



TE106/17

Papakowhai Renovations: Householder Experiences and Perceptions

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About This Report

Title

Papakowhai Renovations: Householder Experiences and Perceptions

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Abstract

This report presents the findings of post project interviews in March 2009 with three of the nine households involved in the Papakowhai Renovations Project in Wellington. Positive reported impacts of the renovations included physical and mental health benefits, increased warmth, cost savings and greater energy efficiency. Less positive aspects were some poor workmanship, the need for stronger project management and quality control of the renovations and better communication with householders. Overall however the renovations had significant reported positive impacts on the quality of life of occupants, their house values and on the 'look and feel' of these houses.

Reference

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Contents

1	Executive Summary	4
2	Introduction.....	6
3	Purpose and scope of this report	7
4	Method and limitations	8
4.1	Case study method and Papakowhai.....	8
4.2	Limitations	9
5	Case study findings.....	10
5.1	Household characteristics	10
5.2	House 3	11
5.3	House 9	18
5.4	House 10	23
6	Lessons from each household	30
6.1	House 3	30
6.2	House 9	30
6.3	House 10	31
7	Implications for future renovations.....	32
7.1	Heating.....	32
7.2	Water.....	32
7.3	Waste	32
7.4	Health and wellbeing	32
7.5	Greatest impact and influence.....	33
7.6	Future projects	33
8	References.....	34
9	Appendix A: Interview schedule example (House 3).....	34

1 Executive Summary

As part of Beacon Pathway's efforts to improve the sustainability of New Zealand homes through quality research, nine case study homes were renovated in Papakowhai, Porirua, in 2007 and their performance monitored between 2006 and 2008. The renovations involved sustainability features designed to impact on energy and water use, indoor environment quality and waste.

Physical monitoring occurred throughout this period of the temperature, humidity, water and energy use and waste associated with these homes. Information on the renovations and their market value was also provided to the householders and each household was interviewed in late 2007 as to their experience of the renovations to date.

This report presents the findings of post-project interviews with three of the households, in order to gain further understanding of their experience of the renovations, including positive and less positive aspects, impact of the renovations on their behaviour, use and experience of the home and to probe issues arising from the detailed physical monitoring of their homes.

One in-depth interview was held in March 2009 with each household. This involved a semi-structured, conversational interview at the participants' homes. While the information emerging has no statistical weight and can not be generalised to other households and populations, it captures and gives weight to the views and experiences of those directly involved and identifies areas of consistency and contrast among these households.

A summary of the key characteristics of the households involved are as follows.

Unique identifier	Occupancy	House type	Renovations undertaken	Approximate cost
House 3	Couple and three children	1.5 storey, 3 bedroom, mixed cladding, poor condition	High	\$76,590
House 9	One adult	2 storey semi-detached, 2 bedroom, mixed cladding, reasonable condition	Moderate	\$7,830
House 10	Couple and three children	2 storey, 4 bedroom, mixed cladding, poor condition	High	\$74,070

The key findings and implications from these interviews are as follows.

The two larger, family households both:

- Used more hot water than before the renovations as they perceived that the solar hot water system provided cost effective, unlimited hot water.
- Linked their higher hot water use to having teenage/growing children who were seen as high energy users.
- Saw value in having a heat transfer system to spread heat around larger houses.
- Considered insulation and double glazing combined to be highly effective.
- Noted mental health impacts in terms of being happier because increased warmth meant they were more relaxed, less stressed and their home provided a healthier environment for their children.

In terms of all households:

- Overheating in summer occurred in all three households but was generally addressed by opening windows (and by using a heat pump for cooling in one case).
- In one household, the convenience of a heat pump led to greater energy use by being more convenient than lighting the wood burner and used for cooling in summer.
- In two of the three households the worm bin was misused and became defunct. The remaining case study household involving the single resident saw the worm bin as “nice to have but not essential”.
- All households noted physical health benefits from the renovations, particularly in terms of experiencing fewer colds and flu (though this may also be linked to receiving flu injections).
- Features most liked overall were insulation, double glazing, solar hot water and having several forms of heating.
- All households were attracted to the project by the opportunity for increased warmth, energy efficiency and cost savings, and warmth and cost are likely to be key drivers of uptake for others. This project however had little reported impact on householders’ environmental awareness and behaviour, and cost seemed to be more of a driver for their behaviour than environmental impact.
- Once people have experienced a warm, dry home they are less likely to accept a lower standard in future homes.

In terms of future projects, implications include:

- Ensure close project management and quality control of work undertaken.
- Ensure good ongoing communication with householders as to the purpose of the project, what to expect, who is involved and key contact people.
- Clarify what room there is for negotiation with the householders and how they can maximise the work undertaken through contributing themselves.
- Linked to the above, in terms of household selection for future projects there may be sense in balancing low income households with those who can afford to contribute to the works to maximise the benefits received.

2 Introduction

Beacon Pathway Limited is a research consortium committed to improving the sustainability of New Zealand homes and neighbourhoods through quality research. One of its research strands involves exploring the benefits and impacts of renovating existing homes with sustainability features relating to:

- Energy use
- Water use
- Indoor environment quality (temperature and humidity)
- Waste (construction waste and waste produced by the households).

Nine¹ case study homes were renovated in Papakowhai, Porirua, in 2007, with different levels and types of sustainability features intended to enable the homes to meet a HSS High Standard of Sustainability® (HSS®). The Papakowhai Renovation project was undertaken to achieve two key objectives:

- Identify the best (most cost effective and easy to implement) packages and combinations of retrofit options to significantly improve the standard of sustainability of the homes.
- Develop the cost benefit analysis at a house level for a range of retrofit technologies in the areas of energy, water, indoor environment quality and waste.

BRANZ monitored and analysed the physical performance of the homes, including temperature, humidity, water and energy use and waste. BRANZ worked with EnergySmart Limited to project manage the renovations. The physical works were undertaken by a range of qualified tradespeople, and all consents required were applied for prior to the work being undertaken. Porirua City Council was also engaged with the project, both as the Consenting Authority and in providing financial assistance by waiving the cost of the Building Consent Fees.

The results of the physical monitoring of the homes needs to be contextualised within the perceptions, behaviours and experiences of the householders. This has occurred through semi-structured, conversation based interviewing.

■ ¹ *There were originally 10 homes involved, but one dropped out due to a change of ownership.*

3 Purpose and scope of this report

This report presents the findings of post project interviews with three of the households involved in the Papakowhai Renovation project, and draws out implications and lessons emerging. The aim of the interviews was to:

- gain a clear understanding of the experience of these householders of the renovations, including their benefits and less positive aspects
- explore how the renovations have impacted on householder behaviour, use and experience of the home
- probe issues arising from the detailed physical monitoring undertaken of the homes.

