HN2800/4

Concluding Beacon's NOW100 project

Final

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About This Report

Title
Concluding Beacon's NOW100 project

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Abstract
The purpose of this report is to document Beacon's new homes research, at the point of early wrap up of the NOW100 project. The intended audience is Beacon shareholders and researchers although it is envisaged that selected parts of the report may be extracted for use in communicating our approach to partners and other stakeholders. The decision to withdraw from the NOW100 project marks a shift in Beacon's approach to new homes research. This report serves to act as a repository of our knowledge to date: it therefore informs uptake pathways for the current technical knowledge (e.g. single residential rating tool project) and as a baseline should new homes research programme be re-established in the future.

Reference
Popping, A, Cowan, V. December 2009. Concluding Beacon's NOW100 project.Report HN2800/4 for Beacon Pathway Limited.

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Executive Summary

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1 Purpose

The purpose of this report is to capture Beacon's learning from NOW100 and report against the workplan given the shortened timeline of the project. The report gives a short history of the project, lists progress against original objectives, captures additional learning and identifies future opportunities.

2 Introduction

The NOW100 project sought to extend the knowledge base and technical transfer of Beacon's two NOW Homes®. Several Beacon documents plot the pathway from Waitakere and Rotorua to this ambitious project.

2.1 Homes strategy

In October 2007 the Board adopted the Homes Strategy, which covered research for new and existing homes (subsequently split and managed by two research team leaders). The target table for new homes is as follows:

Target 2 : New homes are built to meet a High Standard of Sustainability			
All new homes are built to achieve a High Standard of Sustainability by 2012			
Milestones			
2006	2009	2010	2012
Estimated 5% of new homes	10% of new homes	25% of new homes	100% of new homes achieve a HSS
HSS defined	Info available to the value chain on how to build homes to a HSS HSS benchmarks underpin Rating Tools for new build residential (eg TUSC, Greenstar Residential)	Private sector funders (utilities, insurance, finance cos.) promote & incentivise new build to meet HSS Significant commercial uptake of Now Home® Procedures	Regulatory framework (central + local government) in place so all new homes required to meet a HSS

The strategy identified the following stakeholders as key to new home segment.

- Developers
- New Home Buyers
- Trades
- Design professionals
- Manufacturers and retailers
- Water and energy utilities
- Local Councils
- Central Government (DBH, HNZC)

Builders and developers in the mass build market were identified as the 'target' audience for codified procedures resulting from the NOW100 research.

The research questions the strategy posed with regard to new homes were:

Target 2: New Homes are Built to Achieve a High Standard of Sustainability	How can Beacon's tacit knowledge and IP be best captured and presented to ensure development of new NOW Homes by other stakeholders which meet the high standard of sustainability? What is the value of building new sustainable homes to different stakeholders and how can that understanding build to a convincing case for change for different stakeholder types? What type of information and tools are needed to catalyse change within the different stakeholder groups and how are these tools best presented to achieve mass change?

2.2 FRST homes objectives

Beacon's first objective in the FRST contract (finalised after the strategy was operational) is entitled "more sustainable homes". It covers all homes: therefore the NOW100 project was designed to read to the new homes segment of the market.

The achievement measure for this FRST objective is as follows:

- By 2010, an industry standard defining a home's sustainability has been developed and the standard has been adopted by the NZ Green Building Council, 20 top priority councils, DBH and at least 4 key industry organisations (e.g. NZIA, IPENZ, Institute Surveyors, Valuers, Property Institute, Master Builders, BOINZ) as the benchmarks that inform the measurement of a home's performance.
- By 2010 protocols for the development of new homes and the retrofitting of existing homes will have been developed, piloted and finalised for dissemination. At least 50% developers/builders will be using the protocols to design and construct new homes, and the retrofit protocols will be in use by a commercial retrofit company.
- By 2010, a portfolio of ten public and peer reviewed conference papers and publications (e.g. articles, submissions) have been accepted and where appropriate IP has been identified, captured and mechanisms for protection are in place.

2.2.1 Comment on status

In January 2009, as part of the Oct-Dec08 quarterly reporting, Beacon signalled to FRST the decision to withdraw the new homes research component from the portfolio. The Research Guidance Committee when reviewing the revised portfolio confirmed they were comfortable with the decision, indicating FRST acceptance should be sought. The reporting approach was agreed with Beacon's FRST Business Manager in advance. At time of writing, Beacon is still to receive a 'formal' response: informally FRST's BM for Beacon accepted the logic behind the decision.

The conclusion of NOW100 project coincided with Beacon renaming its homes research: new homes research is now called Home*Smart* Homes and existing homes research Home*Smart* Renovations.

At the 2009 shareholder symposium, shareholder input to the "new homes station" indicated that Beacon should reconsider engagement with new homes as the recession was seen to be lifting. This, along with NOW100 commitments to NZHF and Stonewood Homes, has resulted in Beacon establishing (Dec09) a limited new homes project entitled HomeSmart Homes. It has two components: limited monitoring and reporting on one NZHF and two Stonewood research homes and revision of the procedures.

2.3 NOW100 workplan

The workplan for this project outlined four objectives. They were to:

1) establish the credibility and robustness of the **NOW Home®** by broadening the baseline numbers of monitored stock and the typology of stock meeting **NOW Home®** standards
2) develop a robust set of **procedures** that Beacon can commercialise and which will allow builders to build homes that meet Beacon's HSS High Standard of Sustainability® (HSS®)
3) demonstrate that NOW Homes® can be shifted from a prototype to a leading product in the new-build market which people associate with comfortable, quality living at an affordable price
4) act as a catalyst for market transformation and the wider uptake of building new homes to achieve the HSS High Standard of Sustainability® using a range of available products.

An additional expectation of 'where Beacon would be at the successful conclusion of the NOW100 project' was indicated in the workplan.

At the end of this programme we expect to achieve the following:

- **NOW Home® Procedures**[1] which, when used by stakeholders in the new homes value chain, will enable the development of new NOW Homes® which meet Beacon's HSS High Standard of Sustainability®.
- A simple and cost-effective home performance monitoring tool which will allow:
  - Beacon to monitor a large number of homes, cheaply, against Beacon's HSS High Standard of Sustainability®, and
  - Developers and householders to monitor the performance or their homes.
  - Project partners who accept the findings of the research and are actively improving their practice with respect to sustainable building as a result of the project
- Conference presentations and publications

Section 3 deals with the status of each component.

[1] ***Later renamed HomeSmart Home Procedures. Industry feedback on the NOW Home brand led to the development of the new HomeSmart Home brand (see Development of the HomeSmart Home Procedures HN2800/2).***

3 Status of NOW100 research at closure

From the approved workplan the NOW100 research was to involve:

1) developing prototype procedures that enable the replication of the **NOW Homes®** (as Home*Smart* Homes) by the wider industry
2) piloting those procedures with industry
3) developing a simple and cost effective monitoring system to measure the success of the development of new Home*Smart* Homes
4) evaluating the performance of homes to see if the procedures result in a home that meets the HSS®; and
5) evaluating the procedures in terms of ease of use and value to builders and developers in creating Home*Smart* Home buildings.

