous houses the boys had often been sick and snuffly, and that his wife had often used an inhaler. Now she didn't use the inhaler at all and no-one had been sick since arriving in the house. James commented that "now we know the baby is teething when he is out of sorts" (instead of being cold or otherwise sick).

One aspect lost by the move to this house was closeness to friends in South Auckland where they lived previously.

In terms of what the family would look for in future houses, James noted warmth (insulation), good ventilation, open plan layout and spaciousness, plus a hot water heat pump if possible.

## 5.5 Experience of the neighbourhood

In terms of the local neighbourhood, the features described as being the most positive were having family close by, getting on really well with the neighbours and having a strong local community. The only negative aspect had been the break-ins in the area, but these had brought people closer together and James commented that the level of community experienced here he had last experienced only in Fiji.

Things he would look for in a neighbourhood in future were having family close by and a strong local community.

### *5.5.1 Description of behaviour and use of the house*

James was asked on a scale of one to ten, with ten being extremely eco conscious and one being not at all, how he would rate their level of environmentally friendly behaviour while living in the Home*Smart* Home. James rated his aspiration as being 10 but the reality as being 5-6, and that this "was a work in progress".

James noted that his general awareness of the environment had increased in recent years, including power usage and greenhouse gases. He stated that he is careful what the family consumes, from salt to oil. He noted that up until a few years ago he had not cared about "what we eat or consume, but lately I have been more focused on what we consume. I wasn't interested in gardening even though I grew up in a place where we grew our own food. I am changing – is it age? Now I am keen to grow our food and control what we eat, and to see the impact on mine and my family's health".

In terms of the impact of the house on the behaviour and attitudes of his children, James felt that the house would influence them by making energy efficiency normal and the energy tracking devices showing them the impact of their actions.

James noted that being in the house had influenced him, in that before arriving he was aware that they needed to reduce their carbon footprint and look at what they ate and so on, but that "coming here has helped us to do it – by having a 'green house' I can make a difference". He noted that "before it was just an idea to compost etc, but this made it a reality, it was all done for me and made it easier to do".

### *5.5.2 Impact of monitoring*

James felt that it had made no difference to himself or his household knowing that their energy usage etc was being monitored: "We wanted the results to be real, we just live as normally as possible".

### 5.5.3 Suggestions for the future

James was asked what suggestions or advice he had for future homes in terms of the house itself, future occupants, research and monitoring and any other area. In terms of future homes he suggested:

- move the stove to the outside kitchen wall
- make the living areas open plan
- have a heat pump for hot water (he noted that there were more energy efficient heat pumps available than the Rheem one they had and suggested that future houses had a more efficient heat pump)
- put in a split system hot water heat pump where the cylinder sits in the house and the fridge unit outside, especially if there is a garage (heat is currently lost by the cylinder sitting outside)
- connect the pathways outside of the house (currently there are unconnected concrete slabs in the back yard)
- the rainwater tank is good but it needs to sit on a higher base (the outlet is currently too close to the ground and more pressure is gained if it sits higher)
- do not put carpet in the dining room, make it concrete or vinyl or timber, especially with children (there is carpet throughout the house except for vinyl in wet areas)
- put a splashback around the oven's stove top (James noted that these little features actually have quite a big impact over time on the house)
- move the toilet from being adjacent to the lounge (James noted that this took up valuable lounge space and raised privacy issues).

James commented that if he purchased the house he would seek to change the aspects above, as far as possible.

Suggestions for future occupants of Home*Smart* Homes were to use a digital camera to capture any issues with the house and keep records, so that everything is captured and clear.

In terms of future research and monitoring, James had no suggestions and said that the family had had no issues with the monitoring of the house.

# 6 Comparison with Waitakere and Rotorua NOW Homes®

This section compares the experiences of the occupants of the Waitakere and Rotorua NOW Homes®, with those of the Home*Smart* Home, to highlight similarities and differences. It begins by comparing the households involved, before focusing on their reported perceptions and experiences. The comparison is based on a report bringing together the Waitakere occupant experiences and perceptions by Trotman (2008), and a report by Pollard and Jaques (2009) on the final performance monitoring of the Rotorua home, which includes a summary of occupant satisfaction.

