Quantitative analysis & compendium of past statistics on energy hardship

24 May 2022

Purpose, Contents, Notes, and Caveats

PURPOSE

- Principal purpose: Undertake quantitative analysis to cast light on the nature and scale of drivers of energy hardship
- Secondary purpose: Compile a 'compendium' of insights from past studies which relate to various aspects of energy hardship

CONTENTS

- Section 1 – Quantitative analysis
  - A) Energy costs in the broader context of household expenditure and income
  - B) Energy cost drivers
  - C) Focus on electricity issues
- Section 2 – Compendium of past energy statistics
  - This section is effectively an annex, containing supporting material which has been used as inputs for the analysis in section 1, plus a variety of other aspects relating to energy hardship which have been included to have all material 'in one place'.

NOTES

- Some data presents information on populations segmented into income or deprivation deciles. (Rather frustratingly) the order of these deciles is different in each situation: ***Income*** deciles have those with lowest income in decile 1. **Deprivation** deciles have those with highest deprivation – which is generally those with lowest income – in decile 10.

CAVEATS

- Stats NZ have advised there can be significant margins of error in the absolute income and expenditure values for different income deciles, with decile 1 subject to the greatest margin of error. Nonetheless, while there is uncertainty around such absolute levels, we believe the relativities between deciles and trends over time are robust for the purposes of drawing the key insights around such analysis.

Section 1 Summary: Quantitative analysis highlights some 'mega themes' on the causes and challenges of energy hardship

- Although energy hardship is generally associated with broader income inadequacy issues that also affect other essential goods (eg, food, housing), there are special characteristics of energy that make it particularly problematic
- Many low-income consumers live in poorly-insulated houses and have less-efficient appliances. For these consumers it costs more to get energy services
- But low-income consumers have less to spend on energy
  - In many cases this is not enough, leading to foregoing of energy and other services, with difficult trade-offs (eg, 'heat or eat?')
- Under-heating causes adverse health, mortality, and other human welfare costs (eg, affected education, domestic violence)
- There is massive variation in the costs to deliver energy services for different low-income consumers. This is due to variations in house situation (location, insulation, appliance efficiencies) and household situation (number, occupancy patterns).
  - Significant within-year variation in energy requirements (particularly needing more in winter for heating) exacerbates this variation
- This variation is much greater than for other goods and services, posing real challenges for delivering targeted energy assistance
- Electricity companies' pricing approaches are exacerbating this variability, as well as generally increasing residential prices to the benefit of business consumers. The low-fixed charge regulations further increase this variability.
- Making the 'right' energy choice is significantly more complex, and faces more barriers, than for other goods and services:
  - There is significant complexity in determining the right appliance or home insulation choice, how best to use the appliance, or what electricity plan to choose
  - Many appliance or insulation options require up-front capital that low-income consumers find harder to access
  - Some are under the control of a landlord who doesn't face the same incentives to choose the lowest lifetime-cost option

Section 1 Summary: Quantitative analysis highlights some possible measures to address energy hardship*

Energy-specific measures

- Improving house condition and appliance efficiencies

The challenge is targeting the right measures (eg, roof insulation is generally cost-effective, whereas rooftop solar is almost always not cost-effective) at the households in greatest need (eg, worst house condition, most vulnerable ages (elderly and infants))

- Lowering residential electricity prices by improving the cost allocation of shared network assets between business and residential consumers
- Increasing the proportion of energy costs recovered via fixed charges to more cost-reflective levels to:
  - Reduce bills for those in greatest energy hardship (ie, having low incomes but high energy requirements)
  - Reduce the extent of winter bill surges
  - Reduce the incentive to under-heat homes to save money
  - Better enable energy-cost subsidy support to be proportional to need

The challenge is introducing changes at a rate which doesn't result in unacceptable levels of 'bill shock' to those who will face higher prices (businesses, very low users)

- Introduce better-targeted energy cost subsidy schemes than the low-fixed charge or winter energy payment
- Extend programmes to educate consumers on how to make the best energy choices
- Work to ensure that prompt-payment discounts are permanently banned. (Their effect is generally a tax on those who struggle with budgeting or who find it hard to navigate energy choices)

Non-energy-specific measures to address gross societal inequality

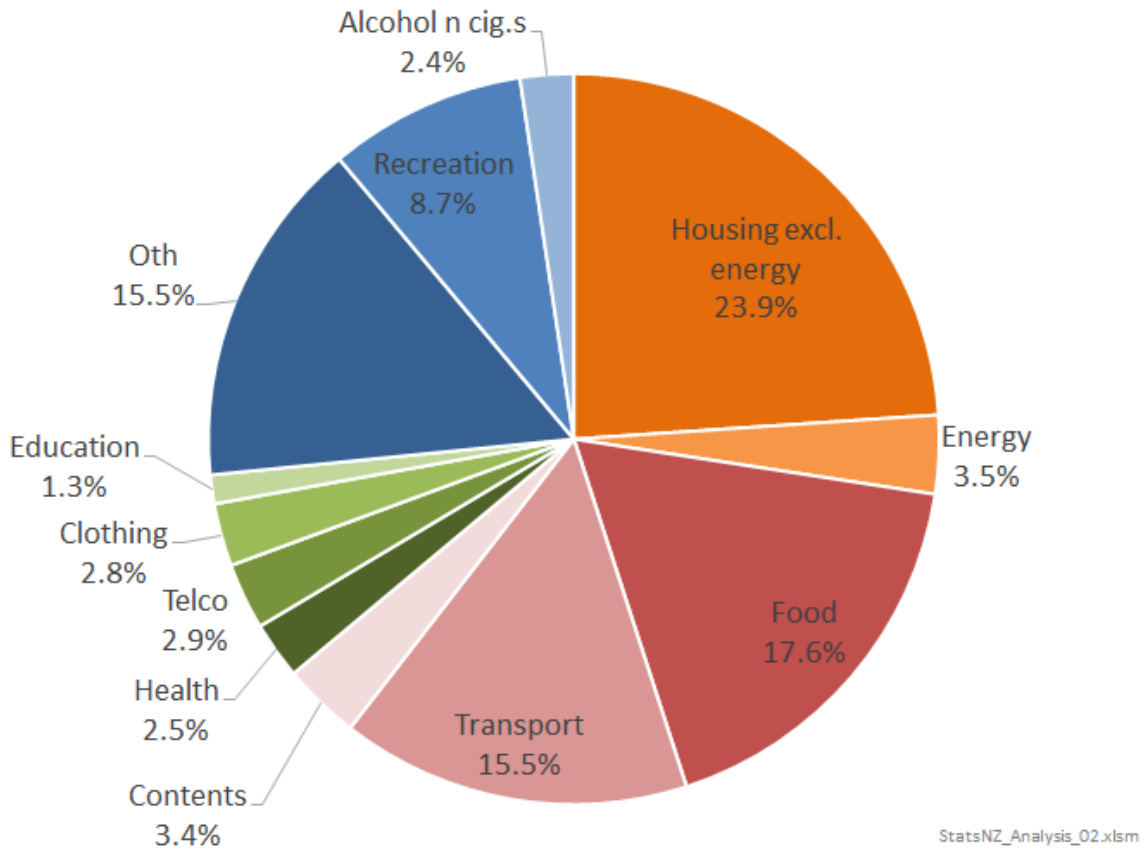
- Increased minimum wage; Tax reform (eg, more progressive income rate bands, broadening the tax base to better include wealth-generating assets), Welfare reform (eg, UBI), etc.

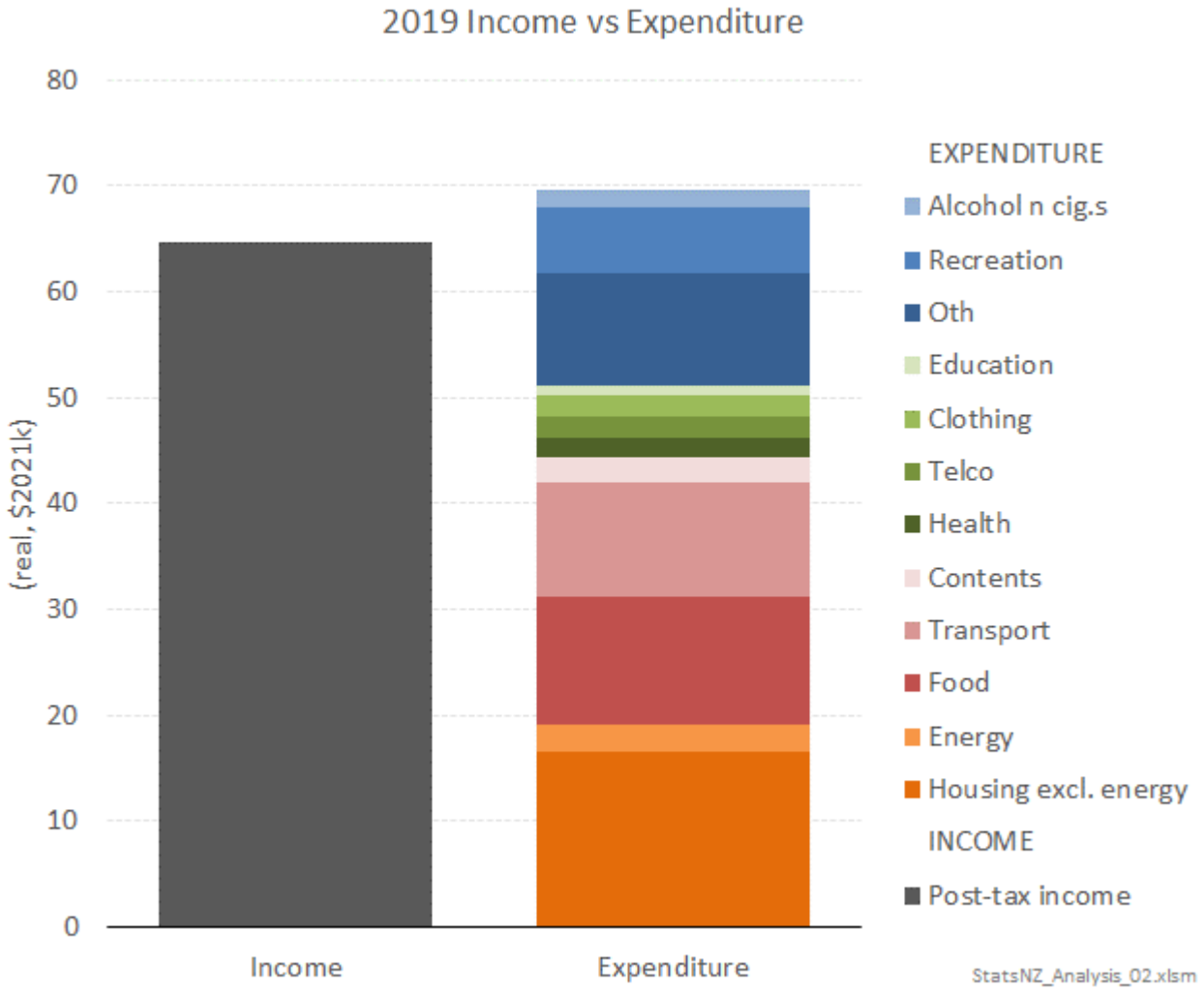
  Given low-income consumers spend a higher proportion of their income on NZ goods and services than higher-income consumers, increased transfers to lower-income consumers (within reason) will arguably boost NZ economic activity. Further, to the extent gross income inadequacy contributes to costly societal outcomes (eg, crime, reduced educational achievement, poor health), reducing income inadequacy should deliver additional economic benefits

*Consideration of design issues and relative merits of measures to address energy hardship out of scope for this engagement

Section 1A) Household energy costs within the broader context of overall household expenditure and income

In 2019, energy accounted for 3.5% of the median* Kiwi household's expenditure, with post-tax income just below expenditure



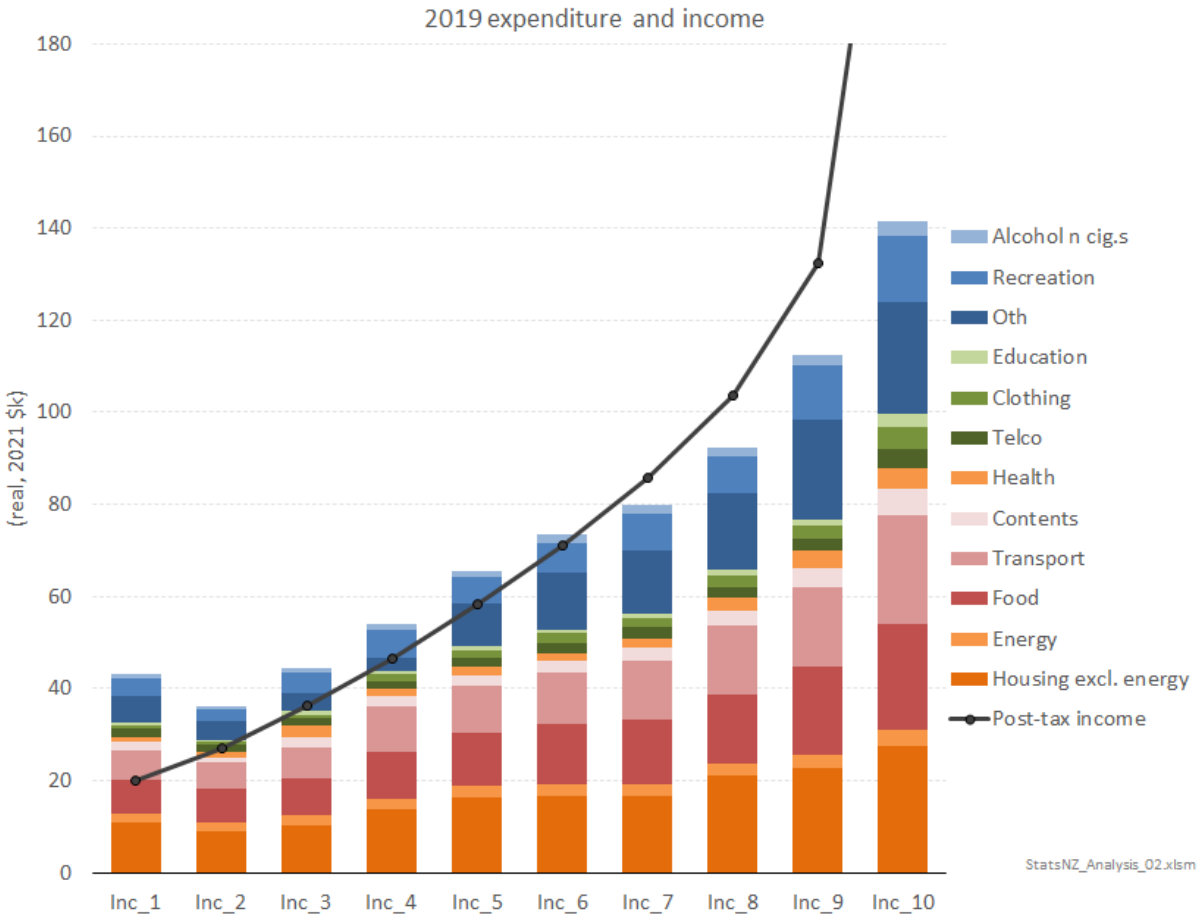


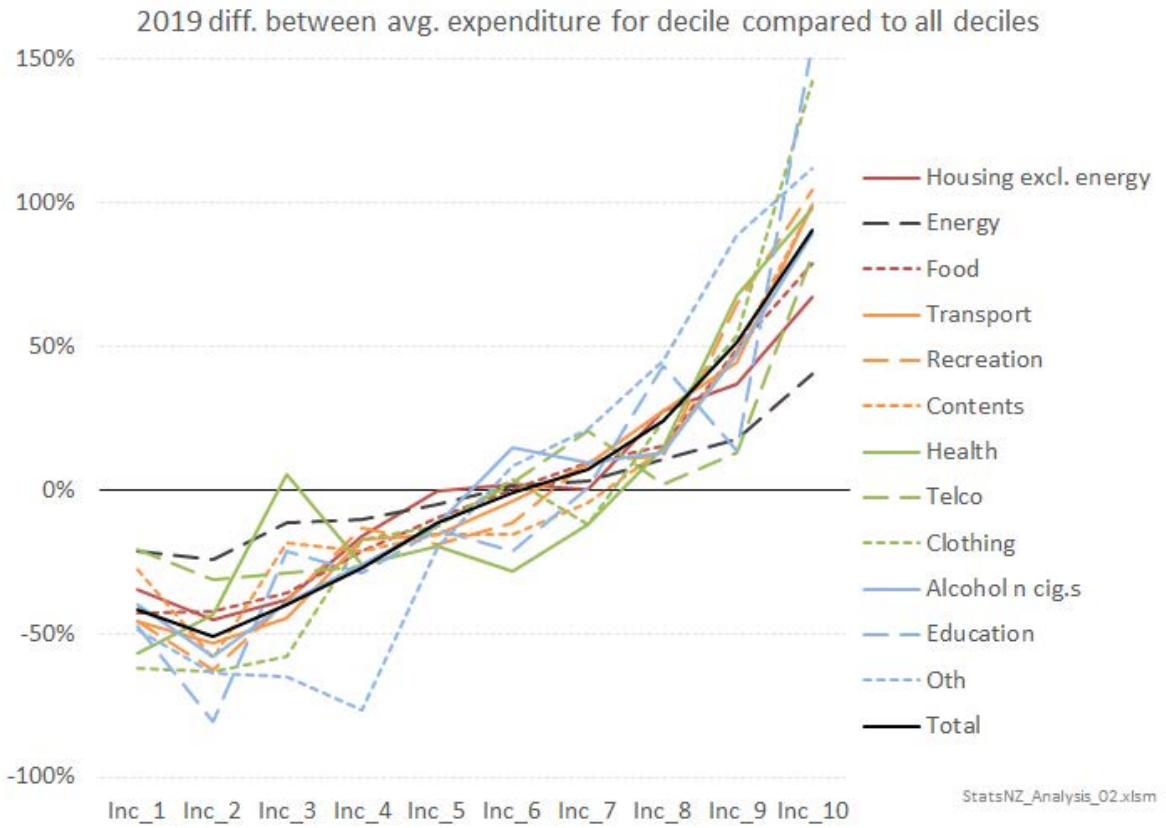
* Median estimated as average of income decile 5 and 6

Income exceeding expenditure may reflect some combination of households drawing down on savings – particularly retirees – plus some level of income not being captured by the StatsNZ survey: self-employment and investment income. It also reflects some households going into debt.

