

Existing Homes Roadmap:

Retrofitting our existing homes to improve health, productivity and progress towards net zero



The Existing Homes Roadmap is published by the New Zealand Green Building Council. This report is intended to promote and engender discussion about environmental and health-based improvements to existing homes. We have thoroughly researched all our claims about existing homes and why they should be improved and believe that they are based on evidence. However, the views, opinions and conclusions reached by the NZGBC and set out in this document are opinion only and we encourage you to ask questions, discuss and even contact us to find out more about this important issue.

We're grateful to our industry partners for their support



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Existing Homes Roadmap

A proposed pathway to reduce carbon emissions from existing homes by aiming to have all homes near zero emissions by 2050.



“Reports show that delivering improvements like those set out in this report can deliver benefits worth billions in value for Aotearoa, as well as creating healthier, more comfortable, energy efficient homes.”

— **Andrew Eagles, Chief Executive,**
New Zealand Green Building Council

Recommended Actions

1. **Implement a deep retrofit programme** for 200,000 of our worst performing homes, starting with a pilot of 300 homes from 2025

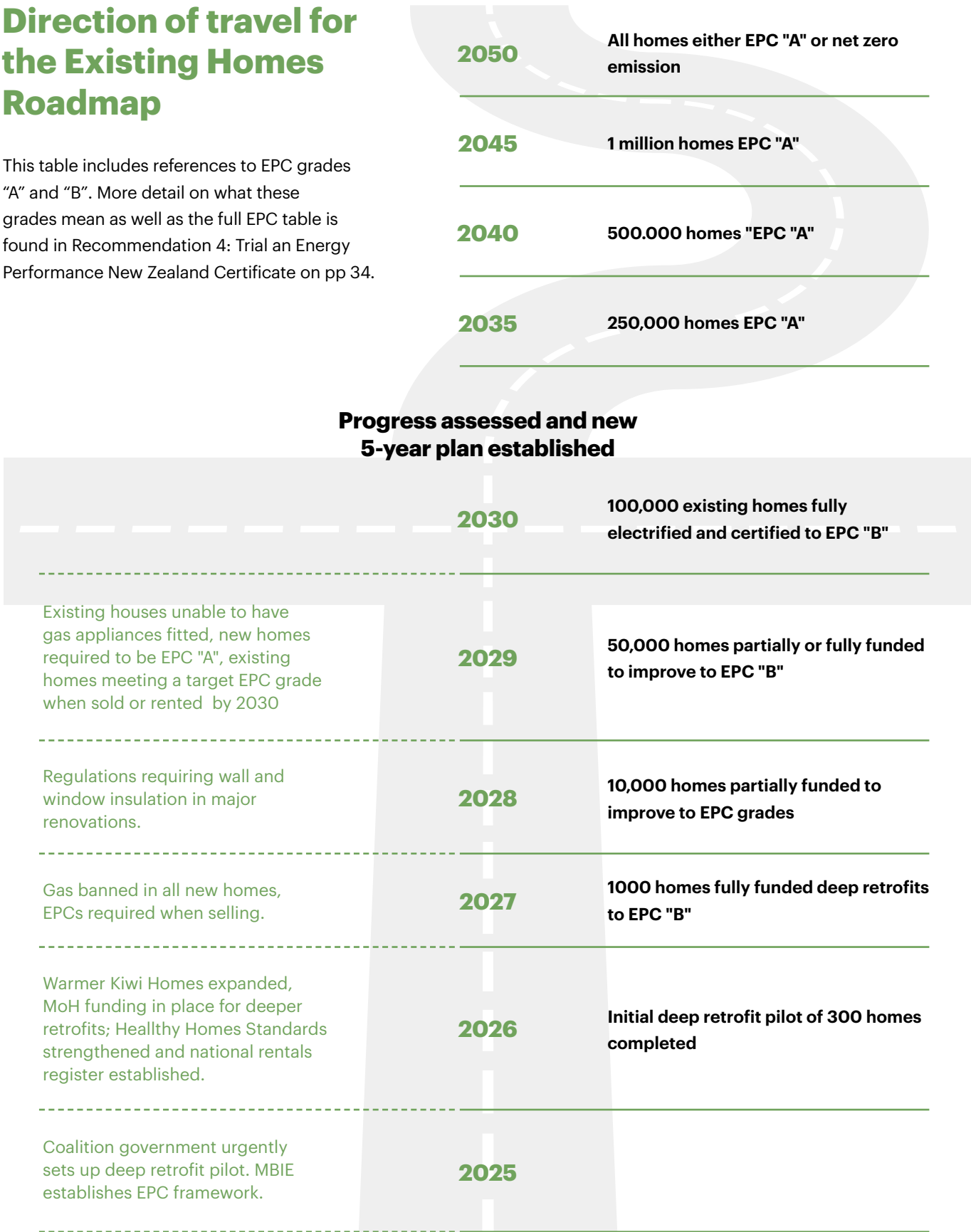
2. **Radically expand the Warmer Kiwi Homes subsidies for a shallow retrofit programme** – broaden measures covered and expand eligibility for subsidies to allow 100,000 owner occupied homes to be energy efficient by 2030.
3. **Roll out a national housing improvement loan programme** to provide resourcing local authorities to provide the balance of funding at Government interest rates for owner occupiers and landlords to achieve 250,000 energy efficient homes by 2035.

4. **Trial an Energy Performance New Zealand Certificate** by 2026, and phase in mandatory energy and carbon emissions targets with all homes meeting a target EPC grade when sold or rented by 2030.

Figure 1:

Direction of travel for the Existing Homes Roadmap

This table includes references to EPC grades “A” and “B”. More detail on what these grades mean as well as the full EPC table is found in Recommendation 4: Trial an Energy Performance New Zealand Certificate on pp 34.



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Executive Summary

Cold, damp, inefficient homes are costing the country dearly. The New Zealand Green Building Council (NZGBC) believes that New Zealand's poor-quality, unhealthy, existing homes are a major cause of the high incidence of respiratory illness in New Zealand. This Roadmap details our view on policies that can address the issues Kiwis are experiencing in our existing homes, and deliver a range of benefits for our nation's health and productivity, to the health system, for the environment and more.

Around a million people in Aotearoa New Zealand, or one in five New Zealanders, are living with a respiratory disease, costing the country \$8.7 billion per year.¹ One in ten hospital admissions can be attributed to respiratory illness, from conditions such as asthma and pneumonia². We believe poor quality housing is a contributing factor.³ Around a third of these admissions are children – around 30,000 Kiwi kids.

Studying at home is difficult when you are sick - or even if it's just cold - parents taking time off work to care for their sick children may then get sick themselves, costing the economy in lost time and productivity, and potentially affecting education standards. At the other end of the spectrum, older people may have shortened lives as a result of uncomfortable living conditions – an estimated 1450 people die each winter over and above the annual average mortality rate.⁴

The call to action, *The Homes We Deserve*,⁵ led by Te Kaunihera Hanganga Tautaiāo | New Zealand Green Building Council (NZGBC), and supported by more than 160 other organisations, is aimed at improving the lives of those living in our coldest homes.

Our homes also contribute to our overall carbon footprint. We must reduce greenhouse gas emissions from the operation of homes by 80% to meet our carbon emissions budget and for housing to play its part in Aotearoa New Zealand's commitment to achieve net zero carbon emissions by 2050.⁶

This Roadmap focuses on actions to facilitate the retrofit and improvement of thousands of homes which can help to tackle health issues, related economic outcomes and reduce our impact on climate caused by carbon and other pollutants. It calls on the Government to mobilise a plan of action that can contribute to our country meeting the challenge of climate change and fulfilling our emissions reductions commitments while improving living conditions, costs of living, wellbeing, and quality of life for hundreds of thousands of New Zealanders in the process.

Retrofit programmes have been underway in other developed countries for a number of years. The experience in these countries, as well as through programmes such as Warmer Kiwi Homes and Healthy Homes Initiative have repeatedly proven that funding improvements to our homes is money well spent.

Implementing the actions recommended within this Roadmap could deliver significant benefits:

- to our national productivity through positive health, social and economic outcomes.
- by creating new jobs and opportunities for building workforce capacity while developing a robust pipeline of home improvement work stretching out to 2035 and beyond
- to our health system, with significant health savings and reduced pressure on health and hospital services.





The high costs of respiratory illness in Aotearoa New Zealand

According to the Asthma and Respiratory Foundation:⁷

- 1 in 5, equal to around 1 million people in Aotearoa New Zealand are suffering from a respiratory disease.
- The cost to the country is conservatively estimated at \$8.7 billion per year
- Respiratory diagnoses accounted for around one in 11 hospital admissions in 2019 and is New Zealand's third leading cause of death.

Auckland District Health Board reports:⁸

- The average cost per day for an adult patient in ICU in Auckland with a respiratory complaint is \$7259. This includes all costs associated with their ICU stay including laboratory, radiology, pharmacy and associated theatre costs if theatre support is required during their stay.
- The average cost per day for an adult patient in a ward in Auckland is \$1219.

Addressing illnesses related to poor housing can free up our health service to focus on other issues. According to Auckland Council's Auckland Plan 2050, unhealthy homes can also heighten the risk of physical injury and can lead to depression and other forms of mental illness.

What is the goal?

The NZGBC represents a community of over 700 member organisations – as well as working with hundreds of other stakeholders across the built environment – who all believe in a better built Aotearoa. Through our work and discussions with leading voices in the housing sector, it is clear government and industry should act urgently to ensure that everyone in New Zealand has a home that is:

1. **Weathertight** - keeps out rain and draughts.
2. **Comfortable** - warm in winter and cool in summer.
3. **Dry** - lower humidity reduces risks of condensation and mould.
4. **Energy efficient** - to keep energy bills affordable and carbon emissions low.
5. **Electrified** - fossil fuels are eliminated.
6. **Accessible** - housing is future proofed for all abilities, ages and needs.
7. **Climate resilient** - to impacts such as storms and extreme heat.
8. **Safe** - from flooding, fire, injury, and invasion.
9. **Affordable** - housing for everyone.⁹

In this Roadmap, we are concentrating on the elements of fabric and services¹⁰ – the first five items in this list - that contribute most to health improvement and carbon reduction outcomes for our existing homes. While out of scope for this Roadmap, retrofitting homes to improve thermal comfort and energy efficiency can effectively improve resilience to extreme temperatures. In addition, building enough new housing, and especially social housing, to reduce fuel poverty and eradicate homelessness in Aotearoa New Zealand is a critical part of how we can achieve the other goals for our homes listed above. With enough housing for everyone, we can start to provide greater choice and affordability.

Retrofitting our existing homes

This Roadmap aims to demonstrate why Aotearoa New Zealand needs wide-scale programmes for deep and shallow retrofits¹¹ to our existing housing stock, how we can achieve this and what we stand to gain. Building on the call for action, *The Homes We Deserve*¹², the NZGBC is calling for a government-led, fully-funded programme of deep retrofits for Aotearoa New Zealand's 200,000 worst performing homes. The main objective is to improve the health of our most vulnerable households who struggle to afford the costs of heating and, in a rapidly changing climate, cooling their homes. A deep retrofit programme for this segment is costly. However, full subsidy by the Government is justified by the significant savings it will help to deliver to our health system along with other cost of living, productivity and learning benefits for our most in-need households.