Progress against these at time of wrap up is summarised in following table and an expanded commentary against relevant activities is in the following sections.

Table 1: Status of research components

	Component	Status
1	Develop prototype procedures	Completed.
2	Pilot procedures with industry	Initiated with New Zealand Housing Foundation building one home on basis of Beacon's procedures
3	Develop simple cost effective monitoring to test performance against HSS®	Not completed: learning drawn on and developed by Home*Smart* Renovation Pilot
4	Evaluation of performance of homes	Not achieved: not enough homes being built to support this demonstration programme.
5	Evaluation of procedures (builders/developers ease of use)	Achieved to some degree after consultation with some builders.

3.1 Prototype Procedures

This research component is completed with the production of a report entitled *Development of HomeSmart Home Procedures v1 for piloting* (Easton et al, 2008), to which the v1 procedures are annexed. This report provides no further treatment of this component: but it should be noted that the new Home*Smart* Homes project includes a review of the procedures alongside Home*Smart* Renovation procedures.

3.2 Pilot with industry

The status of the activities listed for this component is captured in the following table.

Activity	Status
Development of pilot partnerships	Achieved: under management of Andries Popping (RTL) with Nick Collins in support. Considerable learning, despite numbers engaged in pilot not as expected. Reported below in section 4.2
Construction of pilot homes	Not achieved to intended scale: ■ One home (construction begun in May09) designed to meet most but not all of the Home*Smart* Home specifications with New Zealand Housing Foundation. ■ Additional three homes under construction with Stonewood Homes in Rangiora, have incorporated energy elements of the Home*Smart* Home Specification, but not the water components or some other aspects.
Work in progress workshop	Not achieved: overtaken by decision to stop NOW100

3.3 Cost effective monitoring

The status of the activities listed for this component is captured in the following table.

Activity	Status
Investigate best options for cut down monitoring	Partially achieved: E-Cubed contracted to help Beacon think through how to simplify in-house monitoring. Work is ongoing amongst RTL team to explore the potential for a simple, effective and low cost monitoring option for NZ homes.
Piloting of monitoring method in Home*Smart* Home	Partially achieved: E-cubed failed to install cut down monitoring into Waitakere NOW Home® before home sold. BRANZ calibrated I-buttons (Temperature, Relative Humidity) E-Cubed with Energy Intellect trialled a smart meter with remote data collection in one Auckland home.
Report on monitoring system	Partially achieved: Working paper (Arnold et al, 2008) specifying cut down monitoring for 100 NOW Homes produced but monitoring system was not fully trialled. However the learning from component trials are reported in section 4.1.2

3.4 Evaluate performance of homes

The status of the activities listed for this component is captured in the following table.

Activity	Status
Development of research frame for pilot	Achieved: Working paper outlining proposed research frame and evaluation developed (Arnold et al, 2008). At time of publishing, the decline in new-build industry was becoming clear creating questions around how we would run the pilot with fewer homes etc.
Development of monitoring case frame and analytic framework	Achieved: Documented in Working Paper (Arnold et al, 2008)
Development of monitoring protocol and identification of homes	Partially achieved: reported in Working Paper (Arnold et al, 2008)
Budget review	Not achieved: overtaken by wider review of Beacon's portfolio and subsequent decision to stop NOW100
Purchase of monitoring equipment	Partially achieved: small scale purchases to enable testing of cut down monitoring - 5 I-buttons and 1 smart meter.
Set up monitoring	Not achieved: new project, HomeSmart Homes will pick up Beacon commitments to monitor NZHF home and to be part of the monitoring of Stonewood properties (one of which is trialling a Firth thermal mass wall).

3.5 Evaluate procedures

The status of the activities listed for this component is captured in the following table. Contributions to Beacon's knowledge base are documented in section 4.2.

Activity	Status
Design of 100 Home*Smart* Homes	Partially achieved: work with following partners involved joint close review of their plans against the Home*Smart* Home Procedures (under licence). New Zealand Housing Foundation (West Coast Road project), Stonewood Homes (Rangiora Project, with connection to Firth via EnerGWall trial).
Phase 2 report: monitoring and pilot progress	Not achieved. However, this report serves as replacement to capture learning at point of project closure.
Development of v2 procedures	Not achieved: intent was to revise v1 technical procedures after piloting, which didn't happen. Home*Smart* Homes project (established end 2009) includes revision of procedures alongside Home*Smart* Renovation project.
Technical report: final analysis of performance of homes	Not achieved: NOW100 stopped. Home*Smart* Homes project has limited monitoring of NZHF home (Auckland) and 3 Stonewood homes (Canterbury) and final reporting.

4 Key Beacon Learning

4.1 Technical knowledge base

The research emphasis of this project was to generate a dataset from 100 newly built homes that would enable analysis to prove or disprove our three research hypotheses. Namely,

1) That **Home*Smart* Home Procedures**[2] can be developed, which, when used by stakeholders in the new homes value chain, will enable the development of new NOW Homes® which meet Beacon's HSS High Standard of Sustainability® (HSS®).
2) That a cut down monitoring tool can be delivered which can be used to monitor a large number of homes, cheaply, against Beacon's HSS High Standard of Sustainability®.
3) That development of the **Home*Smart* Home Procedures** and their piloting will act as a key market transformation method in the wide uptake of building new homes to achieve an HSS High Standard of Sustainability®.

4.1.1 Research and analytic framework

The framework drafted for the NOW100 project was not finalised due to the decision to halt the research programme.

The learning to this point represents an important intermediate step for Beacon. It advanced the research team's thinking beyond the intense case study approach taken in the two NOW Homes® and the nine Papakowhai renovated homes. But given NOW100's truncated timeline, this learning was transferred and has been further developed in the Home*Smart* Renovation Project.

The key learning can be summarised against the issues the team had to address to develop a robust framework.

- Scaling up from 2 homes to 100 (moving from case study approach to a statistically significant dataset which should allow commentary on issues such as climate zone)
- Collection of an integrated dataset on each house, i.e. performance data aligned with household data (characteristics and behaviours) and environmental conditions. This was a key learning from the NOW Home analysis: without contextual data it is very hard to explain patterns in the household performance datasets.
- Develop a comprehensive dataset that will inform three quite different research hypotheses. In short address house performance to HSS®, determine success of procedures as a mechanism to push out Beacon's NOW Home® knowledge and test a simple household monitoring system.

