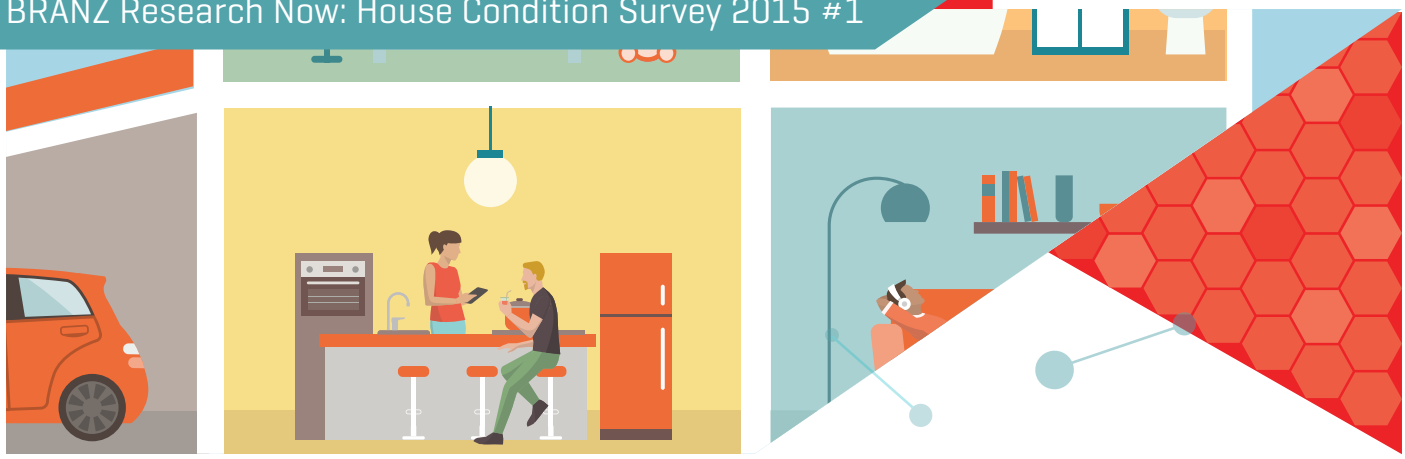


Energy efficiency in the New Zealand housing stock

This Research Now describes the findings around energy efficiency from the BRANZ House Condition Survey 2015. The survey results show large opportunities to improve the energy efficiency of New Zealand's existing housing stock.

BRANZ has surveyed the condition of a large sample of New Zealand houses approximately every 5 years since 1994. The 2015 sample of 560 houses was designed to be broadly representative of the national housing stock and included both owner-occupied and rental houses. The survey comprised an on-site physical house assessment, a telephone interview with the occupant and an appliance use questionnaire completed by the occupant.

Insulation and glazing

For ceiling insulation, the government's Energy Efficiency and Conservation Authority (EECA) recommends a minimum depth of 120 mm across at least 80% of the accessible roof space. Just 39% of houses had ceiling insulation that met this requirement (Figure 1). Around half of houses had at least one defect such as gaps in insulation (31%) or insulation settling (22%), not fitted properly (16%) or displaced (11%).

The findings suggest that around 47% of houses (representing 740,000 dwellings) could benefit from additional insulation in the roof space, and 28% of houses with a subfloor cavity (representing 290,000 dwellings, 19% of all houses) could benefit from additional insulation of the subfloor. Combined, over half the housing stock (53%, representing 830,000 houses) could benefit from retrofitted roof or subfloor insulation or both. (Percentage figures do not always add to 100% because some roof or subfloor areas were not accessible to inspectors.)

Only 10% of houses had double-glazed windows throughout, with a further 8% having a mix of double and single glazing. In 81% of all houses, there were only single-glazed windows - this figure was 90% for rentals.

Space heating and heating habits

The most common types of heating appliance in the homes were counted:

- Portable electric heaters were present in around half of all houses. Convection heaters (such as oil column heaters) were the most common, followed by fan heaters.
- Solid fuel heaters (typically wood burners) were the second most common heating in owner-occupied homes, present in nearly half (49%). They were found in 36% of rentals.
- Heat pumps were common in owner-occupied houses (46%), less common in rentals (27%).
- Fixed electric heaters were present in 23% of homes - 25% in owner-occupied dwellings compared to 18% of rentals. Panel heaters were the most common fixed electric heater (13%).
- Fixed gas heating was found in 20% of houses, slightly more commonly among owner-occupied houses (22%) than rentals (16%). Most common were enclosed flame-effect (8%) and panel heaters (no visible flame, 7%). Around 70% of fixed gas heaters were flued.