Overall the findings seek to provide information on household experiences to support case studies of the homes for use on the internet and as part of wider reporting on the project.

This report is structured as follows:

- Section Four presents an overview of the method applied, including limitations.
- Section Five presents the case study findings for each household.
- Section Six comments on the lessons arising from each household.
- Section Seven draws out overall implications from these case studies for renovating existing homes with sustainability features.

4 Method and limitations

4.1 Case study method and Papakowhai

This project employed a case study method involving an in-depth interview with each of the three households. Case studies provide micro-level data, both objective and subjective, that can be collected and analysed (Saville-Smith 2008 p6). While the data arising has no statistical weight and can not be generalised to other households or populations (ibid), nonetheless it captures and gives weight to the views and experiences of people directly involved, and identifies areas of consistency and contrast among the three households. The method utilised in this project involved:

- The collection of qualitative, narrative data from householders via semi-structured conversational interviews on 10 and 11 March 2009 (see Appendix A for an example of the interview schedule used for one of the houses).
- The interviews were undertaken by the author and were held at the homes of each participant household for up to two hours.

The interviews covered the following aspects:

- Household context and impact on how they use the house
- Winter energy use and temperatures
- Summer temperatures
- Humidity and dampness
- Water use
- Waste
- Description of their behaviour and use of the house
- Benefits and negatives associated with the renovations
- Any changes noticed in their behaviour and attitudes
- Future plans
- Recommendations for future renovations and research

Three sets of data have already been collected in relation to these cases, as described in Saville-Smith's June 2008 report (p7). These are as follows.

1. Pre and post retrofit monitoring and administrative data from the households relating to:
 - Energy use
 - Water use
 - Indoor temperatures
 - Indoor humidity
2. Information about the renovations and their approximate market value
3. Data related to the household and household experiences, captured through initial self-reports and the Saville-Smith June 2008 report, which involved semi-structured conversational interviews with all nine households in the study.

In effect the post project interviews presented in this report represent 'exit interviews' for the three households from this study, providing them with a chance to reflect on their experience.

4.2 Limitations

The three households involved have high levels of variation in terms of dwelling type, household composition and renovation undertaken (see 5.1 for their key characteristics). This presents challenges in terms of making comparisons and as noted these findings can not be generalised to all households or populations. Given the variability among the households and inevitable changes occurring for the households over the three years of the renovations, the analysis in this report is limited to:

- Capturing the perceptions and experiences of each household
- Noting the variations among the households
- Noting similarities of experience and perception.

5 Case study findings

5.1 Household characteristics

Each household was given an identifier number: House 3, House 9 and House 10. Key characteristics of each household are summarised below, including the renovations undertaken in each home.

Table 1: Key characteristics of households

Unique Identifier	Occupancy	House Type	Renovations Undertaken
House 3	Couple and 3 children including primary and secondary aged children	<ul style="list-style-type: none"> • 1.5 storey • 3-bedroom • 2-bathroom • 1-living room • Mixed cladding • Aluminium window frame • Concrete slab • Corrugated iron roof • Mixed skillion and cavity ceiling • Poor condition • Residential use only 	High <ul style="list-style-type: none"> • Heavy ceiling, underfloor and wall insulation • Double glazing • Solar hot water • New wood burner • Two dual flush toilets • Worm farm • Polythene vapour barrier on ground • (Two heat pumps replaced by homeowner with ducted heat pump)
House 9	1 adult	<ul style="list-style-type: none"> • 2 storey semi-detached • 2-bedroom • 1-bathroom • 2-living room • Mixed cladding • Concrete slab • Concrete tile roof • Reasonable condition • Already insulated to 1978 standards • Residential use only 	Moderate <ul style="list-style-type: none"> • Ceiling insulation top-up, heavy underfloor and midfloor insulation • Wall insulation added to one wall • Hot water cylinder wrap • Worm farm • Shower dome • Polythene vapour barrier on ground • (Installed own heat pump)
House 10	Couple and 3 children including primary and secondary aged children	<ul style="list-style-type: none"> • 2 storey • 4-bedroom • 2-bathroom • 1-living room • Mixed cladding • Mostly timber frame • Concrete slab • Concrete tile roof • Poor condition • Residential and work use 	High <ul style="list-style-type: none"> • Heavy ceiling, wall and underfloor insulation • Combined solar/wetback hotwater system • New wood burner • Leaks fixed • Worm farm • Extractor fan in bathroom & laundry • Polythene vapour barrier on ground.

The descriptions of the houses and renovations in the sections below are all derived from Saville-Smith's June 2008 report.

5.2 House 3

This interview initially took place with the male adult of the household, who was joined halfway through by his wife. The children were present for some of the interview and were asked one question about perceived benefits of the renovations (see 5.2.10). These occupants were reportedly attracted to the project through the opportunity to increase warmth and energy efficiency, modernise the house and address issues of noise, cold and excessive condensation (Saville-Smith 2008 p20). They also had a personal and professional interest in monitoring for increased warmth and energy efficiency, as they own a heat pump business (ibid).

5.2.1 *The dwelling*

BRANZ describes this house as built in the 1970s, with an office addition in the 1980s, split level with timber frames and weatherboard cladding. The roof is corrugated iron and the windows were single glazed aluminium. The living areas are located above the garage and offices on the bottom floor, with the three bedrooms, main bathroom and entrance located on the split level. For the purposes of this project, the bottom floor was largely ignored as it contained a business run from home in 2006 and 2007 and the garage was used for business storage purposes.

The house condition at the start of the project was described by BRANZ as poor, for example leaks in the roof being mitigated by duct tape, windows needing replacing, the wood burner had rusted, peeling and split weatherboards, hot water cylinder too small for a family of five and the décor much the same as when the house was built.

5.2.2 The renovations

Table 2 shows the issues needing to be addressed, renovations made and their market value for this dwelling.