[2] ***Formerly NOW Home Procedures***

4.1.2 Cut down monitoring

The proposed monitoring system is outlined in Arnold et al, 2008. The higher level learning is captured here against the issues the team sought to address:

- cut-down monitoring of physical performance (NOW Homes method too complex, rely on high tech tools requiring expert management, and expensive so beyond Beacon's capacity to repeat in 100 homes)
- monitor variables that read to the HSS High Standard of Sustainability® (collect the minimum data to achieve the goal, distinguishes dwelling performance and appliance-based energy use)
- physical monitoring that is cost-effective and affordable for Beacon (determining the required intensity of measurement when taking into account the practicality of use, minimised transaction costs, easy capture and analysis of data, enables remote collection).
- Physical monitoring that is 'simple' (able to be used by a wide variety of end-users to support the market transformation aims, e.g. home owner can see and share information about their home's performance, Beacon was also 'silently' testing to see if there was a monitoring 'widget' in the market with this work)

4.1.3 Design of homes using procedures

Central to the design component of the procedures was the "Home*Smart* Home Requirements and Best Practice Guide" which specified the design requirements and features for future Home*Smart* Homes. During their development, the Requirements settled on a HERS Thermal 6 star minimum rating for the critical design consideration being solar orientation and passive temperature control. This change allowed greater design flexibility and allowed an alternative to the previous elemental (wall, ceiling, floor) R value thresholds. This was consistent with EECA's support for the HERS modelling. Similarly the hot water system was required to achieve a HERS Hot Water 6 star minimum rating and any fixed heating system was required to achieve a HERS Heating 6 star minimum rating.

It is clear from the modelling work conducted to date on unconstrained sites, that the threshold of HERS 6 stars for the thermal component in particular provides a reasonable amount of stretch but nevertheless is readily achievable. When the Thermal and Hot Water component of the Waitakere NOW Home®, at its New Lynn location, were modelled using HERS, the home received a HERS Thermal 8 Star rating and HERS Hot Water 7 Star rating. Modelling also provided insight to some practical and applied systems based research.

There was a distinct preference from those development partners who were familiar with the HERS scheme to take up the HERS approach; however, others who were not actively engaged with the HERS preferred the simplicity of the "rule of thumb" approach. Consequently both methods were retained in the Home*Smart* Home Requirements and Best Practice Guide.

The following two tables summarise the Home*Smart* Home Specification and resultant designs for NZHF home (Table 2) and Stonewood Homes (Table 3).

Table 2: Comparison Between HomeSmart Home Specification and the HZHF HomeSmart Home House

HomeSmart Home Specification	NZHF HomeSmart Home House	Variation in Specification
Thermal Envelope – 6 Star HERS	Thermal Envelope – 7 Star HERS Insulation R2.6 in walls, R 4.6 (inserts + blanket) in ceiling Rib raft floor with edge insulation Double glazing PVC framed	Meets HERS Rating but not checklist in relation to floor– HERS does not differentiate between Rib Raft floors and solid concrete floors, but Beacon promotes use of insulated solid concrete floors
Hot water System – 6 Star HERS OR Solar Hot Water OR Hot Water Heat Pump	Rheem Hot water heat pump	No Variation – but note Rheem is the worst performer in recent Consumer tests of hot water heat pumps
Lighting – natural, energy efficient, no thermal compromise	LED Lighting throughout except halogens in kitchen, no inset lights in thermal envelope, good natural light in each room	No Variation
Fixed Heating – 6 Star HERS. Designed for home to meet HSS Temperature Benchmarks	HERS modelling indicates should be able to meet HSS Temperature Benchmarks with less than 10 heating days/year Small electric heater inset into living room wall (not HERS rated).	Inefficient heating system installed.
Appliances 4 Star Energy Efficiency	4 Star Washing Machine, 3.5 Star Dishwasher, Fridge/freezer 4 Star	Unable to source 4 Star Dishwasher within budget
Outdoor clothesline, any dryer vented outside	Clothesline outside. No dryer provided as yet but no provision for venting – would sit on outside wall though.	No laundry ventilation

HomeSmart Home Specification	NZHF HomeSmart Home House	Variation in Specification
Maximum Dwelling Size ▪ 165m^2 for 2 bedroom ▪ 180m^2 for 3 bedroom ▪ 200m^2 for 4 bedroom ▪ 222m^2 for 5 bedroom home.	160.5m^2 – 3 bedroom home	No Variation
No Presence of Mould Rating" is achieved using the ALF 3.2 ventilation section for all areas (i.e. kitchen, bathroom, ensuite, bedroom, living space).	All wet areas mechanically ventilated except for toilet room. Opening windows in all living spaces and bedrooms	ALF 3.2 testing not available so not undertaken.
All wet area rooms with openable windows	Openable windows in bathroom, kitchen and toilet room. No windows or other ventilation in laundry located in garage.	No windows or other ventilation in laundry
Low toxicity products & materials – VOC low	Some attempts made in specification but generally poor implementation	Wattyl "eco" paints used (not Environmental Choice certified), wool carpet. Vinyl was used in wet areas. Poor understanding of this issue
Environmental Choice certified materials	Some attempts made in specification but generally poor implementation	Didn't comply. Poor understanding of this issue. Plans included the following : Linoleum in wet areas (Vinyl was used instead). Enviro friendly paint Wattyl "eco" paints used instead Recycled plastic carpet (Wool carpet used instead)
No comfort cooling system	Solar passive ventilation system (may be a HomeTech Solar Star but information unable to be obtained from NZHF)	No Variation
3 star WELS rated shower, taps & toilet	4 Star Toilet, 3 Star Shower, 3 Star Taps	No Variation
Water meter	Water meter	No Variation
4 star WELS rated washing machine	4 Star WELS Washing Machine	No Variation
3 star WELS rated dishwasher	4 Star WELS Dishwasher	No Variation

HomeSmart Home Specification	NZHF HomeSmart Home House	Variation in Specification
Alternative water source washing machine, toilets and garden	4500 litre rainwater tank for garden use EcoPlus Greywater system to supply toilet	Alternative water source not supplying washing machine although location means could be very easy to retrofit.
A maximum of 2.6 tonnes per house or 16kg/m^2 of construction waste	Construction waste managed as part of wider 9 home construction – WCC monitoring indicates specification met for the 9 houses	Individual house waste not quantified as part of a wider development of 9 homes – which meet the specification as a group.
Waste Management Plan in accordance with REBRI	Significant waste reduction measures were made in practice and WCC audit identified construction waste was less than produced in Waitakere NOW Home.	Not known
Space in kitchen for organic waste – 5l	Two under-sink bins provided. Could be used for compost or recycling.	No variation
Space for recycling bins -20l	Sufficient space but no bins provided	No variation
Space for compost	Sufficient space but no bins provided	No variation.
Green Home Scheme 70 points or more	Not calculated	Not considered.
Consistency with NSF for site	Not calculated	Not considered.
House Manual provided	Prepared by Beacon and provided to Homeowner.	Not able to include all information required as unable to obtain info from NZHF.