Source: Concept analysis of Stats NZ Household Economic Survey Data

Compared to other household expenditure categories, energy costs exhibit least variation with income



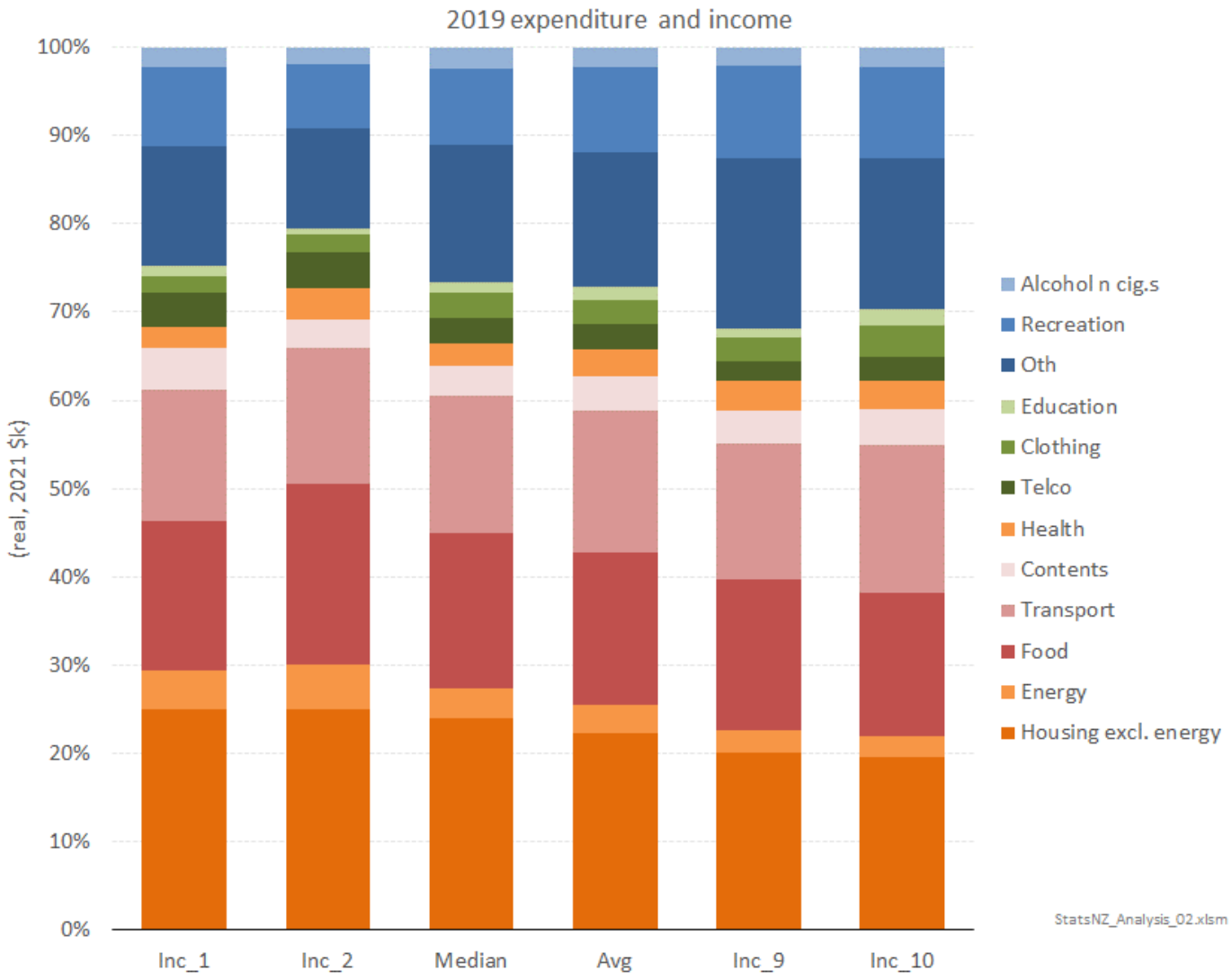


This reduced variation between income deciles for energy costs is likely a combination of:

- Minimum physical quantities of energy to deliver an energy service (lighting, heating, refrigeration, etc)
- Fixed charges for energy pricing
- The cost of energy to deliver a given service being higher (per kWh) for low-income households due to worse housing and appliance efficiency

Source: Concept analysis of Stats NZ Household Economic Survey Data

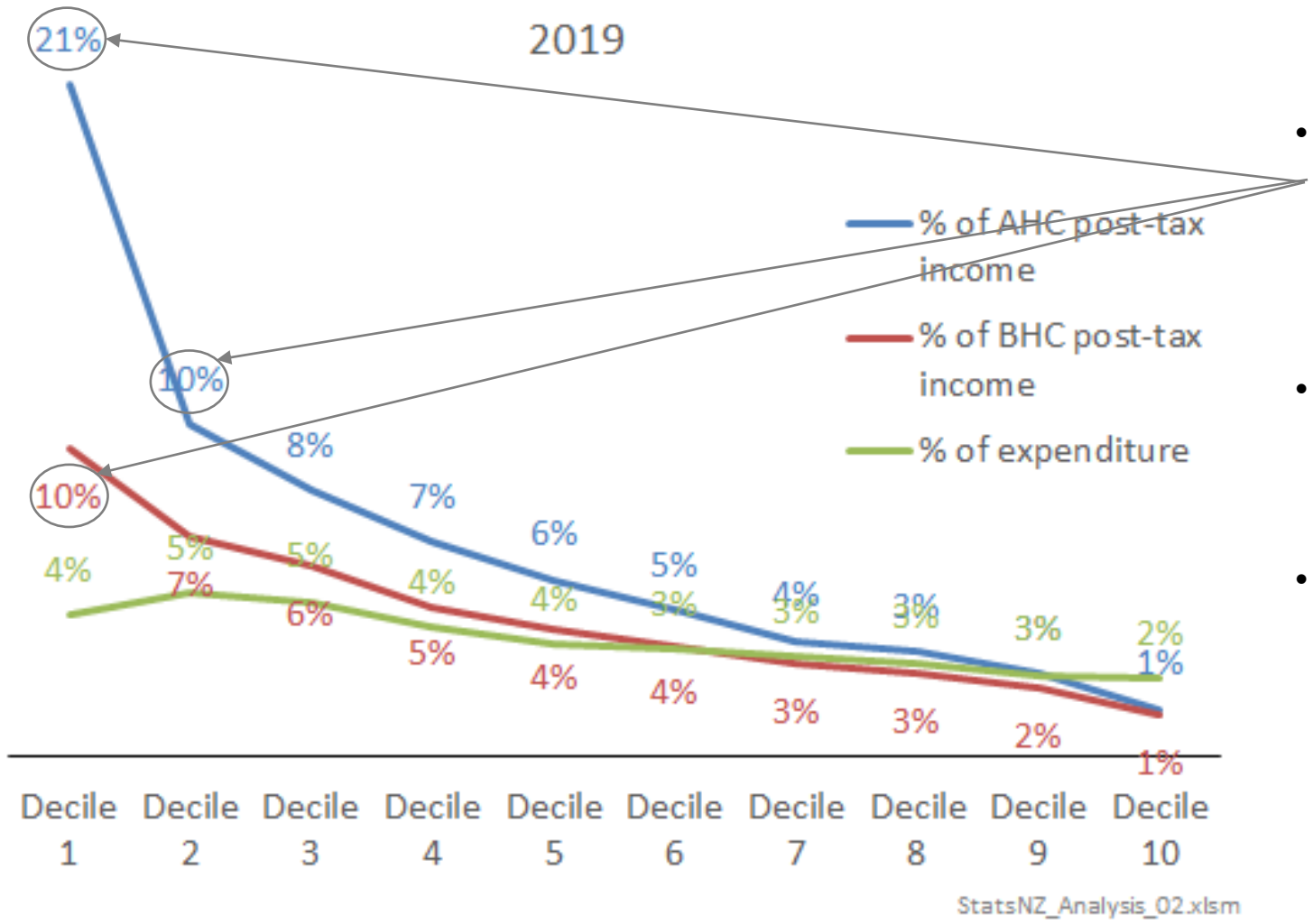
Low-income households spend proportionately more of their expenditure on housing, energy, and telco costs. (And much less on recreation, 'other', and education)



- Note on what is included in some categories:
  - Contents = Furniture, appliances, textiles, tools & equipment, glass & tableware and utensils, other
  - Telco = Telecommunication services
  - Oth = Insurance, interest payments, personal care, contribution to savings, other

Because energy costs don't vary as much with income as other costs, energy accounts for a much higher proportion of income & expenditure for low-income consumers

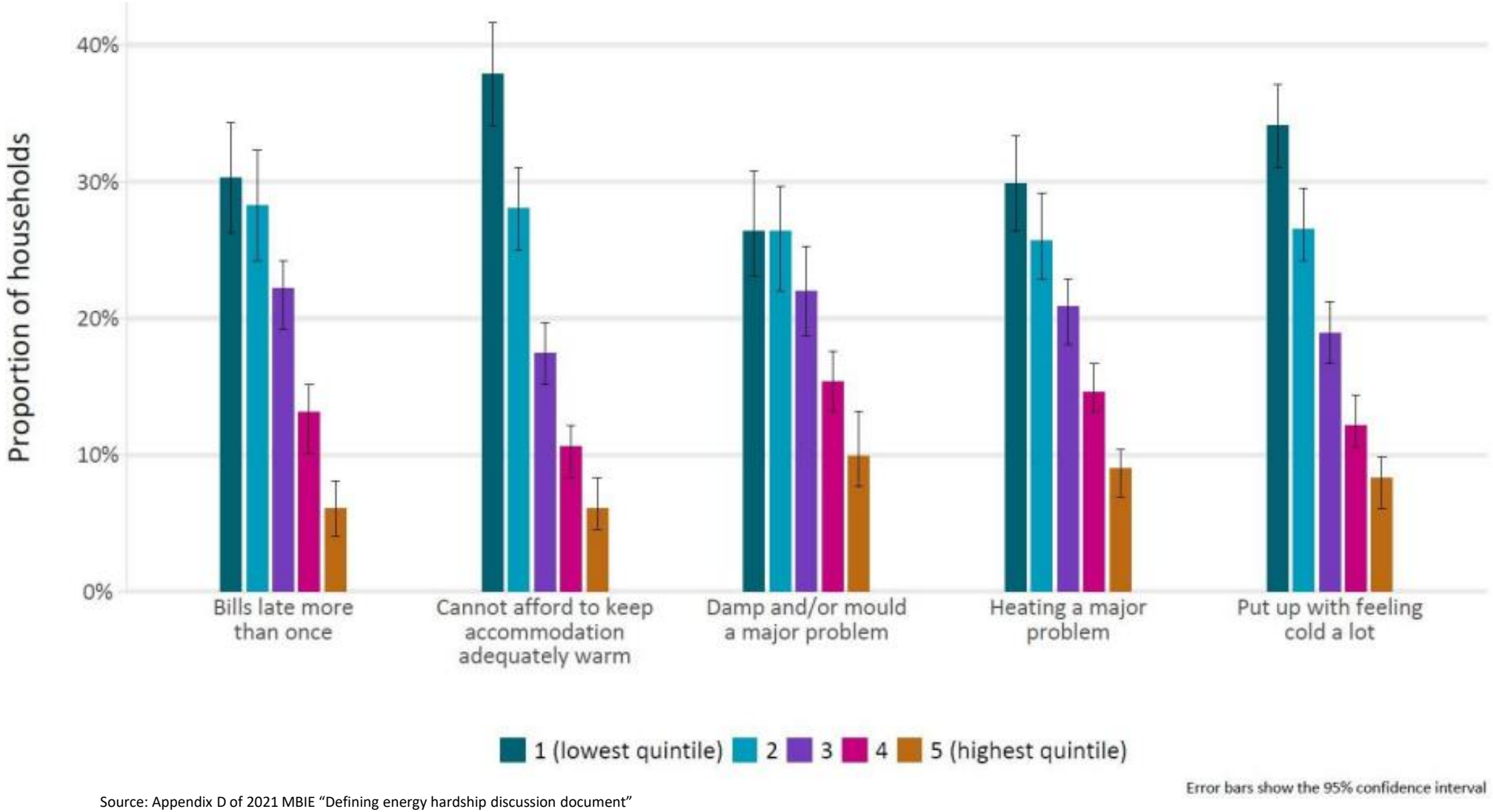
Energy costs as a proportion of income or expenditure



- Households deemed to be suffering energy hardship if energy costs greater than 10% of before housing cost (BHC) or after housing cost (AHC) income.
- Using observed energy spending, Average decile 1 household faces BHC energy hardship, and average decile 1 & decile 2 household faces AHC energy hardship.
- However, subjective measures (see next slide) indicate that significant numbers of households have insufficient income to adequately heat their home
- Amount of required energy to deliver adequate energy service levels would result in many more households spending more than 10% of the BHC or AHC income on energy