In addition, BRANZ (the Building Research Association of New Zealand) has identified that a programme of shallow retrofits, in particular upgrading services, for all existing homes will also be needed as part of New Zealand's climate change commitments.¹³ A new report from advocacy body, Rewiring Aotearoa, champions switching from gas to electrical heating, hot water and cooking in our existing homes, and installing solar, battery storage and EV charging as a cost effective way to help the country achieve net zero carbon by 2050.¹⁴

A range of mechanisms will be required to enable the retrofit movement we need, such as:

- continuing and expanding the successful Warmer Kiwi Homes programme (WKH)
- expanding funding mechanisms such as green or healthy home loans from banks and council lending through Voluntary Targeted Rates (VTRs) or a nationally consistent home improvement loan programme
- providing unbiased information and advice through programmes like Eco Design Advisor
- empowering homeowners and renters to make more informed choices through the implementation of Energy Performance Certificates (EPCs)¹⁵ on all homes at point of sale and rental

- developing a focus on existing homes as part of building regulation upgrades within ongoing programme to improve the New Zealand Building Code (NZBC)¹⁶.
- building industry capacity by expanding apprenticeship schemes in core skill areas such as construction, electrical, plumbing and insulation.

Barriers to retrofits

There are many reasons why so many homes in Aotearoa New Zealand are not already undergoing deep retrofits. These include:

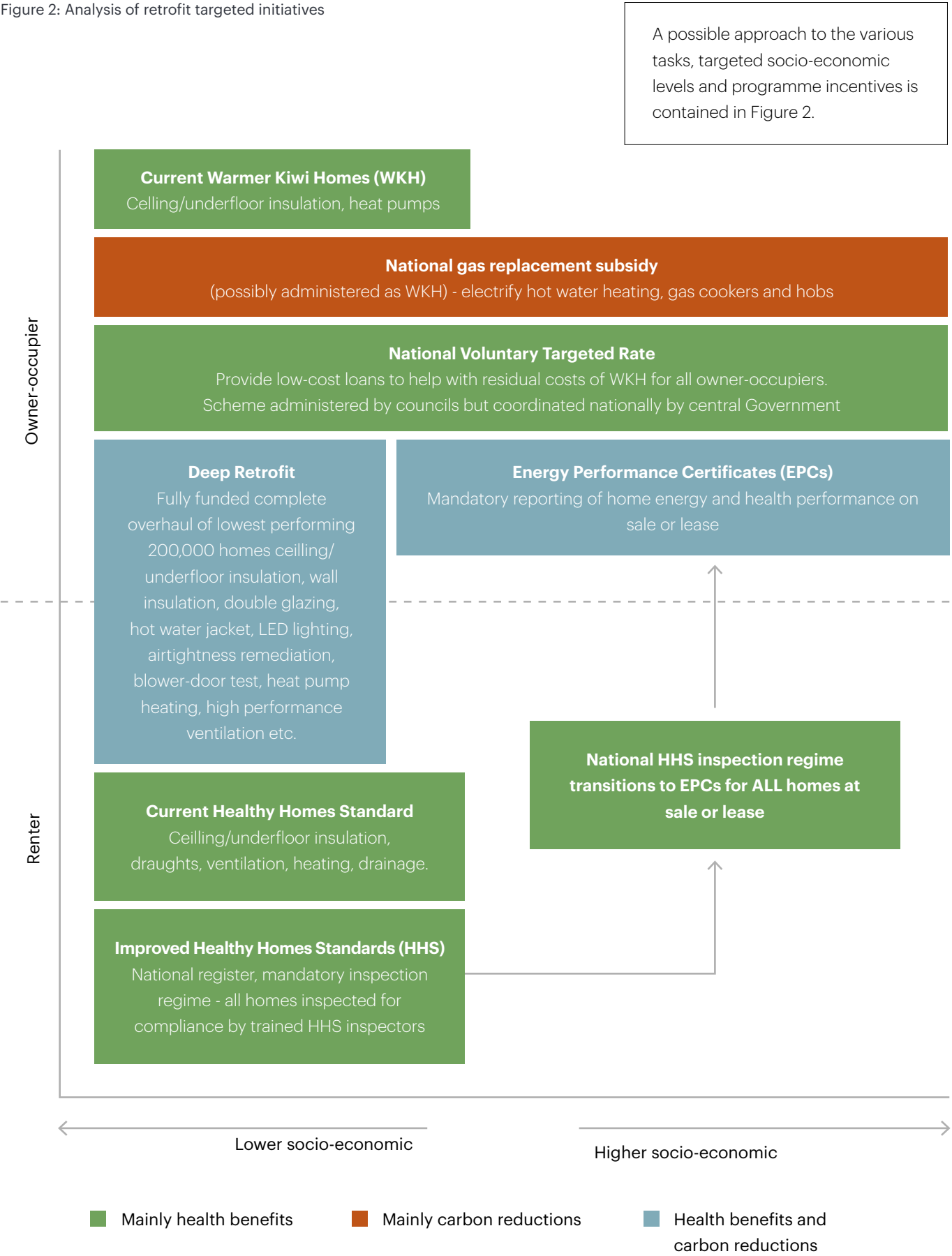
- **Lack of access to finance** - for a range of reasons, people may lack access to appropriate finance, or to programmes that can assist them with retrofits.
- **Lack of ownership** - research shows that tenants are more likely to be living in homes in need of improvement, but they can only make the most superficial interventions.¹⁷
- **Split incentives** - in rental homes, landlords must spend the money to make improvements, but tenants reap the benefits if comfort is improved and energy bills are reduced. There is no nationally approved methodology for energy labelling homes that might see better performance reflected in housing values.
- **Complexity** - deep retrofits can be complex, involving a range of trades and services, and many people lack the knowledge and/or confidence to take on this kind of project. In addition, homeowners may hesitate to start a renovation for fear of what might be uncovered once work begins. Issues might include subsidence, insufficient drainage, unsafe wiring, asbestos, or damage caused by water ingress.
- **New Zealand's house types** - a large cohort of housing built before insulation was mandatory may have issues that make them harder to retrofit. Features such as skillion roofs (sloping roofs without an attic space) make insulating more difficult and expensive; concrete or low suspended floors often cannot be adequately insulated; and aluminium joinery limits the benefit of retrofit double glazing.



- **Legislation** - when people make improvements to their homes, they can legally replace like-for-like (for example single glazed windows or insulation). Not only do current regulations allow replacements below current standards, but making improvements may trigger a consenting process.
- **Conflicting or biased information** – Some homeowners may have limited access to independent advice while suppliers may create confusion with conflicting advice.
- **Lack of awareness** - people may not realise the impact that retrofits can have on their comfort, health, and the energy performance of their homes. Some home improvements focus on adding space, or improving kitchens or bathrooms, and miss the opportunity to improve the thermal comfort and energy performance of their homes.



Figure 2: Analysis of retrofit targeted initiatives





Why improving our homes matters

A strategy to improve our existing homes is needed to address two critical objectives – the human, financial and wider economic costs of housing-related illness, and the urgent need to decrease residential building carbon emissions to meet our climate goals. Both are significant challenges for Aotearoa New Zealand, and they require different strategic and funding approaches due to the differences in target populations and housing types.

The good news is that in addition to the significant gains we can make against our national health and climate goals, taking action to improve our existing homes delivers multiple additional benefits, particularly for improving productivity, creating jobs and opportunities to upskill our buildings-related workforce. A report by NZGBC released in 2020, *A Green Recovery: Kick-starting a just transition with healthy homes, providing a multi-billion dollar boost*,¹⁸ proposed three key actions that would improve 120,000 existing homes. These actions were to:

- expand and scale up Warmer Kiwi Homes
- stimulate private investment in improvements through expanding Voluntary Targeted Rates (VTR) schemes
- kick-start a market transformation by introducing energy ratings for homes.

Modelling showed that these actions would deliver over 1000 jobs and a net benefit of \$1.5 - \$3.1 billion. Benefit cost ratios for investment in improving Kiwi homes through Energy Efficiency and Conservation Authority (EECA)-led programmes are some of the strongest for government policy intervention in any area.¹⁹ This is without even considering benefits beyond healthcare savings related to respiratory illness and household electricity and gas savings. If other housing-related health savings, economic or social benefits of reduced days off school or work, carbon reductions or improvements in air quality were also factored in, the net benefits would likely be even higher.²⁰

This Roadmap recommends actions that build on those outlined in A Green Recovery and The Homes We Deserve call to action to deliver greater benefits to our most in-need households and set Aotearoa New Zealand's housing stock on a path to net zero emissions by 2050.

We have broadly characterised these approaches as deep and shallow retrofit strategies and detail these in our first two recommendations.





Recommendation 1: Implement a wide-scale deep retrofit programme

We are calling for a government-led, **fully funded programme to retrofit Aotearoa New Zealand's 200,000 coldest homes.**

The impacts of undertaking 200,000 deep retrofits has the potential to be profound, not just for the health of those households targeted by the programme, but for upskilling industry, improving supply chain capacity and choice, and driving down costs of materials and products that will be critical to the retrofits we need to hundreds of thousands more existing homes (see Recommendation 2).

It could be argued that because the benefits of such a programme largely accrue to the health and wellbeing of occupants, this programme could come fully or partially from the health budget. This is not to further burden the health system in trying to correct a problem caused by our historical building standards. Any funding for this programme should be in addition to that already budgeted for the health sector. As cost benefit analysis shows, it is likely that this investment will return significant benefits.

Programmes like the Healthy Homes Initiative show the benefits of health outreach initiatives in the community, with targeted households being those presenting at hospitals or their GP and community/health providers identifying a need for support. Because reduced healthcare and hospitalisation costs are the major benefits of a deep retrofit programme, we propose that the HHI be expanded to fund a wide-scale deep retrofit programme, initially as a 300 home pilot and expanding to 1000 homes in Year 2 with wide-scale rollout in ensuing years.

A wide-scale deep retrofit programme will target Aotearoa New Zealand's 200,000 coldest homes, both rentals and owner-occupied, and fully-fund their complete transformation with ceiling, underfloor and wall insulation, double glazing, airtightness, and ventilation as well as upgrading services such as space and hot water heating, and lighting where appropriate.

House construction standards

Aotearoa New Zealand has over 1,865,000 households.²¹ We are building approximately 30,000 new homes²² each year but almost half of the houses we live in are more than 45 years old.²³ Around 800,000 existing homes were built before insulation became a requirement in 1978. Worldwide, eighty percent of the homes that exist today will likely be standing in 2050²⁴, by which time our nation has committed to achieve a net-zero-carbon economy.

Data from Statistics New Zealand's 2021 General Social Survey (GSS, also known as the Wellbeing Survey)²⁵ shows that just under half of all respondents felt that their house was too cold all or some of the time. This number was broken down further:

- People renting were more likely to be living in homes that were too cold most of the time, and people living in crowded homes were even more likely to be living in cold homes.
- Single parent with children households were more likely than other family types to be living in homes that were too cold most of the time.
- People who identified as Pasifika were the most likely to be living in homes that were too cold most of the time, followed by Māori and Asian households.
- People who identified as disabled were much more likely to be living in homes that were too cold most of the time.