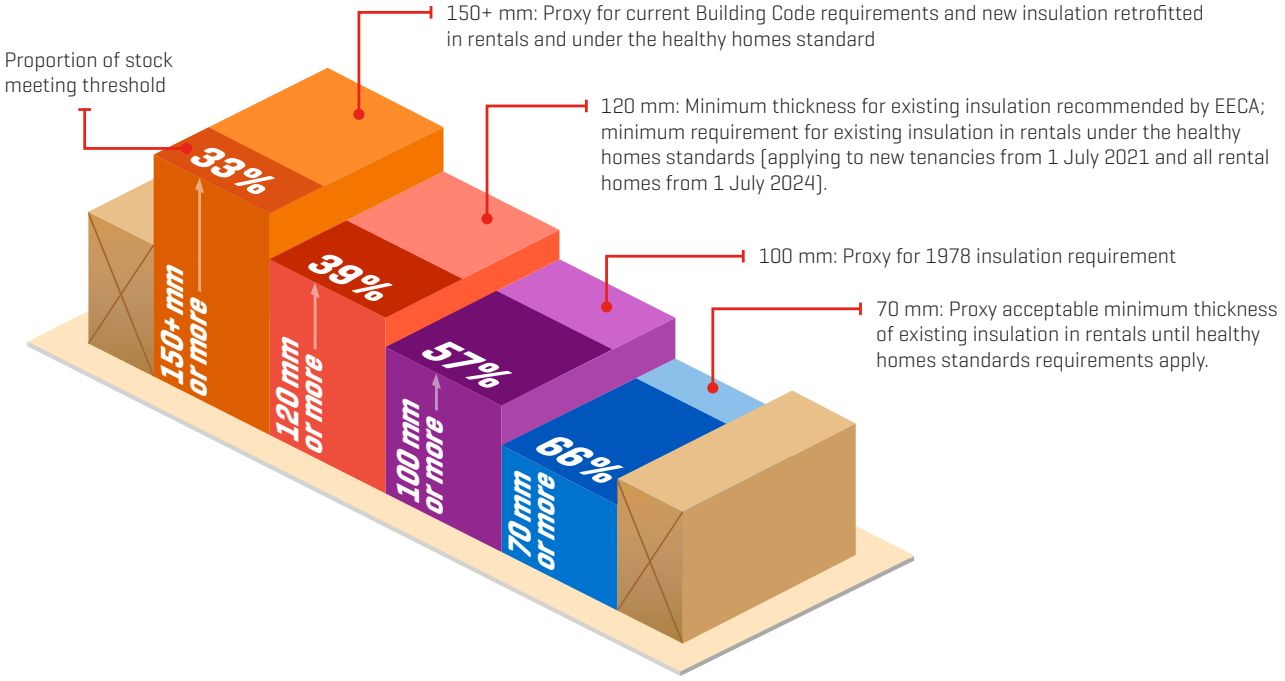


Figure 1. The proportion of houses where ceiling insulation depth meets a particular requirement.

Heaters vary greatly in efficiency and running cost. Heat pumps, enclosed wood burners and flued gas heaters are among the more cost-effective options and were more common in owner-occupied homes (88%) than rental homes (62%).

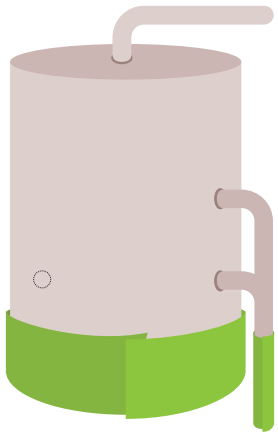
One-fifth of rental properties had no fixed heating system and were reliant on portable heating - almost three times the proportion of owner-occupied homes (7%). Portable heaters are typically more expensive to operate per unit (kWh) of heat released - two to five times more expensive than a heat pump, for example.

The largest differences in heating appliances were around wood and LPG. Wood burners were present in 43% of owner-occupied houses compared to 28% of rentals. Unflued LPG heaters were found in 17% of rental homes but only 6% of owner-occupied dwellings.

The presence of a heater does not necessarily mean it is used. The appliance use survey asked when householders usually heated the living area(s) and occupied bedroom(s) in winter and the type of heater used most in each room:

- Overall, 5% of households did not usually heat living areas at all in winter.
- In 32% of households, all occupied bedrooms were usually heated at some time in winter.
- In 22%, some occupied bedrooms were heated in winter.
- In 46% of households, no occupied bedrooms were heated in winter, even where those bedrooms were occupied by children or older adults.

