Facing

Newsletter of Beacon Pathway June 2010

In this issue

Beacon comes to an end

At the end of June 2010, Beacon has completed its six year research contract with the Foundation for Research, Science and Technology. An end-of-term review by FRST has commented on the success of Beacon's research programme in terms of both research advances and driving change. You can read the executive summary from the FRST Review at: www.beaconpathway.co.nz/about-us

The end of the contract also brings to an end the formation of Beacon Pathway Ltd. We are proud of our achievements:

- Establishing a whole-of-house focus, with measurable key performance benchmarks.
- Monitoring homes as well as modelling, creating unique databases of evidence.
- Demonstrating best practice for new and existing homes to provide the evidence for government, industry, and consumers.
- Establishing a joint venture (Beacon, BRANZ, NZGBC) to develop a national Residential Rating Tool.

Thank you all

Beacon would not have been established without the commitment of its shareholders. Their vision, coming at a time when sustainability was still a poorly understood concept, was both aspirational and far-sighted.

We have also appreciated the help and participation of stakeholders from across the housing value chain. We thank you all for your input and enthusiasm.

The future

Beacon's shareholders are currently considering how best to build on this success in the future, and what vehicle will ensure the work begun by Beacon is continued toward the same goal. We will keep you informed of progress.

In the meantime our website will be staying live to enable continued access to Beacon's learnings.

The Home*Smart* Renovation project wraps up

Beacon's large scale, New Zealand-wide renovation project has been wrapped up and the final report is out.

The project's goal was to test what it takes to get consumers retrofitting to improve their homes' performance. Based on an In-Home Assessment, 430 participating homeowners were given renovation plans which would bring their homes to Beacon's HSS High Standard of Sustainability®.

While Beacon's earlier live research projects identified the best ways to make homes warmer, drier, healthier and cheaper to run, the Home*Smart* Renovation project focused more on whether homeowners, provided with independent advice on achieving an affordable and effective retrofit, will continue on to make the changes needed to bring homes to the HSS®.

Critical to the project were a series of homeowner surveys and interviews to find out what steps the homeowner has taken or is planning, based on the renovation plan. Additionally, participating homes were monitored for energy and water use, as well as indoor humidity and temperature, to see if the resulting renovations actually improved the home's performance.

What the data showed

Homeowners generally entered the project because they were keen to improve comfort and warmth. Given that, there were a **surprising number of modern homes** among the participants.

65% of homeowners put in or **upgraded their insulation** as a result of their renovation plan, showing that the insulation message has got through. However, only 18% of householders enquired about EECA Warm Up New Zealand subsidies, and fewer still (13%) took advantage of them.

The importance of dealing with moisture sources is still poorly understood. Nearly half of the households (47.1%) reported mould or dampness problems; 57.6% homeowners reported musty smells, and 24.5% had leaks or dampness under their floors. Nevertheless, most **homeowners**, concerned about cold temperatures, **prioritised heating and insulation over simple extract ventilation and moisture control actions.** Only 6.7% acted on the recommendation to install a rangehood or kitchen extractor, and only 7.2% installed bathroom extractor fans

Homes had **high humidity all around the country** – not just in humid north! In fact there were eight Auckland houses which had no humidity issues, showing that it is possible to control humidity despite outdoor conditions. Additionally, humidity was high right throughout the house.

Water efficiency was not seen as a priority by participating homeowners. Few households took measures to reduce water use, even though they are often very easy to implement and cheap to install. Interestingly their **perception of water use was very inaccurate**. 71% of households thought they weren't high water users, yet only 45% of monitored households actually met Beacon's HSS® benchmark for water use. Perhaps not surprisingly, the most water-efficient households were in areas that were metered and directly charged for water use.

Homes were cold all over New Zealand, even in Auckland, although they are better heated in the South Island. **Bedrooms are chronically under-heated** - over a third of households indicated that they preferred not to heat their bedrooms – but only 5% actually had healthy bedroom temperatures of 16°C or over.

Time Period	Min Bedroom Temps	Average Bedroom Temps
7am-9am	7.98° C	13.18° C
9am-5pm	8.13° C	14.57° C
5-11pm	8.45° C	15.18° C
11pm-7am	8.24° C	14.43° C
24 hours	8.24° C	14.43° C

These householders were **lower electricity users** than other Beacon studies. Around half of the homes in the study met the HSS® benchmarks for energy. While that is good news for energy resources and power bills, the bad news is that this came **at the cost of health and comfort** – only 3.6% of monitored homes had temperatures in both the bedroom and living rooms which met World Health Organisation minimums.