Table 3: Comparison Between Stonewood Waimakariri District Council Houses and HomeSmart Home Specification

HomeSmart Home Specification	Stonewood House 1 23 Maple Place (Lot 36 "EcoSure" House)	Stonewood House 2 9 Maple Place (lot 49 "EnerGWall" House)	Stonewood House 3 (lot 261 "Control"House)
Thermal Envelope – 6 Star HERS	Ribraft floor CA rated inset lights used throughout Maximum insulation	Ribraft floor CA rated inset lights used throughout R 2.4 wall insulation	Ribraft Floor CA rated inset lights used throughout R 2.4 wall insulation

HomeSmart Home Specification	Stonewood House 1 23 Maple Place (Lot 36 "EcoSure" House)	Stonewood House 2 9 Maple Place (lot 49 "EnerGWall" House)	Stonewood House 3 (lot 261 "Control"House)
	specified but actual R value not known by project team. Double glazing. HERS 4.5 Star	R 3.2 ceiling insulation Double glazing Firth EnerGWall HERS 6 Star	R 3.2 ceiling insulation Double glazing
Hot water System – 6 Star HERS OR Solar Hot Water OR Hot Water Heat Pump	Rheem 250 litre high pressure electric hot water cylinder	Rheem 250 litre high pressure electric hot water cylinder	Rheem 250 litre high pressure electric hot water cylinder
Lighting – natural, energy efficient, no thermal compromise			
Fixed Heating – 6 Star HERS. Designed for home to meet HSS Temperature Benchmarks	Heat Pump – no HERS Assessment of heating system	Heat Pump – no HERS Assessment of heating system	Heat Pump – no HERS Assessment of heating system
Appliances 4 Star Energy Efficiency	Not known	Not known	Not known
Outdoor clothesline, any dryer vented outside	Space for dryer in garage next to washing machine. No venting provided. Not known if clothesline provided.	Space for dryer in garage next to washing machine. No venting provided. Not known if clothesline provided.	Space for dryer in garage next to washing machine. No venting provided. Not known if clothesline provided.
Maximum Dwelling Size ▪ 165m^2 for 2 bedroom ▪ 180m^2 for 3 bedroom ▪ 200m^2 for 4 bedroom ▪ 222m^2 for 5 bedroom home.	142.01 m^2 for 3 bedroom house	142.01 m^2 for 3 bedroom house	142.01 m^2 for 3 bedroom house
No Presence of Mould Rating" is achieved using the ALF 3.2 ventilation section for all areas (i.e. kitchen, bathroom, ensuite, bedroom, living space).	ALF 3.2 not tested Bathroom extract ventilation, kitchen rangehood present.	ALF 3.2 not tested Bathroom extract ventilation, kitchen rangehood present.	ALF 3.2 not tested Bathroom extract ventilation, kitchen rangehood present.
All wet area rooms with openable windows	Openable window in bathroom and living areas. Laundry in garage with external door, no window.	Openable window in bathroom and living areas. Laundry in garage with external door, no window.	Openable window in bathroom and living areas. Laundry in garage with external door, no window.
Low toxicity products &	Environmental Choice	Environmental	Environmental Choice

HomeSmart Home Specification	Stonewood House 1 23 Maple Place (Lot 36 "EcoSure" House)	Stonewood House 2 9 Maple Place (lot 49 "EnerGWall" House)	Stonewood House 3 (lot 261 "Control"House)
materials – VOC low	certified finishes and paints used.	Choice certified finishes and paints used.	certified finishes and paints used.
Environmental Choice certified materials	Unknown	Unknown	Unknown
No comfort cooling system	Heat pump located in living area – able to be used for summer cooling.	Heat pump located in living area – able to be used for summer cooling.	Heat pump located in living area – able to be used for summer cooling.
3 star WELS rated shower, taps & toilet	Unknown.	Unknown	Unknown
Water meter	None	None	None
4 star WELS rated washing machine	Unknown	Unknown	Unknown
3 star WELS rated dishwasher	Unknown	Unknown	Unknown
Alternative water source washing machine, toilets and garden	Not present	Not present	Not present
A maximum of 2.6 tonnes per house or 16kg/m^2 of construction waste	Unknown	Unknown	Unknown
Waste Management Plan in accordance with REBRI	Not undertaken	Not undertaken	Not undertaken
Space in kitchen for organic waste – 5l	Unknown	Unknown	Unknown
Space for recycling bins -20l	Sufficient space but no bins provided	Sufficient space but no bins provided	Sufficient space but no bins provided
Space for compost	Sufficient space but no bins provided	Sufficient space but no bins provided	Sufficient space but no bins provided
Green Home Scheme 70 points or more	Not calculated	Not calculated	Not calculated
Consistency with NSF for site	Not calculated	Not calculated	Not calculated
House Manual provided	Standard Stonewood Homes Manual	Standard Stonewood Homes Manual	Standard Stonewood Homes Manual

4.2 Partnership Development

4.2.1 Intent

Whilst the procedures were being refined, a series of meetings were held with the aim of securing partnerships with a number of leading housing companies to trial the draft procedures.

4.2.2 Overview of progress with each partner

The following companies were approached a brief analysis indicates the degree of engagement Beacon has had with each company. A brief summary of the interaction is provided below.

High degree of engagement	Moderate engagement	Low level engagement
NZ Housing Foundation	McConnell Property	Fletcher Residential
Stonewood Homes	GJ Gardner homes	Stratum Management
		Generation Developments
		David Reid Homes

4.2.2.1 NZ Housing Foundation- www.housingfoundation.co.nz

The NZ Housing Foundation (NZHF) is a not-for-profit trust involved in the development of affordable housing for assisted home ownership. Their model sees them purchase and undertake the land development, house design and construction of subdivisions and then provide affordable housing on an equity sharing basis.

Beacon had a past history of involvement and providing assistance to the NZHF and the neighbourhood sustainability and subdivision design components of their 70 house residential subdivision off West Coast Road in Waitakere City as well as in the design of a smaller subdivision in Auckland City. Given this history of partnership, NZHF were receptive to engagement with Beacon over the NOW100 project on their West Coast Road site.

When it came to the house designs, NZHF Project Manager, Terry Foster, was seeking advice and ideas from a number of sources including Beacon in the planning for a high spec ECO - Home. Right House also provided input; however, as matters progressed NZHF elected to work more closely with Beacon. On 9 September 2008, they entered into a Memorandum of Understanding.

After a series of meetings, Beacon commissioned HERS Thermal modelling work on their type 4a design. NZHF accepted the suggestions and elected to construct an HERS Thermal 8 star Home*Smart* Home. Not all elements of the Home*Smart* Home Specifications were, however, adopted into the final design.

Table 2 provides a summary of the Variance between the final design and the Home*Smart* Home specifications. In addition, because the home is being built as one of a group of homes, the common construction approach means that some aspects of the Procedures were not practical to include. Some of the changes have however been beneficial –for example construction waste on the site is substantially lower than the specification in the Home*Smart* Home Procedures due to the ability for offcuts and other potential construction wastes to be used in one of the adjacent homes.

Building consent was lodged in late November 2008, with approval being received on 24 February 2009. Construction commenced in April 2009. The dwelling was completed and occupied in September 2009.

(Type 4a design – NZHF)

Expectation on Beacon: To monitor house performance for 12 months to capture temperature/ humidity and electricity / water consumption. This house has been fitted with a photovoltaic system. It is proposed the Energy Intellect meter owned by Beacon be installed in this house, with the photovoltaic and hot water heat pump performance also monitored.

