Author: Lois Easton, Policy and Regulatory Research Team Leader, Beacon Pathway Limited MSc (Hons)

Co-author: Nick Collins, General Manager Beacon Pathway Limited, MA, MBA

Presenter: Lois Easton

Title: **Beacon's High Standard of Sustainability – implications for the sustainable development of the residential built environment**

Proposed Paper Stream Business and Governance

Beacon Pathway Limited, PO Box 11 338, Ellerslie, Auckland Telephone: +64 9 846 9446 Email: loise@beaconpathway.co.nz

Abstract
The sustainability of the residential built environment is an important issue for New Zealand, as much of the energy and water consumed and waste produced in the country occurs in people's homes. Similarly the health of the indoor environment within homes has a significant impact on the overall health of the community, particularly as relates to respiratory conditions. Beacon, a FRST funded research consortium, aims to see the majority of New Zealand homes achieve a high standard of sustainability by 2012. Beacon has developed benchmarks for energy and water consumption and checklists for waste, indoor environment quality and materials used in house construction which define Beacon's high standard of sustainability. These benchmarks and measures represent a "line in the sand" against which the sustainability of New Zealand's homes can be measured and for which retrofit packages for existing homes, and standard methodologies for design of new homes can be developed. In the case of the energy and water measures they also create the opportunity for individual households to consider their own sustainability against and for the ongoing measurement of the sustainability of the residential built environment.

Introduction
The sustainability of the residential built environment is an important issue for New Zealand, as much of the energy and water consumed and waste produced in the country occurs in people's homes. Similarly the health of the indoor environment within homes has a significant impact on the overall health of the community, particularly as relates to respiratory conditions.

Beacon Pathway Ltd is a FRST funded research consortium, which is focused on bringing sustainability to New Zealand's residential built environment. Established in 2004, with a focus on new technology for new homes, it became quickly apparent the principal opportunity for Beacon to impact lies not with the 25,000 new homes we build each year, but in transforming our existing homes and neighbourhoods, and our existing 1.6 million homes, a large proportion of which are poorly insulated, damp,

and relatively high consumers of energy and water (Storey, Page, van Wyk, Collins and Kreil 2004).

Beacon's key goal is for the majority of New Zealand homes (90%) to achieve a high standard of sustainability by 2012. In defining this goal Beacon has developed benchmarks for energy and water consumption and checklists for waste, indoor environment quality and materials used in house construction which defines the high standard of sustainability.

In developing these benchmarks and addressing the challenge it has become clear that:

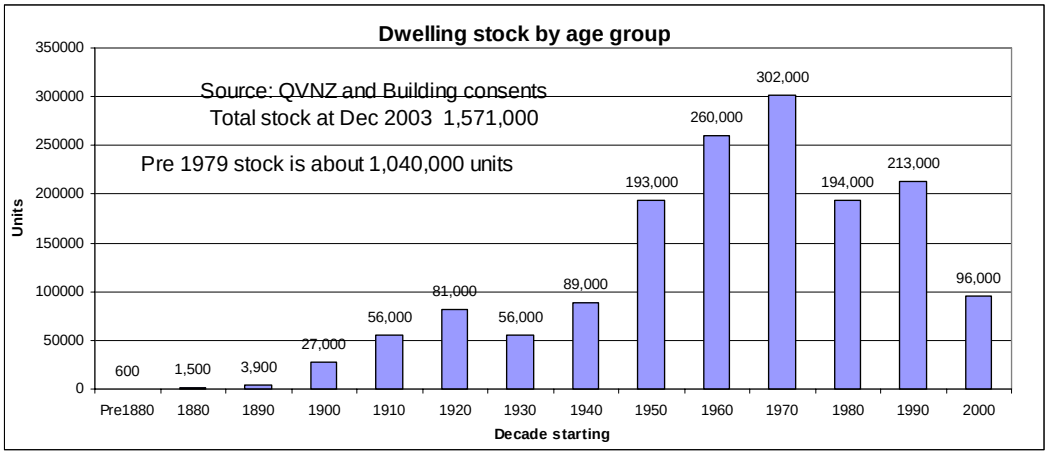
- we have the technology to address the challenge to deliver warm, comfortable, resource efficient homes which are affordable to operate
- most New Zealanders are not engaged in the "performance" of their homes.
- the data needed to accurately assess the sustainability of homes is disparate, poorly compiled and difficult to access;
- leadership from both the public and private sector is needed if we are to move rapidly towards improving the sustainability of the residential built environment.