Note that comparison is limited by differences in the method and level of feedback from the households. In Rotorua, due to difficulties accessing all of the occupants, four face to face interviews were undertaken with the female adult occupant, using a survey that covered 35 specific sustainability features. The Waitakere NOW Home's two adult occupants participated in six face to face interviews, including an 'exit interview' just before they left the home (their children were considered too young to take part). This compares with one face to interview with the adult male occupant of the Home*Smart* Home.

Only three households are being compared and not all households were asked the same questions in the same way. Noting these qualifications, and the inevitable differences in the households involved as summarised below, the findings below are indicative only and should not be generalised.

## 6.1 Occupant characteristics

Key characteristics of the households are compared below.

| Characteristic | Waitakere NOW® | Rotorua NOW® | HomeSmart Home |
|---|---|---|---|
| House built by | Beacon, Waitakere City Council provided the land, 2005 | Housing New Zealand Corporation[6], 2006 | New Zealand Housing Foundation, 2009 |
| Housing type | Single storey, three bedrooms | Single storey, three bedrooms | Two storey, four bedrooms |
| Household composition | Two adults, two young boys | One adult, two children, plus one adult lodger | Two adults, three teenagers, one infant |
| Ethnicity | Māori and pakeha | Māori | Fijian |
| Income | Higher than average | Low | Medium |
| Time spent in the house | Two and a half years | Arrived September 2006 | Nine months |

The above shows that the housing providers in each case are different; each household involved a unique family, though all included children, each with different ethnicity, income and time spent in the house. Each house also included different sustainability specifications.

## 6.2 Rotorua NOW Home®

The principal adult of this house consistently rated the home perfect or near perfect (nine or ten out of ten) in only four of 35 categories: cool in summer, ventilation, natural light and no step shower tray. Positive differences in the house from previous houses that were repeatedly mentioned were:

- A good large bathroom
- Sunlight coming through the whole house
- No dampness (except for a temporary leak to the roof)
- Quite warm throughout the house when sunny
- The indoor/outdoor connection to the outside
- Aesthetic look from the outside.

[6] *As part of its Community Renewal programme in the Rotorua suburb of Fordlands.*

Areas in which the tenant/s had mixed or negative feelings were:

- Spaciousness of the house and inadequate storage
- Privacy from neighbours and within the house
- Security (feeling safe and secure)
- Specific features (wide doorways for wheelchair access, extractor fans, concrete floor, clothes line).

House features which were least appreciated were:

- The overall quality of the work (finishing related faults, including door handles coming loose, unfinished paint covering to skirtings, a poorly built trellis fence, improper floor polyurethaning and a delay in completing the extractor fan over the kitchen hob)
- Other functionality issues in the house including low water pressure in taps, a drop in shower flow when a tap is turned on, a low main road boundary fence and restricted storage (for an occupant who wanted to store a large range of items).

Insulation in the Rotorua NOW Home®, while higher than Building Code standards at the time, is considerably lower than that for the Waitakere NOW Home®. Pollard and Jaques note that the wood pellet heater in the Rotorua home operated virtually every day in winter (compared to the Waitakere home where heating was only required on one or two days in winter), and that the Rotorua NOW Home® had an average evening temperature of 17.5 degrees in winter, and 12.5 degrees in the master bedroom overnight; the latter being significantly lower than the 16 degrees recommended in the HSS High Standard of Sustainability®.

As such it is no surprise that insulation and warmth of the home are not noted as positively as for the other two homes (ie warmth was only noted positively in that the house was "quite warm when the house was sunny"). Overall, the level of satisfaction of the principal occupant of the Rotorua NOW Home® is noted as "fair" by the researchers (p28).

## 6.3 Waitakere NOW Home®

The features that consistently impacted most positively on this family's experience of the house were (in no order):

- Layout and open plan design
- Sun and natural light
- Thermal performance, warmth, even temperature and negligible need for winter heating
- The concrete floor
- Reduced electricity costs.