Table 2: Renovations and Market Value House 3

Issue	Actual renovation	Approx market value (excl GST)
Old wall insulation in unknown state	Stripped, reinsulated and refined walls of thermal envelope to R2.4. Pelmetts rebuilt.	\$10,050
Old skillion ceiling insulation in unknown state	Lounge, dining and kitchen skillion ceilings lowered and insulated with R3.6 batts	\$5,930
	Plasterboard for walls (10mm) and ceilings (13mm)	\$1,450
No underfloor insulation	Floor insulated with R2 foil backed insulation, polythene put on ground	\$2,020
1351 B Grade electric hot water cylinder serving a family of five	Solar water heating system installed with 300L cylinder	\$10,060
Old woodburner past useful life	Occupant installed new MEPS compliant woodburner	\$3,000
Ceiling insulation in cavity needing a relay	New ceiling insulation put over existing insulation in accessible places. Existing insulation relaid, R2.6 put over top and over ceiling joists to remove thermal bridging	\$1,080
Plumbing in unknown state	Plumbing checked	\$80
No smoke alarm	Some alarm installed	\$30
Fridge seals potentially need replacement		
Food waste not being reused	Worm farm installed	\$160
Extraction fan in kitchen out of commission	New rangehood in kitchen	\$870
High water-use toilets	Two dual flush toilet cisterns installed	\$90
Old window aluminium frames past useful life	Windows replaced with standard clear double glazing and standard frames	\$41,770
	Occupants replace roof	N/A
2 heat pumps and oil column heaters used to heat the house	Occupants installed ducted heat pump central heating system	
	TOTAL	\$76,590

5.2.3 The household

This dwelling is occupied by a couple with three children; one of secondary school age and two of primary school age. In 2006 and 2007 both adults ran their business from the bottom floor of the home, but at the beginning of 2008 this was moved out into external offices.

The main factors affecting how they use the house are the children and the fact that they moved their business out of the home in early 2008. In 2006 and 2007 they had between two and four people in the house during the day, running computers and other office equipment, plus oil heaters in winter. Now the house is vacant more often and used less during week days.

The adults were aware of the Home Energy Rating System² (HERS) programme and were informed that their home rating rose from 2.5 out of 5 pre retrofit to 5 stars post. They commented that they had indeed noticed big changes since the renovations, as described below.

5.2.4 Winter energy use and temperatures

The respondents were asked why they replaced the existing two heat pumps with a ducted heat pump system. They responded that the heat pump in the garage was removed when the business shifted out of the house, though there is still a heat pump in the rumpus room downstairs which is hardly used. The ducted heat pump system was put in as the bedrooms were cold and this removed the need to use oil heaters in the bedrooms.

When asked whether their hot water use was consciously increased between 2007 and 2008 the respondents were unsure, noting that the children may use more hot water as they no longer worried about hot water running out: “The kids like the warmth and the hot water, we don’t have to ask them to get out [of the shower]”. They also commented that as the children got older they may shower more, but otherwise were not aware that their hot water use had increased significantly.

In terms of winter temperature improvements attributable to insulation or some other non heat pump reason, they commented on significant solar gain in the living room, through the sun being trapped more efficiently and for longer, due to double glazing and insulation.

■ _____
² *A Home Energy Rating is an assessment of the energy efficiency performance of a home. This includes:*

- *How well the building’s design, materials, construction and orientation enables it to maintain a comfortable indoor temperature.*
- *The efficiency of a home’s two biggest energy users: the space heating system and the water heating system.*

The assessment process provides a comparative star rating along with tailored, expert recommendations as to the most cost effective ways in which your home’s energy efficiency – and therefore its rating – can be improved.

5.2.5 Summer temperatures

In the previous interview with this household (Saville-Smith, 2008) the respondents noted concern at possible overheating in summer. When asked whether they continued to notice an increase in summer temperatures inside they responded that they did notice a marked increase, especially if they had forgotten to turn the ducted heat pump system on. The biggest problem area for overheating was the lounge.

Cooling actions undertaken were mainly opening windows and over summer the heat pump was used for cooling at times, as well as the ducted heat pump system, on average once a week in the lounge over summer. In 2008 they installed sunscreens in the lounge to mitigate this overheating issue.

5.2.6 Humidity and dampness

In terms of changes in dampness within the home respondents noted a marked improvement, with “No condensation on the windows, a damp musty smell minimal in the bathroom and no mould”. They did not use dehumidifiers before or after the renovations.

5.2.7 Water use

Average outdoor water use was considered to be minimal – they did not consider themselves to be gardeners and left water outside for the dog but otherwise used very little water outside. They did not consciously change their water use habits over the 2007/2008 drought and did not consider that they made any other water use changes as a result of the renovations.

When told that the monitoring data indicated that they used more hot water, they confirmed that the solar hot water heating system meant that they were less concerned about high use of hot water.

5.2.8 Waste

When asked whether they changed their waste disposal behaviour as a result of putting in worm bins, they responded that yes they did for a while, by diligently using the worm farm. However over time they had a barbeque and someone put fish in the worm farm, which then attracted bugs and flies and spelled the end of the worm farm. This occurred around mid 2008, and they saw little incentive to restart the worm farm as they were not gardeners.

5.2.9 Behaviour and use of the house

The respondents were asked on a scale of one to ten, with 10 being extremely eco conscious and one being not at all, as a household how they would rate their level of environmentally friendly behaviour in this house. The male gave the household a 7 rating and the female 7-8: “The four wheel drive jeep brings it down”.

In terms of any changes experienced in relation to understanding of environmental issues or attitudes towards the environment linked to the renovations, they felt that they could now relay the benefits of heat pumps to others based on personal experience. They felt they could also recommend double glazing to people. The male noted that “If I was building a home I would put in the highest R value insulation I could find”.

In terms of whether there was anything further they could have done to reduce their environmental impact, actions they felt they could have taken were:

- Continued to use the worm bin
- Use the wood burner more: “It’s easier to use the heat pump than the fire, but fires cause humidity in homes”
- Car pool to work: “We take two cars to work now; she takes the young ones to school”
- Use lower energy light bulbs: “They heat the room”
- Use lights less in the lounge and lift the sun screens instead

When asked if they would have done anything differently in terms of the renovations in hindsight, they noted that they would have also double glazed downstairs.

5.2.10 Benefits of the renovations

The children were present for some of the interview and were asked what they liked most about the renovations. The children most liked the increased warmth of the house and that they could have longer hot showers. The adults commented here that now they didn’t have to ask the children to get out of the shower and didn’t have to worry about hot water running out in general.

In terms of any physical health benefits noticed the adults remarked that “the kids don’t get up shivering”, and that one child with asthma used her inhaler less; another child had not had croup since the renovations (though she may have grown out of this); and that they had not had the flu (though they had also had flu shots).

Noise reduction was noted as a positive in the last interview and this was still the case, to the extent that they didn’t hear someone breaking into their car outside at one time.