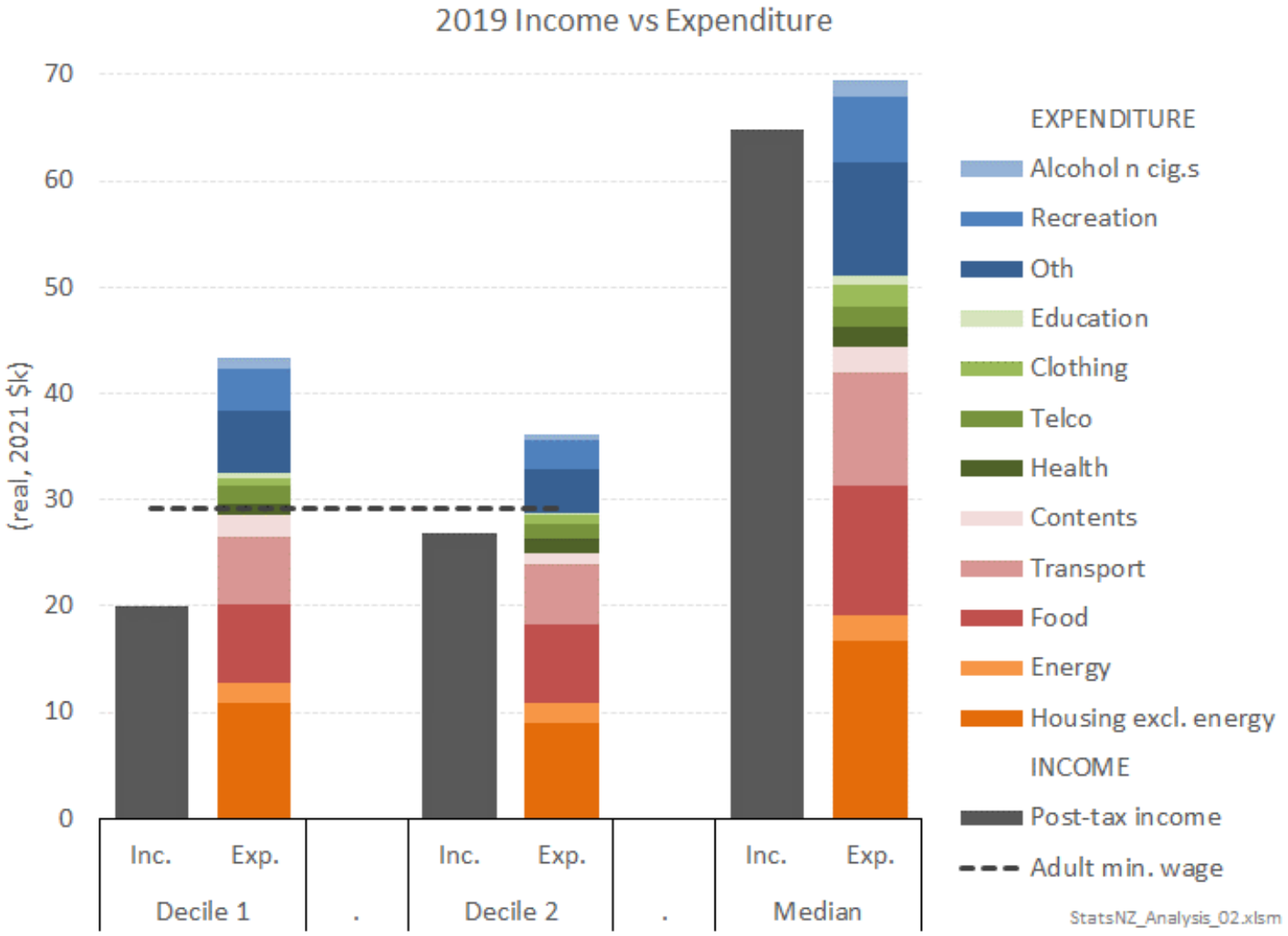
Source: Concept analysis of Stats NZ HES data

Almost 20% of all households report having insufficient income to adequately heat their home, rising to 37% of households in the lowest income quintile



Source: Appendix D of 2021 MBIE "Defining energy hardship discussion document"

For those in the lowest income deciles, total household expenditure significantly outstrips income



Stats NZ caveat around the degree of income/expenditure disparity:

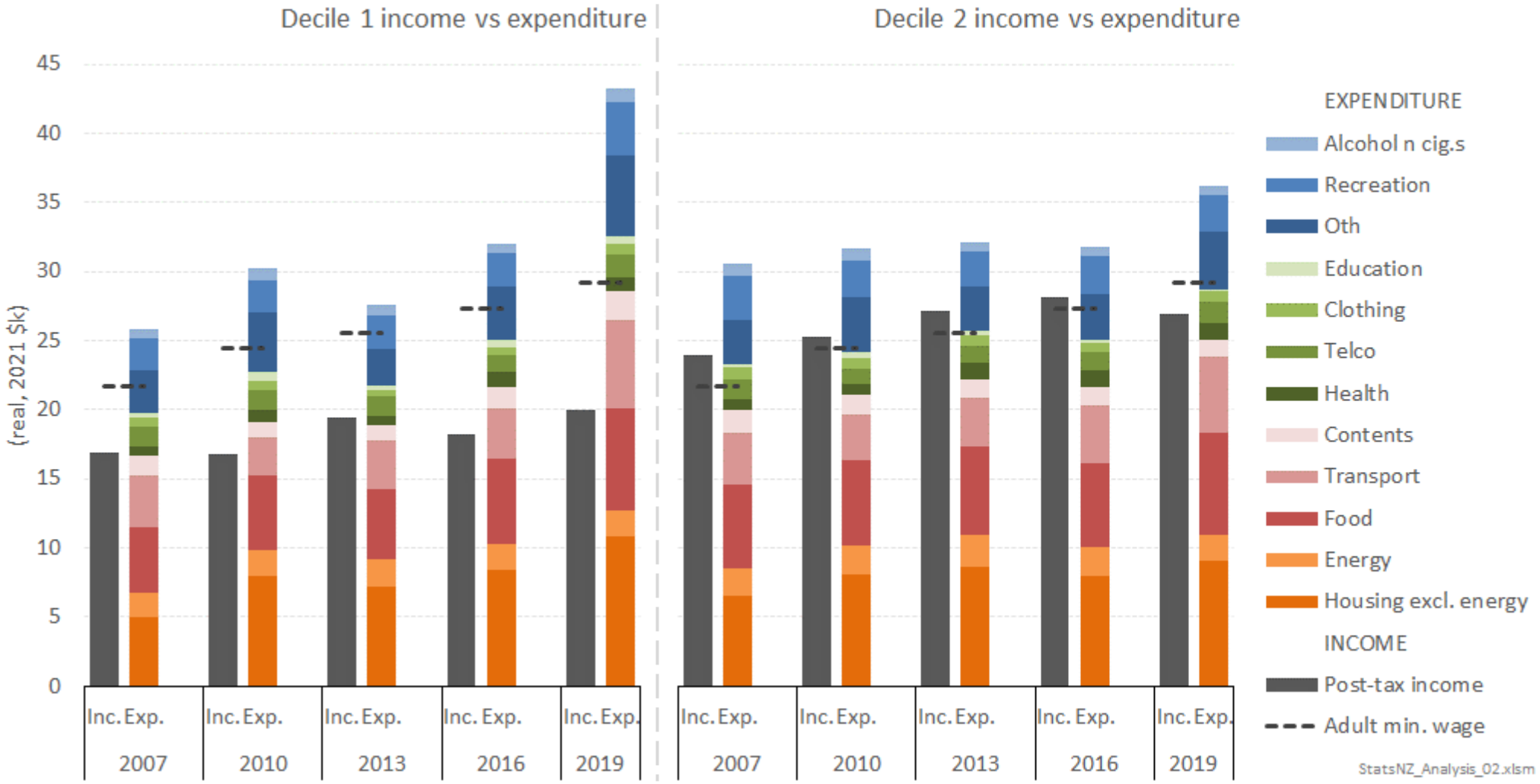
"For some households in the first decile (and possibly for some the second decile) the income /expenditure disparity is mostly due to these households deriving most of their income from either self-employment or investment income. With self-employment income people may declare a loss or have low amounts of profit for tax reasons but maybe able to draw on the business income to fund their expenditure. Or the losses can be a temporary situation for the current year only so they may have made a significant profit in the previous year and therefore can sustain their previous year's expenditure during this year (i.e. they can ride out the temporarily low income)."

"There is some sampling error in both the income & expenditure measures. Eg, +/-18% for decile 1 expenditure"

In other words, Decile 1 captures a significant number of households with low levels of reported income captured by the HES, but high levels of actual income derived from self-employment or investment returns.

Source: Concept analysis of Stats NZ Household Economic Survey Data

For the lowest income deciles, household expenditure has risen faster than incomes



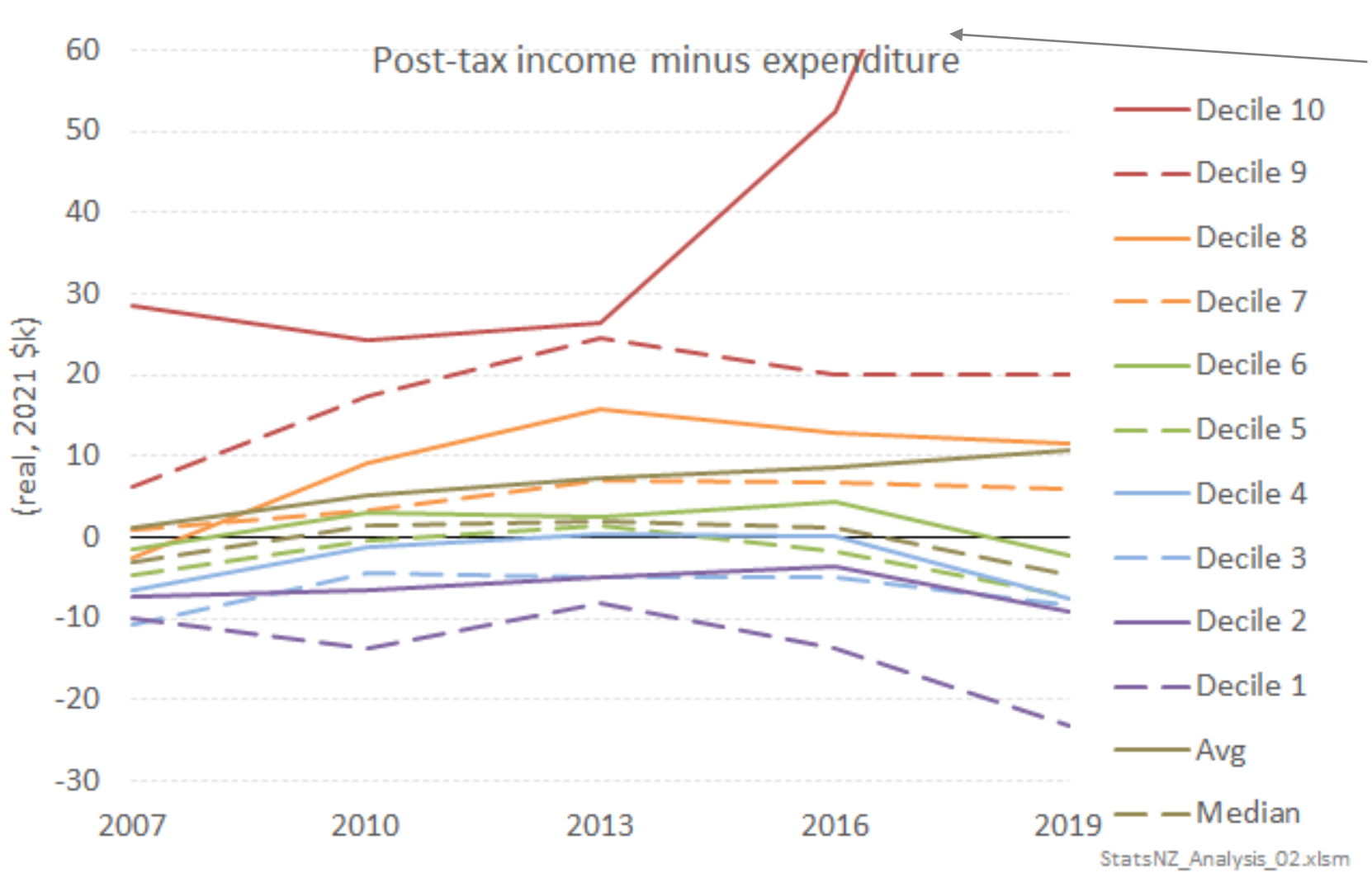
Stats NZ caveat:

The methodology has changed for 2019:

- More accurate income sources
- Better representation of households with low income / high deprivation. This may mean the composition of decile 1 has changed between 2019 and earlier surveys

Source: Concept analysis of Stats NZ Household Economic Survey Data

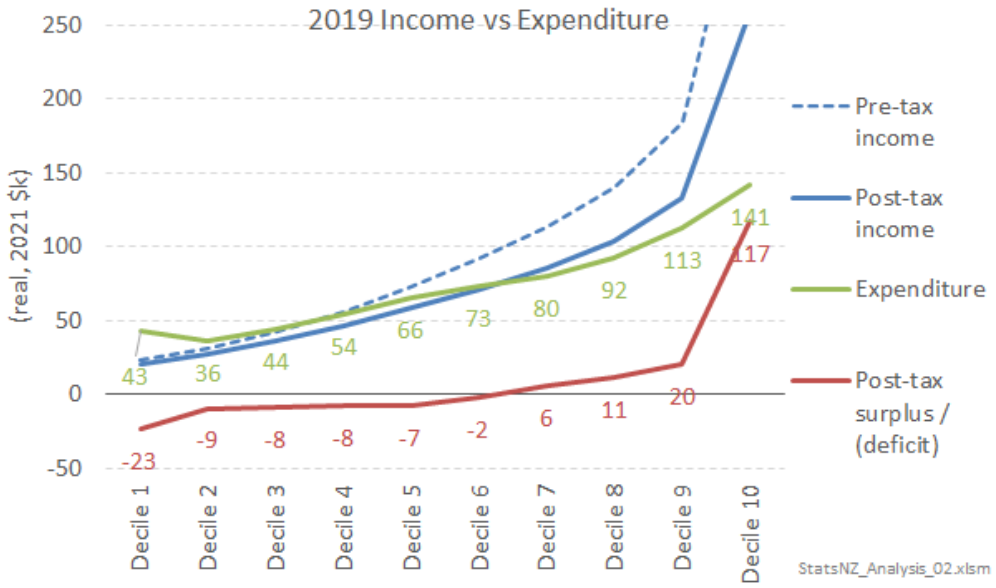
For the upper deciles, incomes have been rising faster than expenditure

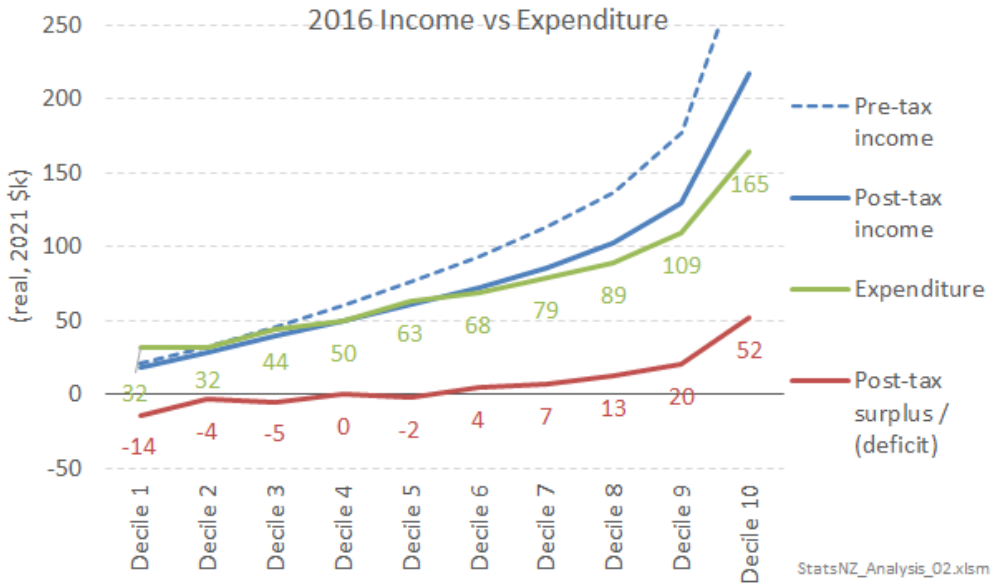


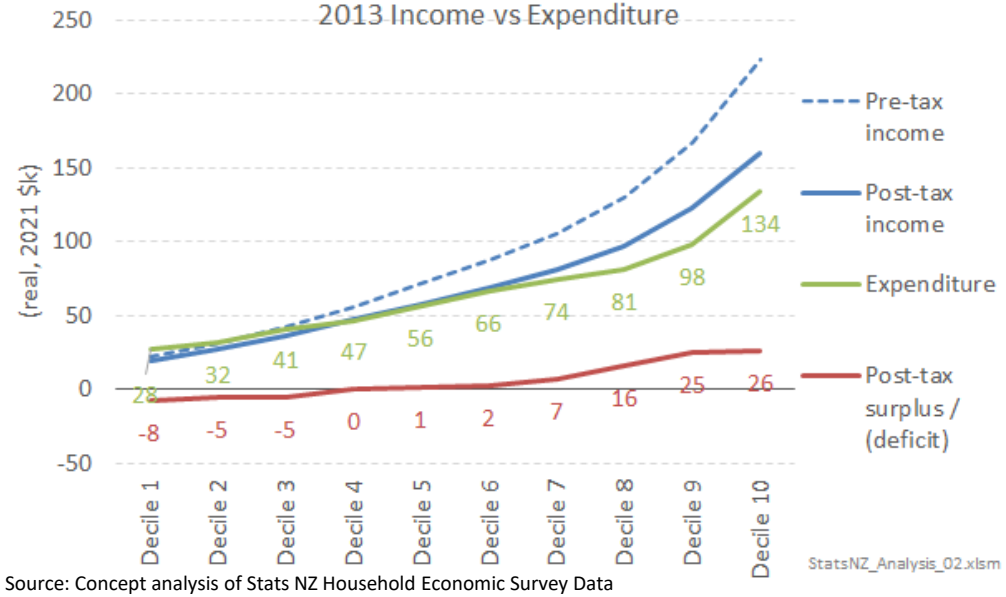
2019 value for Decile 10 is $117k (off the scale)