Combining good insulation, efficient heating, and effective use of heating would not only bring greater comfort, it would enable the 50% of households with higher energy use to make considerable gains in energy efficiency also. However, in the South Island, any change to heat pumps from wood burners will increase electricity use.

Surprisingly, there was **very little use of CFLs** - 16.4% of dwellings have no CFLs while the majority of dwellings have ten or less CFLs. Yet only 16.7% of households were unable to replace incandescent bulbs with CFLs.

Main conclusions

While Home*Smart* participants still tended to over-estimate the condition and performance in their homes, they were more likely to recognise the performance problems of their dwellings than most New Zealanders.

The In-Home Assessment and the Home*Smart* Renovation Plan have generated a more realistic understanding of the condition of the householders' dwellings.

New Zealand householders are motivated to make their homes warmer and more comfortable, rather than by energy efficiency.

Participants spent relatively little on renovation given the condition of their homes and their stated performance outcomes.

As a result of the information provided to homeowners, most concentrated on improving thermal performance; fewer took up recommendations for managing internal moisture, water efficiency measures and solar hot water heating.

While the independent information provided by the project both stimulated and shaped renovations, many homeowners wanted further advice on which products and service providers to select.

Read the report at:

http://www.beaconpathway.co.nz/existing-homes/article/reports_and_presentations_existing_homes

Homeowner Manual

We are collating the advice pulled together for our Home*Smart* Renovation participants with what we've learned in all our new build and renovation projects to develop a Homeowner Manual. It provides advice on how to get the very best from your home.

As a homeowner, you have a lot of influence over how well your home performs. Partly this is because your behaviour and the things you do in your home, affects how much water and energy you use, and how damp or cold your home is inside. The good news is that these things are easy and generally inexpensive to change. For that reason, this Homeowner Manual includes top tips for using your home.

You also make choices which affect your home's performance. It can be difficult to decide what choices to make to get the best result for your home. The Homeowner Manual aims to give you the best information on renovating to improve performance.

The Homeowner Manual is being finalised and will be available at:

http://www.beaconpathway.co.nz/existing-homes/article/homeowner_manual_get_the_best_from_your_home

Forced air ventilation systems

A new study looks at how well these perform

Forced air ventilation systems are increasingly being promoted as the solution to house performance problems such as dampness and cold. However, very little research has been done to show what sort of houses, climates and situations they work in. Given the large investment required to install one of these systems, and the need to address cold and damp in New Zealand homes, Beacon commissioned a study to understand if these systems are providing a solution and, if so, under what conditions.

Ten homes with forced air ventilation systems in Christchurch and Wellington were selected as case studies. Eight of these houses were tested for airtightness using blower door testing, and all ten had their temperature and humidity levels monitored to establish how effectively the systems make use of "free heat" and the impact they have on humidity levels within the house.

Did the homes need ventilation?

The airtightness testing revealed that, rather than needing a mechanical system for ventilation, **nearly all the homes were draughty**. Draughty is defined as approximately 0.9 air changes per hour.

House	Age	Air changes / hour	Classification
A	1900's	0.88	Draughty
B	1930's	0.75	Draughty
C	1950's	1.10	Draughty
D	1950's	1.24	Draughty
E	1960's	0.52	Average
F	1930's	1.03	Draughty
G	1950's	1.27	Draughty
H	1950's	1.08	Draughty

As the case study homes were also part of the Home*Smart* Renovation project, their condition was assessed as part of the In-Home Assessment. This showed that the cold and dampness in the homes was not because of lack of ventilation but rather caused by:

- Lack of insulation
- Not enough heating
- Uncontrolled moisture sources (leaks, ground water, unvented wet areas, unflued gas heaters)

Measuring humidity

Rather than just using relative humidity which takes the percentage of moisture in the air, the researchers also used the humidity ratio – the ratio of the mass of water vapour in moist air to the mass of dry air. This makes a difference because warmer air will have a lower relative humidity than colder air; however, heating air does not add or remove moisture to the room so that the humidity ratio will be the same.

Did the systems improve dampness and temperature?

Using humidity ratio measurements, monitoring of the roof space air and the air delivered into the house shows that in winter during the day there is more moisture in the roof space than in the house. However, the system is turned on by a thermostat based on roof space temperature which will increase with solar heating over the day. This means that the **increased operation of the ventilation system during the day actually increases the moisture in the house during the day**.