NZHF are also planning an integrated housing project for Hornby, Christchurch, which could provide learning opportunity for Beacon with higher density attached house typologies.

4.2.2.2 Stonewood Homes www.stonewood.co.nz

Stonewood Homes generally operate as a "Group Home" contract builder – where homeowners engage Stonewood to build a home for them on a site of the homeowner's choice. However they have also diversified outside of this model and been involved in at least one land development with some house + land packages being offered for sale. As a result of the downturn of the housing market they have further diversified their business model, taking on major renovations and building social housing for councils.

Stonewood Homes had developed a higher spec Eco-sure option for their homes range. This incorporated many aspects found in the Home*Smart* Home specifications and in particular offered energy saving options including higher levels of insulation, double glazing and solar hot water heaters.

After initially considering the Home*Smart* Home specification for the larger more costly homes, it was consideration more logical to focus on their smaller affordable range of houses. Initial HERS thermal modelling, commissioned by Beacon, was conducted on their Merivale range in August 2008. The standard house rated 4.5 stars and modelling suggested that the interventions required to bring the house to a HERS Thermal 6 stars rating were very straight forward.

Tony Anderson's (Stonewood Sales Director) attendance at the Beacon's Christchurch seminar catalysed his interest in working with Beacon as he was looking for a way to drive greater uptake of their Eco-Sure house type.

A 7 home affordable development in Rangiora by the Waimakariri District Council presented an opportunity to test a number of interventions across houses with almost identical in design and orientation. The houses are owned by the District Council and are rented. Stonewood received a final unconditional approval to progress with this development on 12 March 2009. Construction commenced in mid April 2009. Firth agreed to participate in the project by trialling a passive high mass internal wall that when modelled contributed a HERS 1 star improvement in the house's thermal performance. The houses were completed in September 2009 and tenanted from October 2009.

Several points need to be noted in relation to why Stonewood did not proceed with the Home*Smart* Home specification. The level of commitment was quite low – the project only reaching this stage through considerable effort by Beacon's RTL and Tony Anderson's commitment. Firth's contribution was helpful – both in terms of the wall and the floor. Beacon's RTL attempts to get additional funding via EECA's innovation fund and via the local council to introduce solar to the site were unsuccessful. Similarly the Beacon team were unable to convince either the builder or the Council to value water.

Table 3 provides a summary of the variance between the designs of the 3 "most sustainable" homes and the Home*Smart* Home specifications.

Expectation on Beacon: to monitor temp/humidity and power usage on 3 houses.

4.2.2.3 McConnell Property www.mcconnellproperty.co.nz

McConnell Property is a development company involved in residential and commercial developments. Their model is to put house and land packages together and contract builders to build. So they develop the land and partner with builders to sell homes on spec.

McConnell have been involved in the testing of Beacon's Neighbourhood Tool on their Addison development in Papakura and the success and usefulness of this created a good level of engagement. McConnell in a deal with Housing New Zealand were setting up a 500 home development at McLennan, South Auckland. This was to be a combination of HNZC houses (200) and private homes (300).

Mark Fraser - Development Manager for McLennan was seeking to promote and push for a higher level of sustainability for this development. A provisional house specification was developed in 2007 with input from Lois Easton and Verney Ryan and this was released to builders in December.

Mark expressed a desire to influence builders to build a number of Home*Smart* Homes to be built within the development that could provide a data reference for different house types and orientations. In order for the development to get off the ground, a minimum number of sections needed to be pre-sold by McConnell. In April 2008 McConnell announced a decision to delay the civil construction start of the McLennan project in response to a general downturn in residential construction.

Expectation on Beacon: none

4.2.2.4 GJ Gardner Homes www.gjgardner.co.nz

GJ Gardner is like Stonewood Homes, a Group Home contract builder, whereby consumers contract the company to build a home on the consumer's site. GJ Gardner's South West Auckland franchise were involved in building the Waitakere NOW Home®, and Bob Greenbury was the key contact.

Bob Greenbury provided valuable input earlier to the Home*Smart* Home® process through his experience of building the Waitakere NOW Home®.

In Auckland, Bob suggested the opportunity for Beacon to link into the Housing New Zealand Corporation (HNZC) building programme in the city. GJ Gardner has been involved in building a number of homes for HNZC, and felt that the "higher spec" required by a Home*Smart* Home might fit well with HNZC as a home buyer. He indicated 3 types of development activity.

1) Redevelopment of existing land, subdividing existing lots.
2) Major project 12 or more sections where the houses are designed by HNZC designers or contracted designers - builder selected on a tender basis.
3) Design and Build – one-off projects where HNZC call for a proposal to build on a HNZC section

Bob was keen to reinforce the concept of lifetime cost as opposed to the initial capital cost with HNZC. Initial discussions centred on a potential subdivision of a HNZC property in Mt Roskill. At the time indications were that HNZC wished to avoid the additional cost of double glazing. HERS Thermal modelling was contemplated to determine whether double glazing could be avoided while still meeting the HERS Thermal 6 Star rating; however, this did not progress.

Expectation on Beacon: none

4.2.2.5 Fletcher Residential www.fb.co.nz

Fletcher Residential is a developer / builder who develop at subdivision scale – building for sale rather than to contract.

David Halsey – GM Fletcher Residential - was very familiar with Beacon Pathway. Despite taking on board a number of well-presented arguments and opportunities for Fletcher Residential to showcase sustainable building innovation across the Fletcher Building group of companies, David remained unmoved. He indicated that Fletcher Residential was well tuned to the market and that they were delivering on customer expectations. David also cited that if and when consumers sought a higher level of sustainable features in their houses, Fletcher was capable of meeting those expectations very rapidly. Essentially David was comfortable with a fast follower strategy.

Expectation on Beacon: none (but would appreciate any assistance with achieving a closer relationship with HNZC)

4.2.2.6 Stratum Management www.stratum-mgt.co.nz

Stratum Management are a land and building developer in Wellington. They operate on the design and build model, however a minimum number of pre-sold homes are required for them to progress to the development stage.

Wellington City Council had expressed support for Beacon's Home*Smart* Homes initiative and this led to contact with Stratum Management. Whilst most of Stratum projects were high density multi-story apartments, the Altair development, being a moderate density project of attached apartments, showed promise. Stratum sought Beacon input /comment on an existing design for a series of north facing apartments. At the time Stratum were finding market conditions were becoming much more difficult. Prior to the tightening of the Building Code on insulation requirements, Stratum sought to accelerate consenting to beat the requirement for double glazing and thus save on cost. As any Beacon input would not result in changes the opportunity was abandoned.

Expectation on Beacon: none

4.2.2.7 Generation Developments www.generation.co.nz

Generation Developments are a group home builder, predominantly located in the Bay of Plenty. They have been well known as members of the Sustainable Business Network for their focus on reducing construction waste, and have also engaged in the Lifetime Design initiative.