Research undertaken in 2021²⁶ analysed the condition of owner-occupied and rented houses by linking a Pilot Housing Survey (PHS) with the 2018 Census, and the 2018 GSS. Their conclusions were:²⁷

- 49.2% of houses had less than adequate levels of insulation in the roof space (no difference between rented or owner-occupied houses on this measure).
- 75.7% of houses were entirely single glazed (compared with nearly 90% double glazed in the UK).²⁸
- Owner-occupied houses were twice as likely to be double glazed as rented houses.
- 72.5% of houses lacked any kind of ground moisture barrier.
- Rented houses were more likely to have either no heating measures, or portable electric heaters, or fixed electric heaters (not to be confused with heat pumps).²⁹

Other issues include poor indoor environmental quality (IEQ) from a range of pollutants including gases from combustion, which can include carbon monoxide, a lethal and odourless gas from malfunctioning gas appliances; carbon dioxide and moisture from normally operating gas equipment such as unflued gas heaters and stoves; and particulate from inefficient wood burning fires (which also contribute to outdoor air pollution).³⁰





Case study 1: Asthma

While asthma has a high prevalence in English-speaking countries, across socio-economic demographics, Aotearoa New Zealand has a higher prevalence of asthma in children than other OECD countries.³¹ Asthma affects a person’s airways and makes it difficult to breathe. Poor indoor environment conditions, such as indoor dampness and mould are associated with the increased risk of developing asthma in children.³² Research also shows that a child living in a home with gas cooking faces a comparable risk of asthma to a child living with household cigarette smoke.³³

- According to Asthma NZ’s website, as well as the health effects:
- People with asthma have **ten more days off work** per year than the national average.
 - Children with asthma **miss four more days of school** per year than children without asthma
 - **74%** of those with asthma are unable to work to their full potential.

Evaluating the benefits to respiratory illness from home improvement programmes

EECA’s Warmer Kiwi Homes (WKH) programme has now completed more than 110,000 installations of insulation, heat pumps and solid fuel burners since its launch in July 2018. Combined with predecessor programmes, Warm Up New Zealand: Healthy Homes and Warm Up New Zealand: Heat Smart, the Government has subsidised just under half a million heating, insulation, and other improvements. An evaluation of WKH found that it delivers \$4.66 of benefits for every \$1 spent. This is primarily realised through health benefits and flow-on effects.³⁴



Case study 2: Rheumatic fever

Rheumatic fever is a disease which is rarely found elsewhere in the developed world. It can be exacerbated by cold, overcrowded homes and leads to serious health outcomes, particularly in disadvantaged Pasifika and Māori communities.

An example of what could be achieved through retrofit interventions is demonstrated in the evaluation of the Healthy Homes Initiative (HHI), which was implemented specifically to address this illness. A five-year evaluation of the HHI interventions concluded that:

"In the first five years post-intervention, the expected savings in healthcare costs are approximately \$300 million. In addition to these impressive returns, which are attributable to significant improvements in health outcomes, there are indications of social co-benefits including more days at school for kids and higher employment earnings for those of working age." ³⁵

Evaluating the benefits to incidence of rheumatic fever from home improvement programmes

- The impacts of the campaign to reduce rheumatic fever included:³⁶
- The number of hospitalisations per person reduced by 18.6%, this means 10,354 hospitalisations avoided per year.
 - Increased school attendance with absences due to illness decreasing by 5%
 - After the intervention, adults aged 24 to 64 were on 9% fewer benefits, and were 4% more likely to be employed.
- The evaluation of HHI concluded that the expected value of social benefits from the 28,625 HHI interventions, in the first year following the intervention, was approximately \$95 million. Given a total cost of \$91 million, this means that in the first year alone, the value of the social benefits alone exceeded the cost of the programme.



Why only deep retrofit our coldest homes?

Previous economic analysis of EECA programmes has focused on the relatively shallow retrofits funded, such as ceiling and underfloor insulation and living room heat pumps. NZGBC commissioned work in 2022 to examine the likely costs and benefits of deeper retrofits including wall insulation, double glazing, and airtightness. The benefits examined include reduced demand on the electricity grid and the New Zealand health system.

This study has some interesting conclusions:

1. Deep (fabric) retrofits can be expensive compared with the shallow retrofits subsidised by EECA to date. The cost per home of a deep retrofit was found to range from \$22,000 to bring an older villa up to current H1 standards³⁷ in Auckland, up to \$190,000 to bring a 1970s home up to the German Passive House EnerPHit³⁸ standard in Queenstown.
2. Cost-benefit ratios range from good (over 1) to poor depending on a range of factors. Most importantly, the highest cost-benefit ratios are found in easy-to-treat homes in colder climates that are currently underheated and therefore impacting the health of occupants. 'Easy-to-treat' generally means older homes with suspended floors and attics and timber joinery. The analysis underpinning the study estimates that around 5-10% of New Zealand homes fit this category (underheated and easy-to-treat).
3. There can be a trade-off between health and carbon savings. Generally, treating the coldest homes has the best cost-benefit ratio from a reduction in health costs but can result in higher carbon emissions because of the 'take back' effect.³⁹ In colder homes occupants tend to 'take back' most of the savings from improvement by running heaters longer – this means higher indoor temperatures and better health, but may mean less opportunity to reduce energy costs or carbon emissions. It should be noted, however, that this may not be the case if 'system' improvements are also made, such as replacing electric heaters with more efficient heat pumps. This was not examined in this

study, but WKH has shown that heat pumps result in *both* warmer temperatures and electricity savings.

4. Cost-benefit ratios are much higher where labour costs can be reduced. This would be in instances where homes are being renovated anyway and therefore labour is already on site.

It is important to note that the work was limited to fabric improvements. More work is planned to examine the costs and benefits of a full package of retrofits that includes upgrades to services such as heat pump hot water and space heating, and LED lighting, and to find the most economically beneficial level of retrofit for different housing cohorts. However, the work's most important conclusion is that government funding of deep (fabric) retrofits should focus on families in fuel poverty.



Recommendation 2: Radically expand the Warmer Kiwi Homes subsidies for a shallow retrofit programme

We are calling for a government-led, **partially subsidised, shallow retrofit programme** to improve hundreds of thousands of other existing homes, predominantly aimed at reducing energy use as the sector's contribution to our climate change targets.

We need to encourage the electrification of our existing homes if we are going to achieve net zero carbon by 2050. Funding for this programme will require investment from the emissions reduction plan budget.

Warmer Kiwi Homes and other programmes (see Appendix A) have made measurable improvements to homes and significant improvements to health and wellbeing outcomes for their occupants.

To set Aotearoa New Zealand's existing housing stock on a path to net zero, while improving comfort, health, and cost of living outcomes, Warmer Kiwi Homes should be substantially expanded to include additional measures to reach more households, support further energy efficiency improvements and replacement of gas space and hot water heating and gas cooking appliances.

Warmer Kiwi Homes is currently only open to community service card holders and homes in NZ Dep deciles 7, 8, 9 and 10. Including other deciles should also be considered, perhaps with a sliding scale of subsidy. For example, opening the scheme to homes in decile 6 with a 50% subsidy, instead of the 80% subsidy currently available to deciles 7-10.



Energy use and carbon

The Ministry for the Environment's (MfE) Emissions Reduction Plan identifies that the operation of buildings contributes around 10% of total carbon emissions. Around half of these - or 5% of our total national carbon emissions - can be attributed to residential buildings.⁴⁰

Approximately 90% of electricity⁴¹ in Aotearoa New Zealand is drawn from renewable sources. However, when electricity demand is high - for example, during winter cold snaps - coal and gas-fired generation is used to meet shortfalls. In addition, electricity demand spikes during cold snaps increasing the chances of power grid blackouts. Inadequate housing conditions mean households require more energy to maintain a comfortable temperature level.

The Residential Baseline Study⁴² examines energy use in homes and shows the average energy use per dwelling has been falling since 2004, outweighing the growth in energy use due to increasing housing numbers. There is no evidence, however, that this drop in demand will continue, particularly as we electrify our homes (replace gas appliances with electric ones) and add EV charging.

Research in 2020 modelled that existing housing stock emissions (67,030 kt CO₂-e from 2018-2050) are exceeding the carbon budget (13,974 kt CO₂-e) by a factor of five.⁴³ This research also indicates that new buildings need to be far more energy efficient than current building standards require. To meet our carbon budget, the energy performance of both new and existing buildings must be lifted.

In 2023, BRANZ published the research report, *Housing Stock Strategies Responding to New Zealand's 2050 Carbon Target*.⁴⁴ This study investigates three possible future scenarios to better understand the potential to reduce Aotearoa New Zealand's carbon contributions from dwellings. Both operational and embodied carbon emissions for new and existing dwellings are accounted for. Three dwelling typologies are examined: detached, townhouses (medium density) and apartments.

Given the findings of this research, the following sections of the Roadmap examine the types of improvements that can address either or both of the health and emissions challenges.





What do we change?

Retrofitting is the process of modifying a home after its initial construction and occupation and aims to improve the performance of the building and improve amenity and comfort for the occupants. Retrofits to homes can be extensive, also described as “deep”, or “shallow” (though it is important to note that shallow retrofits can still deliver noticeable improvements to comfort and energy efficiency). Retrofits can focus on changing the fabric of a home (such as cladding, roofing, windows and insulation) or services (such as upgrading appliances for space and water heating, lighting upgrades and adding or improving mechanical ventilation) or both.

To compare, **shallow retrofits**, such as those delivered by Warmer Kiwi Homes, focus on ceiling and underfloor insulation, ground moisture barriers and heating for the main living room.

Shallow retrofit measures could also include continuous mechanical ventilation, replacement hot water systems,⁴⁵ lighting and water saving fixtures (see figure 3).

For the purposes of this Roadmap, a **deep retrofit** means significantly improving the energy and carbon performance, thermal comfort, indoor air quality and resilience of an existing home by upgrading multiple aspects of its fabric and services. For example, deep retrofits could include best practice ceiling, underfloor and wall insulation, high performance windows, airtightness measures and continuous mechanical ventilation (see figure 4).