They also noted in their last interview that the house felt healthier and more modern. It still felt healthier; they commented that “We used to have to wipe the mould off the walls, we could see it growing on the ceiling”, and that this was gone. In terms of modernisation they commented that they would rather have lost the pelmets completely but were used to them now (they were advised to keep them to support insulation). In terms of general wellbeing they commented that “The house feels and smells drier”.

In terms of family life the male commented only half tongue in cheek that his wife “wears nicer stuff to bed in winter” as it was not cold anymore, and that it was nicer to get up out of bed. They noted that they forgot quickly what the house was like before the renovations. They felt that they used the whole of the house more now as it was warmer, whereas before they used to “huddle round the fire”.

An unexpected benefit was how quiet the house is now with double glazing: “We used to hear the train doors open now we can hardly hear the train”. A further unexpected plus was being able to advise potential customers in their heat pump business based on personal experience.

Features particularly liked were the panel on the solar hot water which they could watch and the warmth. The warmth and health benefits were considered to have made the most difference to their lives, including the lack of mould, plus the more modern look of the house.

5.2.11 *Less positive aspects*

Other than not being able to hear the rain on the roof anymore, they could not think of any negative features or experiences resulting from the renovations.

5.2.12 *Changes to behaviour and attitudes*

They did not notice any changes to their behaviour as a result of the renovations, in terms of doing anything differently in the house. Knowing they were being monitored made little difference other than being careful to use the worm farm initially.

5.2.13 *Future plans*

In terms of future renovations planned, these were kitchen and bathroom renovations, new carpet and insulating downstairs.

Based on this experience, features they would look for in future homes were:

- Double glazing
- Good insulation
- Several forms of heating
- If building new, solar hot water
- Good quality curtains
- Sun screens to control heat

They commented that their experience had changed their understanding and priorities around renovation – they felt that they had learned the value of insulation and that it had been helpful for their area of work in that they could talk to potential customers based on their own experience.

5.2.14 Recommendations for future renovations and related research

When asked whether Beacon could have done anything to make the experience of the renovations better or more rewarding, they commented that “It is hard to complain, it’s been like winning Lotto”. At the same time they felt that the builders “didn’t know what they were doing”, and that EnergySmart needed to project manage more closely and ensure quality control. For example, windows went in and out three times, and the building work was considered very poor, with basic mistakes made, “Even with BRANZ looking over their shoulders”.

They had to move the children out for six weeks at one stage which created quite a lot of inconvenience for the family. There was also some poor communication about what was happening and when, and sealing had to be done twice. Two layers of plasterboard were put on the ceiling which increased insulation but made it harder to fit inset lights. If they could have done the project again they felt they would have kept more of an eye on the builders.

A recommendation for future renovations was to get the type of double glazing that cuts down on solar gain.

Advice for future occupants of houses undergoing renovations was to ensure good builders and good project management, including checking for the options available – “Make sure you speak up and ask about options”.

In terms of the research aspects, these respondents felt that the research and monitoring was the least intrusive part of the project. They felt it would have been nice to see a flow chart of who was involved in leading and running the project, as well as its purpose. They commented that the way the project was initially presented they were only expecting low energy light bulbs, and that the project was presented very differently to how it turned out. At the same time they felt it was good that the project leaders downplayed the potential gains, so that they got households genuinely interested in making changes rather than just getting free or subsidised home improvements.

Overall these householders were extremely appreciative of the changes made and felt they had significantly raised their standard of living and value of the house.

5.3 House 9

5.3.1 *The dwelling*

This house is a semi-detached unit with one male resident. BRANZ describes this dwelling as built in 1976, timber framed, with fibre cement weatherboard cladding upstairs and sheet cladding downstairs. There is a concrete block firewall between this townhouse and its neighbour, and the lower level has an uninsulated concrete floor while the upper level has suspended timber. The roof is concrete tiles. It has two bedrooms, two living areas and one bathroom.

The initial condition of the house was described as reasonable, with insulation to a low level by today's standards, with no underfloor insulation and low to moderate level ceiling insulation. The weatherboard cladding required maintenance and possibly replacement in some areas.

In Saville-Smith's 2008 interview the occupant was initially attracted to the project through an interest in energy efficiency and concern with rising costs (p35). While he was reportedly not interested in capital gains as he had no intention of moving, the appeal of the renovations lay in increasing warmth, addressing health related problems and reducing energy costs.

5.3.2 *The renovations*

Table 3 shows the issues needing to be addressed, renovations made and their market value for this dwelling.

Table 3: Renovations and Market Value House 9

Issue	Actual renovation	Approx market value (excl GST)
Ceiling insulated to a low-moderate level	Layer of R2.6 put over top of existing insulation and over ceiling joists to remove thermal bridging, raising insulation to approximately R-4	\$710
No underfloor insulation	Insulated with R2 foil backed insulation, polythene put on ground	\$490
Floor of main bedroom is above uninsulated garage	Midfloor insulation installed between garage and main bedroom	\$2,270
	Plasterboard (13mm) for garage ceiling	\$320
Wall between garage and stairwell/rumpus, rumpus/underfloor insulated	Wall insulation on rear of wall to underfloor and garage installed	\$180
Slight mould in bathroom	Shower dome installed	\$310
No fixed heating	Home owner installed heat pump	\$3,000
	Heat pump rewired	\$150
Draught from garage sliding door into living area	Sliding door to garage draught stopped	\$40
Single glazed aluminium windows throughout with poor insulation performance		
B grade electric hot water cylinder with poor insulation performance	Cylinder wrapped, pipes lagged	\$90
Energy inefficient lighting used	Compact fluorescent bulbs put into high use fittings	\$30
No significant water re-use methods or appliances		
Poor fridge/freezer seals		
Plumbing in unknown state	Plumbing checked	\$80
Food waste not recycled	Worm farm installed	\$160
	TOTAL	\$7,830

5.3.3 The household

The main factor affecting how the occupant used his home was the fact that he was home a lot when not at work. Little had changed in the way he used the house over the three years of the renovations project.

The occupant was not aware of the Home Energy Rating System (HERS) programme and was informed that his home rating rose from 4.5 pre retrofit to 5 stars post.

5.2.4 Winter energy use and temperatures

The occupant had noticed a definite improvement in warmth over winter: “It has been warmer; it heats up quicker and takes longer to cool down”. He had noticed the amount of electricity used had decreased, with his annual electricity use down on the year before.

In terms of heat pump use, the heat pump is situated in the lounge and during the week it was set to start 15 minutes before he was due to arrive home from work. Unless it was really cold in the weekends it was not reportedly used. The occupant considered that the house was warm enough in winter and he only used a fan heater in the mornings in the bedroom (rather than switching the heat pump on in the mornings).