The occupants regularly and consistently referred to significant health and wellbeing benefits from living in the house, including decreased levels of ill health, increased children's confidence, enhanced interfamily relationships, a supportive environment when health problems occur (such as migraines), a low noise environment and generally feeling "happier". Occupants also reported significant growth in their entertaining and visitors enjoying being in the house.

Features or experiences that were less favourable were as follows:

- Stones from outside being carried in
- Overheating in some rooms, which was addressed by adding solar powered ventilation
- Moisture in the main bedroom, which was addressed by putting an extractor fan in the ensuite bathroom
- Quality of some of the build work
- Breakfast bar and kitchen partition being too high
- Lack of privacy from neighbours
- Security issues due to being located on a public park and lack of surveillance
- Problems with not knowing when the water in the rainwater tank was running out, which was addressed through adding a rain gauge
- Not enough power points and phone jacks.

The occupants reported increasing their understanding and awareness of environmental and sustainability issues through living in the house and that this led to easily assimilated small scale changes in behaviour such as composting and recycling ("I don't think about it I just do it").

Their NOW Home® experience also had a significant impact on their choice of future house, with their key criteria being features which impact most on comfort, family interaction and health: sun and natural light, insulation and warmth, lack of damp and moisture, and house flow and layout.

## 6.4 Overall comparison

The table below summarises key likes and dislikes among the three households (in no order).

| | Rotorua | Waitakere | HomeSmart |
|---|---|---|---|
| Likes | Natural light<br>Ventilation<br>No step shower tray | Natural light<br>Warmth<br>Open plan and layout<br>Concrete floor<br>Cost savings | Warmth<br>Hot water heat pump<br>Energy efficiency features<br>Cost savings |
| Dislikes | Finishing<br>Privacy<br>Security | Privacy<br>Security<br>Range of minor issues all addressed | More open plan<br>Move the stove to the outside kitchen wall |

The Waitakere occupants appeared to be most satisfied with their home, based on the research findings. Security was an issue for all three houses (noting the break-in at the Home*Smart* Home), and to some degree privacy was also noted as an issue by all three. Two of the houses noted warmth, cost savings and natural light as being important.

# 7 Implications

## 7.1 The NZHF Home*Smart* Home

The occupants had been in the house for nine months and had not experienced a full winter at the time of the interview. Regardless, this household via the male adult occupant reported a reasonably high level of satisfaction with the house overall, particularly in terms of its level of insulation and thermal performance, dryness, spaciousness, the hot water heat pump and other energy efficiency measures, cost savings and the double garage.

The cost savings were significant and appreciated by this household, and clear health benefits were noted for the whole family of having a warm, dry, well ventilated house. The family's wellbeing was also enhanced by having extended family living nearby and strong relationships with neighbours. The adult occupant interviewed noted that living in a "green house" forced a lowering of the household's carbon footprint and made it easy to act more sustainably.

In terms of future NZHF housing, key implications from this Home*Smart* Home experience to date include the following.

- A high level of insulation, proper ventilation and lighting result in reported health benefits and are greatly appreciated by occupants.
- The ventilation system in this house worked well but there was overheating in summer – due in part to safety catches on upstairs windows and being unable to open the lounge doors.
- Proper ventilation of the kitchen to the outside is needed, including placement of stoves on outer walls.
- Cost savings from energy efficiency features will be valued by low income households.
- Open plan living is likely to facilitate family connection.
- High quality finishing is important, as well as attention to detail (for example placing of lighting over work areas).
- Spending money on small features such as stovetop splashbacks can save money in the longer term.
- Do not put carpet in areas where eating commonly occurs, such as dining rooms (note also that the Waitakere NOW Home® family rated their concrete floor very highly).
- Consider how to ensure proper ventilation in upstairs rooms that have safety catches on windows.[7]
- Ensure stairways are well lit, with natural light if possible (for example via solatubes).
- Do not put toilets next to shared social spaces such as lounges, kitchens or dining rooms.