Figure 3:

Shallow Retrofit

Partial retrofit	Thermal comfort/ health benefits	Efficiency/ carbon saving benefits	*Costs	*Ease of installation
Insulate ceiling (if accessible or when reroofing), and upgrade downlights to IC-rated LEDs (add floor insulation plus ground vapour barrier where suspended floor)	Low	Medium	\$\$	Moderately easy
Insulate old electric HWC/switch gas system to heat pump or solar	Low	High	\$\$	Easy
Replace gas space heating with heat pump.	High	High	\$\$	Easy
Install continuous extract ventilation	High	Low	\$\$	Moderately difficult

*(see Appendix C for detail)

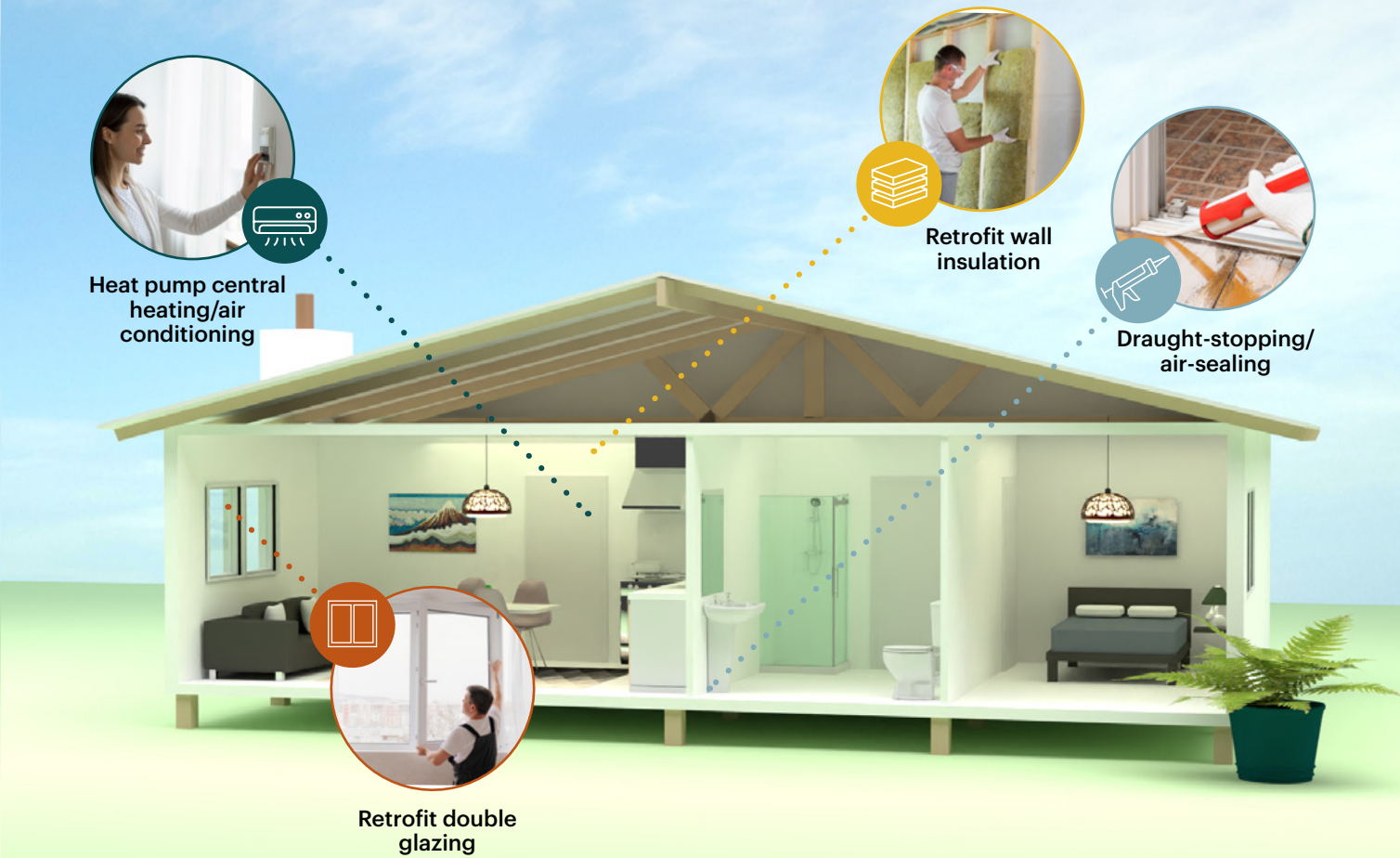


Figure 4:

Deep Retrofit

Full retrofit (all of the partial retrofit features plus)	Thermal comfort/ health benefits	Efficiency/ carbon saving benefits	*Costs	*Ease of installation
Wall insulation (H1 standard)	High	Medium	\$\$\$\$	Moderately difficult
Double glazing (H1 standard)	High	Low	\$\$\$\$	Moderately difficult
Install heat pump central heating/air conditioning	High	High	\$\$\$	Moderately easy
Retrofit for airtightness/pressure testing	Medium	Medium	\$\$\$	Moderately easy

*(see Appendix C for detail)

Expand the package of measures. While insulation and heating are two of the most impactful measures, and have been the focus of Warmer Kiwi Homes and its predecessors, a more comprehensive package of measures will deliver cost-effective outcomes for energy hardship, health and comfort, and emissions. Additional measures should include:

- **Home assessment.** Include an independent home assessment before and after each Warmer Kiwi Homes package to contribute to a national data set and form the basis for future deeper retrofit planning.
- **Hot water cylinder retrofit insulation and controls.** According to the BRANZ House Condition Survey⁴⁶ nearly 500,000 homes have older cylinders that would benefit from a ‘wrap’. Insulating these cylinders would save in the region of \$40 million annually in electricity costs and reduce carbon emissions by around 20,000 tonnes per year.
- **Gas system replacement.** Subsidise the replacement of gas heaters with heat pumps and replace gas hot water systems with electric-based systems. The funding for 7,500 heat pump hot water systems included in Budget 2023⁴⁷ that was removed in Budget 2024 should be resurrected and scaled up significantly. These systems offer efficiencies up to three times that of conventional electric storage water heaters or gas water heating
- **Downlight replacement.** Older downlights are usually energy inefficient halogen or incandescent models with open fittings, bringing in potentially damp and unhealthy air and allowing heat to escape to the roof cavity. Replacing them with either IC-rated LEDs or removing them altogether (and fitting ceiling mounted lights) results in a win-win outcome with improved energy efficiency as well as allowing improvements to the ceiling insulation. Budget 2023⁴⁸ provision for LED lighting in WKH (that was similarly defunded in Budget 2024) needs to be returned and must go further to address the issues with older downlights.

- **Installing efficient and effective kitchen and bathroom ventilation.** Install efficient bathroom fans (powerful and quiet) that operate on timers (or continuously) and kitchen fans that can be run intermittently (e.g. exhausting smoke quickly) or quietly removing moisture for longer periods at lower speed (e.g. kitchen rangehoods with motors located in the ceiling space).
- **Basic draught stopping and double layer curtains.** Warmer Kiwi Homes could refer households to local community providers that have access to curtain banks and stocks of simple and cost effective draught stopping products. For example, organisations such as Community Energy Action, Habitat for Humanity and Sustainability Trust operate curtain banks and provide a range of draught-stopping products at low or no cost.
- **Fund building repair and improvement work to support home retrofit programmes.** Funds for repair work was included in Budget 2023⁴⁹ for Warmer Kiwi Homes and is also a critical element of a deep retrofit programme. Currently homes with walls, cladding or roofing in bad repair are not eligible for Warmer Kiwi Homes, meaning the homes in most need of help can be overlooked. This element of the programme will need to be scaled and funded appropriately.
- **Expand funding to include heating for bedrooms as well as the main living room.** The overnight temperature of bedrooms has a higher impact on health outcomes for occupants. The World Health Organisation suggests that the optimal overnight temperature should be 18°C for healthy adults and 20°C for bedrooms of young, old, and unwell people.⁵⁰ In many homes in Aotearoa New Zealand, bedroom temperatures may be as low as below 16°C or lower.

A summary of critical measures for deep and shallow retrofit measures is outlined in more detail in Appendix C.

The extent of the challenge

To design a wide-scale retrofit programme, we need to understand more about our existing homes so we can decide how and where to target retrofit efforts most urgently and effectively. A 2023 report⁵¹ segments existing homes by their construction typology, their location according to the New Zealand Index of Deprivation (NZ Dep)⁵² and the proportion that is likely to be suffering from dampness and/or mould (extrapolated from census data). See Appendix D for more detail.



How do we create change?

Retrofits are most urgently needed in our worst-performing homes - we are calling for a government led, fully funded deep retrofit programme for our 200,000 coldest homes. This should be coupled with a wide-scale shallow retrofit with a focus on electrifying homes (replacing gas appliances) to radically reduce their carbon emissions and enabling a range of other retrofit activities that will improve comfort, health outcomes and energy efficiency and get our existing housing stock to net zero carbon by 2050. Facilitating the transition to healthier, more efficient, low carbon Kiwi homes will require a range of delivery and funding mechanisms.





Recommendation 3: Roll out a national home improvement loan programme to provide the balance of funding (not subsidised by Warmer Kiwi Homes) at Government interest rates for owner occupiers and landlords to achieve 250,000 energy efficient homes by 2035

Government has the opportunity to commit to offering a national finance scheme, or agree to underwrite a Voluntary Targeted Rates (VTR) scheme with a nationally consistent offer, process and loan guarantees for any council that is not able to offer these (utilising the Government's lending strength to make loans as cheap as possible, preferably zero interest).

Other funding programmes that need to be considered:

Sustainable finance. We recommend that the Government and other providers explore further opportunities to issue or access sustainability or green bonds to fund retrofits and to provide tax incentives for landlords on retrofit measures.

Explore funding opportunities from energy and charitable sector. Seek funding from the energy sector through an expansion of the levy required under the Energy Industry Act in home improvement and advice services such as EnergyMate (see Appendix A). Another resource that remains relatively

untapped is philanthropic funding. Charitable trusts and NGOs may benefit if there were increased tax incentives for donations aimed at home improvement projects.

Accelerate the transition to zero carbon by encouraging fossil-fuel free homes. Offer incentives for switching from gas to electric appliances in existing buildings while requiring new homes to be fully electric and new developments to avoid gas infrastructure completely.

Recommend banks to consider extending the terms of home improvement loans to similar terms as council VTR loans (i.e. 10 years).

Funding mechanisms

Retrofitting the rest of our existing homes – beyond the worst 200,000 homes – at the scale and pace we need, will require government leadership coupled with funding to support and incentivise the market to make improvements. It will be an investment into our nation's health, wellbeing, and productivity as well as critical to ensuring our existing homes are net zero carbon by 2050. A range of funding mechanisms and programmes will help address the diversity of Aotearoa New Zealand's existing homes.

Voluntary Targeted Rates

Councils offer a range of various subsidies, programmes, and initiatives to support people to make improvements around the home to positively impact outcomes for comfort, energy use and more. Voluntary Targeted Rates (VTR) schemes for home improvements optimise councils' opportunity to collect repayments for loans and administer subsidies. Underwriting councils to facilitate this mechanism at local level, or establishing a central scheme can build on the success of such programmes run by local and regional councils to date. See Appendix A for more details.

Sustainability finance and tax incentives

Green bonds and other debt instruments focused on sustainability outcomes are increasingly important in global finance markets. Kāinga Ora is Aotearoa New Zealand's largest issuer of sustainability bonds⁵³ and raises Wellbeing Bonds to fund eligible portfolios of sustainable activities, including retrofit of existing public homes⁵⁴.

Tax-related incentives to encourage and support landlords to undertake independent home assessments and selected retrofit activities could result in a range of positive benefits for the quality of rental housing stock and tenants.

An incentives programme could be backed by a compliance check or regulations to ensure minimum standards are met, and aiming for higher targets is encouraged.

Targeted incentives

Even in the able-to-pay market, we know that incentives can be effective. For example, the Warm Up New Zealand: Heat Smart programme had broader eligibility for subsidies than the Warmer Kiwi Homes scheme, and saw strong uptake. Owner-occupiers, who are not currently captured under the provisions of the Healthy Homes Standards (HHS) as it falls under the Residential Tenancies Act, are currently not required to make improvements. Expansion of the Warmer Kiwi Homes subsidies (where eligibility is subject to income levels), may encourage improvements through the availability of grants, rebates, or subsidies.

While landlords are required to comply with HHS, research shows that rental properties are generally in poorer condition than owner-occupied homes.⁵⁵ Landlords must take responsibility for retrofitting and upgrading their assets, but if we want to move further and faster towards our goals for healthier homes and emissions reductions, incentives for landlords should be considered. This is particularly true for measures currently outside the scope of the current HHS, such as replacement of gas appliances.