Energy use was recorded as low in this house through the monitoring undertaken and the respondent was asked whether there was any reason causing him to underheat the house, to which he replied no, and that the heat pump had made a major difference to the heating he needed to use.

5.2.5 Summer temperatures

In the previous interview with this householder (Saville-Smith, June 2008 p36) the respondent noted that the house overheated in summer. When asked whether this was still an issue he replied that it was, with temperatures of up to 30 degrees. He noted that the bedroom was quite hot in summer.

Cooling actions undertaken were mainly opening windows; the heat pump was not used for cooling.

5.2.6 Humidity and dampness

In terms of changes in dampness the occupant noted that there was still some condensation on the windows, although the shower dome had reduced mould in the bathroom and he didn't need to use as much hot water. He did note that his tall nephew had come to stay and had some trouble breathing in the shower with the shower dome. The respondent was happy however with the shower dome, especially when combined with the fan in the bathroom, which resulted in little to no mould in the bathroom. Dehumidifiers are not used in this house.

5.2.7 Water use

The occupant used water outdoors every couple of weeks on average, although a bit more than this in summer. He did not consciously change his water use habits over the 2007-2008 drought and did not change his water use habits over the period of the renovations.

5.2.8 Waste

When asked whether he changed his waste disposal behaviour as a result of putting in worm bins, he responded that he put out less rubbish for collection and commented that the worm farm was easy to use with no smell, although he did forget sometimes to use it.

5.2.9 Behaviour and use of the house

The respondent was asked on a scale of one to ten, with 10 being extremely eco conscious and one being not at all, how he would rate his level of environmentally friendly behaviour in this house. He gave this a 6 rating, noting that he had always been reasonably conscious of environmental issues.

When asked if he would have done anything differently in terms of the renovations in hindsight, he noted that he would have liked double glazing.

5.2.10 Benefits of the renovations

In terms of any physical health benefits noticed the respondent noted that he seemed to have fewer colds; but that he had only been getting flu jabs in the last few years as well. He did not notice any impact from the renovations on his general wellbeing.

An unexpected benefit was the insulation and regibbing of the garage, and features he particularly liked were insulation out the back of the garage under the floor (the polythene) and extra insulation in the ceiling.

5.2.11 Less positive aspects

The respondent could not think of any negative features or experiences resulting from the renovations.

5.2.12 Changes to behaviour and attitudes

No changes to his behaviour or attitudes were noted from the renovations, and knowing that the house was being monitored made little difference; he only thought about this when people came to do the readings, even though four different monitors were in the house.

5.2.13 Future plans

In terms of future renovations planned, he had just painted in the lounge and planned to reclad outside, with more decorating planned at some future stage.

Based on this experience, features that he would look for in future homes were:

- Double glazing
- Good insulation

He commented that his experience had taught him the value of trapping the sun.

5.2.14 Recommendations for future renovations and related research

When asked whether Beacon could have done anything to make the experience of the renovations better or more rewarding, he commented that the renovations weren't what he was expecting. He had a list of things that could have been done, for example he thought that double glazing was going to happen – the glazing was even delivered and then taken back, and there was a bit of to-ing and fro-ing which was a bit annoying, but that overall he was happy with everything.

In terms of advice for future renovations, he suggested focusing on insulation and that a worm farm was “a nice to have but not essential”, although the worm liquid was useful.

In terms of advice for future occupants of renovated homes in projects such as this, he suggested that they be flexible but prioritise the list of potential things that could be done. He noted that “you can't call the shots if you are not paying for it”. He noted that other people seemed to like the shower dome and that he may be influencing others by promoting the shower dome: “It's warm in there in winter”.

He had no suggestions for future monitoring and research, noting that the people doing this work always gave him plenty of notice of their next visit. Overall he felt the people involved had been helpful, even with several changes in personnel during the project.

5.4 House 10

This dwelling houses two adults and three school age children. This interview initially took place with the male adult of the household, who was joined after a short period by his wife. The children were present for some of the interview and were asked one question about perceived benefits of the renovations (see 5.2.10).

These occupants were reportedly attracted to the project as it gave them an opportunity to ‘kick-start’ work they had already planned but been constrained in progressing due to limited income (Saville-Smith 2008 p38). Their main concerns with the house were cold, damp and mould, and they had already started to double glaze the children’s rooms prior to this project.

5.2.1 The dwelling

BRANZ describes this house as built in the early 1970s, with timber frame walls with sheet cladding upstairs and reinforced concrete walls downstairs. The windows were mostly wooden timber framed, with a concrete tile roof. It has four bedrooms, one living room and two bathrooms, with living areas located above the garage and rumpus room, and bedrooms, bathroom and laundry located over the sub-floor area.

The house condition at the start of the project was described by BRANZ as poor, with peeling paint, rotten windows, patched roof, and original décor, hot water cylinder (though wrapped and lagged) and wood burner.

5.2.2 The renovations

Table 4 shows the issues needing to be addressed, renovations made and their market value for this dwelling.

Table 4: Renovations and Market Value P10

Issue	Actual renovation	Approx market value (excl GST)
Ceiling insulation thin and patchy	Two layers of R2.6 put over old insulation, top layer put over ceiling joists to remove thermal bridging	\$2,100
No underfloor insulation	Timber suspended floors above subfloor and garage insulated with R2 foil-backed insulation, polythene on ground in subfloor	\$2,380
Flat roof above foyer uninsulated	Flat roof insulated with R3.6 midfloor batts and lined (13mm)	\$540
No wall insulation	Walls stripped, insulated with R2.4 and relined (10mm) throughout thermal envelope, except downstairs bedroom	\$7,810
	Plasterboard for flat roof and walls	\$1,230
Original electric hot water cylinder (wrapped) losing excess heat	Solar water heating system installed on foyer roof	\$10,040
Old inbuilt woodburner past useful life	New high efficiency woodburner installed with wetback pumped to hot water cylinder	\$4,050
Old timber window frames in poor condition and rotted through in places	Double glazing units and window frames provided for installation into living wing only. Installation costs included (estimated)	\$45,000
Standard incandescent bulbs in high use fittings	Compact fluorescent bulbs put into high-use fittings	\$30
No extraction fans in bathroom and laundry	Householders install extraction fans into bathroom and laundry	\$380
Desire to reduce discharge to sewage system		
Desire to reduce stormwater runoff and mains water use		
Draughty door to garage losing heat	Garage door draught proofed	\$50
Older fridge/freezer seals may be leaking		
Plumbing in unknown state	Plumbing checked, vanity moved for relining, leaky tap fixed	\$300
Food waste not effectively dealt with	Worm farm installed	\$160
	TOTAL	\$74,070

5.2.3 The household

This couple bought the house knowing it needed major renovation and have worked “non-stop” on it: “The house became our life”. This project reportedly moved the renovations ahead significantly and “jump started” the rest of the renovation work. Around mid 2007 the male adult in the house went back to work full time, which significantly increased the household income.