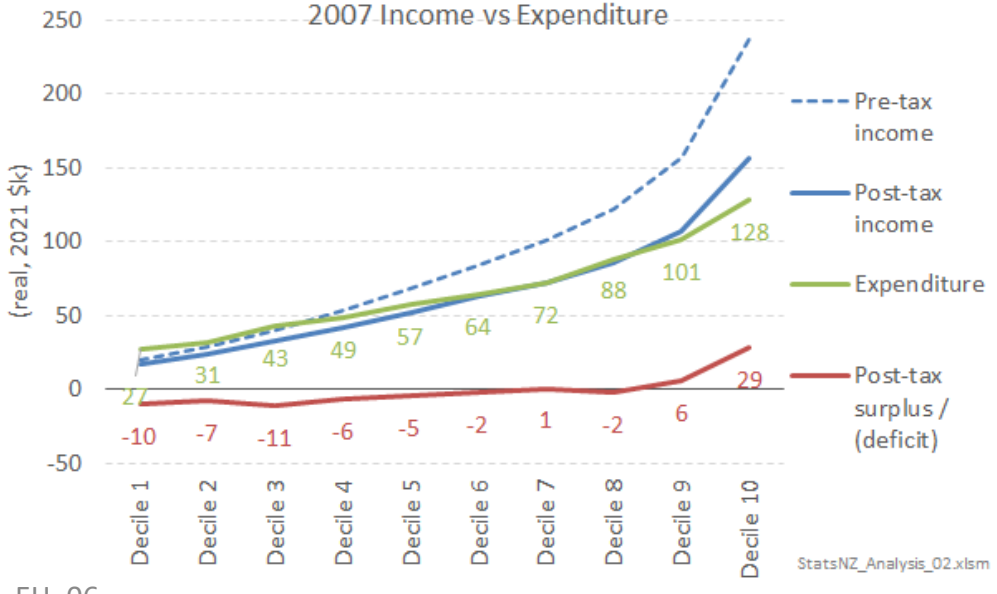
Source: Concept analysis of Stats NZ Household Economic Survey Data

Income vs expenditure has been broadly consistent across deciles over time, except the highest and lowest deciles which have got more extreme over recent years



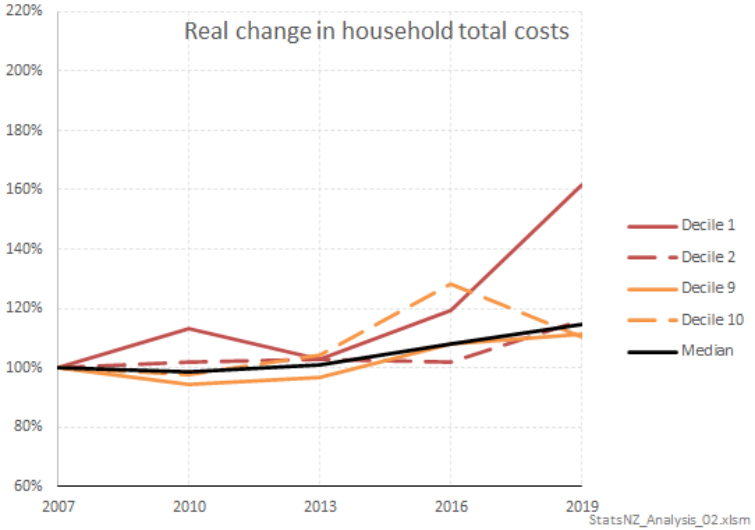


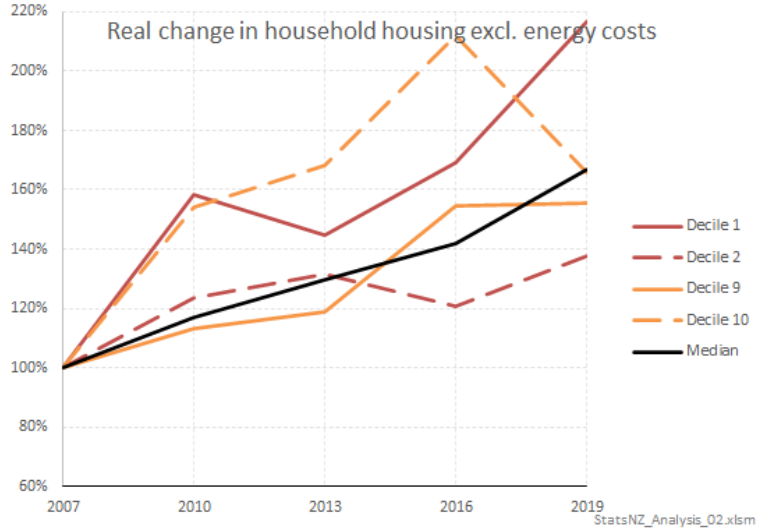


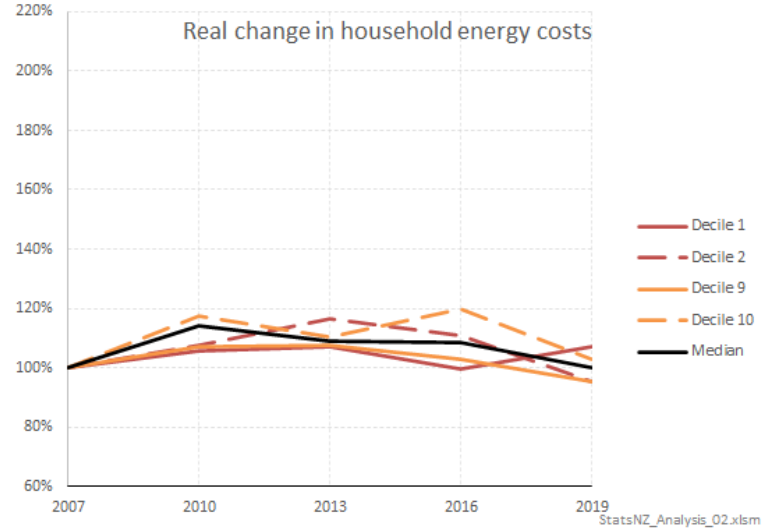


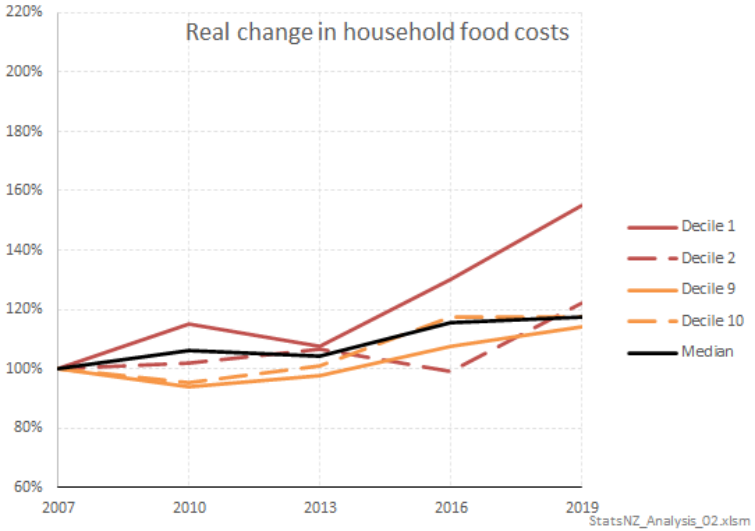
Source: Concept analysis of Stats NZ Household Economic Survey Data

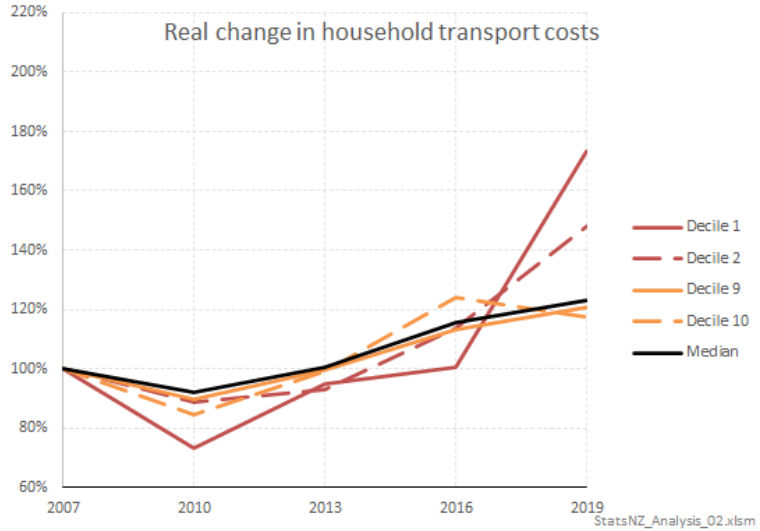
The lowest decile has seen the biggest real increase in household expenditure, largely due to non-energy costs

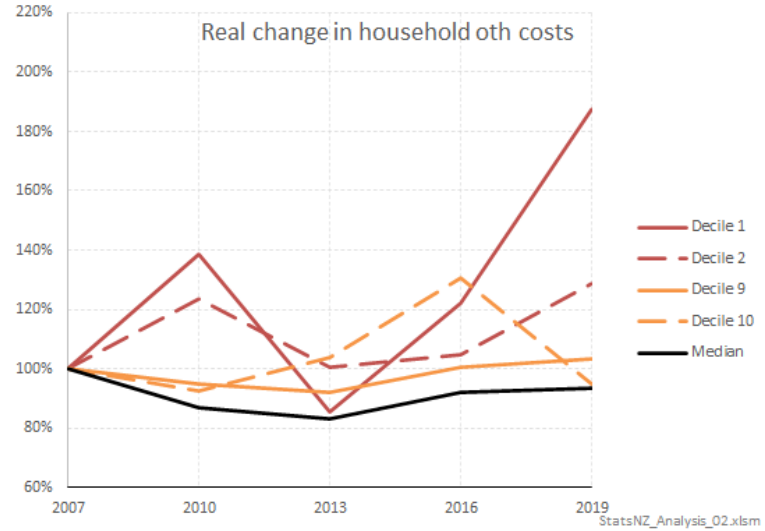










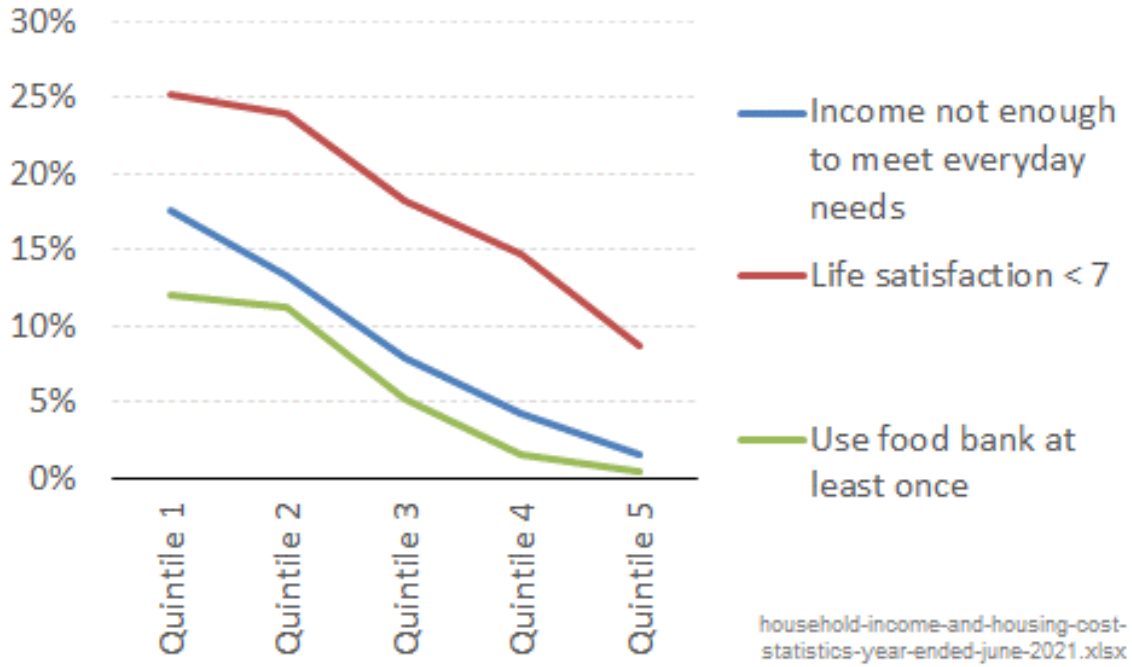


Source: Concept analysis of Stats NZ Household Economic Survey Data

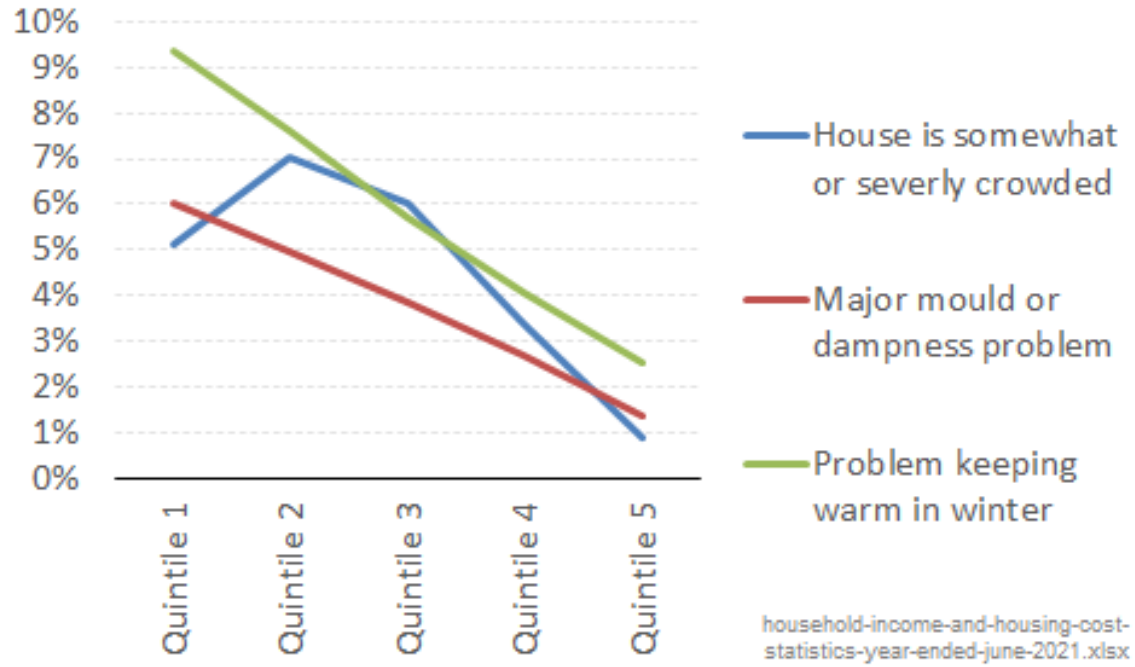
Income inadequacy appears to be affecting various measures of quality of life

- Stats NZ survey for YE Jun'21 includes measures on standard of living for disposable income quintiles