New Zealand's Third World Housing Stock

New Zealand's housing stock has a reputation for being cold and damp. New Zealand has one of the highest levels of asthma and bronchial diseases. Asthma affects approximately 600,000, or one in six New Zealanders and New Zealand's children have among the highest rates of Asthma in the world (Asthma and Respiratory Foundation of New Zealand 2006). Our colonial mind set has been to "harden – up" or put on another jersey, rather than build warm comfortable homes.

Almost two-thirds of our houses (over a million in total) were built before 1979, the first full year when insulation was mandatory in new-build New Zealand houses (Amitrano, Kirk and Page 2006).

Figure One: New Zealand Dwelling Stock by Age
Source: Storey, Page, van Wyk, Collins and Kreil 2004.



BRANZ estimates that only 42% of New Zealand houses have overall insulation levels that conform to the 1977 New Zealand Building Code Standard for insulation (NZS 4218P:1977). Of those houses built since the introduction of the 1977 Building Code Standard, 30% do not now meet those standards (Clark, Jones and Page 2005). The World Health Organisation's recommended minimum optimum indoor temperature is 18°C for occupied living areas and 16°C for bedrooms (World Health Organisation 1987). The BRANZ Household Energy End-use Project (HEEP) data shows the average evening temperature of the living rooms of houses across the country is around 17-18°C with 30% of houses below 16°C (Isaacs, Camilleri, French, Pollard, Saville-Smith, Fraser and Rossouw 2005). However this data also shows that the average winter bedroom temperature in pre-1979 houses was 13.2°C, whilst in post-1979 houses the bedroom temperature rose to 14.5°C. This suggests that we tend to heat one room, rather than the whole house.

Only 18% of pre-1979 homes have insulated their hot water cylinders, 15% have installed dual flush cisterns, and 1% have installed sub-floor insulation. The installation of energy-efficient lighting, low-flow showers and draught stripping is limited, and very few existing homes have been retrofitted with solar water heating and double glazing (Clark et al 2005).

The contribution of the building sector to the NZ economy is significant, not only in providing buildings as a generic service for business and households, but also :

- In 2005, the Reserve Bank estimated the aggregate private sector residential dwelling values at $506 billion.
- 90% of households net worth is represented by housing assets.

Most of us who occupy these homes have little idea of how our largest single investment performs in terms of energy consumption, or water use. However many people know what it costs us to fill up our motorcars, and particularly the males amongst us can cite fuel consumption data, top speed and other key attributes of their car performance.

Energy efficiency or water conservation improvements to dwellings are almost always considered in terms of the economic payback, (the direct savings which added insulation, solar water heating, double glazing, rain-water tanks will provide are evaluated in dollars and cents), and a pay back of more than seven years is often not considered worthwhile, especially when the average period of home ownership is 7 years. Yet payback periods are not considerations with the majority of consumer purchasing decision – for example when purchasing a new car, a boat , or taking the winter holiday in the sun to escape the cold, damp house in winter.

Beacon's High Standard of Sustainability

In order to provide a framework for Beacon to measure the influence it is having on the sustainability of houses at a national level, and to provide a useful benchmark against which individual households can evaluate their home's performance, Beacon has developed benchmarks for a High Standard of Sustainability in homes (Easton 2006). These benchmarks have focused on five key aspects of dwelling sustainability:

- Energy use
- Water use
- Indoor Environment Quality
- Waste
- Materials

Underpinning these five technical aspects of dwelling sustainability are the issues of affordability and future proofing. When considering the individual household benchmarks at which the high standard of sustainability performance indicators should be set, affordability was a significant consideration (Easton 2006). The benchmarks have therefore been set at levels where many of the features used to bring about the achievement of the benchmarks are:

- At a low cost for retrofitting (eg simple measures such as fitting of draught stoppers and use of low flow shower heads)
- Have a payback period estimated at less than 10 years (eg additional insulation or energy efficient appliances); or
- In the case of new development, can be undertaken at no or minimal extra cost (eg passive solar design).