When approached, Kevin Atkinson, CEO, expressed a strong interest and requested a copy of the procedures. It was indicated that as these were proprietary to Beacon, they would only be available to participating companies. Kevin indicated at the time that Generation were preoccupied with their Lifetime Design initiative would not be in a position to commit resources to NOW100 until this was under control.

Expectation on Beacon: none

4.2.2.8 David Reid Homes

David Reid Homes are a group home company aimed at the upper end of the housing market – as a result homes were significantly larger than Beacon's target market. Beacon met with the Kapiti Coast franchisee to scope the level of interest in involvement in the NOW100 project. The feedback received was that while the franchisee would be interested in gaining access to the Procedures and Specification, their primary interest was to "cherry pick" and use as he saw fit in particular instances.

Expectation on Beacon: none

4.2.2.9 Right House

Beacon met with Right House on several occasions exploring where there were opportunities to work together. Right House was approached as it is another organisation offering services to the building industry. The relationship did not progress but the engagement clarified the importance of separating knowledge provider role (Beacon) from solution providers (Right House) and the value of Beacon maintaining its credibility and independence.

4.2.3 Conclusions

A variety of elements influenced the "success" of Beacon's engagement with this set of eight volume builders. This conclusion has been developed with benefit of hindsight and with the sole purpose to inform future Beacon engagement with partners, any future research in new homes space.

Management of Intellectual Property - through NOW100 Beacon was determining the best uptake pathway for its knowledge, including the potential that tested HomeSmart Home Procedures would be of value to shareholders. As a result, early engagement with partners involved memoranda of understanding and more formal legal agreement to protect Beacon IP. Partners were generally unwilling to commit to such agreements and this may have been a significant barrier to closer engagement. In addition, partners were wary of "losing control" of their own intellectual property.

Another element was our partners' perspective of their place in the market, in relation to perceived value of Beacon engagement. The eight volume builders reviewed here all had different aims and objectives about "their place in the market", i.e. leader, follower or laggards. This guided their valuing of what Beacon would bring to their business.

NOW Home® brand. There was a general perception from the partners that the "NOW Home®" Brand had little currency in the housing market. Initially there were some suggestions from partners that Beacon re-brand the NOW Homes – and hence, after some time the Home*Smart* Home brand was developed. However even if the housing market had not collapsed in the way it had, the perception of Beacon personnel is that without Beacon providing substantial marketing push, the partners would have been reluctant to promote a brand perceived as Beacon's ahead of their own. As discussed above the group home builders have carefully

positioned themselves and their house products in the market, on the basis that they are offering a unique proposition to the home buyer. A generic "NOW Home" or "Home*Smart* Home" brand which could be purchased via a number of house builders had limited marketing appeal to the group home builders.

Timing – Beacon's ambitious NOW100 programme unfortunately coincided with the downturn in the building and construction industry with the global recession. The impact on the market was significant with the volume of residential building work in New Zealand falling by 40% between September 2007 and September 2009[3] - the period NOW100 was operating.

Commitments - to meet established partnership agreements, Beacon has developed a limited monitoring and reporting project: Home*Smart* Homes. Therefore reporting on the single NZHF and Stonewood homes monitoring will fall to this new project.

4.3 Trialling Research in 'real world'

The enormous success of the Waitakere NOW Home® confirmed for Beacon the value of demonstration as a powerful tool to generate interest and simply show what can be achieved. The intense monitoring of that home, along with the Rotorua NOW Home® and renovation projects (Papakowhai and Home*Smart* Renovations) have provided Beacon with strong proof statements about better performing homes.

NOW100 was an ambitious extension - aiming to prompt a market transformation while maintaining the requirement for the project to contribute to Beacon's knowledge base with quality research. The project also tested the market's response to Beacon's Procedures, as a potentially valuable research output. Therefore, project required Beacon to develop robust process around management of IP and risk. This in-house learning has been built upon in the development and implementation of the Home*Smart* Renovation project.

Legal advice cautioned against commercialising research knowledge in what was summarised as a "litigious market still reeling from leaky homes". As NOW100 was not selling its knowledge (i.e. Home*Smart* Home protocols including specifications for homes and 'advice') Beacon was not entering relationships that 'activated' the Fair Trading Act. Should Beacon begin to charge for products or advice, rather than simply "putting into the public domain and letting consumers drive uptake, the risk profile would change significantly and require specific legal input.

Beacon was also cautioned strongly to maintain independence from individual products. In providing advice via best practice guides etc. Beacon's "solutions" must not lead consumers to

[3] ***Statistics New Zealand. Retrieved from www.stats.govt.nz/browse_for_stats/industry_sectors/construction/valueofbuildingwork_mrsep09qtr.aspx***

one provider. This would be deemed anti-competition by the Commerce Commission. For example if Beacon advice led to one of our shareholders it would expose them to risk for anti-competitive behaviour. Legal advice also cautioned against "exclusivity" – particularly in relation to partnering with Beacon's shareholders. Important to ensure clear criteria are established for participation and explicitly note in risk management plan.

4.4 Strategic review

Beacon focussed on volume builders, the uptake pathway identified and documented as far back as the Homes Strategy. The arrival of a recession and the resultant pulling back from new build activity impacted negatively on Beacon's project: driving the decision to withdraw the pilot. Reflection amongst the team at the conclusion of NOW100 added these points to our learning from the experience:

- The project focused focussed on **builder /developer recruitment as opposed to home owner recruitment**. Therefore Beacon was reliant on the builder/developer's knowledge and experience of their customer base and on them recruiting homebuyers to the project. In effect this was a product push approach with industry. Potentially greater traction could have been made if the home owner was directly engaged and their authority was used to "pull" the procedures through their service providers, i.e. designers and builders. Using the indirect approach via builders' sales agents was not tested due to concerns over potential risk.
- **Knowledge v Solutions Provider**: Beacon has developed an enviable position as a knowledge provider, an approach that contrasted with solution-oriented companies such as Right House and Future Proof Homes. This was particularly evident when working with the NZ Housing Foundation. The Home*Smart* Home Procedures, whether used to provide additional support to new homeowners via Beacon's excellent websites or to lobby for a single rating tool, remain a very useful asset for Beacon to influence the residential construction sector.
- Demonstration through partnership requires significant Beacon resource (time and travel): trusting partnerships take time to develop; partners have different constraints on their activities which are beyond Beacon's remit to influence.
- The experience informed the development of the Home*Smart* Renovation project, which has been successful in establishing a pilot in the current economic climate. The legal advice improved Beacon's process around identification, assessment and management of risk.
- The project, while explicitly not specifying individual products, highlighted an enormous gap in the New Zealand built environment – no credible product verification process.

4.5 Future opportunities

The experience of NOW100 together with learning from other parts of the portfolio (e.g. housing typologies and neighbourhoods) indicate the following points may be opportunities Beacon might follow up in any second phase funding.

- Medium density homes;
- Different thermal envelope and heating solutions to achieve the HSS® - and better quantifying the difference between modelled and actual thermal performance
- Expansion of the HSS® to explicitly include affordability and flexibility.