General measures



Housing and heating-specific measures



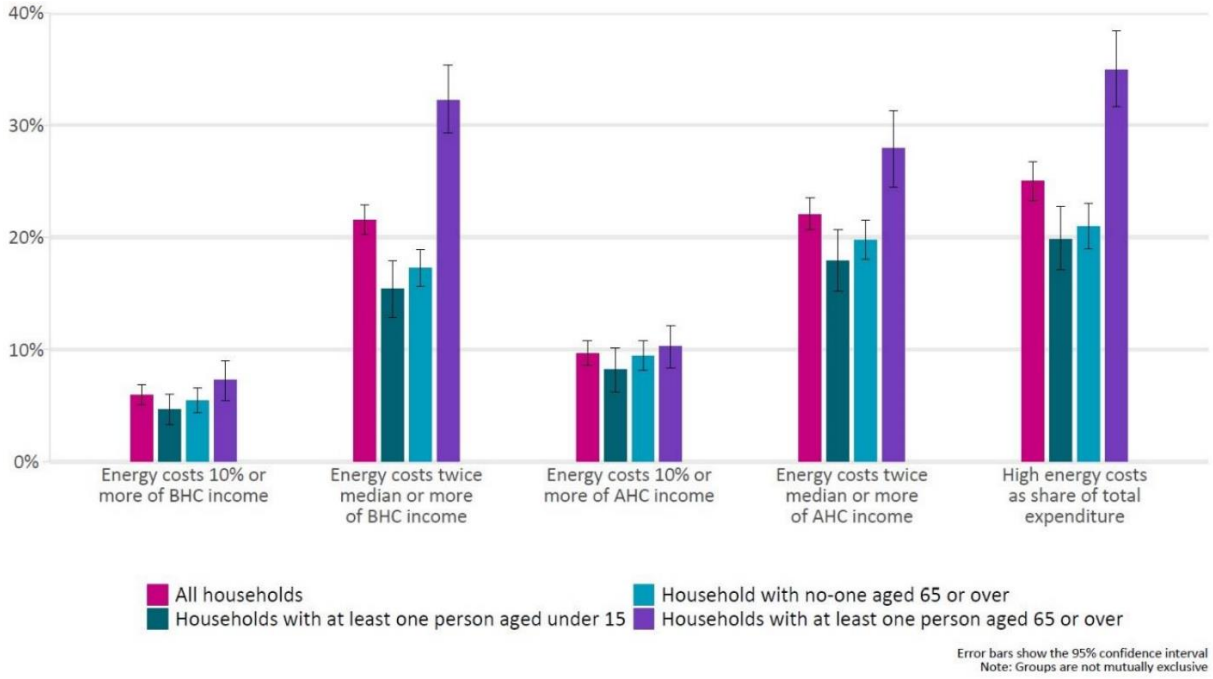
- Many households are foregoing consumption of goods and services to make ends meet.
- Difficult choices as to what not to have: "heat or eat?"

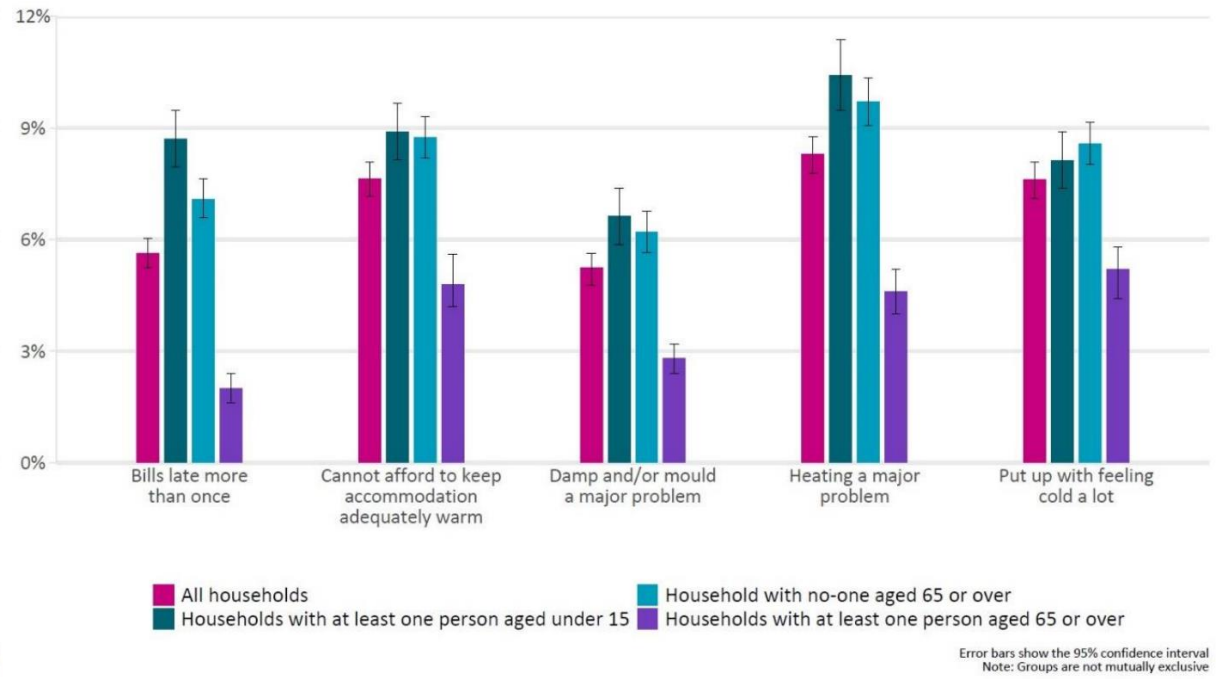
Examining outcomes for older New Zealanders reveals low income doesn't necessarily mean high energy hardship

Although older households are more likely to exhibit 'objective' measures of energy hardship…

… they are much less likely to be suffering 'subjective' measures such as inadequate heat or struggling with bills

2018/19 proportion of households

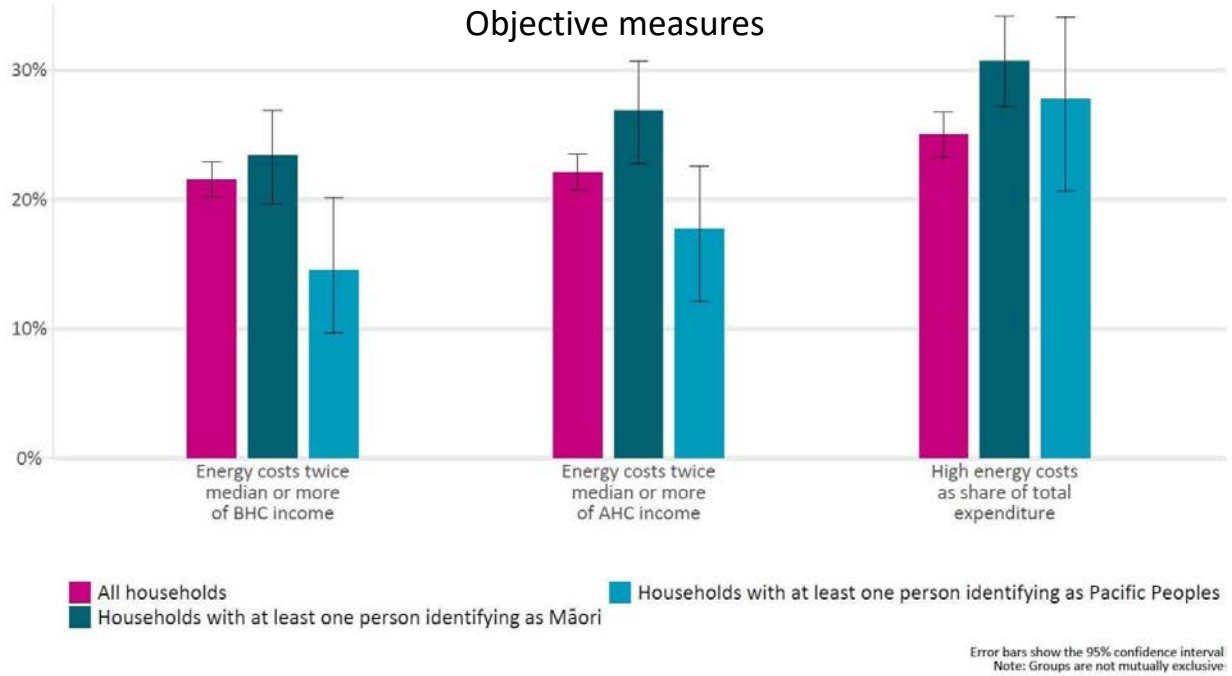


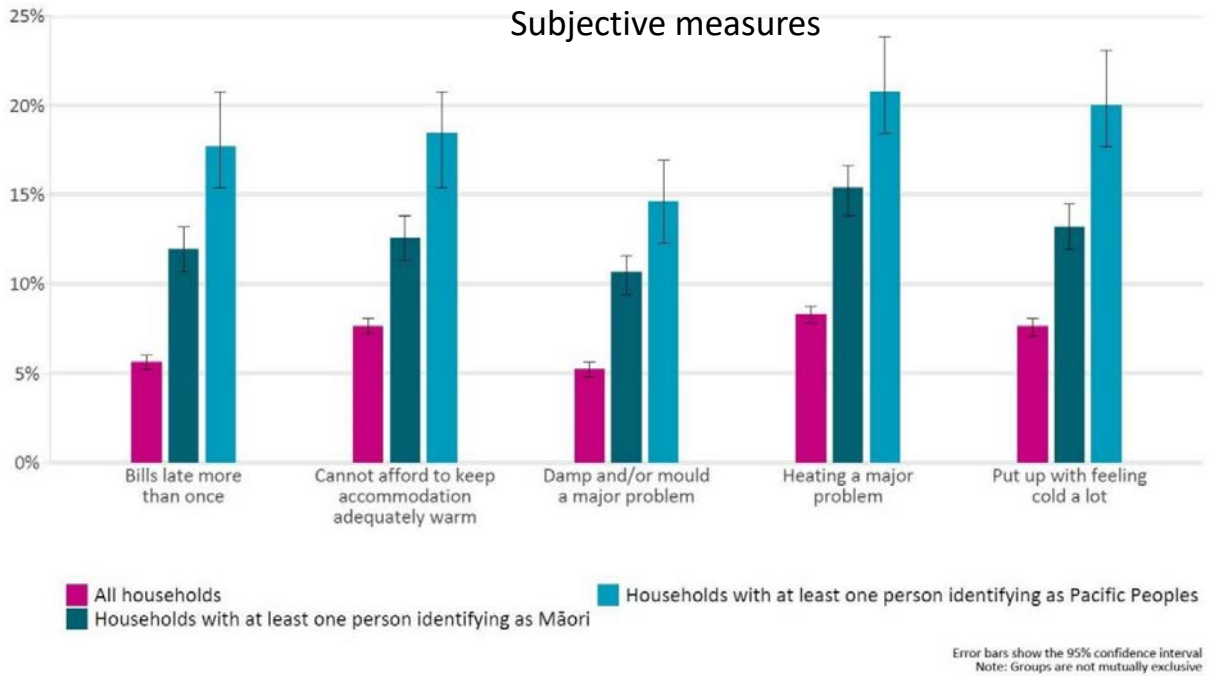


Source: Appendix D of Defining energy hardship discussion document

Households with Māori and Pacific peoples are more likely to experience subjective measures of energy hardship

2018/19 proportion of households



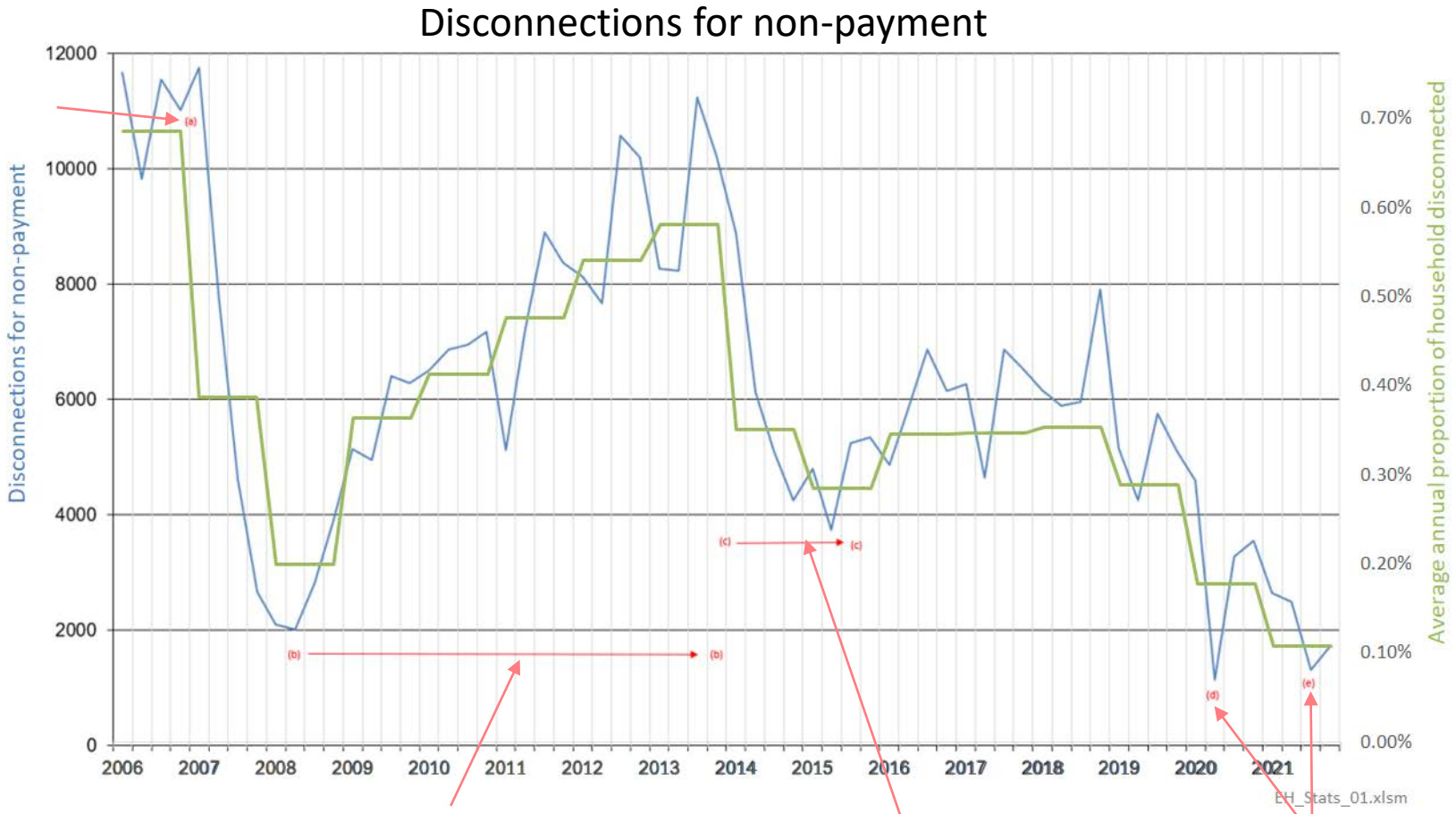


Source: Appendix D of Defining energy hardship discussion document

- Pasifika report lower-than-average incidences of objective measures, but much higher than average subjective measures
- This is the inverse relationship to that for older households (on previous slide)
- This highlights the challenge of using energy expenditure-based measures of energy hardship

Disconnections have fallen materially since the levels seen 15 years' ago

Medically dependent consumer dies after disconnection



Retailers re-start using disconnection to manage bad debt. Bad debt trebles by Q3 2013

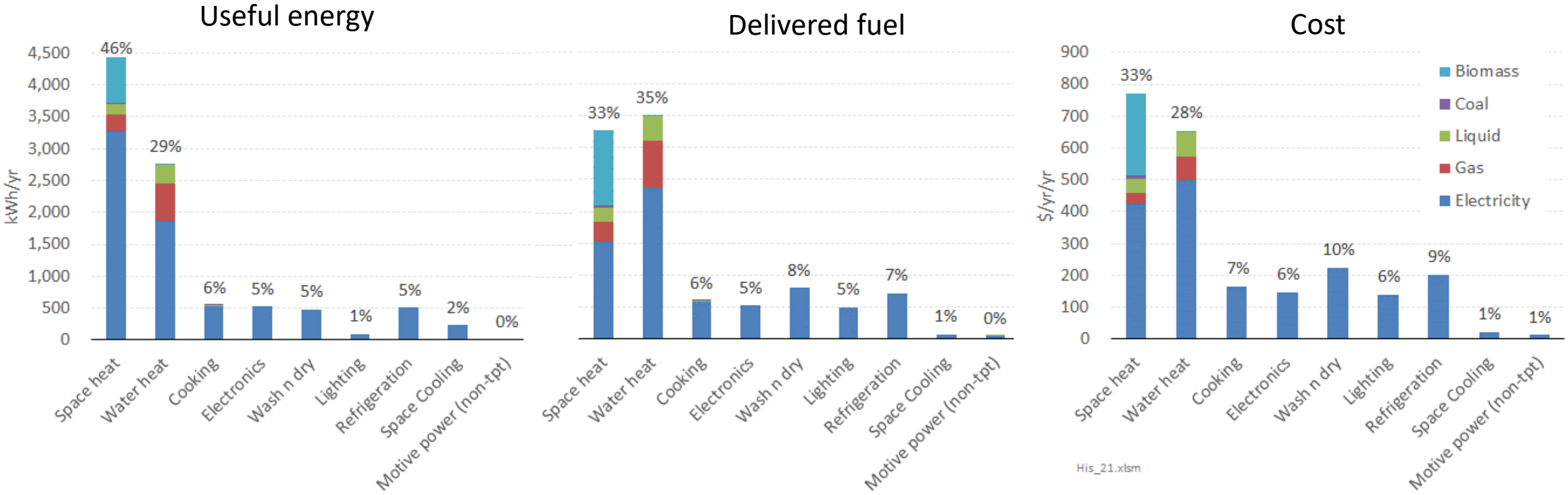
Retailers review disconnection practices following request from Minister of Energy

Disconnection suspensions during Covid lockdowns

Source: Electricity Authority plus additional Concept analysis

Section 1B) Focus on energy cost drivers

What does the average Kiwi house use energy for?