Energy sector and philanthropic funding

The Electricity Industry Act 2010 includes provision of levies on participants in this sector to pay for various home improvement services, including funding towards EECA. The amount is at the discretion of the Minister but could be substantially increased. Lines companies (or their shareholding trusts), for example, could provide retrofit funding for their customers (as has previously been provided).

Not-for-profit community-based organisations help households bridge gaps in funding (often providing top-ups on government subsidies), as well as offering a range of small-scale interventions themselves. Partnerships between these organisations and energy companies or charitable trusts are already in place in various regions around the country but could be further leveraged to ensure that those most in need of interventions do not miss out.





Retail finance products

Most of our major banks now offer green financing products that are linked to improving the comfort and/or energy performance of the homes of mortgage customers. Some banks offer mortgages with lower interest rates for customers that can demonstrate their homes have greater energy performance and other sustainability and wellbeing outcomes, such as those with Homestar ratings of 6 or greater. Other products include mortgage top-ups at a low or zero interest rate for a fixed term to allow homeowners to make improvements such as installing insulation, heat pumps, moisture barriers, double glazing and more.

Aotearoa New Zealand's banks have strong commitments to supporting the economy and the community in the transition to a zero-carbon future through their commitment to the Net Zero Banking Alliance. Banks will also have increasing commitments to climate-related financial disclosure and mortgage lending will eventually need to be accounted for in this reporting. An EPC-type Performance New Zealand scheme (see page 34) would support this approach.

While interest rate discounts are attractive, limitations on the terms of these discounted rates mean customers may be taking on more mortgage debt than they expect and can pay off within the terms of these rates. To make such rates comparable with local government loans, we recommend banks consider extending these discounted rates to similar terms (i.e.10 years).

New Zealand banking products that support healthier homes:

- ANZ Good Energy Home Loan⁵⁶ of up to \$80,000 at 1% pa interest – fixed rate for 3 years.
- ASB Better Homes Top Up⁵⁷ of up to \$80,000 at 1% pa interest – fixed rate for 3 years.
- BNZ Green Home Loan Top-Ups⁵⁸ of up to \$80,000 at 1% pa interest – fixed rate for 3 years.
- Westpac Greater Choices Home Loan⁵⁹ of up to \$40,000 at 0% interest for 5 years.
- Kiwibank Sustainable Energy Loan⁶⁰ offers a grant of up to \$2000 (paid over 4 years) on loans for an approved renewable energy system – solar PV, small scale hydro, wind energy or geothermal, at 8.25% pa interest.

These bank offerings are subject to change. It is recommended that readers contact their bank or check bank websites for latest offerings.





Recommendation 4: Trial an Energy Performance New Zealand Certificate

Implementing a mechanism to measure and report a home's energy, health and carbon performance provides a valuable dataset, a baseline for improvement and empowers homebuyers and renters to make informed decisions about the homes they choose to live in. In Europe, this mechanism is often known as an Energy Performance Certificate (EPC), and similar mechanisms are already in use in many countries.

Delivery mechanisms

We recommend that Ministry of Business, Innovation and Employment (MBIE) work with stakeholders from across the property sector, as well as with financial institutions and others, to create a mechanism to capture a home's energy, health, and carbon performance. This information would be easily accessible through council LIMs or a national register. It would need to include an assessment for homes (with a balance between cost and thoroughness of assessment) and could include a plan for recommended improvements.

MBIE is working on changes to the Building Act 2004 that would allow it to introduce mandatory energy labelling of buildings. At present, the main proposal in the Emissions Reduction Plan is the introduction of EPCs for new commercial (i.e. offices, warehouses etc) and residential apartment buildings.

The Healthy Homes Standards, which currently only apply to rental properties, could be developed as a starting point for a mechanism to report a home's energy, health, and carbon performance on a national register. It is already mandatory to record the level of compliance with the HHS on rental agreements.

We recommend exploring how this could be advanced by:

- Recording the level of compliance on a national register. For rigour and transparency this must include a formal, mandatory inspection regime with trained and licensed inspectors. This would also offer better protection to tenants who must currently report landlords to MBIE if their home does not meet HHS and this can make them vulnerable to rent rises or other repercussions.
- Expanding the requirement to report on homes for sale. We propose that there would be no requirement to reach a minimum level of energy efficiency, just transparency at point of sale, but scope should include the potential for mandatory minimum energy performance standards soon (possibly within five years, see proposed Timeline Figure 1).
- Expanding the items required to be reported to include the presence of wall insulation, glazing type, hot water type, and level of insulation (where relevant).

EU legislation requires the above information to be fed into an algorithm that gives the home an energy efficiency score (A-G). MBIE would need to develop this algorithm for New Zealand conditions, considering the nature of housing typologies here compared with Europe and designing it to be modelled remotely to reduce assessment and modelling fees. Much of this data already exists and, if well designed, would potentially lead to much greater savings to homeowners.

Energy Performance Certificates

As a precursor to implementing retrofit programmes, the European Union requires all homes to have an Energy Performance Certificate (EPC)⁶¹ on sale or lease of a home. Also known as Building Energy Rating certificates (BER) in Ireland, EPCs are like energy efficiency labels for vehicles and appliances and give the home an A-G rating typically based on its predicted energy running cost.

EPCs improve transparency and allow people to understand the performance of the home. Buyers and renters of homes can see how one home compares with another and are able to make decisions based on the current performance of the home and the potential improvements needed to improve the health, running costs, and carbon performance of the home.

They are critical tools in the development of housing, health and climate policies and they allow governments to target interventions towards homes identified as poorly performing and to bring these homes up to a certain standard.

A mechanism like an EPC (but developed for the New Zealand market) to report a home's energy, health and carbon performance on a national register could also be displayed on real estate platforms, raising awareness and demand for homes with better performance and/or features.

Valuers, banks, real estate and rental agencies welcome the opportunity to provide independently verified information to prospective borrowers, buyers, and tenants.

For more detail on EPCs and other delivery mechanisms, see Appendix B.





Case Study 3: How an Energy Performance Certificate might work in NZ

- An EPC would offer two scales, one covering thermal efficiency (i.e. how warm and dry) and one covering carbon emissions. This is A++ to G in the EU.
- Ratings would ultimately be based on a visit to the property by a trained inspector, but initial indicative desktop ratings could be offered based on data already known about the home including era of build, known upgrades (e.g. WKH) and type of home (e.g. standalone house, apartment, unit etc).
- Ratings of existing homes might be of the order of \$200-\$300. Ratings of new homes would be carried out as part of building consent when mandatory energy modelling is brought in.

Pathways to upgrade ratings

As an indication of likely ratings for different era of build (assuming no upgrades), then bands might range from G for early 20th century homes (with no ceiling or underfloor insulation) to B for those built to the current building code, and up to A++ for the most thermally efficient new homes. Increments of grades would be aligned to improvements in building regulations that applied at the date of construction.

EPC assessments could offer recommendations (sometimes called Renovation Passports) to upgrade to a higher energy rating.

Retrofit measures are readily and cost effectively available for early and mid-20th century homes with ceiling and underfloor cavities to bring them up to Healthy Homes Standards (allowing up to a C rating for those with wall insulation) or even B rating in retrofits that included double glazing.

More difficult would be bringing homes built in the 1930s (Art Deco) and 1970s with limited ceiling or underfloor spaces to retrofit insulation. They may require deep retrofit solutions such as warm roofs and repiling in order to meet the desired insulation levels.

Modelling thermal efficiency

Homes that were identified by built date would be relatively easy to model in terms of thermal performance. Date of construction and typology are readily available on valuation and council websites. EECA's records could also be used to verify Warmer Kiwi Home funded insulation or heating upgrades.

A standardised performance indicator range would be created after examples were modelled, and the indicator used as a default for all homes showing those age and typology characteristics.

This would simplify assessment (a quick desktop survey would allow all homes in New Zealand to be given a provisional EPCNZ rating). More detailed independent inspection and modelling, considering features that have been added since construction (including insulation upgrades and services like replacement heating, lighting, and hot water) would allow homeowners wanting to sell to upgrade their rating.

Adding operational emissions

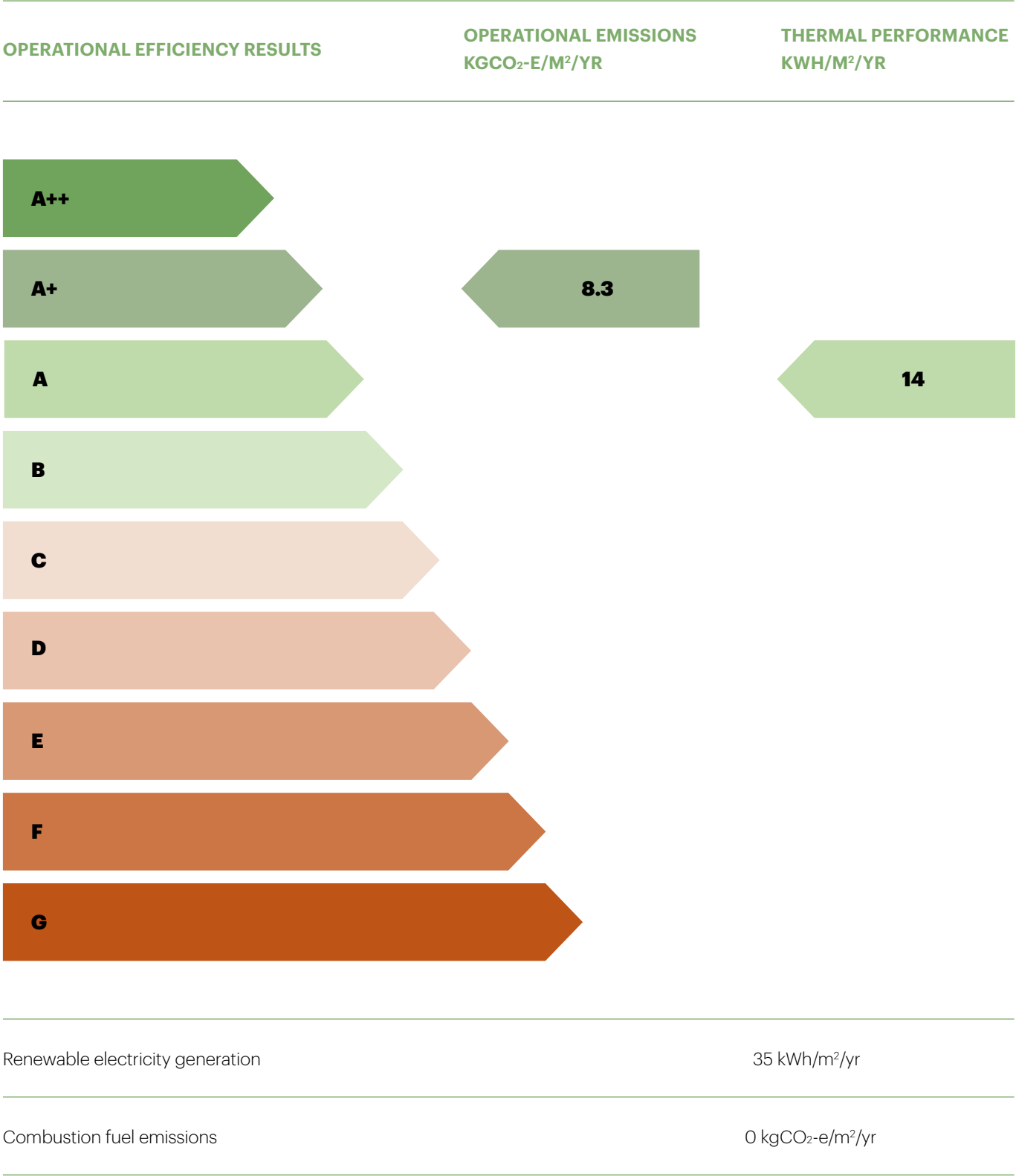
MBIE's Building for Climate Change programme has recommended a similar approach in its 2023 paper *Operational Efficiency Assessment: Technical Methodology*.⁶²

The paper adds a second tier of indicators for a more comprehensive report, modelling energy and water use in the home to report predicted carbon emissions.