The benchmarks developed represent a preliminary "line in the sand" for Beacon and are expected to be updated and refined over time, and as the research into the state of New Zealand's home performance continues. Beacon has developed two new research NOW Homes™ (in Waitakere City and Rotorua) which have been built utilising today's easily available and affordable technologies and is currently researching the effects of retrofitting 10 ordinary homes in Wellington. The gathering of data from these research homes and other future research homes will enable further verification and refinement of the benchmarks, and the development of packages of options for retrofitting and building new homes to achieve Beacon's high standard of sustainability.

The benchmarks set represent:

- a 25% reduction in energy use in new homes;
- a 15% reduction in energy use in existing homes;
- a 25% reduction in water use in both new and existing homes;
- indoor environment temperatures which meet the World Health Organisation standards of 18^{o}C;
- adequate ventilation without excessive draughts;
- provision for waste minimisation during construction, renovation and operation of homes;
- consideration of sustainability issues in the choice of materials used for construction or renovation of homes.

The % reduction in energy and water use are attributable to the design and features of the home and have been set acknowledging the particular attributes of New Zealand housing stock. For example home energy uses is lower than countries such as Australia and the United States and the United Kingdom (McChesney, Smith and Baines 2006), and as discussed above, New Zealand homes are significantly underheated. It is also expected that occupier behaviour modification could see further significant improvements in the efficiency and healthiness of the homes.

Features to Achieve a High Standard of Sustainability

A number of key features have been identified which would enable homes to be built to meet the high standard of sustainability measures. While occupant behaviour will affect the actual outcome in terms of energy and water use, and the quality of the indoor environment, houses with these features can inherently be operated in a more sustainable manner. These features can be grouped into low, moderate and high categories which reflect both their impact on the sustainability of a home and the amount of capital investment required to be put in.

Basic low cost measures which will have a modest impact on the sustainability of the home include measures such as:

- Low flow shower head;
- Fluorescent light bulbs ;
- Dual flush toiletl
- Outdoor clothesline;
- Hot water cylinder wrap & pipe lagging;
- Draught stopping;
- Ventilated fridge space;
- Opening windows;
- Mechanical venting of bathroom and kitchen;
- Incorporation of passive solar design into new homes and extensions to existing homes;
- Provision of space for recyclables storage;

- Provision of facility for collection and composting of organic waste;
- Use of materials for new homes and alterations to existing homes which have been selected with reference to a sustainability checklist;
- Elimination of unsustainable features such as – air conditioning; in sink waste disposal units; and unflued gas heaters.

Moderate cost features which will have a significant impact on the sustainability of a home include the following measures:

- Ceiling, external wall and underfloor insulation to meet "better" recommended values for each climate zone;
- Rainwater tanks supplying the garden;
- Windows with passive venting;
- Thermal curtains and pelmets;
- Water and energy efficient appliances

Depending on the type of home (new or existing, efficient or inefficiently designed) some higher cost features such as solar hot water systems, insulation levels to meet "best" recommended values for each climate zone, double glazing, greywater reuse or rainwater tanks supplying non potable uses may be required to fully meet the Beacon high standard of sustainability.

Depending on whether the home is new or retrofitted, a combination of basic and moderate features with one or two higher cost features will enable a home to achieve the Beacon high standard of sustainability in relation to energy, water and waste. Further work is underway by Beacon to determine the most efficient and effective means of achieving a high quality indoor environment and ways in which to determine what are the most sustainable building materials available in New Zealand.

Discussion

When considering how to move New Zealand homes towards a higher degree of sustainability, engagement of dwelling owners is a primary consideration. The vast majority of homes which will be in use over the next 50 years have already been built (Amitrano, Kirk and Page 2006). Yet, the BRANZ House Condition Survey indicates that New Zealanders already under-maintain their homes (Clark et al 2005). When renovation data is considered, it is clear that much of the renovation undertaken is cosmetic in nature (Amitrano et al 2006) and does not address the sustainability of New Zealander's homes.