Equally, operating the ventilation system at night takes drier air from the roof space, thereby reducing the level of moisture in the house. However the **roof space temperatures are colder at night and will cool down the house as well.**

The control systems in forced air ventilation systems **are controlled by temperature** and not by the humidity ratio or moisture content of the air. These sensors do not provide the necessary information to the system to reliably reduce the moisture levels in the house.

This report will be available at:

www.beaconpathway.co.nz/further-research/article/reports_and_presentations_indoor_environment_quality

Our recommendations

When it comes to moisture removal, the actions we do recommend (getting rid of moisture sources by extractor fans, vapour barriers under the house, drying clothes outside and making sure dryers are vented to the outside, getting rid of unflued gas heaters, insulating, and regularly airing your house) are cost-effective and proven methods for reducing moisture in all houses. These actions should be undertaken **before** considering a whole house ventilation system.

Heat or energy exchange ventilation systems pre-warm the incoming air from the heat or energy in the outgoing air. These systems are most effective in very airtight, new, well-heated homes in very cold parts of the country. Most existing homes are not airtight enough, even if they have full wall insulation and window replacement.

If you are thinking of installing one of these systems, **address moisture sources and insulation levels in the home first**. Get your house tested for draughts (often called a blower door test) and we recommend you only consider one of these systems if your house is quite airtight.

Unflued gas heater update

Beacon has developed a fact bank to draw together all the international and national knowledge about unflued gas heaters. This document is available at:

http://www.beaconpathway.co.nz/further-research/article/reports_and_presentations_indoor_environment_quality

We believe that New Zealand homes would be better off without unflued gas heaters because:

- They emit nitrogen dioxide, carbon dioxide, carbon monoxide and particulates which cause health and respiratory problems.
- They are a greater fire risk than electric heaters.
- They produce 0.5 L of water per hour, making homes damper.
- Running a dehumidifier to get rid of the moisture is common and creates a hidden cost to using unflued gas.
- They are a costly way to heat.

The IEQ benchmarks in Beacon's HSS High Standard of Sustainability® are concerned with keeping homes warm, dry and free of pollution sources. Removing unflued gas heating is a core intervention for New Zealand homes to meet the HSS®.

Beacon presented this fact bank to the MED review of unflued gas heaters and has talked with Trade Me, The Warehouse, Consumer NZ and PlaceMakers. PlaceMakers already do not sell cabinet gas heaters because of the fire risk. Beacon has also engaged with organisations who work in the community helping people make good choices in their homes, such as energy trusts, Home Energy Advice Centres, and Eco-Design Advisors. Based on their experience, we have divided consumers with unflued gas heaters into three groups.

1. Households who, with a bit of information, would stop using the heaters.

2. Households who, with a bit more support and good information, would stop using the heaters.

3. Households who are struggling on multiple fronts and need intensive support on budgeting, engagement with government services.

For this third group of households, unflued gas heaters are really the least of their problems: many know the heaters are bad but have no choice or capacity to stop using them. Community groups are best placed to support these vulnerable households.

Beacon is working with these organisations to continue to develop the value case for change and identify how to appropriately help all house-holds stop using unflued gas heaters.

Final results from the Rotorua NOW Home®

The Rotorua NOW Home® was Beacon's second new-build research house. It followed the Waitakere NOW Home®, which established that it is possible to build and design a home that performs well using basic principles and materials available today.

The Rotorua NOW Home® took the next step, applying principles from the Waitakere experience to a cooler climate zone.

The house was built as part of Housing New Zealand's Community Renewal programme in the existing Rotorua suburb of Fordlands. While the house was designed with the advice of Beacon's researchers, it still had to conform to the requirements of Housing New Zealand.

As with Beacon's first live research project, the Rotorua NOW Home® was extensively monitored while its tenants went about their daily lives, reflecting normal household use. Data was collected, over a year, on energy and water use, temperature, indoor air quality, rainwater collection, humidity and moisture levels.

The results highlighted the extent to which principles developed in the Waitakere NOW Home® can be adapted or compromised.

Layout and design

Part of the brief was to design a state house that didn't look like a state house – the result was an aesthetic 'butterfly' roof.

The design included a single central gutter, which was an efficient rainwater collector. Unfortunately, the complex roof structure meant it was prone to leaks and internal gutters made it hard to diagnose the problem.