While primarily aimed at new buildings, the paper says a similar approach could be used to guide renovations of existing homes.

An example of a combined thermal efficiency and carbon emissions EPC label is shown in Figure 5.

Figure 5: Example non-technical graphical output for illustrative purposes



Source: MBIE 2023, Operational Efficiency Assessment: Technical Methodology



Learning from international retrofit programmes

A critical aspect of any programme will be its delivery model. A report delivered by BERL, *Overseas programmes for improving the operational carbon emissions from existing residential buildings – lessons for Aotearoa New Zealand*⁶³, examined a range of international retrofit programmes, the delivery models they have adopted, and key lessons learnt. Models examined include:⁶⁴

- Atomised market model: The homeowner is the nucleus of this model and is responsible for independently sourcing the retrofit measures, the finance, energy audits, and installers.
- One-stop shop: This is an integrated supply chain and interface that functions as a single point of contact for the homeowner, usually for a whole-house approach.

International retrofit programmes explored in the BERL report used various combinations of these models. Further work would be needed to consider how the features of the international programmes and the different models would best apply to Aotearoa New Zealand’s own set of circumstances and the scale of the retrofit programme to be implemented.

For example, Ireland’s current, ambitious (500,000 homes to be improved to a level of ‘very good’ energy efficiency by 2030) National Retrofit Plan utilises three models for three different grants packages:

- Individual energy upgrade grant package - using the atomised model. Eighty percent of the retrofit cost is paid by the Irish Government, but the homeowner manages and pays for the retrofit work themselves and then claims the grant afterwards.
- One-stop shop service package - a complete home retrofit package provided by a company registered with the programme. The Irish Government pays 45-50% of the cost and everything, including the grant application, is managed by the service provider.
- Fully funded upgrade package - for homeowners on low incomes, all costs are covered by the Irish Government.

A one-stop shop example makes things simple and streamlined for households but requires investment of skill and time to effectively and efficiently bring together all the services needed. In this model we must also consider how smaller, local providers can be included as service delivery partners. An atomised model relies heavily on the homeowner having the capacity to source and manage all aspects of the retrofit work. This would be challenging for a deep retrofit project and while there will be a cohort of homeowners willing and able to manage this process, this model is unlikely to be able to support a programme with a target of retrofitting 200,000 homes.

Legislation

Insulation was not a requirement for new homes in Aotearoa New Zealand until 1978. The passing of the Building Act 1991 led to the New Zealand Building Code (NZBC) coming into effect as Schedule 1 of the Building Regulations 1992.⁶⁵

While the newly introduced building code was world-leading for its performance-based criteria for durability of structural elements, requirements relating to thermal performance and energy efficiency for Kiwi homes have consistently lagged significantly behind those of other developed countries with comparable climates.⁶⁶

Legislative options:

- » Mandatory upgrades to current building code when renovating walls (insulation and windows)
- » Phase out gas and other fossil fuel burning stoves, space and water heating
- » Mandatory assessment at point of sale and rental
- » Healthy Homes Standards includes Energy Performance Certificate assessment and mandatory minimum grade.



**Recommendation 5:
Bring retrofit improvements up to code**

When people make improvements to their homes, they can replace like-for-like (for example, single glazed windows or insulation). We recommend that replacement of ‘controlled fittings’ (to use UK terminology), such as windows and walls, should be to current building code standards. The costs of upgrades to the homeowner could be offset with reduced consent fees or subsidies.

The New Zealand Building Code must be updated to ensure that we set clear expectations for existing homes making alterations and encourage homeowners to do better. For example, some items of the building envelope (e.g. roof, windows) can currently be replaced without building consent provided they are replaced like-for-like, while improvements often need consent. Requiring all replacement items to meet current requirements within the building code should be compulsory, as it is in many other OECD countries.

To offset the extra administration, reduce costs and to speed up consents, implementing a ‘competent persons’ scheme’ would mean a qualified builder would be empowered to carry out the work and vouch for its compliance. Risk could be managed through use of a national accredited installer scheme for retrofit wall insulation, and requiring replacement items in homes that meet the current standards within the building code, for example, for insulation and energy efficiency.



When does it happen?

With no time to delay, we recommend that a fully-funded deep retrofit programme (Recommendation 1) is established as a high priority and takes a phased approach, initially targeting 300 homes in 2025 (with a cost of circa \$24m) and then ramping up to retrofit 200,000 homes by 2035. Simultaneously, Warmer Kiwi Homes should be expanded into a wide-scale shallow retrofit programme (Recommendation 2) and several funding and finance mechanisms should be introduced to stimulate and facilitate homeowner investment into retrofitting their own properties. This will kick-start a coordinated effort to improve hundreds of thousands of cold, inefficient Kiwi homes, and help us get to net zero emissions by 2050.

Wide-scale and deep retrofit programmes have been underway in many OECD countries for years and the European Commission's 'Green Deal', presented in 2019, commits to 'rigorously enforcing the legislation related to the energy performance of buildings', further driving retrofit efforts across member states.⁶⁷ See Appendix B for several international examples.

Staging the implementation of the deep retrofit programme means we can get started on retrofitting homes at the same time as we get started on designing the wide-scale phase of the project. The initial phase will be an opportunity to learn and gather information to inform the wide-scale programme design, such as:

- Actual costs and lessons learned on ways to balance positive outcomes with cost-effectiveness
- Training needs and supply chain considerations
- Benefits, through monitoring of the homes - BRANZ is undertaking a major monitoring programme currently (HEEP 2.0) and is intending to keep the monitoring equipment for future projects.
- How best to structure and fully cost the wide-scale phase of the programme.

The Existing Homes Roadmap (Figure 1) proposes an initial five-year period of developing assessment and certification systems, identifying targets for retrofitting, training assessors and installers and trialling deep and shallow retrofit delivery packages on a cohort of houses.

A proposed five-year plan to 2030

- Policy development and trialling, starting with the pilot phase of retrofitting 300 homes in 2025 and rapidly scaling up the programme from 2026 onwards
- growing retrofit industry capacity (external wall insulation, retrofit double glazing)
- trialling best retrofit solutions and identifying target typologies (combination of deep and shallow retrofit targets per timeline in Figure 1)
- development of Energy Performance New Zealand Certificate (EPC) modelling protocols, training of assessors



What else needs to happen?

Recommendation 6: Build industry capacity

We recommend the Government works with key organisations, tertiary institutions and training providers, industry associations and other stakeholders to:

- identify opportunities to attract and retain people to home assessment, insulation and heating installers, and other retrofit-supporting trades but adding a focus on the needs of the retrofit market and standardising qualifications for those currently not covered.
- provide greater exposure to sustainability to students and apprentices and build consistency across courses and providers with the development of a framework and supporting unit standards.



Training and building industry capacity

A programme of deep retrofitting 200,000 homes creates its own significant pipeline of work as well as helping to catalyse retrofits across the existing homes sector. To deliver such a programme, we will need a robust workforce of qualified and skilled people.

Training and qualifications exist for numerous trades, skills and providers in the industry that service existing home retrofits. Much of the work undertaken during home improvements and retrofits is governed by the New Zealand Building Code (NZBC), regulations and health and safety legislation or must be carried out by appropriately qualified tradespeople. However, there are still aspects of retrofits that remain inconsistent.

For example, home assessments are currently offered or required by a range of initiatives, including HomeFit, the Eco Design Advisor and Home Energy Advice services. These assessors are usually trained and experienced, but rolling out a wide-scale retrofit programme, or a mechanism to require a home's energy, health, and carbon performance to be captured on a national register, will require many more assessors with good technical skills and a consistent level of training.

Insulation is a critical component of any retrofit effort. The Insulation Association of New Zealand (IAONZ) offers training (one-day, online) and a qualification for insulation installers (undertaken over six months while on the job). However, most installers learn on the job, and while a growing number of companies recognise the value of formal training and qualification, this is not a requirement for installers.

The nationwide scarcity of plumbers, electricians, builders and other trades is well known. Continued focus by the Government on boosting the numbers of qualified tradespeople is critical, as is further developing the residential ventilation industry (which has no governing body) and establishing an airtightness testing industry.

Listen to what the experts say

Aotearoa New Zealand has internationally respected academic and research institutions undertaking a range of valuable research projects to better understand our buildings sector, its challenges, and the impact our homes are having on our health and economy.

This research provides an evidence base for policy design and reform. For example, the BRANZ House Condition Survey 2015 helped to inform the development of the Healthy Homes Standards.

Another way to maximise research impact is by ensuring research institutions such as BRANZ, Beacon Pathway, the world-renowned He Kāinga Oranga housing research division of the University of Otago and others can collaborate with stakeholders from the inception of projects through to communicating findings to the people who can get the most value from them - from policymakers to the community.

Engagement and raising awareness

Raising awareness of the need to improve our homes and the many benefits of healthier, more comfortable, more efficient homes will help to mobilise those who can afford to make improvements to their homes.

EECA's Gen Less initiative⁶⁸ provides a range of information, resources and campaigns for businesses and the community to encourage taking actions that will reduce energy-related greenhouse gas emissions. Some information about retrofitting homes is available but could be further developed so that people have access to the right resources at key decision points (for example, when they buy a home, or when they are thinking about extensions, alterations, or upgrades to their homes).

We recommend the Government and councils provide more funding for community-based, not-for-profit organisations that are best-placed to build trust and connect hard-to-reach households. These organisations must be well-supported to deliver services directly to households as well as referring and connecting them with government programmes, services, and agencies where appropriate.

The influence of community-based organisations is not limited to vulnerable households. They also help to raise awareness across the community about opportunities to make homes healthier and more sustainable. However, many charitable services are struggling with lack of funding, with moves to restrict community education to basic literacy and numeracy by previous governments.

Opportunities for the market

Both a government-led deep retrofit of 200,000 homes, and wider efforts to retrofit and improve hundreds of thousands more existing homes represent huge opportunities for the construction industry and the economy. A pipeline of retrofit work on this scale will require investment and planning to ensure we have enough skilled people and a reliable supply chain. However, creating a significant baseline of work can help flatten the peaks and troughs traditionally experienced by the construction sector and greater certainty allows providers in the industry to grow their teams, develop their skills and to invest in more innovative and sustainable products, materials, technologies, and services.

A baseline of retrofit work coupled with more sustainable new builds will also create opportunities for more circular models for building materials and practices.⁶⁹ For example, most people are now familiar with Mobility-as-a-Service through ride-sharing and e-bikes and e-scooter hire. Options for our homes and buildings such as Lighting-as-a-Service⁷⁰ and Comfort-as-a-Service are being adopted in many countries.