Compounding this issue is the increasing proportion of dwellings which are rented – home ownership rates decreased by 9% in the decade between 1991 and 2001 to 62% (Statistics New Zealand 2001). Decisions on whether or not to make alterations to existing housing stock to increase their sustainability will therefore be increasingly be made by landlords who will not accrue the direct benefits of such alterations.

In addition to this, the average age of home owners living in their own dwelling is increasing (Amitrano et al 2006), with the result being that families with young children are increasingly living in rented accommodation. These are both the household type with some of the largest demands for energy and water, and one of those of greatest susceptibility to the negative effects of a poor quality indoor environment.

New Zealander's homes are the single largest investment that many people will make in their lifetime. They are also the place where many people spend most of their time. Yet when compared to a motor car, existing New Zealand homes have very few regulatory requirements placed upon them. A car requires a six monthly warrant of fitness and an annual registration, yet our homes do not require any kind of check, even at change of ownership or tenancy, to determine whether they are healthy, efficient or suitable for the household type who are proposing to live in them.

Conclusion

Currently there is no widely used methodology within New Zealand to evaluate the sustainability of New Zealand's homes. Beacon has developed a set of preliminary benchmarks across a key range of indicators to assist in the measurement of the sustainability of New Zealand's homes and the debate about ways to improve this.

Monitoring data from Beacon's New Lynn NOW Home™ indicates that energy and water savings, and improvements in indoor environment quality, which meet or exceed Beacon's high standard of sustainability can be achieved in a home designed to be affordable and standard in appearance using technologies and design easily able to be incorporated into any new home (BRANZ Now Home™ Monitoring – unpublished data). Research is currently underway to verify or disprove the hypothesis around the ease of achieving the Beacon high standard of sustainability for retrofitted existing homes.

References

Amitrano L. J., Kirk N. R. and Page I. C. (2006) Market Segmentation of New Zealand's Housing Stock. Report PR 106 for Beacon Pathway Limited.

Asthma and Respiratory Foundation of New Zealand (accessed 16/03/2006). About. http://www.asthmanz.co.nz/in_new_zealand.php.

Clark, S.J., Jones, M., Page, I.C. (2005) New Zealand 2005 House Condition Survey. Study Report No. 142 (2005), BRANZ, Judgeford, Porirua

Easton L. 2006 Defining the Benchmarks for Beacon's High Standard of Sustainability. Report PR 109 for Beacon Pathway Limited. Auckland, New Zealand.

Isaacs N.P., Camilleri M., French L., Pollard A., Saville-Smith K., Fraser R.. & Rossouw P. (2005). Energy Use in New Zealand Households: Report on the Year 9 Analysis for the Household Energy End-use Project (HEEP). *BRANZ Ltd Study Report 141*, Judgeford, Porirua, New Zealand.

McChesney I., Smith N., Baines J. (2006) The Impact on Housing Energy Efficiency of Market Prices, Incentives and Regulatory Requirements. *Report for the Centre for Housing Research and Building Research*. Christchurch, New Zealand.

Pracsys(2006) Western Australia Basix: Triple Bottom Line Cost Benefit Analysis. Report 06/72 for the Department for Planning and Infrastructure, Western Australia

Standards Association of New Zealand. (1977). NZS 4218P:1977 Minimum Thermal Insulation Requirements for Residential Buildings

Statistics New Zealand (2001) Census (available on line at http://www.stats.govt.nz/census/default.htm accessed 16 January 2006)

Statistics New Zealand (2005**)** The Six Dimensions of Housing Adequacy (available on line at http://www.stats.govt.nz/analytical-reports/six-dimensions-hsing-adequacy/default.htm accessed 16 October 2006)

Storey, J., Page, I., van Wyk, L., Collins, M., Kreil, T. (2004) RF1 Housing Retrofit – Housing Interventions, Stock, and Markets. BRANZ, Wellington

World Health Organisation, (1987). Health Impact of Low Indoor Temperatures. Copenhagen, WHO Regional Office for Europe. (Document ICP/RUD 003/m01)