The complex layout and the limited ceiling cavity also meant it was impossible to install a heat transfer system to effectively distribute warmth from the 10kW pellet burner. This, coupled with the bedrooms' distance from the heat source, meant the bedrooms were colder than Beacon recommends for comfort and health.

This highlighted the importance of combining a centrally-located heat source with a heat transfer or ducted system to ensure bedrooms are well heated.

Clearly, complex design features aren't always compatible with sustainable building. Indeed, part of the Waitakere NOW Home's success was its simplicity.

Dampness and condensation

Dampness and condensation weren't problems in the Rotorua NOW Home®, thanks largely to a combination of active and passive ventilation: cedar louvres helped to lower relative humidity levels in living areas, and mechanical extract ventilation removed moisture from wet areas.

And, unsurprisingly, the double-glazed windows didn't attract any condensation.

Indoor temperatures

The indoor environment is a key factor in the performance of any house. The temperatures within a space are a result of the outdoor conditions, the effectiveness of the home's thermal design, and how the space conditioning (heating and cooling) systems are used.

In the case of the Rotorua NOW Home®, several issues combined to prevent the house from performing as well, thermally, as anticipated.

The concrete slab floor of the home was well insulated both underneath and around the perimeter with polystyrene. However, the finish of the exposed concrete floor was poor and the occupants covered most of it with rugs and mats, limiting its ability to store warmth from the sun.

Hindsight suggests a thermal wall, which gets direct sunlight on it in winter, with a wood or pellet burner installed next to it, would have been more appropriate in this instance.

And while the insulation levels in the Rotorua NOW Home® were much higher than Building Code requirements at the time of construction, they were less than the levels achieved in the Waitakere NOW Home®. What's more, while the plans specified R5.0 fibreglass insulation in the ceiling, R4.0 was incorrectly delivered to site and installed.

These factors, combined with Rotorua's cool climate, meant the house struggled to achieve Beacon's recommended indoor temperatures without a lot more heating.

Water system

The average daily water use per person was relatively high – 200L compared with 189L in Waitakere. That said, Rotorua's year-round rainfall meant a smaller tank (4000L) supplied 72% of household needs.

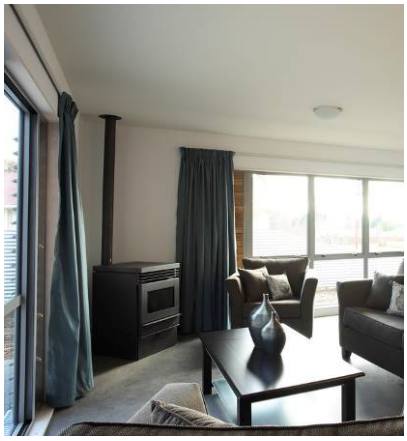
A controller was effective at optimising the water sources – rainwater versus mains supplies. The downside was that it had quite a high power demand, consuming 5% of the total electricity.

Solar water heater

The results of this system were disappointing, largely due to poor installation, under-sizing and poor performance.

The solar panel was not well oriented to the winter sun, and was too small for a family of four.

In addition, the technology simply wasn't suited to the climate. The outdoor hot water cylinder needed more insulation, resulting in significant heat loss. An internal hot water cylinder would be more appropriate for a colder climate – be it a solar or a heat pump system.



Valuing water

A new report by Beacon Pathway (*Water Demand Management: An economic framework to value with case study application*) shows that both councils and ratepayers stand to benefit financially, and in a wide number of other ways, from water demand management.

In simple terms, water demand management is about getting the most from the water we have. It is not about having to lay new pipes and build new sewers, it's about ensuring water is conserved and used efficiently – making better use of existing systems,

Beacon's report offers hope to all territorial authorities, particularly those which regularly struggle with drought conditions.

Beacon Pathway recently completed an analysis of Tauranga City Council's water demand management initiatives. As a result of implementing this approach, Beacon estimates that Tauranga City has **deferred investment in a new water supply project plant by approximately 10 years.**

Over a decade ago Tauranga City Council, faced with an increasing population, started investigating options for a new water source to supplement the existing supply. At the same time, however, mindful of the huge cost to ratepayers of any new major infrastructure, it explored ways to reduce water demand.

As a result, Tauranga City Council began work to introduce water metering and pricing at the same time as embarking on an active education programme to build community awareness of their water use and help them to appreciate it as a valuable resource.

The result of Tauranga's moves – a combination of education initiatives, metering and user-charging – was to not only defer the need for a new water source, but **save the ratepayers $53 million**.