Glossary of terms and abbreviations

ABBREVIATIONS	TERM
BER	Building Energy Rating certificates
BfCC	Building for Climate Change
BRPs	Building Renovation Passports
CCCFA	Credit Contracts and Consumer Finance Act 2003
ECO	Energy Company Obligation
EECA	Energy Efficiency and Conservation Authority
EPC	Energy Performance Certificate
GSS	General Social Survey, also known as the Wellbeing survey
HHI	Healthy Homes Initiative
HHS	Healthy Homes Standards
LED	Light emitting diode
LIM	Land Information Memorandum
MBIE	Ministry of Business, Innovation and Employment
MfE	Ministry for the Environment
MHUD	Ministry of Housing and Urban Design
NZBC	New Zealand Building Code
NZGBC	New Zealand Green Building Council
NZDep	New Zealand Index of Deprivation
PHS	Pilot Housing Survey
The Government	The New Zealand Government
WKH	Warmer Kiwi Homes
WUNZ:HH	Warm Up New Zealand: Healthy Homes
WUNZ:HS	Warm Up New Zealand: Heat Smart



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Appendix A

Current and past policies and programmes



Current policies and programmes

A range of current policies aim to improve our existing housing stock. These are proven, effective initiatives but can be fragmented, small-scale, regionally patchy, and arguably inadequate as a result. Aotearoa New Zealand needs to scale up what works and properly fund both a deep retrofit programme and a shallow retrofit programme that builds on these successful programmes to achieve the transition to healthy, efficient, low carbon homes that we need.

More information on the following programmes can be found below:

- Building for Climate Change
- Eco Design Advisor Service and Home Performance Advice
- EnergyMate
- Healthy Homes Initiative
- Healthy Homes Standards
- HomeFit
- Support for Energy Education in Communities
- Voluntary Targeted Rates schemes
- Warmer Kiwi Homes

Building for Climate Change

Building for Climate Change (BfCC)⁷¹ was a long-term work programme run by MBIE. It was intended to align with and contribute to the National Adaptation Plan and Emissions Reduction Plan. Unfortunately the programme had little focus on existing homes but was focussed on:

- Improving the efficiency of buildings to reduce energy and water use and improve ventilation and building temperatures.
- Reducing the whole of life embodied carbon footprint of buildings from construction materials, process, waste disposal, and building disposal at the end of its life.
- Improving the ability of buildings to withstand future climate change events.

The programme has recently been suspended and absorbed within the Ministry of Business, Innovation and Employment.

Eco Design Advisor Service and Home Performance Advice (HPA)

Eco Design Advisors⁷² provide free advice on new builds, significant renovations and other improvements homeowners can make to existing homes to people living within supporting council areas (Dunedin, Christchurch, Hutt City, New Plymouth and Auckland).

Home Performance Advisors⁷³ operate in environment centres and district health organisations to deliver healthy home messages and programmes such as the Healthy Homes Initiative. An official training course was set up by research organisation Beacon Pathway and the Community Energy Network, with training frequently provided by Eco Design Advisors.

The HPA course Principles of Home Energy Performance is one of the pre-qualification options to undertake the HomeFit qualification.

EnergyMate

Run by ERANZ (Energy Retailers Association NZ) on behalf of energy retailers, EECA and Auckland Council, this service provides a “coach” to householders struggling to pay electricity bills in targeted regions, giving advice on ways to reduce electricity use and giving away energy saving devices such as LED bulbs.

Healthy Homes Initiative

The Healthy Homes Initiative⁷⁴ (HHI, not to be confused with the HHS) is a programme funded by the Health New Zealand Te Whatu Ora to provide warm and dry housing for low-income families with children up to 19 years old and pregnant people.

A three-year outcome evaluation of the programme found: “Cold, damp, crowded homes can increase the risk of respiratory issues and other preventable health conditions, such as rheumatic fever and skin infections. There is strong evidence, nationally and internationally, of improved health outcomes resulting from warmer and drier homes.”

The programme is provided by Māori and Pacific organisations, health providers and housing/home performance advisors, to deliver a “by community, for community” approach. The HHI focuses on delivering three key interventions:



- Access to insulation, curtains, beds, bedding, carpet, draught proofing, heating, and child safety devices
- Education and advice to support behaviour changes to keep applicants’ houses warm and dry
- Advocacy with landlords to improve the thermal envelope of a home, and to the Ministry of Social Development for support to access social housing and/or eligible allowances.

Healthy Homes Standards

The Healthy Homes Standards (HHS)⁷⁵ set minimum standards for rental properties. The HHS became law on 1 July 2019. Between 2021 and 2025, all private rentals must comply with the standards from the start of any new, or renewed, tenancy and all rental properties must comply by 1 July 2025. The standards are as follows:

- **Heating Standard** - Landlords must provide one or more fixed heaters that can directly heat the main living room.
- **Insulation Standard** - Ceiling and underfloor insulation has been compulsory in all rental homes where it is reasonably practicable to install since 2016.
- **Ventilation Standard** - Rental properties must have openable windows in the living areas and bedrooms. Kitchens and bathrooms must have extractor fans.
- **Moisture Ingress and Drainage Standard** - Efficient drainage for the removal of storm water, surface water and ground water and properties with an enclosed sub-floor space must have a ground moisture barrier.
- **Draught Stopping Standard** - A rental property must not have unreasonable gaps or holes which cause noticeable draughts. Open fireplaces must be closed off.

Landlords who fail to comply with the HHS within the compliance timeframes are in breach of the Residential Tenancy (Healthy Homes Standards) Regulations 2019 Act and could be fined.

While Ministry of Housing and Urban Development (MHUD) carries out some random spot inspections there is no requirement in the HHS for landlords to get an HHS inspection carried out by approved inspectors and no centralised register of homes that have had an inspection. The model is entirely reliant on tenant complaint, which is flawed given the possible repercussions on the tenant.

HomeFit

HomeFit⁷⁶ was created by the New Zealand Green Building Council in conjunction with the housing sector, including many of the people later involved in drafting the HHS. Achieving the HomeFit certification also demonstrates compliance with the HHS, but differs from HHS in several ways:

- HomeFit was designed as a voluntary standard for all homes, not just rentals.
- HomeFit includes higher standards than those required in HHS, requiring all ceiling and floor spaces to be insulated (with no exemptions for inaccessible spaces), plus the absence of mould, furnishing of windows and/or double glazing, and hot water efficiency.
- HomeFit has a free self-assessment option and the option of an independent verification that a home meets both the HomeFit and HHS standards.

More than 70,000 self-assessments using HomeFit have been undertaken since it was launched in 2018, and more than 5000 homes have been independently assessed.

Support for Energy Education in Communities (SEEC)

The SEEC Programme has been established to deliver community-level energy education to help households in need. The SEEC Programme includes funding to build and expand the network of services to support people experiencing energy hardship to achieve warmer, more energy-efficient homes and lower their energy bills. Funding is available to eligible community-level groups, organisations, or businesses.

Examples of initiatives that will be considered for the SEEC Fund are:

- Preparing and delivering education material
- Hui to provide advice and resources to groups
- Training community-level advisors
- Providing personalised advice in-home or over the phone.



Voluntary Targeted Rates (VTR) schemes

Several local authorities in Aotearoa New Zealand established VTR schemes to enable people to undertake energy efficiency improvements to their homes. These schemes are long running (the first was established in 2006) and have successfully improved home energy performance and health in over 45,000 homes. The improvements include insulation, ventilation, heating, and other measures. Auckland Council, for instance, was enabling around 2,700 properties a year to finance improvements through its VTR scheme before it was closed in 2019.

The councils who continue to take part have an accredited list of installers. The loans and interest are paid off by homeowners over time through the rates paid to the council (interest rates are set by each council and help to cover funding and administration costs). When VTRs were first introduced, finance from banks for these kinds of home

improvements was not always readily available. While banks now have loan products specifically targeted at making energy efficiency and health-related improvements to homes, not all homeowners would be able to access one of these bank loans for a range of reasons.

While most Council VTR schemes are of a generally similar design, they all vary in the details of the measures that are included, interest rate charged, process followed and whether a home assessment is required or not.

The majority of VTR schemes in Aotearoa New Zealand were on hold following a review of the Credit Contracts and Consumer Finance Act (CCCFA) which had implications for loans included as part of VTR schemes. Cabinet has agreed to exempt councils from the CCCFA and new regulations were about to come into force at the time of writing, allowing VTRs to return.



Warmer Kiwi Homes (WKH)

WKH⁷⁷ is a government programme offering grants to low-income homeowners that cover:

- Up to 90% of the total cost of ceiling and underfloor insulation and ground vapour barriers. In some areas the cost to the householder may be even lower, thanks to funding from community organisations.
- Up to 80% of the cost of an approved heater (capped at \$3000). This could be a heat pump or an efficient wood or pellet burner for the main living area.

Eligibility criteria include owning and living in a home built before 2008, and either having a Community Services Card or the home being situated in an area identified as low-income (currently this applies to homes in NZ Dep areas of deciles 7, 8, 9 and 10).

A selection of past policies and programmes which can provide valuable lessons for the development of wide-scale deep and shallow retrofit programmes

There are several effective past policies and programmes which can provide valuable lessons for the development of wide-scale deep and shallow retrofit programmes. These are listed below and NZGBC is happy to provide further information on these and key learnings:

- Build Back Smarter – Canterbury⁷⁸
- Environment Canterbury (ECan) Clean Heat Project⁷⁹
- Rental Housing Warrant of Fitness⁸⁰
- Sustainable Living Programme – Future Living Skills
- Warm Up New Zealand: Heat Smart and Warm Up New Zealand: Healthy Homes⁸¹

Build Back Smarter - Canterbury

Build Back Smarter⁸² was established to take advantage of the once in a lifetime opportunity to repair homes damaged by the 2010-11 Canterbury earthquakes to a better standard than they were before. Assessors visited homes to review a range of features such as insulation, heating, glazing, window coverings, ventilation, lighting, and water heating and prepare a tailored plan showing the most beneficial things that could be done to improve the performance of the home.

Environment Canterbury (ECan) Clean Heat Project

ECan’s Clean Heat Project⁸³ offered Christchurch homeowners a range of subsidies for removing old, high-polluting forms of heating and replacing them with modern heat pumps, pellet fires and woodburners, as well as a minimum level of ceiling and floor insulation.

The project was launched in February 2003 with an initial budget of \$38m funded by a targeted community rate on Christchurch ratepayers. An interest free loans scheme, repaid through a voluntary targeted rate, was added in 2006, with interest funded from the same rate. It was extended to Timaru, Ashburton, Rangiora and Kaiapoi in 2008. The VTR programme continues but is now called Healthy Homes Canterbury and is available throughout the province.

The process for accessing funding included a mandatory home assessment to confirm eligibility and to determine the home’s heating and insulation needs. A team of assessors was employed by ECan for this purpose.

The Clean Heat Project ended in 2011 after having overseen the replacement of heating in 19,450 homes and insulation in many of these, earlier than initially intended due to the effects of the Canterbury earthquakes which resulted in the loss of some older woodburners and damage to many houses in the region.

When the project began in 2002, the city was generally reporting around 40 to 60 high pollution nights⁸⁴ per annum. Air quality in Christchurch and other Canterbury towns and cities steadily improved thanks to the project and parallel regulatory changes to the extent that Christchurch now typically exceeds the air quality standard on only one to three nights per annum.

Similar projects have since been implemented in other towns and cities around the country with air quality issues, such as Nelson and Rotorua.