The adults were aware of the Home Energy Rating System (HERS) programme and were informed that their home rating rose from 2.5 out of 5 pre retrofit to 5 stars post. They noted that when they arrived “everything was broken” and that there had been a “massive improvement” through the renovations.

5.2.4 Winter energy use and temperatures

The respondents were asked whether they had noticed an increase in their electricity use between 2007 and 2008. They were unsure about this, but had noticed a huge decrease in their electricity bill in 2008. They felt an increase in energy use could be linked to their teenage daughter’s bedroom “coming on line”, which has a TV, stereo, hair irons, heater, lights left on and so on.

When asked if they had run their wood burner in the 2008 winter more consciously they replied that they had, running it from March to September, but that they always did this as they get free wood through work: “We have the fire going 20 hours a day”.

The bedrooms no longer feel cold to the occupants, although when it gets really cold they do run supplementary heating in the bedrooms. They commented that while the wood burner was very efficient it can’t get heat down to the other end of the house, so a heat transfer system is needed and this is something they plan to do at some stage. Overall they noticed that temperatures have risen in the house during winter, with the morning temperature “much higher”.

5.2.5 Summer temperatures

Respondents noted that it did get too hot in the house over several weeks in summer, but they opened the windows and the heat was not considered to be a problem. Cooling actions undertaken in general were opening windows and doors, including the sliding doors in the main bedroom.

5.2.6 Humidity and dampness

In terms of changes in dampness within the home respondents noted that the dampness had gone in the main living areas, and that with everyone using the fan in the shower dampness had decreased by 80%. They did use dehumidifiers when they first moved in but thought they were “useless” and did not continue with them. They found the extractor fans in the bathroom and laundry to be “excellent”, especially when combined with new windows.

5.2.7 Water use

In terms of outside water use they fill the swimming pool up twice in the summer and water the garden every two to three days in summer, although they estimate their water use dropped by half over the last year. This was related to the drought over 2007 to 2008. The vegetable garden was still active, on a par with the year before.

In terms of general water use this household noted that their hot water tank was too small before the renovations and hot water use was a major issue for the household, with monitoring of showers, fewer showers and sharing of bath water.

They considered now that they tended to have more showers: “We don’t feel so guilty about having showers now, before the renovations we worried about the water in the tank; our water consumption has gone up”. Their daughters were also considered to be showering more over the last year.

5.2.8 Waste

When asked whether they changed their waste disposal behaviour as a result of putting in a worm bin, they responded that they had emptied out the worm bin as they had overfed them and had a problem with bugs and flies. The female adult expressed a wish to resurrect the worm farm, and they are still using the worm fertiliser on the garden.

5.2.9 Behaviour and use of the house

The respondents were asked on a scale of one to ten, with 10 being extremely eco conscious and one being not at all, as a household how they would rate their level of environmentally friendly behaviour in this house. They gave the household a 7-8 rating, commenting that they are “not green people but our footprint must be relatively low, we are doing more than most”. They do not recycle but try and cut down on vehicle trips and often use materials others have thrown away for the house.

In terms of any changes experienced in relation to their understanding of environmental issues or attitudes towards the environment linked to the renovations, they felt that there had not been any change. They commented that “you need money to be environmentally aware” and that they were an “outdoor family” and that like most New Zealanders they would make changes if they thought there was a benefit in doing so. They are “aware of the issues and do the common sense stuff. But it hasn’t made us greenies”. They noted that “If we had a cold house we would be miserable; buying more clothes and burning more wood; this house makes us happier mentally”.

In terms of whether there was anything further they could have done to reduce their environmental impact, actions they felt they could have taken or could take in future were more solar power to run the house (the adult male also wanted a wind turbine).

When asked if they would have done anything differently in terms of the renovations in hindsight they said no, although they “were promised wallpaper”, and do plan to put in a heat exchange system and a drape over the front door. It bothered them that the renovation of the house was unfinished and in hindsight they could have borrowed money and finished everything, including a new kitchen. However they felt that what they care most about is warmth – that the kids are warm and that they have efficient heating.

5.2.10 Benefits of the renovations

In terms of any physical health benefits noticed the adults remarked that they had “A lot less colds; kids always had runny noses, less colds and flu”. They commented that they all felt more relaxed, and that being warmer makes them happier; that they “were on edge before, and cold, it was a nightmare, this has taken a weight off us”. They felt that if this project hadn’t come along they would have “either bailed out [of this house] or sold our other house and put the money into this one”.

In terms of general impact on wellbeing they noted that the renovations created mental benefits as they felt more relaxed and that they had significantly progressed their upgrading of the house.

They remarked that “We didn’t think it [the renovations] would be as good as it has been; we are surprised at how warm the house is, the double glazing and insulation have been great”.

In terms of benefits for the adults in the house, they noted that they felt happier, felt less stress as there was less to fix and the house was warmer. The project also meant they had to borrow less money for renovations, the kids can use more hot water and they can put the washing machine on warm not cold: “We are doing our job as parents by keeping the house healthy for the kids”.

The children saw the main benefits as being warmth, in that it was nicer to come home in winter and it is warm in the mornings, it is quieter and they can open windows in their bedrooms (these weren’t able to open previously).

Family life has improved through less noise from parties in the neighbourhood as a result of the double glazing and through increased warmth. They noted that they had been pleased with everyone involved in the project, who they considered had really made an effort and gone out of their way to assist. They were listened to on several key occasions as to their preferences (including the wood burner and double glazing).

The features that have made the most perceived difference to their lives are the fire and double glazing. The latter was noted as being the biggest cost “that you couldn’t afford yourself”.

5.2.11 Less positive aspects

Less positive aspects experienced included a firmer hand needed in the project management of the work and at times they felt a bit out of the loop; there was a bit of to and fro, “mucking around” and gaps in communication. Other aspects that were less positive were:

- The front door smashed during a visit from BRANZ
- More deals and negotiation could have been done around the materials and work undertaken
- The ranch door slider in the main bedroom was not replaced
- A key door wasn't double glazed.