This case study shows the enormous benefits for councils, businesses and the community, of adopting water efficiency measures.

Read the report at:

www.beaconpathway.co.nz/further-research/article/reports_and_presentations_water

New on the website

Neighbourhood Sustainability Framework and Assessment Kit

Beacon's neighbourhood research has culminated in a Kit bringing together the Neighbourhood Sustainability Framework, and the tools used to apply it to neighbourhoods, for use by neighbourhood planners, developers and managers.

The NSF provides a framework for people and organisations wanting to improve the sustainability of the neighbourhoods they are planning, retrofitting or managing. It integrates the environmental, social, behavioural and economic elements of neighbourhoods, recognising that achieving good outcomes for neighbourhoods is a dynamic, multi-stakeholder process. The Kit is designed to drive conversations about specific aspects of neighbourhood sustainability in order to inform practical decision making.

You will find the *Neighbourhood Sustainability Framework and Assessment Kit* useful if you are a:

- Developer
- Local authority planner, engineer, policy maker or community developer
- Designer
- Planner
- Neighbourhood manager, for example, with Housing New Zealand Corporation or a housing trust

The Kit comprises:

1. Information on the NSF
2. The Observational Tool – the calculator and guidelines to using it
3. The Resident Self-Report Tool – the calculator, guidelines to using it and questionnaires

The *Neighbourhood Sustainability Framework and Assessment Kit* is available at:

http://www.beaconpathway.co.nz/neighbourhoods/article/the_neighbourhood_sustainability_framework

Beacon Research Symposia presentations

The presentations from our 2010 symposia in Wellington, Christchurch and Auckland are now available at:

www.beaconpathway.co.nz/further-research/article/presentations_-_2010_beacon_symposium

Thank you to all who attended for your interest and enthusiasm.

Resource Manual for councils

Policy Options for Sustainable Homes: A Resource Manual for Local Government has been updated and reflects the contribution of council staff around New Zealand, who attended workshops to refine the Manual. This has added considerably to the richness of ideas and examples that the Manual contains.

Hard copies have been posted to all councils in New Zealand.

Download the Resource Manual at:

www.beaconpathway.co.nz/further-research/article/a_resource_manual_for_local_government

Datasets available

Beacon's approach to research has been about monitoring real life situations to get an accurate grasp of what is happening in our homes. This has generated an enormous wealth of raw data. Here is an example from the Waitakere NOW Home®:

"Measurements for the Waitakere NOW Home® include environmental factors affecting the house (outdoor temperature, humidity and solar radiation), the use of services within the house (for example, the use of lights, hot water for showering, or use of the dishwasher) as well as the resulting environment within the house (room temperature and humidity, family room CO_2 levels).

End use information was collected for both the electricity and water use. An electricity meter was assigned to each major electrical channel (8 meters in total) and a water meter for each water end-use (24 meters). Temperature and humidity were measured in each room as well as CO_2 in the living room.

The quantity of data arriving at BRANZ is considerable. Each day the 80 channels of data being collected at one-minute intervals results in over 115,000 data points."

The Waitakere NOW Home® was the most intensively monitored of Beacon's research homes. Monitoring of later projects has been refined and the information sought prioritised. Nonetheless substantial data is held for the following projects:

- Waitakere NOW Home® – 2 years energy use, solar water heater performance, rain tank use, reticulated water use, temperature, humidity and C02 levels
- Rotorua NOW Home® – 1 year energy use solar water heater performance, rain tank use, reticulated water use, temperature and humidity
- Papakowhai Renovations – 9 homes, data from two winters, covering energy use, heating energy, solar water heater performance, reticulated water use, temperature and humidity
- Home*Smart* Renovations – 430 monitored homes, reticulated energy and water use, temperature and humidity, solar hot water performance, householder survey information
- Forced Air Ventilation Project – 10 homes, airtightness testing, temperature and humidity testing
- Neighbourhood Survey data – 1613 people, surveys behaviours, perceptions and experiences in relation to their neighbourhoods

These datasets are currently held by CRESA (neighbourhood survey data) and BRANZ (home monitoring data). The aim is to make them available to researchers.

In the near future, a technical specification of the dataset will be published on Beacon's website with a description of the process for accessing the data. BRANZ and CRESA staff will need to extract the data as it is not in an easily accessible form.

Costs will relate only to any processing required to extract the data required for each request: in essence, the data is free