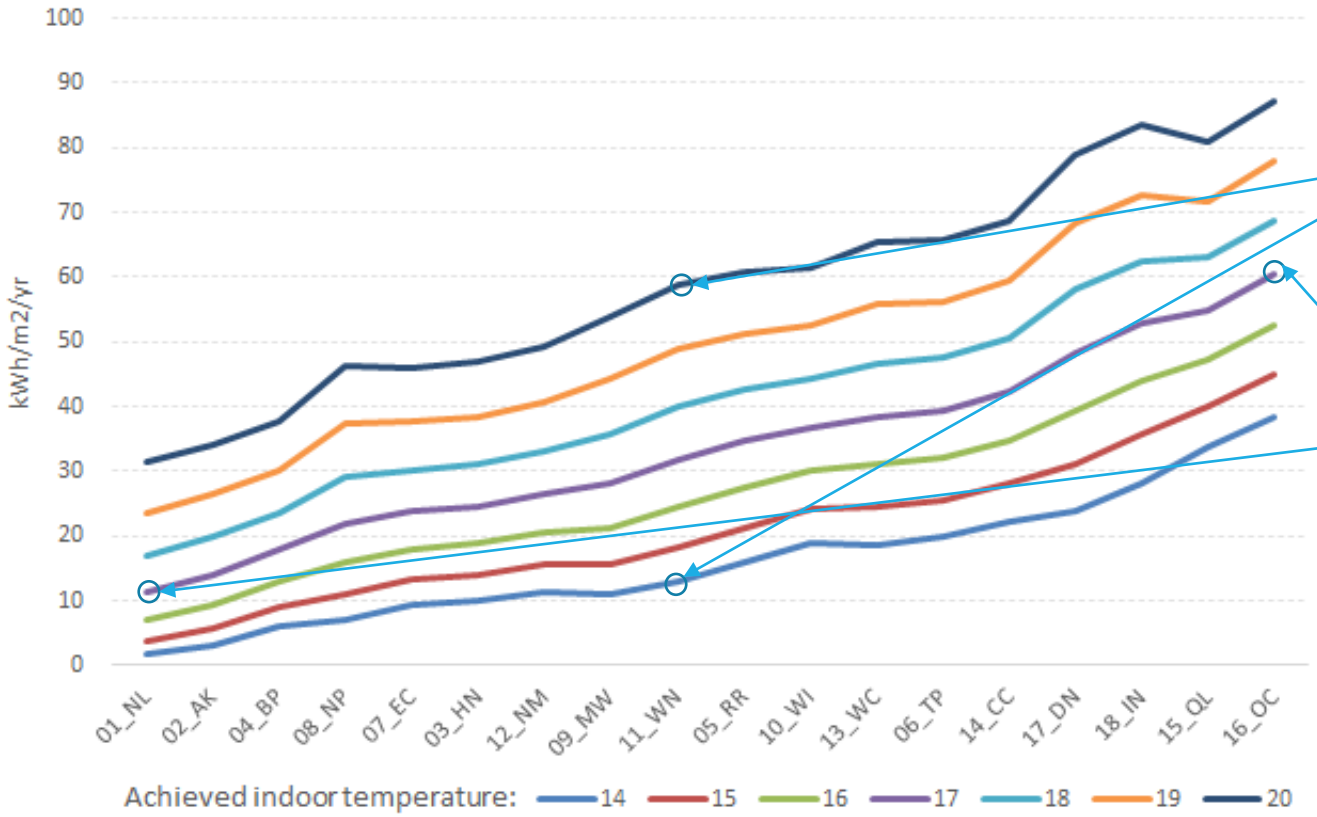
- Space heating an important focus area
  - Significant cost component
  - Major consequences from under-heating
  - Major opportunities for efficiency improvements (insulation & heater)
  - Significant area for decarbonisation
  - Largest variation between consumers

- Notes:
  - Difference between useful energy and delivered fuel due to appliance efficiencies
  - Water heating has lower-cost electricity because of controlled tariffs
  - Motive power covers appliances such as lawn mowers

Source: Concept analysis drawing on EECA Energy End-Use Database data

Geographic location, desired indoor temperature, and heating regime, cause huge variation in the amount of energy required to heat a home

Useful heat energy required to heat a home for 'evening-only-living' regime



4.6 times as much energy is required to heat a home to 20˚C rather than 14˚C in Wellington

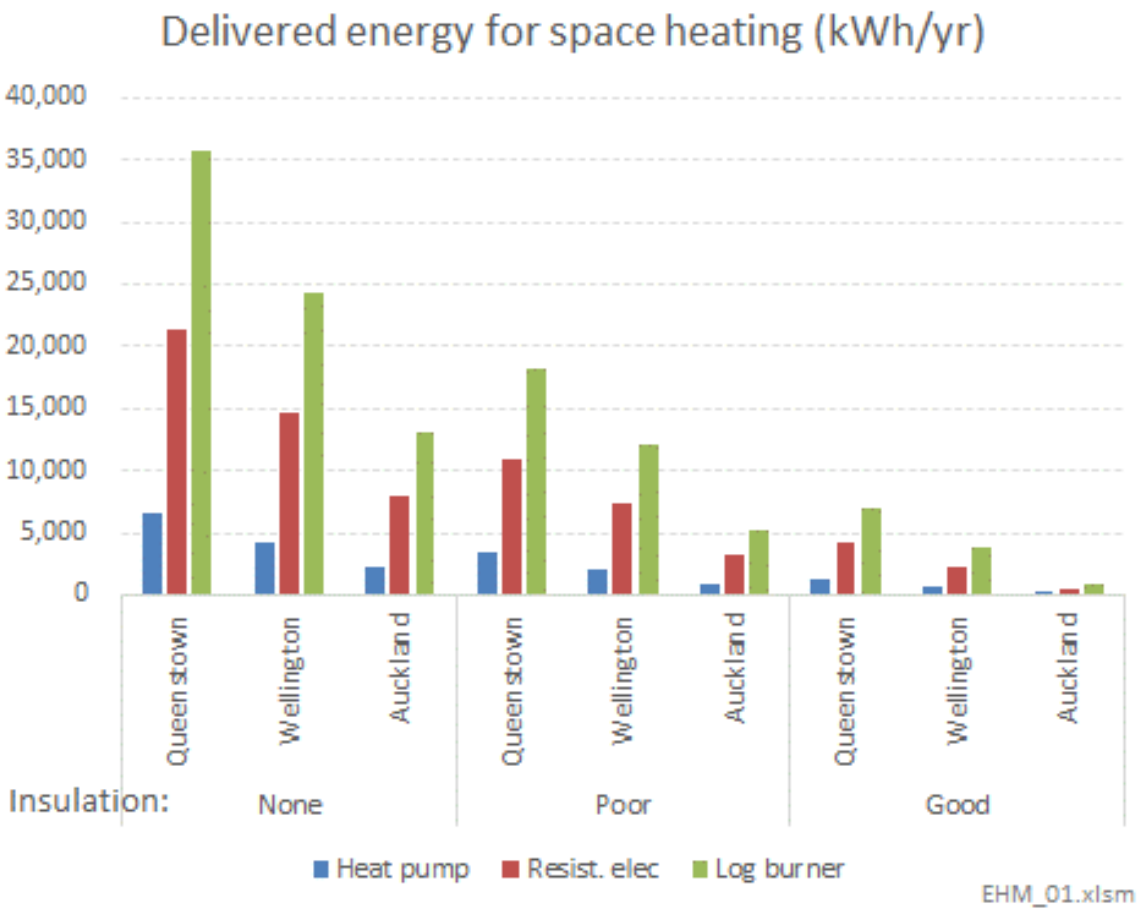
5.3 times as much energy is required to heat a home to 17˚C in Otago than in Northland

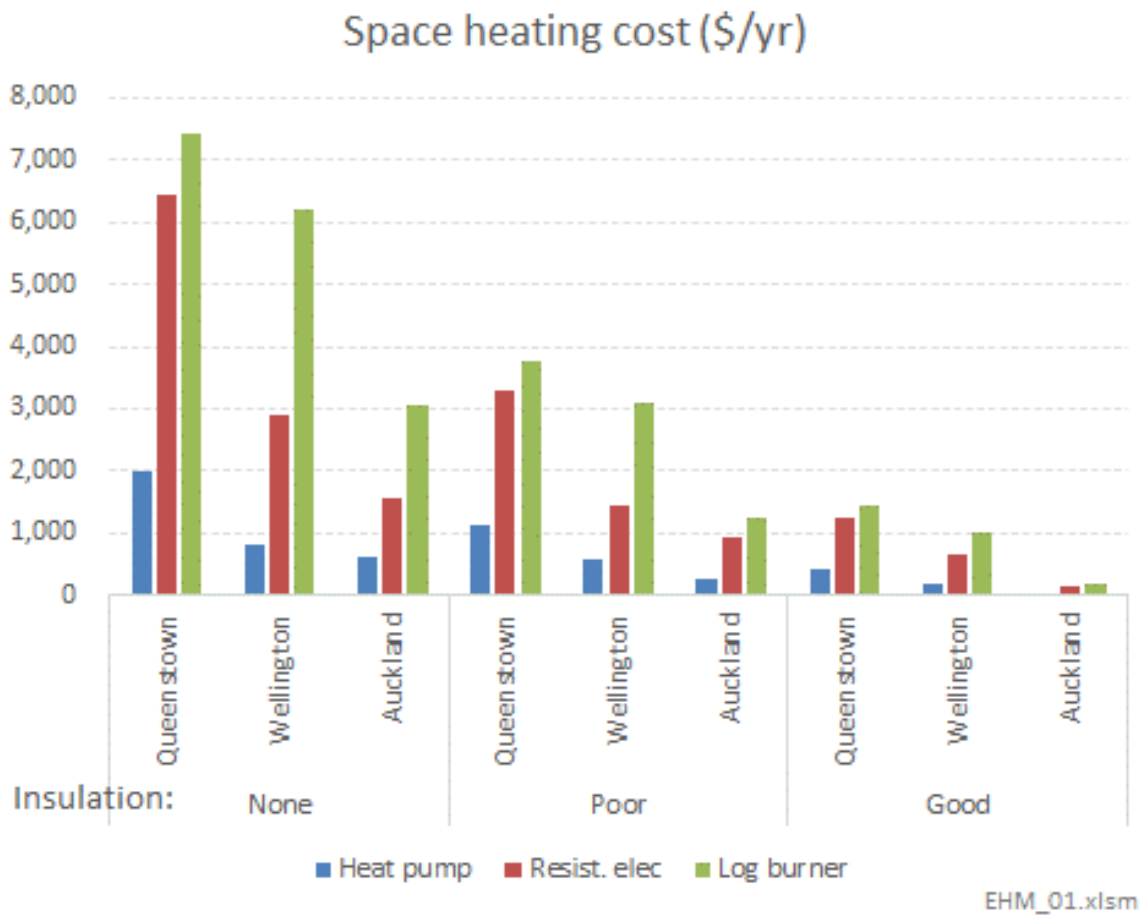
Heating regimes also cause significant variation: Heating all areas of the house 24 x 7 takes 5.5 times as much energy as only heating the living areas in the evening.

Source: Concept modelling

Differences in location, insulation, and heater type used to heat a home, drive significant differences in space heating costs

Modelled energy requirements to achieve 19˚C for a typical* heating regime for a 100m2 home



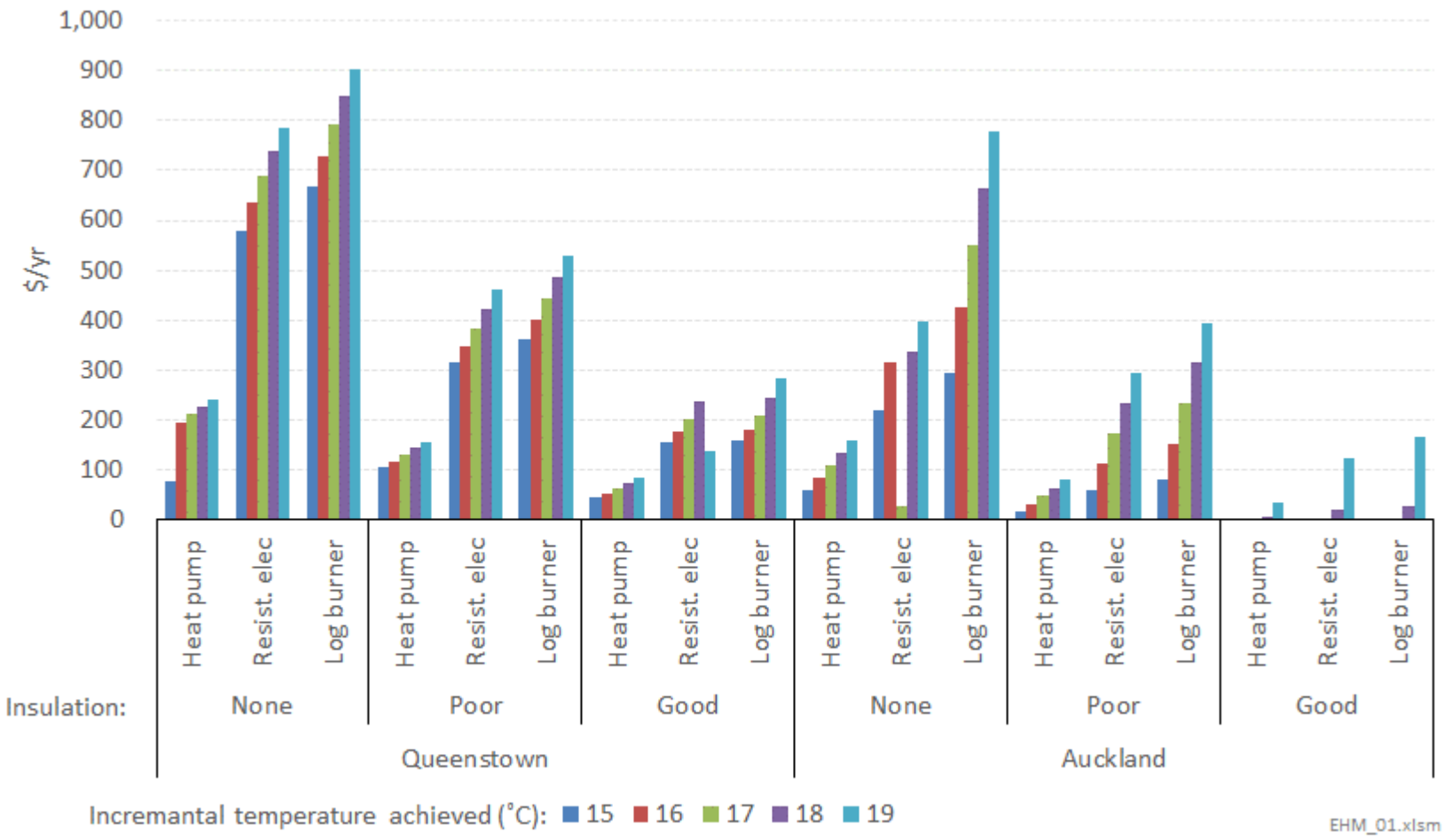


* Approximates to morning and evening heating for living areas. Evening heating for kitchen & bedrooms