5.2.12 Changes to behaviour and attitudes

A key change in behaviour noticed was their increase in water use: “As the family have grown we don't have to worry about the water – we used to boil water on the fire and share the bath with the kids”. In the past they had a small water tank: “The tank size is now spot on”.

They didn't notice being monitored and didn't feel that this changed their behaviour at all, though they took an interest in the results coming through. They noted that it would be good to have the monitor in the kitchen or a central place, so it reinforces what they are using and encourages or reminds them to switch off power and use less.

5.2.13 Future plans

In terms of future renovations planned, these were described as “window dressing mainly”, though they plan to put batts in the floor to keep noise blocked from downstairs, plus carpets, flooring and curtains: “The temperature would have gone up a degree if we had done these things as well”.

Based on this experience, features they would look for in future homes were:

- Double glazing, they would cost in the purchasing of double glazing
- Warmth features, they would check for insulation in floors and ceiling (“We know what a warm house is now”)
- Low maintenance
- Low renovation needed

They commented that their experience had reinforced their existing focus on the importance of warmth and practical comfort.

5.2.14 Recommendations for future renovations and related research

When asked whether Beacon could have done anything to make the experience of the renovations better or more rewarding, they commented that better project management, communication and continuity in who they dealt with could have been better. They noted that the agencies involved were also learning but couldn't get workmen and "were too soft". They felt that it wasn't explained to them who was doing this work and why (ie the purpose of the project and who was behind it).

They also noted some poor workmanship, for example, the double glazing, and the company involved "walked away when they found out we were part of the Beacon thing. If I had paid I would have made a fuss".

A recommendation for Beacon when doing future renovations was to have a firm plan, be clear on what was happening and wary of language used: "We didn't know what a retrofit was". Also to add a heat transfer system to the package and do double glazing: "We wouldn't have seen much difference if they didn't do all the windows".

Advice for future occupants of houses undergoing renovations was to "contribute and do work alongside the other renovations to get the full benefit; we were glad to contribute". They felt that occupants could also expect uncertainty as to decisions and some to and fro and unexpected events, but that involvement was "a good thing in the long run". They noted that people with money may be less willing to cooperate and more likely to complain.

In terms of the research aspects, these respondents felt that the temperature for the hot water gauge should be somewhere visible. Otherwise the research and monitoring was "fine, the people were good, they turned up when they said they would".

Overall this household was extremely appreciative of the changes made and wanted to thank someone but didn't know who: "We are really pleased, but there is no formal way to thank people, we didn't know how to contact these people [Beacon]. It all went well and has made a huge difference – we can't believe our luck. It's good to know the house is sound now, its added \$100,000 in value".

6 Lessons from each household

This section summarises key findings and lessons arising from each household.

6.1 House 3

- This household used more hot water as the solar hot water system gave peace of mind that hot water would not run out and was cost effective. They also linked this increased use with their growing children having more and longer hot showers.
- The insulation and double glazing was so effective they needed sunscreens to mitigate trapped heat in summer.
- Linked to the above, overheating in summer led to the use of their heat pump for cooling occasionally.
- The heat pump was also sometimes used in preference to the wood burner in winter as it was more convenient and easier to flick a switch.
- The insulation, double glazing and fan made a marked impact on damp, humidity and mould.
- The worm farm was not resurrected once ‘spoilt’ and held little appeal to them as non-gardeners.
- While they rated themselves 7-8 in terms of eco-consciousness there was often a gap between their awareness of an issue and taking action (i.e. there were environmentally friendly actions they identified that they could do but were not yet doing).
- The children most liked the warmth and longer hot showers.
- Health benefits were noted in terms of fewer colds and flu and the children being healthier, also that the home ‘felt’ healthier in terms of no damp/mould and feeling and smelling drier.
- The family now used the whole house more as they were no longer huddled in main rooms in winter.
- Overall warmth, health and look and feel of the house were the greatest impacts perceived, and they forgot quickly what the house was like before the renovations.
- They recommended better project management and communications for future projects.

6.2 House 9

- The shower dome and fan in the bathroom were perceived to have largely eliminated mould and the shower dome was positively experienced.
- Fewer changes were made in this home and the householder perceived less of an impact on his life overall, while still experiencing noticeable improvements. He also had a smaller difference in HERS rating before and after the renovations.
- The worm farm reduced his waste output but was seen as “nice to have” rather than essential.
- There was a possible perceived positive health benefit in terms of less colds and flu, though none perceived on his general wellbeing.
- This householder learnt the value of good insulation through this process.

6.3 House 10

- This household increased their hot water use as they perceived the solar hot water system to provide unlimited hot water. They also linked increased use to using hot water in the washing machine and a teenage daughter taking longer showers.
- They feel a heat transfer system is needed to transfer the heat from the wood burner to other parts of the house and plan to do this.
- The house overheats but this is remedied by opening windows and is not seen as a problem.
- The bathroom fan was perceived to be effective in reducing damp in the bathroom.
- The worm bin is now defunct and not likely to be resurrected.
- Cost seemed more a driver for this family than environmental impact.
- They perceived health benefits through fewer colds and flu since the renovations.
- Mental health benefits were also perceived, through having less stress/being on edge, being happier and relaxed with more warmth in the home, and ensuring the kids are healthy makes the parents feel that they are “doing their job”.
- For the children increased warmth and quiet were key benefits.
- For this family the new wood burner and double glazing were perceived to have the most impact, although they considered that double glazing was beyond the reach of most.
- They recommended better project management and communications for future projects.

7 Implications for future renovations

Overall implications from the case studies above are as follows:

7.1 Heating

- The two larger households saw value in a heat transfer system to spread heat around.
- Teenage children were perceived by both family households to be high users of energy, which impacted on their household's overall energy use.
- Double glazing and insulation combined were considered to be highly effective by the two family households who received this. The high cost of double glazing however was perceived to prohibit or reduce uptake, both for themselves and in general. Working on reducing the costs of double glazing is a challenge in increasing housing sustainability.
- Overheating occurred in all households but was generally solved by opening windows, except for one household where the heat pump was sometimes used for cooling.
- The convenience of a heat pump can lead to greater energy use by being a disincentive to light the wood burner and/or be used to cool in summer rather than open windows.

7.2 Water

- The solar hot water system led to an increased use of hot water for both of the family households, as it was perceived to remove fear of hot water running out and to be cost effective.

7.3 Waste

- In two of these three case studies the worm bin was “spoilt” and not reactivated immediately, and there was a view that worm bins may hold less appeal for non-gardeners.