The Clean Heat project was informed by a health impact assessment (HIA) that staff from ECan and Canterbury Community and Public Health (a division of Te Whatu Ora). This was an excellent example of a ‘Health in All Policies’ approach where ECan was responsible for improving external air quality but worked with Community and Public Health to consider how to do that in way that addressed multiple issues including indoor temperatures.

Rental Housing Warrant of Fitness

The Rental Housing Warrant of Fitness (RWoF)⁸⁵ is an evidence-based housing quality checklist. There are 29 criteria, covering aspects such as ventilation, heating, safety, and hygiene, considered to be minimum requirements for the health and safety of occupants.

In 2014, in partnership with five city councils, NZGBC and the Accident Compensation Corporation, He Kāinga Oranga conducted a pre-test of a draft RWoF on 144 dwellings. This showed that all 29 criteria could be easily assessed in a variety of dwellings.

Several councils, including Wellington City Council, introduced RWoFs, however, these are not currently required or enforced by any councils.

Sustainable Living Programme – Future Living Skills

The Sustainable Living Programme, was run by the Sustainable Living Education Trust, providing adult education in night classes and workshops, as well online, from 2002 to 2024. It made resources available to councils and other delivery partners and trained facilitators.

Warm Up New Zealand: Heat Smart and Warm Up New Zealand: Healthy Homes

The Warm Up New Zealand: Heat Smart (WUNZ:HS) programme⁸⁶ and the Warm Up New Zealand: Healthy Homes (WUNZ:HH) programmes were the predecessors to WKH, running from 2009 to 2013 and 2013 to 2018 respectively.

The programmes operated on a co-funding basis with four sets of partners: local government, iwi, existing and new service providers, and energy retailers. Generally, this third-party funding was applied to low-income households to cover the remaining 40% of the costs of insulation not provided by the programme.

Evaluation of WUNZ:HS showed a benefit cost ratio of more than 4:1 (with 99% of the measured net benefit from improved health resulting from warmer, drier conditions after insulation was installed).



Appendix B

Further detail on international policies and programmes



Energy performance certificates

As a precursor to implementing retrofit programmes to bring homes up to a certain standard, the European Union requires all homes to have an energy performance certificate (EPC)⁸⁷ on sale or lease of a home. Also known as building energy rating certificates (BER) in Ireland, EPCs are similar to energy efficiency labels for vehicles and appliances and give the home an A-G rating typically based on its predicted running cost, allowing buyers and renters of homes to see how one home compares with another.

Building renovation passports

In 2019-20, the Ireland Green Building Council and Limerick Institute of Technology undertook a pilot project to explore the role a voluntary passport system could play in supporting large-scale deep retrofits in Ireland.⁸⁸

Building renovation passports (BRPs) are tailored to individual dwellings and include a roadmap and a logbook (developed by a registered home assessor, following a home visit). The roadmap is a masterplan for the deep retrofit of the home and sets out step-by-step measures. The associated logbook captures information relating to the fabric and performance of the home as well as a detailed record of works. BRPs assist homeowners to plan deep retrofit works efficiently, preventing the 'lock in' of less effective renovations.

While this programme has not been implemented at scale, the review⁸⁹ of the pilot programme showed that:

- BRPs could have a positive impact on the rate and depth of home retrofits, especially if integrated into Ireland's BER system.
- Obtaining a BRP could be a requirement or trigger for homeowners to receive retrofit grants, subsidies or other incentives.

International deep retrofit programmes

Many retrofit programmes are underway internationally and are standard in other OECD countries. Research examining programmes from Ireland, UK, France, Netherlands, Canada, USA and the EU showed that the most ambitious programmes were the most successful.⁹⁰

Several are outlined below:

Ireland – National Retrofit Program

The Irish Government⁹¹ has a target of upgrading 500,000 homes to a minimum B2 standard (very good energy efficiency) on their BER scale (highlighting the importance of having a home performance register). A budget of €8 billion has been allocated through to 2030 to achieve this goal.

The National Retrofit Program offers a range of subsidies (up to 100% for poorer households) for a full deep retrofit (including wall insulation, double glazing, replacement high efficiency heating and hot water systems). An assessment of the pilot showed an 85% reduction in energy use on average for renovated buildings and relevant lessons for Aotearoa New Zealand with a comparable climate, population, and number of households.

The Netherlands - Energiesprong

Energiesprong⁹² (Energy Leap) is a Netherlands Government-backed programme aimed at achieving net-zero energy homes through deep energy retrofitting. The programme was launched in 2013 in the Netherlands and involves a comprehensive retrofit of a home's energy system, including insulation, windows, ventilation, and heating systems. The retrofit is completed within one week, using prefabricated, modular components. Energiesprong renovations are generally financed by future energy cost savings plus the budget for planned maintenance and repairs over the coming 30 years.

UK - Energy Company Obligations

Energy Company Obligations (ECOs)⁹³ have been in use in the UK for over a decade. Energy companies (gas and electricity retailers) are required to achieve a set target of carbon saving through promoting and paying for the installation of energy efficiency measures, such as loft insulation and cavity wall insulation, in eligible households. Energy companies recoup the cost of these interventions through a small levy on all energy bills. This scheme has contributed billions of pounds per year in energy efficiency improvements to UK homes.



USA – Inflation Reduction Act

The Inflation Reduction Act (IRA) (enacted in 2022)⁹⁴ makes US\$8.8 billion in rebates available for home energy efficiency and electrification projects.

These home energy rebates aim to help American households save money on energy bills, upgrade to clean energy equipment, improve energy efficiency, and reduce indoor and outdoor air pollution.

The US Department of Energy estimates that these rebates will save households up to US\$1 billion on energy bills each year and support over 50,000 US jobs. The funding is split into Home Efficiency Rebates and Home Electrification and Appliance Rebates. The support ranges from thousands of dollars per home to hundreds of thousands for multifamily buildings.

A state energy office may use up to 20% of awarded funds for planning, administration, or technical assistance. At least 80% of the awarded funds must be provided to single-family and multifamily households with discounts for efficiency upgrades that are predicted to save at least 20% of the home’s energy use.

Programme delivery models

A BERL report (2023) examined a range of international retrofit programmes and the delivery model⁹⁵ they have adopted. A review of these models provided the following key lessons:

- The value proposition of a programme should focus on comfort, health benefits, aesthetics, building longevity, and improvement of capital value for the homeowner. Emphasis on carbon and energy savings are less likely to encourage owners to engage with the programme.
- Energy Services Agreements can be attractive to customers, but they transfer the risk and costs to contractors.
- Supply chain integration can improve product quality and reduce supply risks. However, bringing together siloed disciplines requires a large investment of skill and time.
- A single and trusted point of contact is important for family-focused programmes.
- Capital that is low-cost is essential for the viability of long-term comprehensive approaches.
- Energy Performance Guarantees can reduce perceived risk for investors.
- Integrated financing packages provided with retrofits are likely to encourage demand.
- Networked approaches like the ‘atomised’ model are only suitable for single measure retrofits, not comprehensive ones.
- Intermediary organisations, and their competency, is crucial for the success of a retrofit programme, particularly if it is a new programme with no track record.



Appendix C

Detailed recommendations on measures



Deep retrofit measures – minimum fabric/services upgrades recommended for deep retrofit programmes.

- Full insulation upgrade to 6 Homestar v5, including internal or external wall insulation
- Double glazing with low-e glass and uPVC frames (or retrofit double glazing where wood frames in good order) to H1/AS1 standard
- Balanced ventilation with ducting inside thermal envelope
- Air/vapour control layer (where insulation installed internally) or airsealing, verified by pressure testing
- Warm roof (for skillions and potentially also for attics where ducting installed)

Shallow retrofit measures – minimum fabric/services upgrades recommended for all homes, including those targeted for deep retrofit.

- Insulation – upgrade ceiling and underfloor insulation (where possible) to H1/AS1 2021. Draught stopping to HHS standard. Require upgrades of inaccessible/hard to retrofit elements (walls, skillion roofs, windows) when renovating
- Install good curtains or blinds (HomeFit standard)
- Install ground vapour barrier (where needed)
- Space heating – split heat pump or ducted/radiators sourced by heat pump hot water; where installed in main living areas already, fixed electric heaters for bedrooms

- Overheating protection – install awnings, blinds or other shading devices
- Install cooling systems (heat pumps, ceiling fans, ventilation systems)
- Water heating – transition from gas to electric, or if existing electric, add cylinder wrap/pipe lagging
- Consider solar DC or heat pump hot water replacement
- Lighting – upgrade to LEDs/IC-rated downlights and insulate over where possible
- Upgrade 3-in-one light/heat/ventilation fan units in bathrooms to LED/fan units or separate fans and lights, and insulate around/over
- Put fans on timers and outdoor lights on sensors
- Ventilation – bathrooms as above, kitchens, upgrade to ceiling mounted motors for rangehoods or install downdraught or ceiling extractor fans.
- Consider continuous extract ventilation with strategies for make up air (restrictors on windows, or if replacing windows, install trickle vents)
- Water saving – install water efficient toilets and showers
- Appliances – install energy efficient fridges/washing machines/dishwashers; run off peak/on solar with timers; replace gas with induction hobs
- Transport – install EV charging with solar AC; install cycle parking with charging
- Indoor Environment Quality/Safety – install fixed, connected smoke alarms and CO2 detectors; install power monitoring

Double layer curtains and heat reflecting blinds

While good quality, double layer curtains can make a difference to retaining warmth in a home, there is a risk that curtains hide the problem of inadequate windows. Curtains that absorb condensation from the cold surfaces of glass or window frames can harbour mould growth.

Ideally, windows should be upgraded to double glazing with thermal frames. Good curtains or insulating blinds are useful as an interim measure, but the investment needed for these should not cause a delay in upgrading poor windows.

Blinds are not as insulating as curtains (with the exception of cellular blinds, often called “honeycomb”). However, if designed to reflect sunlight back out the building, while still allowing ventilation through windows, they can play a role in reducing overheating in summer, as well as providing privacy.

This is another example of a shallow versus deep retrofit intervention for a home.



Appendix D

The extent of the challenge



A 2023 report⁹⁶ segments existing homes by their construction typology, their location according to the New Zealand Index of Deprivation (NZ Dep)⁹⁷ and the proportion that is likely to be suffering from dampness and/or mould (extrapolated from census data).

NZ DEP DECILES 7 TO 10			REST OF DECILES		ALL
Total all regions	Total households	Households with mould and/or dampness	Total households	Households with mould and/or dampness	Households with mould and/or dampness
Bungalow	56,384	17,732	89,247	18,953	36,684
State House	147,664	47,622	222,114	47,984	95,607
1970s house	96,511	31,086	146,619	31,364	62,452
Post 1978	354,336	115,625	540,629	115,886	231,512
Total	654,895	212,065	998,609	214,187	426,255 ⁹⁸

Source: Adapted from BERL, 2023.⁹⁹



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11 For the purposes of this Roadmap, a deep retrofit means significantly improving the energy and carbon performance, thermal comfort, indoor air quality and resilience of an existing home by upgrading multiple aspects of its fabric and services. Shallow retrofits, focus only on upgrading a few elements such as ceiling and underfloor insulation, ground moisture barriers and heating for the main living room. See Section 3 for more information.

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98 The estimated number of homes in Aotearoa New Zealand needing retrofit is 460,000 (Stats NZ 2022). Some housing typologies are not included in this table (e.g. 1920s villas) and so these total figures differ.

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