Source: Concept modelling

The cost of achieving an extra degree of warmth in a home varies markedly by location, level of insulation, and heater type

Cost of achieving an extra 1˚C of warmth for homes with a typical heating regime



Note: Occasional discontinuities in results moving from 1 degree to next, as increasing consumption flips house from low-user to standard electricity tariff

- To go from 17 to 18˚C costs
  - $490/yr for a poorly insulated house in Queenstown heated by log burner
  - $6/yr for a well-insulated house in Auckland heated by heat pump
- If you are income constrained and live in a poorly insulated house with an inefficient heater, rationing heating can make more financial sense than rationing other goods and services
  - For this example heating regime, you can save $1,100 by choosing to 'heat' to 15˚C in a poorly insulated house in Queenstown rather than 18˚C

Source: Concept modelling

Rectifying under-heating can deliver significant benefit

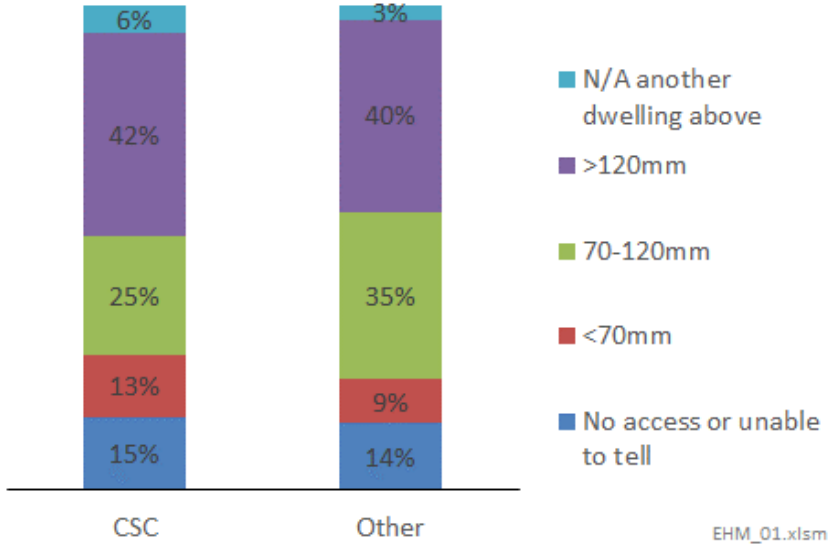
- Past studies evaluating insulation and heating interventions indicate potential for significant benefit:
  - Benefit : cost ratios from approx. 1.5 to 4.5

- Majority of benefit from health & wellbeing outcomes from warmer homes, rather than reduced energy bills: ‘Take back’
  - Reduced: mortality, hospitalisations, domestic violence
  - Increased: educational achievement, life satisfaction

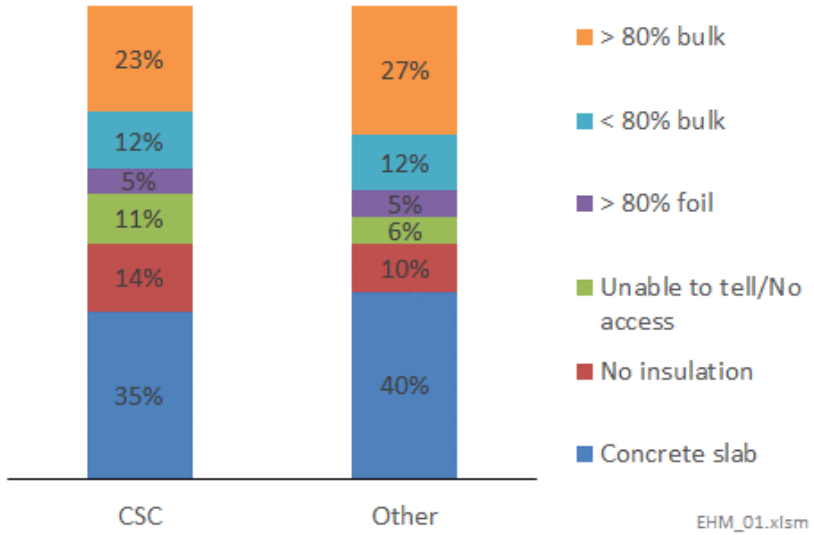
- Significant variation in benefits depending on:
  - Type of household recipient:
    - Higher for more deprived households
    - Health benefits much higher for households with elderly or infants
  - Type of intervention
    - Higher for insulation and heating interventions, lower for draught stopping, negative for ventilation

Although past initiatives have improved insulation, there is still a significant proportion of households with inadequate insulation and heating

Roof insulation

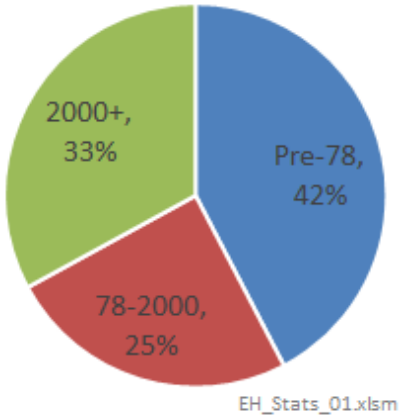


Floor insulation



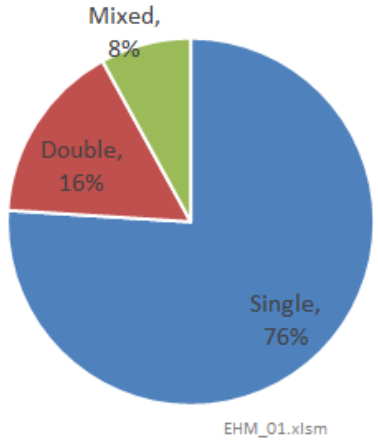
Source: Concept analysis of BRANZ Pilot housing survey data

Wall insulation – inferred from house age

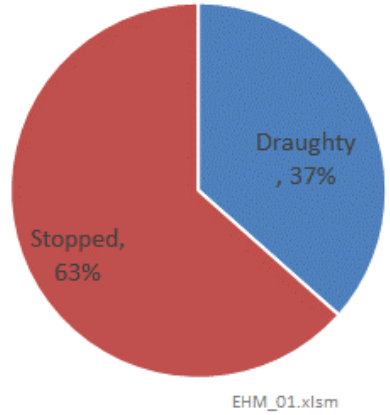


Note: Pre-78 houses which have had substantial renovations may have installed wall insulation at such times. Data not available as to extent.

Windows



Draughts



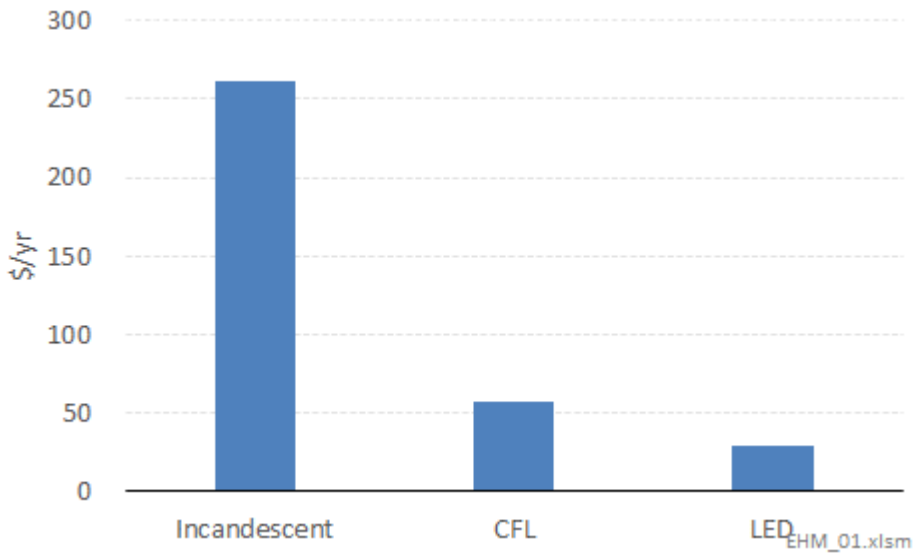
Draughts are around windows and doors

Source: Concept analysis of Stats NZ "Housing in Aotearoa" data

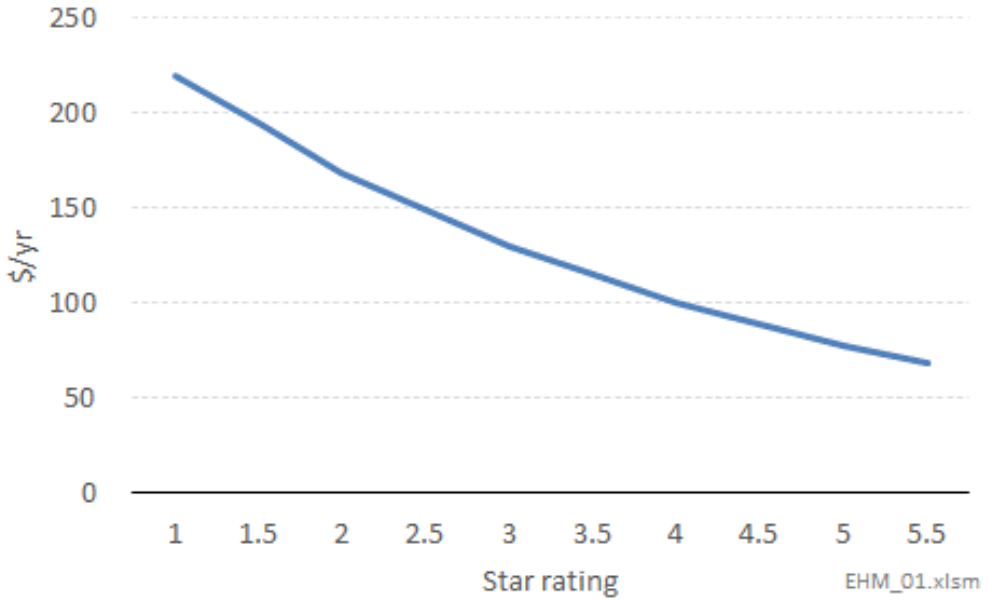
Source: Concept analysis of BRANZ report "Assessing the condition of New Zealand housing: Survey methods and findings"

Having less efficient appliances costs money in other areas

Cost to deliver a typical Kiwi home's lighting load using different luminaires



Annual electricity cost for an average-sized fridge-freezer at different star ratings



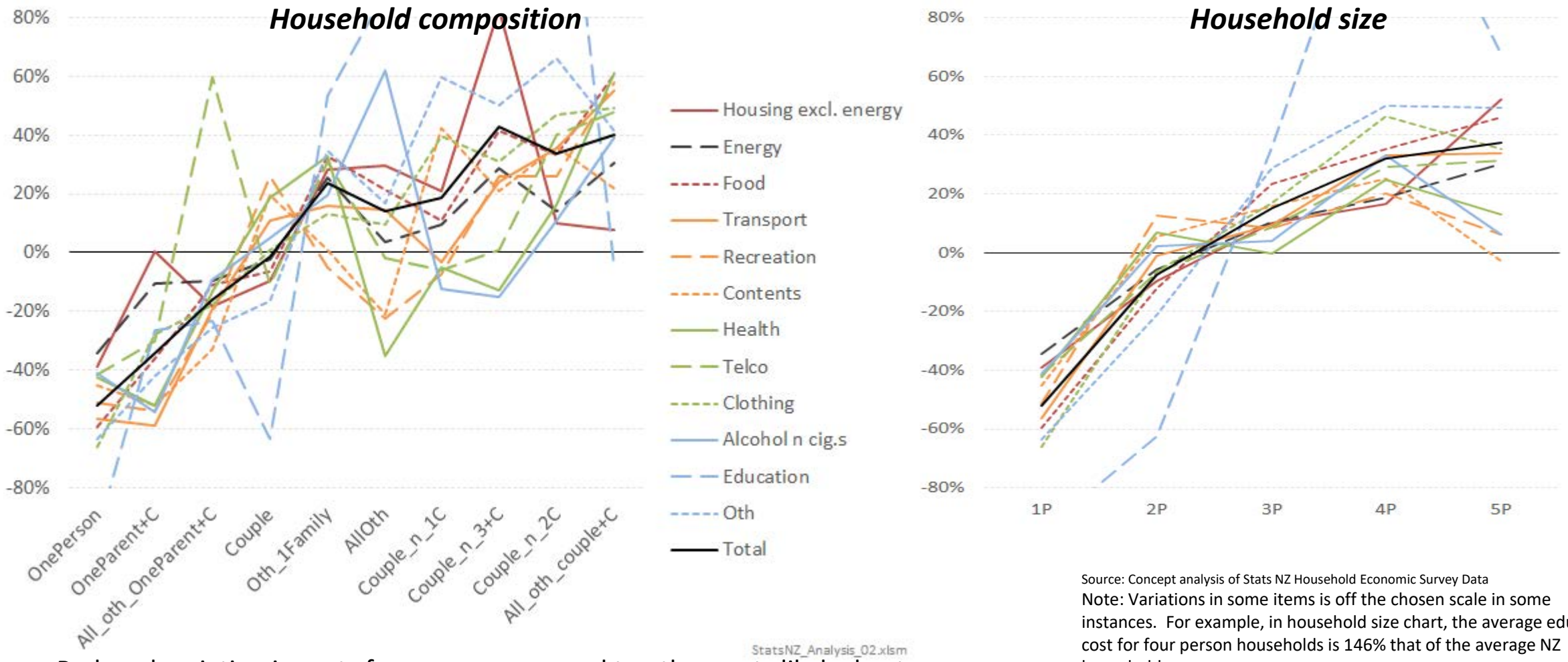
Note: Assumed fridge volume is 278 L with freezer volume of 138 L.
The most efficient model on sale currently has a 5.5 star rating

- No information found as to whether low-income households are more likely to have less-efficient appliances. However, given that, in lighting example at least, more efficient appliances have higher capital costs, it is a reasonable inference to make.
- Further, it is likely that the tenant/landlord barriers which are known to drive sub-optimal heating & insulation provision by many landlords would also apply to provision of the most cost-effective whiteware

Source: Concept modelling using EECA data. Assumed electricity tariff is median tariff for NZ in YE Feb'22

Household composition and size drive energy requirements, but to a lesser extent than other household costs