Without any heating in winter, it is unlikely the indoor temperature would always achieve the World Health Organization's minimum recommendation of 18°C.



Hot water supply

Owner-occupied houses were more likely to have more than one bathroom (55%) compared to rentals (15%). They also had more showers, with 34% having two showers in the house and 8% having three or more, compared to 11% of rentals with two showers and 1% with three or more.

The hot water systems were mostly electric. Types of system were:

- 48% low pressure electric cylinder
- 32% mains pressure electric cylinder
- 7% gas storage
- 6% electric/wetback
- 4% electric/solar
- 11% instantaneous gas.

With regards to the grade of cylinder installed, this information was not always accessible or available, but where data was provided, it shows that 38% were grade A (the most energy efficient), 30% grade B and 16% grade C or D. In houses built after 2000, 74% of cylinders were grade A. EECA recommends adding a thermal wrap around cylinders from before 2002. Overall, 79% of cylinders that pre-dated 2002 (34% of all cylinders) had no cylinder wrap. This equates to just under half a

million houses. Two-thirds of hot water system pipes were not lagged - this equates to over 1 million houses.

The average (mean) size of cylinder was 171 litres and the median 180 litres, with 48% of cylinders 180-190 litres.

The recommended temperature for the hot water cylinder thermostat setting is 60°C. Lower than this risks *Legionella* bacteria growth, while higher temperatures risks scalding and wasteful use of energy.

The average temperature of all cylinder thermostats was 62°C, ranging from 40-85°C. A setting lower than 60°C was recorded on 16% of cylinders, while 25% of houses had a cylinder set at 65°C or higher and 11% set at 70°C or higher. These proportions represent 210,000, 400,000 and 170,000 houses respectively.

The New Zealand Building Code requires that the maximum water temperature at the tap for showers, baths and hand basins is 55°C. 26% of taps had water over 55°C. Bathroom hot water tap temperatures over 55°C were more frequent in houses with an electric low pressure system (39%) compared to those with mains pressure (26%) or instantaneous gas (13%).

Cylinder age was also a factor: 44% of houses with cylinders over 15 years old had a temperature reading over 55°C compared to 26% of houses with a hot water cylinder under 15 years old.

EECA recommends a shower flow rate of 9 litres per minute or less, but in many houses, rates are higher: 46% of houses had at least one shower with a flow rate greater than this, and nearly 15% of showers exceeded 15 litres per minute (Figure 2). Higher flow rates were more likely in:

- owner-occupied houses
- houses built since 1990 - 55% of houses built in the 1990s and 79% of houses built from 2000 onwards had a shower with a flow rate greater than 9 litres per minute
- houses with a mains pressure or instantaneous gas hot water system.

Leaking taps or leaking shower heads were found in 7.5% of owner-occupied bathrooms and 5.6% of rental bathrooms - representing 155,000 bathrooms overall.

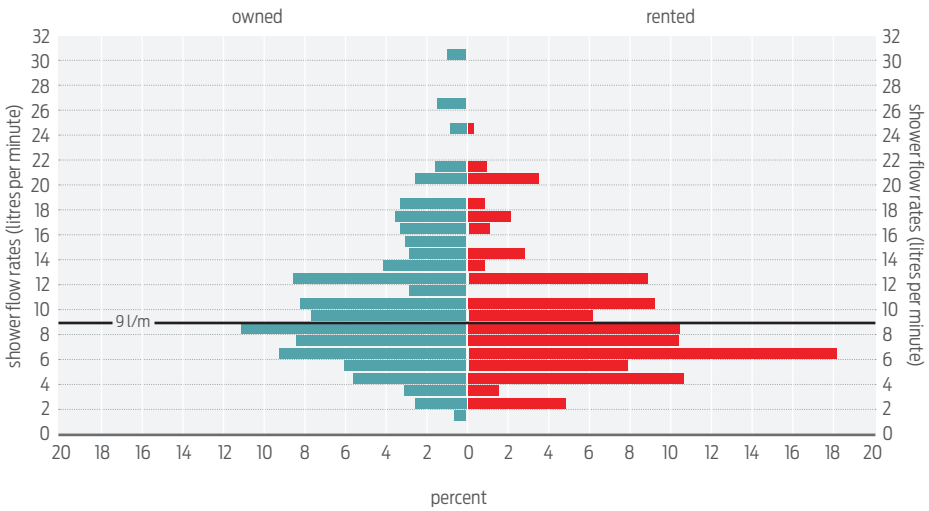


Figure 2. Proportion of showers with flow rates greater than the recommended 9 litres per minute.