5 References

Arnold, P., Easton, L., Popping, A. and Saville-Smith, K., (2008). NOW100 Project Monitoring and Evaluation. Restricted report HN2800/3 for Beacon Pathway Limited.

Easton L. and Cowan, V. (2008) Homes Research Strategy 2007-2010. Beacon Pathway Limited.

Pollard, A. (2009). Using iButton temperature/humidity loggers in monitoring projects. BRANZ report EC1496.

6 Appendix One: Notes from testing of cut down monitoring

6.1 Energy

A trial conducted at 36 Koraha Street demonstrated that the remote electricity monitoring system from Energy Intellect, employing remote data access via the web, worked well. The meter is owned by Beacon and it is proposed to relocate this unit to the NZHF Home*Smart* Home on West Coast Road. The meter will be capable of logging data on 3 channels, namely:

- Phase A _ Total electricity
- Phase B – Hot Water (Rheem Heat pump system)
- Phase C – Photovoltaic output – Mitsubishi PV's supplied by EcoInnovation

The ongoing cost of data retrieval and web service would then be around $30/month ($10 of this fee is the cost of an account fee with a mobile network (i.e. Vodafone).

6.2 Temperature / Humidity

Internal temperature and humidity will be measured using the 'iButton' from Maxim in the United States. The iButton can measure and store 85 days worth of data at half-hourly intervals. It's this storage capacity which effectively sets the contact time for the whole monitoring programme.

In order to assess whether the house meets the performance criteria for temperature a minimum of two iButtons would be required per house; one in the living room, and one in the main bedroom. Placement would be key to avoid spurious heat sources and sunlight.

In order to save on travel costs I buttons can be couriered for down loading. Beacon have 5 i-buttons capable of logging temperature and humidity. 2 could be used on the NZHF with the remaining 3 able to be used in Rangiora.

The I buttons were sent to BRANZ for calibration with the result that the temperature performance is very good and the humidity is ok. (Pollard, 2009).

7 Appendix Two: A. Popping summary of technical input on HERS modelling of procedures

With the reliance on HERS as the determinant for thermal performance, it became necessary for Beacon to develop an increased understanding of the Accurate model, its capabilities and limitations.

Following consultation with BRANZ, contact was made with Ben Bell of Low Impact Design Limited, an ABSA accredited HERS assessor. In July he was engaged to provide HERS assessment services for Beacon. The following outlines the projects involving HERS modelling:

7.1 Waitakere NOW Home®

Typology: 3 bedroom single level house with single garage
Location: Auckland
As Beacon had considerable performance data on the Waitakere NOW Home®, it was logical to have an HERS assessment done. This work assisted in determining whether the provisional 6 star threshold for a Home*Smart* Home was achievable and reasonable. The modelling resulted in the Waitakere NOW Home® being awarded a very credible 8 Star rating and indicated a good correlation between modelled and actual performance.

The influence of location was also completed to provide an insight as to how the house would rate in various locations around New Zealand. The following table demonstrates that the Waitakere NOW Home® would perform well across New Zealand. Greymouth was the only location to model below 6 stars and it was suggested that this may be due to suboptimal performance from the passive design element arising from lower sunshine hours. This work supported setting the HERS threshold at 6 Stars.

Waitakere NOW Home® locations (assuming optimum orientation)

Location	Rating
Kaitaia	8
Auckland	8
Tauranga	7.0
Wellington	7
Nelson	7.5
Greymouth	5.5
Christchurch	6.5
Invercargill	6.5
Queenstown	6.5

7.2 NZ Housing Foundation

Typology (4 bedroom 2 storey house with double garage)
Location: Auckland

Modelling work was completed on NZHF type 4a design to determine the most cost effective interventions in raising the house's thermal performance. This work concluded that

7.2.1 Base rating: 4.5 stars

Rating at minimum building code:

- Un-insulated slab
- Walls R1.9
- Ceiling R2.9
- Windows Single glazed

The house cannot achieve a 6 stars HERS rating without either double-glazing or structural changes. Minimum code levels of insulation combined with double-glazing rate the house above 6 stars.

7.2.2 Minimum to achieve 6 stars without structural changes to plan

- Insulated slab 50mm EPS or Ribraft, 50mm EPS to the edge of slab
- Floor to Air R2.4
- External Walls R1.9
- Ceiling R2.9
- Windows Aluminium Frames IGU Clear/Clear
- (Garage external walls and ceiling un-insulated)

The house will achieve 6 stars using Aluminium single glazing if the lower entry is separated from the living and dining areas as shown on the drawings dated 11/08 and the following insulation levels are applied.

7.2.3 Minimum to achieve 6 stars with structural changes to plan as at 11/08

- Insulated slab 50mm EPS or Ribraft, 50mm EPS to edge of slab
- Floor to Air R2.4
- External Walls R2.2
- Ceiling R1.8 between joists, R2.4 blanket in opposite direction
- Windows Aluminium Frames clear single glazing or better
- (Garage external walls and ceiling un-insulated)

7.2.4 7 Stars Without structural changes to plan, Minimum code insulation

- Insulated slab 50mm EPS or Ribraft, 50mm EPS to the edge of slab
- Floor to Air R2.4
- External Walls R1.9
- Ceiling R2.9

- Windows PVC or Wooden frames IGU Clear/Clear
- (Garage external walls and ceiling un-insulated)

7.2.5 The house will rate at 7.5 stars with the following interventions

- Structural changes to plan as at 11/08
- Insulated slab 50mm EPS or Ribraft, 50mm to the edge of slab
- Floor to Air R2.4
- External Walls R2.6
- Ceiling R2.2 between joists, R2.4 blanket in opposite direction
- Windows PVC or Wooden frames IGU Clear/Clear Ground floor
- PVC or Wooden frames IGU Single Glazing First floor
- (Garage external walls and ceiling un-insulated)

7.2.6 The house will rate at over 8 stars with the following interventions

- Structural changes to plan as at 11/08
- Insulated slab 50mm EPS or Ribraft, 50mm to the edge of slab
- Floor to Air R2.4
- External Walls R2.6
- Ceiling R2.2 between joists, R2.4 blanket in opposite direction
- Windows PVC or Wooden frames - Argon filled Low E glass (WERS 38A)
- (Garage external walls and ceiling un-insulated)

The structural changes proposed were simply to separate the entry area from Dining Living Kitchen by installing cavity sliding doors.

