Renovating Homes for Sustainability

Key Findings of Beacon Research to Date

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SUMMARY

Existing homes are the key to improving the performance of New Zealand's housing stock. Beacon Pathway's research has shown that a 'one size fits all' approach is not the best way to tackle sustainable renovation.

Instead, development of a whole-of-house approach, with a detailed renovation plan which addresses the key performance issues in the house, will mean that as improvements are made, a wide range of holistic benefits will occur. The benefits of improved home performance are multifaceted, with financial considerations being part of a wider set of outcomes that are valued by homeowners.

THE PROJECTS

Papakowhai Renovations

- Renovation of nine homes in Papakowhai, Porirua.
- Homes built in the 1960s and early 1970s – housing in this era is known to be difficult to retrofit for energy efficiency.
- The homes were renovated with energy, waste and indoor environment quality improvements. Each home had a different combination of features installed, to allow comparison of their effectiveness.
- All nine homes were monitored for energy and water use, temperature and humidity, and the amount of waste produced, before and after renovation.

Home*Smart* Renovations

- 530 homeowners from across the range of New Zealand's climate, who were intending to renovate their homes, participated in this large scale project.
- Each home was assessed by both a homeowner self assessment, and by a trained assessor, and the information collected was used to develop a renovation plan individualised to the home.
- The homeowner's implementation of the renovation plans, and effect on the home's performance, is being monitored through to May 2010.
- Strong engagement with the homeowner is a key part of the project – with a Homeowner Manual and regular newsletters (tips and answers to queries) being provided to all participants.

KEY FINDINGS

- **Have a plan** – with a whole-of-house approach to address problems with step-by-step improvements.
- **Insulate everywhere** – walls, ceiling, underfloor and windows.
- **Combine insulation with efficient heating.**
- **Warmer bedrooms don't happen by just heating the living room** – move the heat around with heat transfer systems for wood/pellet burners or ducted heat pumps.
- **Hot water cylinder wraps are a great energy efficiency measure** – even with new electric hot water cylinders.
- **Solar hot water systems will save more energy than most other measures** – but make sure they are size properly, have a high quality controller and are well-installed.
- **Combine solar/instant gas hot water systems with low flow tapware to ensure water isn't wasted.**
- **Rainwater tanks are easily installed, and can have a significant impact on water consumption.**
- **Large numbers of downlights substantially undermine ceiling insulation performance.**
- **A range of values drive retrofit – look beyond the simple cost benefit** – less noise, better comfort and good health are major benefits valued by consumers.

A PRIORITISED RENOVATION PLAN

The project has developed standard retrofit recommendations for different situations in different locations. These are prioritised in the renovation plan:

1. **THERMAL ENVELOPE**
   Priority insulation order: ceiling, underfloor, south walls, south windows and rest of the walls and windows.
2. **VENTILATION AND DAMPNESS SOURCE CONTROL**
   Priority: drainage and/or maintenance; then vapour barrier, bathroom ventilation, vent dryer, kitchen ventilation, outdoor clothesline, laundry ventilation.
3. **EFFICIENT SUSTAINABLE HEAT SOURCE**
   Priority: living space; then bedrooms.
4. **WATER EFFICIENCY BUNDLE (SHOWER HEADS, TAPS, TOILETS)**
   Cheap and simple measures to reduce demand for reticulated water and energy.
5. **EFFICIENT SUSTAINABLE HOT WATER HEATING**
   Priority: efficient cylinder and wrap; then solar/heat pump hot water.
6. **ENERGY EFFICIENCY (IF HIGH ENERGY USERS)**
7. **SUPPLEMENTARY WATER SUPPLY**
   Rainwater tanks for garden, toilet and laundry. Greywater systems in areas with appropriate soils.
8. **WASTE**
9. **ENERGY EFFICIENCY (IF NOT HIGH ENERGY USERS)**