[7] ***Note that in the Rotorua NOW® Home cedar louvres were installed and were considered to work well.***

## 7.2 Comparing the three homes

Little can be drawn from a comparison among the three houses, other than that common features liked were:

- Warmth (insulation and thermal performance)
- Natural light
- Ventilation
- Cost savings
- Energy efficiency features

A need for quality control of the building work and finishing were also important across the households, as were security, safety and privacy.

The experiences of the three households point to the unique nature of each household, but also to the universal requirements for warmth, natural light, ventilation and dryness that every household will have. Outside of these requirements for comfort and health, cost savings are important for most households.

Beyond this, issues such as house layout, storage and space requirements lie more in the realm of personal taste and circumstances, though again some universals will apply, such as increased space and storage needs for larger households, and an open plan preference for many families to support connection and surveillance of children.

Taking a consistent approach to surveying occupants of future housing projects is recommended for easier comparison of data.

# 8 Conclusions

This report has presented the views of the adult male occupant of the NZHF Home*Smart* Home and compared the findings with feedback from occupants of the Waitakere and Rotorua NOW Homes®.

After nine months the occupants are reporting reasonably high levels of satisfaction with this house, and especially its comfort factor, energy efficiency features and cost savings. It will be useful to compare the physical monitoring of the house with perceived energy usage levels.

This Home*Smart* Home has provided useful feedback for future NZHF housing and other housing designers, developers and providers, and occupant perceptions to date compare favourably with the Rotorua NOW Home®, though not quite as favourably as those of the Waitakere NOW Home® occupants.

Findings that support lessons from other Beacon projects or that link to Beacon's goal are as follows.

- These home occupants' awareness of how to run the house to bring down bills grew through living in this home – for example getting the children to look at the water and electricity meter.
- This house highlights the importance of design to enabling the occupants to manage the house – for example security stays on windows, doors opening properly and the positioning of appliances for proper ventilation.
- Setting Beacon's water benchmark to cover household use at 125 litres per person per day is valid, but requires limiting outside taps to only being rain water fed.
- A double garage is not part of Beacon's home specifications – this home occupants' experience implies the desirability for more internal storage and recreation space when building homes for families.
- These findings once again confirm the importance of a warm and dry home to family health and wellbeing.
- Beacon's Homeowner Manual supports and reinforces the decisions this family are making.
- Lawn cover is not considered sustainable by Beacon, which recommends another form of garden cover.

# 9 References

Pollard, A. and Jaques, R. (August 2009). *Rotorua NOW Home® Final Performance Monitoring*. Report NO202/4 for Beacon Pathway Ltd.

Trotman, R. (May 2008). *Waitakere NOW Home®: Occupants' Experience of the Home and Implications for Future NOW Homes®*. Report NO102/5 for Beacon Pathway Ltd.

# 10 Appendix A: Interview guide

**NZHF Glen Eden Home*Smart* Home – tenant interview**
**Question schedule**
**30 May 2010**

**Introduction**
Thank you for meeting with me. Your feedback will be used to influence how other housing for families is built, so we are really interested in your experience of living in this house.

This interview is about your experience of living here, including your likes and dislikes, your experience of particular features in the house, whether living here has affected your attitudes and behaviours and how the house could be improved.

**Context of household and impact on how you use it**
Let's start by looking at the type of household you are and how that affects your use of the house.

- How many people (both adults and children) currently live in this household?
- How many adults over 18?
- How many teenagers (13-17)?
- How many children (under 13?)
- Any changes in who has lived here since you first arrived?

1. What for you are the main factors affecting how you use the house (eg children, work life, priorities, lifestyle, income etc)?

2. Have any of these main factors changed over the time you have been here (eg any work changes)?

**Specific features of the house**
3. Next I would like to ask some specific questions about different aspects of the house.

Temperature
- Was the house too hot over December/January/summer?
- How often have you used the heater inset in the lounge?
- How often have you used other heaters since you have been here?
- How have you found the heat pump hot water system?
- How have you found the solar panels?
- Any other issues with cooling or heating in the house?