NZHF elected to proceed with the series interventions aimed at achieving 8 Stars. The home will also include the following items:

Smart House Requirements

Water Saving	■ Coroma Smart Flush - Water efficient duel flush toilet. ■ Methven Satin Jet - Low flow shower head. ■ Aquatice Eco Smart Taps - Water efficient / aerated / restricted taps. ■ Eco Plus - Grey water recycling. ■ Rain collection water tank - 4500 ltr
Energy & Water Saving	■ Washing machine 4 star min (water & energy) ■ Dishwasher 3.5 star min (energy) 4 star min (water)

Energy Saving	■ Rheem Heat Pump - Hot water heating ■ Insulation R2.6 min in external walls / garage to dwelling / garage ceiling. ■ Insulation R2.2 between trusses in ceiling + R2.4 blanket in opposite direction. ■ Edge insulation 50mm EPS waterproofed - Rib Raft construction. ■ Double Glazing - PVC framed. ■ LED lighting throughout except for kitchen to have downlights. ■ Ecoinnovation solar energy - min production 2000 kWh pa + ■ Hometech solar passive ventilation system. ■ Fridge/Freezer - 4 star min rating.
Environmental	■ Carpet - recycled plastic. ■ Linoleum floor coverings in Bathrooms, Kitchen, Laundry & WC. ■ Enviro friendly paint. ■ Rain garden. ■ Air extraction for bathrooms & laundry.

7.3 Stonewood Homes Merivale Design

Typology: 3 bedroom single level house with double garage
Location: Christchurch
Design: The design was modelled with a view to determining the interventions required to bring the house to HERS 6 stars from a current 4.5 stars

The work concluded that Stonewood has 2 options; increase the levels of insulation, or put in higher specification windows. Both will achieve 6 stars. In tandem higher levels of insulation and high performance double glazing will bring the house to 7 stars.

Ceiling insulation as two layers: one in between the joists and one over, with R1.8 on the lower part and either 1.8 or 2.8 on the top layer.

R2.2 to external walls in the base version, R2.6 (Pink batts ultra) in the higher insulation version 25mm eps under the slab in the base version, 50 mm eps in the high insulation version. (both have edge insulation the same as the eps under the slab). Standard aluminium frame IGU to meet Code.

The interventions modelled demonstrated the relative ease in upgrading the home. Note that the interventions in tandem exceeds the 6.5 star rating had the Waitakere NOW Home® was built in Christchurch.

R4.6 to ceiling (1.8 + 2.8), R2.6 to walls, 50mm eps + 50 x 300 edge -from 4.5 to 6 stars
Code + Thermal broken Ali IGU clear - from 4.5 to 6 stars
Run 1 + pvc or wood IGU low E Argon - from 4.5 to 7 Stars

7.4 Systems Development

As Accurate models the building elements to arrive at an overall rating it was appropriate to investigate in more detail how the model responded to key passive design features such as high mass floors to achieve a higher level of thermal stability.

7.4.1 Insulated concrete slab

Beacon's NOW Homes® feature an insulated concrete slab as a pivotal passive solar design feature. In order to determine how Accurate rewarded such an intervention, a number of modelling exercises were conducted.

Stonewood Homes design Lot 36 was modelled with perimeter insulation and the conclusions were that:

- Accurate consistently rewards edge insulation to the slab of Lot 36 with a 3% reduction in heating load in CHCH and 2% in AKL over the range of interventions we have modelled thus far. This would only make a difference to the star rating if the house was sitting on the border of a starband.
- Or to put another way, removing the edge insulation in any of the scenarios we have modelled will result in an increase in the heating load of around 2 –3%.

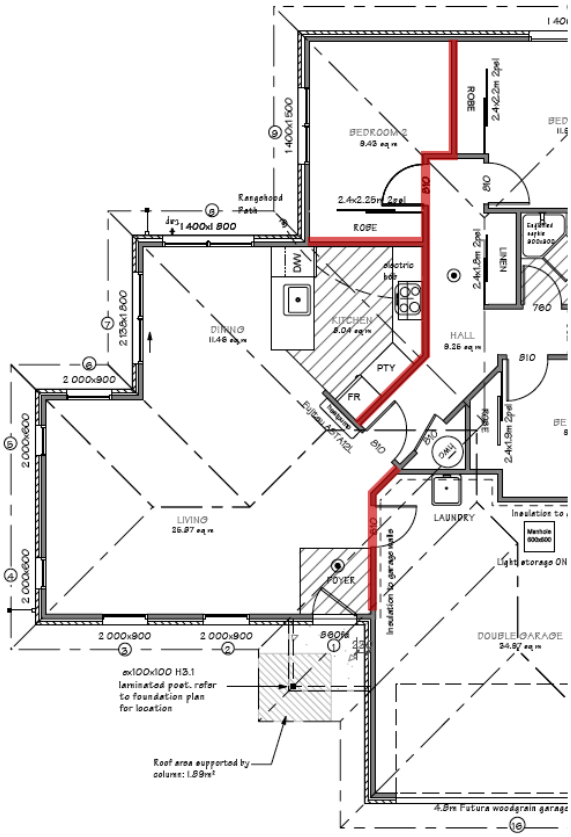
No doubt any modeling system is only as good as the algorithms and assumptions but HERS demonstrated an apparent lack of sensitivity in differentiating between slab types in the overall building rating. A physical trial with and without perimeter insulation on a RibRaft floor was proposed but was not ultimately supported by Firth.

7.4.2 High mass internal wall

Following a meeting in early October, Firth expressed an interest in becoming involved with Stonewood Homes and the Waimakariri project. They also looked to develop further understanding of HERS modelling. Although Firth could not see the value proposition for incorporating perimeter insulation, they were keen to evaluate whether high mass internal walls would provide some advantages in passive design.
Success would also serve to increase Firth's participation in the residential building sector.

EnerGWall™
Firth envisaged incorporation of high mass walls as an easier proposition for colder climates than a polished concrete of tiled floor. Occupier resistance to accepting hard floor surfaces was a factor in the performance of the Rotorua NOW Home® and there were strong indications that this is the case in the colder regions of NZ. Modelling conducted on lot 36 suggested the EnerGWall™ contributed raised the House HERS rating from 5.5 to 6.5 stars. Firth agreed to fund the EnerGWall™ intervention plus 3 Rib-rafts but ultimately did not accept the need to fund the additional costs of a Home*Smart* Home intervention of solar hot water and higher levels of insulation.

Sketch of the proposed EnerGWall™



The modelling by Ben Bell showed: The best results were as expected, found by changing the southern walls of the north facing rooms (bed 2 and the living/ kitchen and the wall adjoining the two). The returned values are around 14% energy saving (0.5 stars) if applied to the house at minimum code, and around 12% (still 8 stars) when applied in addition to maximum levels of insulation, and the highest performing window units. A lot better than I had expected. Application of the high mass internal walls to the entire house had no benefit at the base level, and dragged it down with higher levels of insulation. Increasing the window sizes of the north facing windows (W4,W5) by 100% in the Living area and 50% in Bedroom 2 (W9) gave a 2% saving in the base version and 1% in the higher insulation version.

7.4.3 Summary of modelling results

- Plain slab, WR1.8, CR2.5, Ali IGU (Standard Aluminium Frames, clear/clear IGU) = 5.5 stars
- STD +High mass 2 High mass walls applied to north facing interior walls of B2, DKL, Garage. Garage walls strapped and lined with 25mm EPK, 12mm air gap, gib board. = 6.5 stars
- Interestingly the same High Mass Wall intervention in Auckland would raise the performance from 6.5 Stars to 8 Stars.