7.4 Health and wellbeing

- All noted physical health benefits from the renovations, particularly in terms of experiencing fewer colds and flu (though this may also be linked to flu injections in all cases).
- The two family households noted mental health impacts in being happier when warmer, more relaxed, less stressed and the increased warmth being better for children's health.

7.5 Greatest impact and influence

- Features most liked overall were double glazing, insulation, solar hot water and having several forms of heating.
- All households were attracted to the project by the opportunity for increased warmth and energy efficiency/cost savings, and warmth and cost are likely to be key drivers of uptake for others.
- This project had little perceived impact on householders' environmental awareness and behaviour, and cost seemed to be more of a driver for their behaviour than environmental impact on the whole.
- Once people have experienced a warm, dry home they are less likely to accept a lower standard in future homes.

7.6 Future projects

In terms of future projects implications include:

- Ensure close project management and quality control of work undertaken.
- Ensure good ongoing communication with householders as to the purpose of the project, what to expect, who is involved and key contact people.
- Clarify what room there is for negotiation with the householders and how they can maximise the work undertaken through contributing themselves.
- Linked to the above, in terms of household selection for future projects there may be sense in balancing low income households with those who can afford to contribute to the works to maximise the benefits received.

8 References

Saville-Smith, K. (2008). *Papakowhai Renovations – Impacts on Households and Dwelling Performance*. Report TE106/9 for Beacon Pathway Ltd

9 Appendix A: Interview schedule example (House 3)

Introduction

Thank you for meeting with me - this is the final research interview and you are encouraged to be frank. The focus of past research with you has been on the physical performance of the house and your use of the new features.

The aim of these interviews is to gain a clear understanding of the impact of the home renovations for you, the benefits (expected and unexpected) and any negatives. It also picks up some questions that arose from the physical monitoring of your home.

Any questions before we begin?

Context of household and impact on how you use it

Start by looking at the kind of household you are and how that affects your use of the house.

- What for you are the main factors affecting how you use the house (e.g. children, work life, priorities, lifestyle, income etc)?
- Have any of these key factors changed over the last three years (e.g. work, income etc)?

- Are you aware of the HERS rating programme³? Your score was 2.5 pre retrofit and 5 stars post. This indicates that you would expect a big improvement in warmth and comfort, ease of heating and substantial energy savings after the changes had been made. Any comment on this?

The next sections ask some questions that came out of the monitoring of your home.

Winter energy use and temperatures

- Why did you replace the two heat pumps with a ducted heat pump system? Was it because you felt the bedrooms (in particular) were still too cold? [Note - the occupants ran a heat pump sales business.]
- Did you consciously increase your hot water use between 2007 and 2008?
- Did you notice any temperature improvements post retrofit that you attribute to insulation or some other non-heat pump reason?
- Were there other factors which led to changes in your heating behaviour and hot water usage?

Summer temperatures

- Did you continue to notice an increase in summer temperatures inside? Did you often (or at all) reach uncomfortable temperatures? Did this occur in particular rooms? [Indicated concern at possible overheating in 2007 interview – does this occur?] Did you install sunscreens?

■ _____

³ *A Home Energy Rating is an assessment of the energy efficiency performance of a home. This includes:*

- *How well the building's design, materials, construction and orientation enables it to maintain a comfortable indoor temperature.*
- *The efficiency of a home's two biggest energy users: the space heating system and the water heating system.*

The assessment process will give you a comparative star rating along with tailored, expert recommendations as to the most cost effective ways in which your home's energy efficiency – and therefore its rating – can be improved.

Home Energy Ratings are about better information to help you bridge the gap into a warmer, healthier, and more cost-effective home – whether buying, building, renting, renovating or otherwise.

- What sort of window opening and cooling actions do you take in summer? Do you rely on your ducted heat pump system to cool the home throughout the summer, or do you only use the heat pump when you think it's really hot or in the evening? Do you use the system for cooling all rooms or just some?

Humidity and dampness

- Did you notice any changes in dampness within your home? Within particular rooms?
- Do you use dehumidifiers? Has their use change over time?

Water use

- How much average outdoor water use do you engage in (not at all, once a month, a few times a month, weekly or more often?)
- Did you consciously change your water use habits over the 2007/2008 drought?
- Did you make any other water use changes as a result of the retrofit?
- Data indicates that you used more hot water, does the solar water heating mean you are less concerned about high use of hot water?

Waste

- Did you change your waste disposal behaviour as a result of putting in the worm bins?

How describe your behaviour/use of the house

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

- On a scale of 1 to 10, with 10 being extremely eco conscious and 1 being not at all, as a household how would you rate your level of environmentally friendly behaviour in this house?
- Were there any changes experienced in relation to understanding of environmental issues or attitudes towards the environment?
- Are there any things you could have done to date to further reduce your environmental impact?
- Is there anything that you would have done differently in hindsight regarding the retrofits?

Benefits and negatives

- Any noted physical health benefits?

In your last interview you indicated benefits arising in terms of noise reduction within and outside the house, a feeling that the house is healthier, the modernised look of the house and improved sense of wellbeing.

- Can we look at each of these in turn and see whether that is still the case or there is anything you want to add?
 - Noise reduction
 - House feeling healthier
 - More modernised look
 - Improved sense of wellbeing
- Are there other benefits from the retrofits you have noticed:
 - For yourselves as the adults?
 - For the children?
 - For family life?
- Have there been any unexpected benefits?
- What features do you particularly like? [Warmth and reduction of noise from double glazing particularly noted last interview.]
- What feature/s have made the most difference to your lives? [Noted previously reduced energy costs major benefit.]
- Any negatives or less positive experiences arising from the retrofits?

Any changes noticed in terms of your behaviour and attitudes

- Did you notice any changes in your behaviour as a result of the retrofits (e.g. water and energy use)? Did you do anything differently?
- What difference did knowing you were being monitored make to your behaviour (if any)?

Future plans

- Any further retrofits/ work done or planned for the house since Beacon completed (e.g. curtains, sun shades)?
- What would you prioritise or look for in future homes?
- Has the experience changed the homeowners understanding and priorities around renovation?

Recommendations for the future (house itself and research/monitoring)

- Is there anything Beacon could have done to make the experience of the retrofit better or more rewarding (e.g. education, training, ways to make process smoother, reduce impact)?

Do you have any suggestions or advice for future renovations in terms of:

- Retrofits themselves (things to change etc)
- Occupants or potential occupants in these houses
- Research, monitoring, questions, issues to cover?
- Anything else you would have done differently?

Any further/final comments? Any issues you feel have not been covered?