Water use

- How have you found the grey water system?
- How would you describe your water use (probe – general use, hot water, rain tank water)?

House layout and aesthetics

- How have you found the double garage? Any comments on its size in relation to the rest of the house?
- Any issues with internal layout of house (ie use of space)?
- Any comments on bedroom size?
- Any comment on indoor/outdoor flow?
- Any comment on the amount and location of the outdoor space?
- Any issues or comment on how the house looks from the outside?
- Any issues or comment on how the house looks from the inside?

Ventilation and lighting

- Any issues with ventilation (solar passive ventilation system), probe any mould or condensation?
- Any issues with lighting – natural light and artificial light (stand by light switches and LED lights in the kitchen noted)?

Energy use

- Do you have a dryer? If so how often used?
- How would you describe your general use of electricity – low, medium high? What are your biggest uses (heating, hot water, lights etc)?

Waste

- Do you grow any of your own food?
- Have you used the rainwater tank outside for garden use? Any issues with this (Lois thought there may have been)?
- Do you compost your kitchen waste?
- Do you generally recycle your household waste?

Safety and security

- Any issues with privacy?
- Any issues with noise (within the house)?
- Any issues with safety and security?

Overall

- Are there any particular features of the house that really stand out for you, positively or negatively?

**Experience of the house**

4. What features of the house would you rate most significant and positive for:
   - Children
   - General comfort
   - Awareness raising (of environmental impact, what made them think the most)
   - Cost savings/household expenditure (any savings in water, electricity, phone bills)
   - Health
   - Safety
   - Interfamily relationships

**Overall rating**

5. Overall, what features of the house have you most appreciated – what do you like most?

6. Overall, what features of the house have you least appreciated – what do you like least?

7. Thinking about the house and living in it overall, on a scale from 1 to 10, where 1 is 'not at all different' and 10 is 'extremely different', how does living in this house compare to other houses you have lived in overall (answer as a household)?

8. And on the same scale from 1 to 10, overall how much better or worse is it living in this house (answer as a household)?

9. Comparing this house to other houses you have lived in, what specifically makes this house different in any way for you and your household (as a house)?

10. What are the effects of these differences for you and your household?

11. What do you gain by living in this house?

12. What do you lose by living in this house?

13. What will you look for in a house in future?

**Experience of the neighbourhood**

14. Can you describe your relationship with the surrounding neighbourhood in the area (eg local park, transport etc)?

15. What have been the most positive aspects of the neighbourhood/living in this area?

16. What have been the least positive aspects of the neighbourhood/living in this area?

17. What will you look for in your local neighbourhood in future?

**Any changes noticed in terms of your behaviour and attitudes**

The next few questions are about how your own attitudes and behaviours relate to the features in the house.

18. On a scale of 1 to 10, with 10 being extremely eco conscious and 1 being not at all, how would you rate your level of environmentally friendly behaviour while in this house?

19. Are there any things you could have done to further reduce your environmental impact?

20. Is there anything that you would have done differently in hindsight?

21. Did you notice any changes in your behaviour in this house to previous houses (eg water and energy use)? Did you do anything differently?

22. Do you feel that living in this house will have any ongoing impact on the attitudes and behaviour of your children?

23. Do you feel that there may be any ongoing changes in your own behaviour from living here?

24. Has living in this house made any difference to your attitude towards:
    - What you buy/consume
    - Transport
    - The environment
    - Other

**Impact of monitoring**

We are interested as to whether the fact that people know their use of the house is being monitored has any influence on how they use it.

25. What difference did knowing that the thermal performance of your home is being monitored make to your to behaviour (if any)?

**Recommendations for the future**

26. Do you have any suggestions or advice for NZHF future homes in terms of:

    - Houses themselves (things to change etc)
    - Occupants or potential occupants in these houses (eg anything they should know)
    - Research and monitoring
    - Anything else you would have done differently or suggestions for the NZHF?

27. Any further/final comments?