Some house typologies are easier to retrofit for sustainability than others

HOUSE TYPE	RETROFIT PROS	RETROFIT CONS
 **VILLAS AND BUNGALOWS**	• Good 'bones' with sound native timbers. • Easy to retrofit ceiling insulation. • Ease of installing underfloor insulation depends on space available. • Can accommodate a range of efficient heating options. • Most have a large area of north-facing roof, and sufficient space for a solar hot water cylinder or photovoltaics. • Generally designed so that passive cooling options work very well.	• Oriented to the street not the sun. • Double glazing difficult due to unsuitable frames and non-standard window sizes. Secondary glazing may be more appropriate. • Often lack underfloor crawl space. • Heritage status restricts some measures. • High ceilings and extensive draughts can mean that, even with thermal retrofitting, significant heating is needed. • Can be built close to neighbours, limiting water collection options on small sites.
 **ART DECO**	• Highly valued and stylish, so owners may go the extra mile. • Suitable for solar water heating where the panels can be set up on skillion roof. • Can accommodate a range of efficient heating options.	• Skillion roof difficult to retrofit but possible to install new battens and insulation inside false ceiling. • Many have a renovated roof on top of old due to previous failures. • Built low to the ground with lack of underfloor crawl space. • Often oriented to the street rather than the sun.
 **STATE HOUSES**	• Well oriented to the sun. • Hipped roof with 40-degree pitch – ideal for solar hot water panels and photovoltaics. • Good access in ceiling and underfloor. • Small spaces may prioritise heating systems such as heat pumps or inset wood burners. • Often quite small size on larger section, meaning that extensions (including insulated thermal mass) and water collection and reuse systems are viable.	• Big range of styles – 50's classic through to 70's standard. • Small room sizes may affect heating options.
 **1960'S AND EARLY 1970'S MULTI-UNIT HOUSES**	• Potential for mass retrofit e.g. six units at once. • Modular design might assist solutions. • Possible renewable energy and water options shared between units e.g. solar hot water, combined rainwater collection, combined heating systems.	• Un-insulated concrete slab. • High thermal mass with poor insulation. • Skillion roofs and lack of underfloor access.

HOUSE TYPE	RETROFIT PROS	RETROFIT CONS
 **1970'S HOUSING PRE-1978 INSULATION**	• 95% single storey but garage underneath makes underfloor insulation easy. • Solar hot water system suitable for homes with pitched roof. • Heating retrofits relatively easy. • Aluminium window frames will take double glazing units into existing frames.	• Large numbers, built before insulation required. • Aluminium-framed windows, some floor-to-ceiling glazing (including sliding doors) means big areas for heat loss. • Homes with a skillion roof are difficult to retrofit unless re-roofing or lower ceiling. • Variable cladding (asbestos, fibre cement, manufactured timber, stucco, concrete, plastics, weatherboard…) • Often not well oriented to the sun.
 **1980'S HOUSING**	• Generally have some ceiling insulation (and possibly wall) but will need replacement or top up. • Heating retrofits relatively easy. • Aluminium window frames will take double glazing units into existing frames.	• Often low to the ground or on un-insulated concrete slabs. • Often not well oriented to the sun. • Aluminium-framed windows, some floor-to-ceiling glazing (including sliding doors) means big areas for heat loss. • Often spaces too small for new energy efficient hot water cylinders.
 **1990'S HOUSING (PRE-1996)**	• Generally have some ceiling and wall insulation. • Some aluminium frames will take double glazing units into existing frames.	• Often not well oriented to the sun. • Some poorly built examples show weathertightness problems. • Low-pitched roof makes adding more insulation difficult. • Un-insulated concrete floors.
 **LAST DECADE (1996-2007)**	• Well insulated. • Modern aluminium joinery – often able to take double glazing units.	• Reasonably airtight, so ventilation and indoor air quality are often the biggest issues. • High number of inset downlights, making ceiling insulation less effective. • Untreated timber and construction techniques make some renovations potentially hazardous. • Leaky building era. • Not generally oriented to the sun.

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