Lighting and appliances

Household occupants provided information about appliance use by completing a questionnaire. These were the key findings:

- Owner-occupied houses had an average of 27 **light bulbs**, rental properties an average of 15. This extrapolates to over 35.1 million light bulbs in New Zealand houses - 26.9 million in owner-occupied houses and 8.3 million in rentals. The average number for houses built since 2000 was 33 compared to 18 for houses built in the 1980s. Overall, the less-efficient incandescent bulbs accounted for just over one-third (34%) of all bulbs (Figure 3).
- Most houses (55%) had one flat-screen **television** that was used regularly and 30% had two. The average (mean) screen size of all flat screen TVs recorded was 38 inches, with no difference between owned and rented houses.
- The most common type of **refrigeration** appliance (accounting for 35%) was a vertical fridge/freezer with a bottom freezer. Where estimates of age were provided, the average (mean) age was just over 10 years. Nearly one-third (32%) were up to 5 years old and a further third (33%) were 6-10 years old. EECA recommends replacing refrigeration appliances when they are over 20 years old. This applies to 7% of refrigeration appliances in the survey.

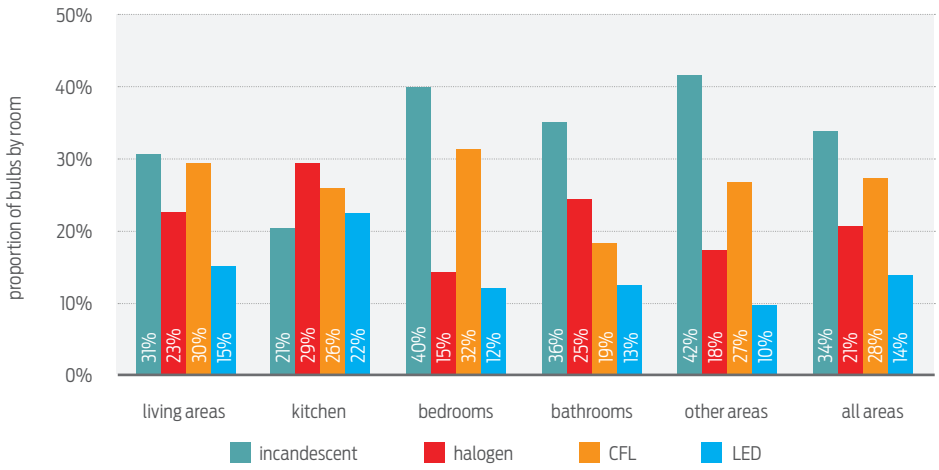


Figure 3. Proportion of different types of light bulb by room.

- **Dishwashers** were used regularly in 68% of owner-occupied houses and 34% of rentals (56% overall).
- **Clothes dryers** were used regularly in 50% of households.
- Top-loaders were by far the most common type of **washing machine**, regularly used in 80% of houses. The more energy efficient front-loaders were used in 19% of houses (22% of owner-occupied homes and 12% of rentals).
- **Rangehood/extractor fans** were used in 62% of houses (68% in owner-occupied homes and 51% of rentals.)

Opportunities for improvement

The survey shows there are considerable opportunities for improvement in energy efficiency in New Zealand houses, including:

- retrofitting insulation
- replacing portable heaters with more energy-efficient space heating options such as heat pumps, flued natural gas heaters and efficient enclosed wood burners
- adding thermal wraps to old hot water cylinders and insulation to hot water pipes
- reducing shower flow rates
- reducing excess temperatures in water heating systems
- replacing incandescent light bulbs with LEDs.

More information

BRANZ Research Now: House Condition Survey 2015 #2 *Maintenance and deferred maintenance in New Zealand houses*

BRANZ Research Now: House Condition Survey 2015 #3 *The state of our subfloors*

BRANZ study reports
These can be downloaded from www.branz.co.nz/study_reports

SR372 *Warm, dry, healthy? Insights from the 2015 House Condition Survey on insulation, ventilation, heating and mould in New Zealand houses* (2017)

SR370 *BRANZ 2015 House Condition Survey: Comparison of house condition by tenure* (2017)

BRANZ websites
www.branz.co.nz/hcs
www.level.org.nz
www.renovate.org.nz