2019 difference in costs compared to average household

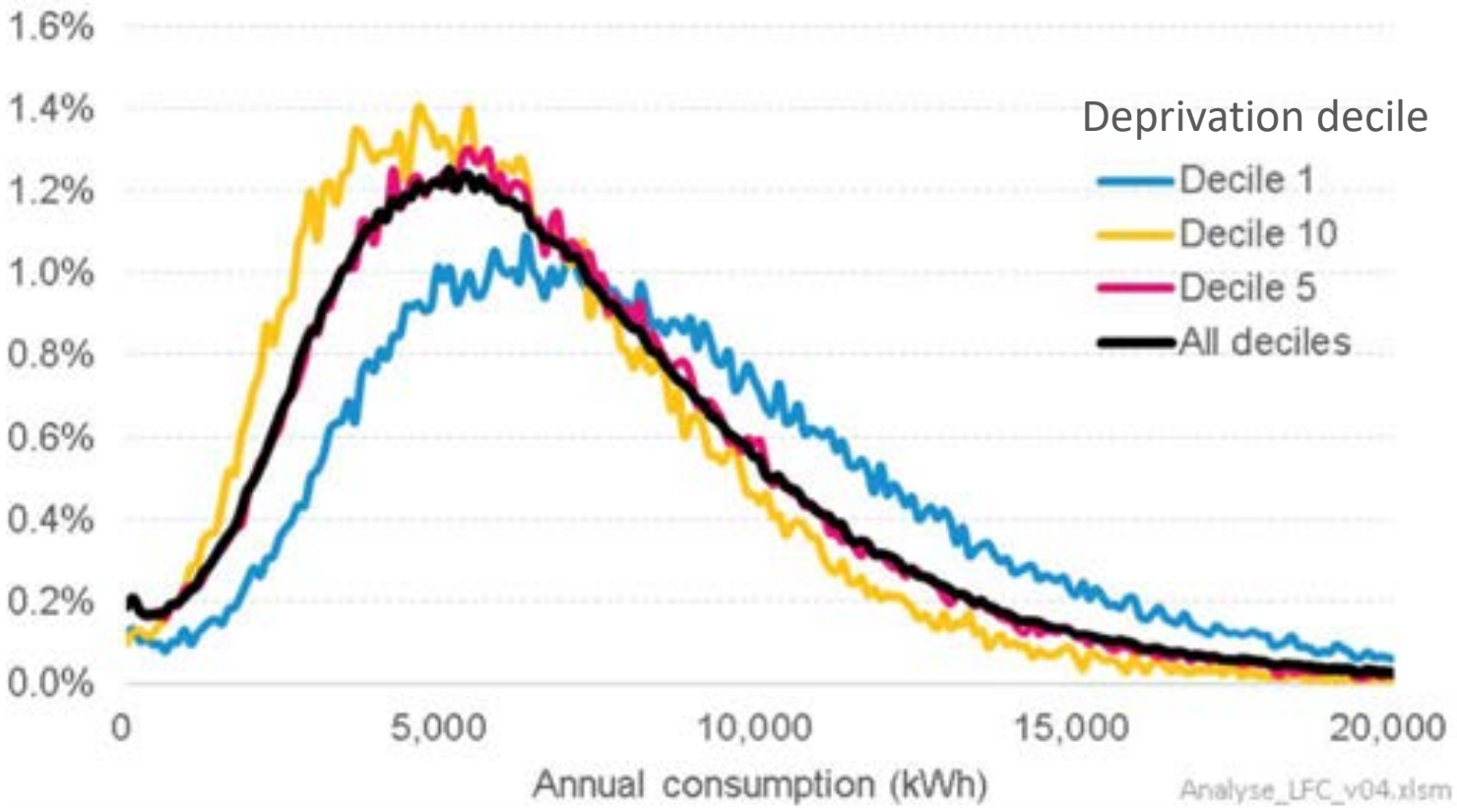


Source: Concept analysis of Stats NZ Household Economic Survey Data

Note: Variations in some items is off the chosen scale in some instances. For example, in household size chart, the average education cost for four person households is 146% that of the average NZ household

- Reduced variation in costs for energy compared to other costs likely due to
  - requiring a minimum / fixed level of energy to provide basic energy services (eg, refrigeration, lighting, heating)
  - presence of fixed charges for energy costs

Electricity Price Review indicated that although more deprived households generally consume less, it is to a relatively small degree

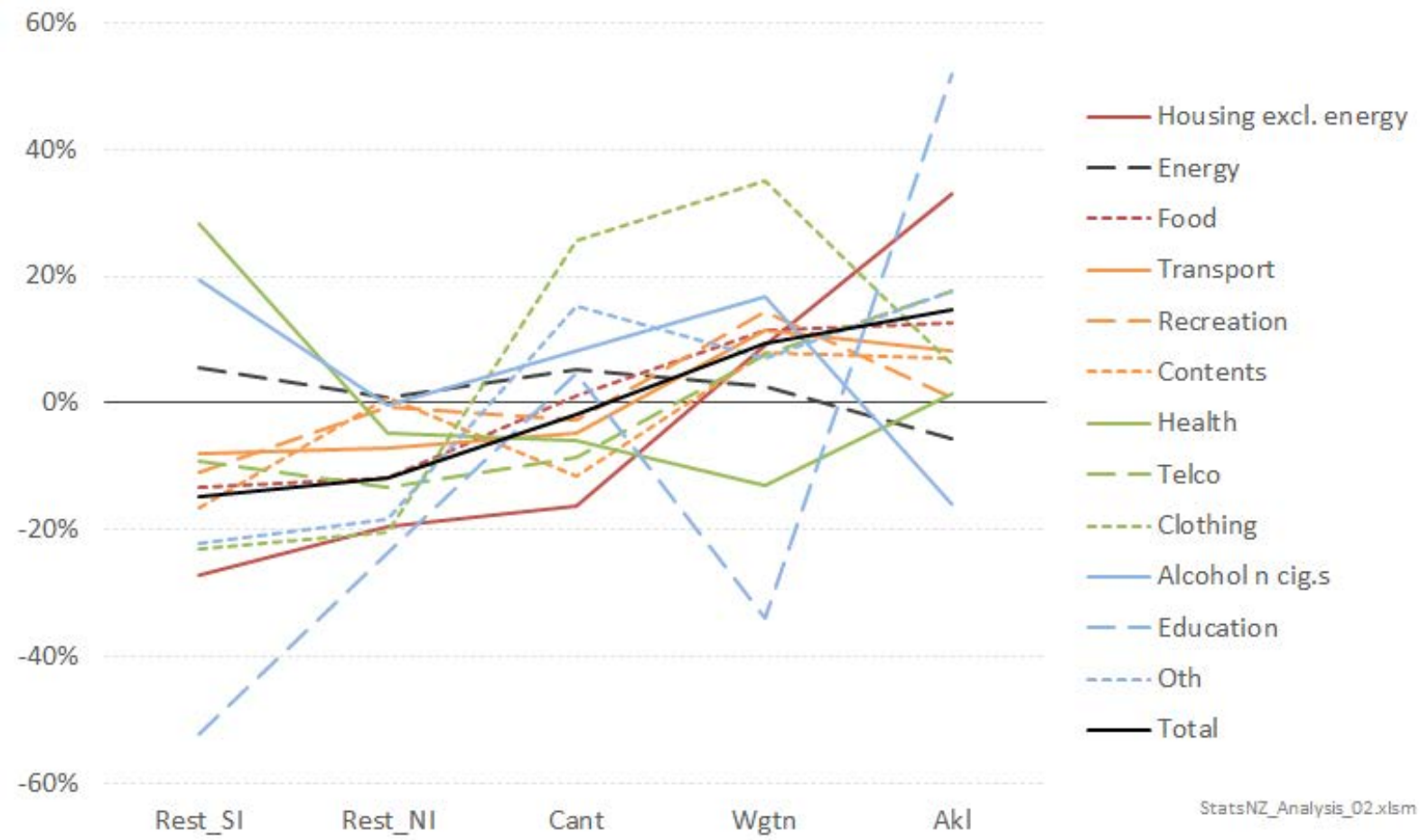


- There are many high deprivation households (Decile 10 in this graph – the reverse of the income deciles!*) whose energy circumstance is such that they have high energy needs
- To the extent that many high deprivation households are rationing their consumption due to income constraints (which generally means under-heating homes below healthy levels), their ***required*** energy requirements could be almost identical to less deprived deciles

* Income deciles have those with lowest income in decile 1. (Rather frustratingly), deprivation deciles have those with highest deprivation – which is generally those with lowest income – in decile 10.

Regional variation in energy costs is significantly less than regional variation in other household costs

2019 regional difference in costs compared to average NZ household

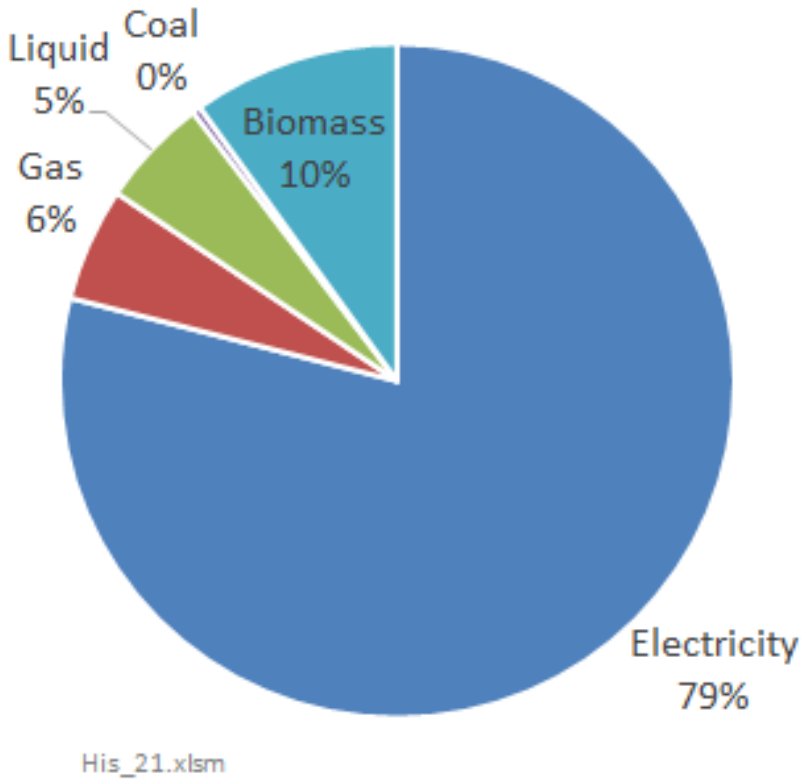


Source: Concept analysis of Stats NZ Household Economic Survey Data

Section 1C) Focus on electricity-specific outcomes

Electricity is the most important source of non-transport energy - particularly for more-deprived households who tend not to be connected for gas

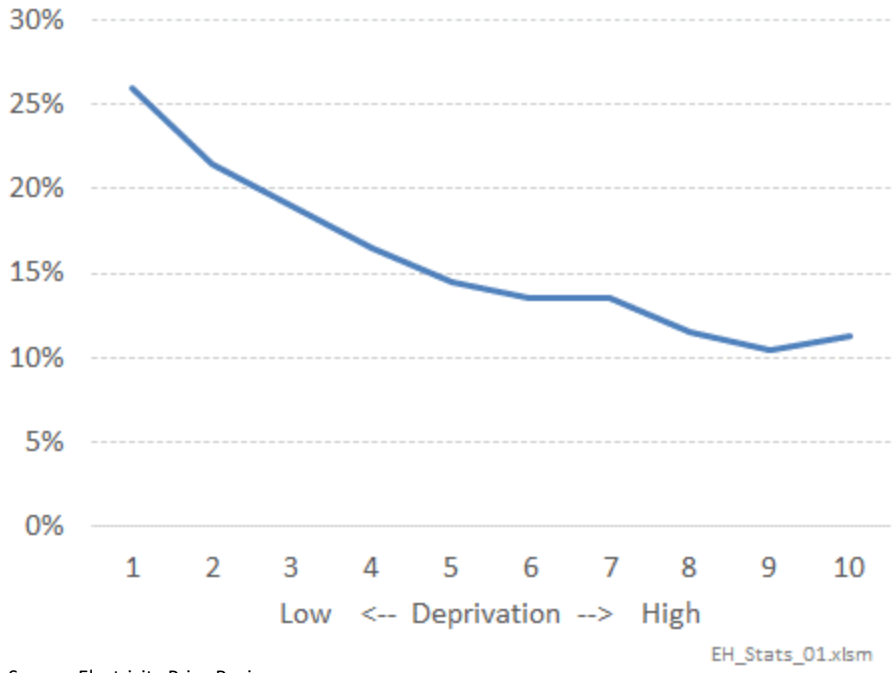
Total NZ residential spending on non-transport energy



Source: Concept analysis drawing on EECA EEUD data

Note: "Liquid" is predominantly LPG

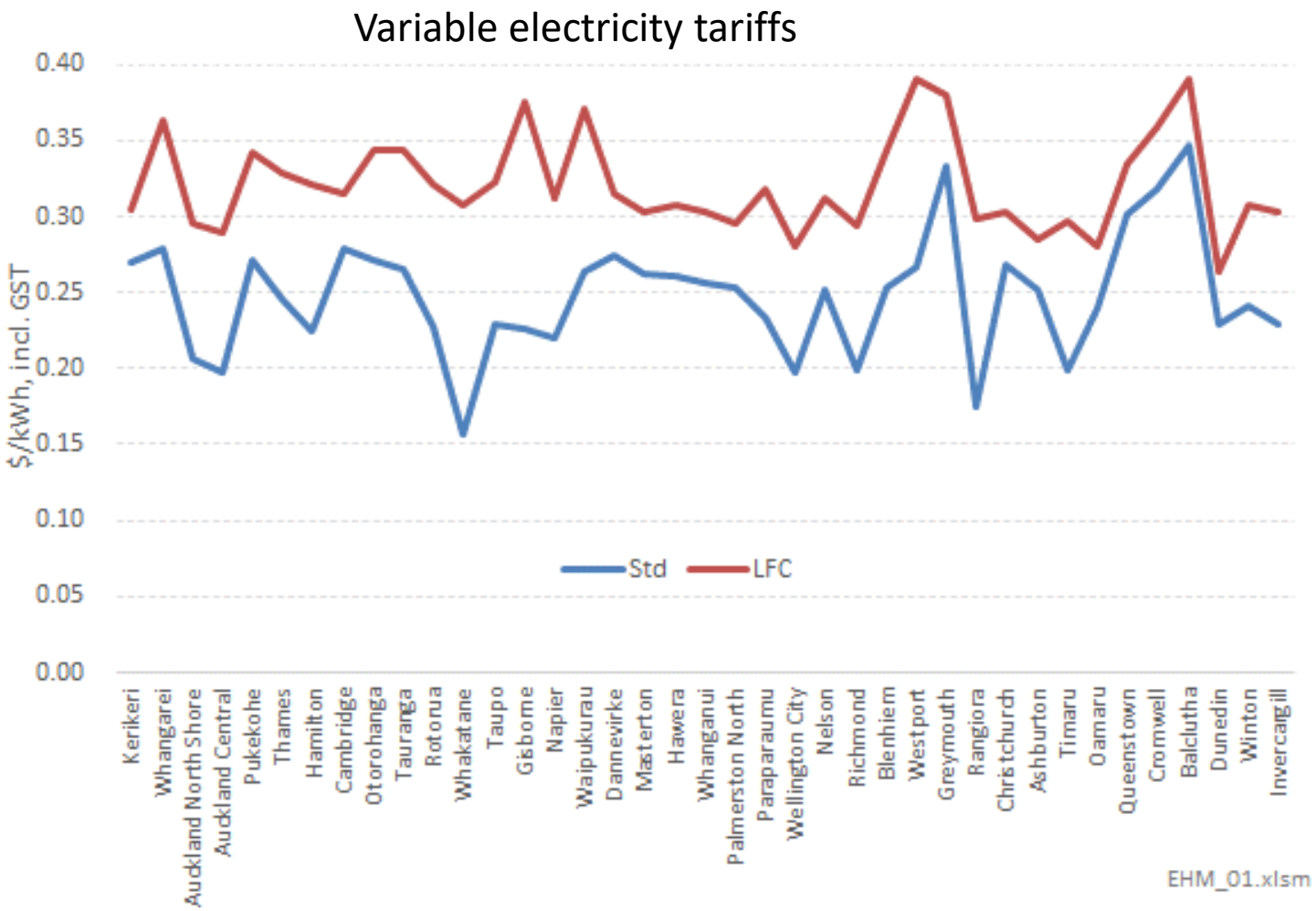
Proportion of households with gas



Source: Electricity Price Review

The much higher costs of LPG compared to gas, means LPG is likely to exhibit a similar relationship

There is significant variation in cost of electricity to heat homes and power appliances



Source: Concept analysis drawing on MBIE QSDEP data, plus published network tariffs

- Largest cause of variance due to factors which could be changed
  - Differences in network pricing approaches
    - Allocation of shared network costs between residential and business
    - Pricing philosophy (eg, prop'n of costs to recover via fixed charges)
  - Low-fixed charge regulations

- Some due to inherent differences in costs
  - Underlying variance in network costs
  - Geographical variance in wholesale cost of power

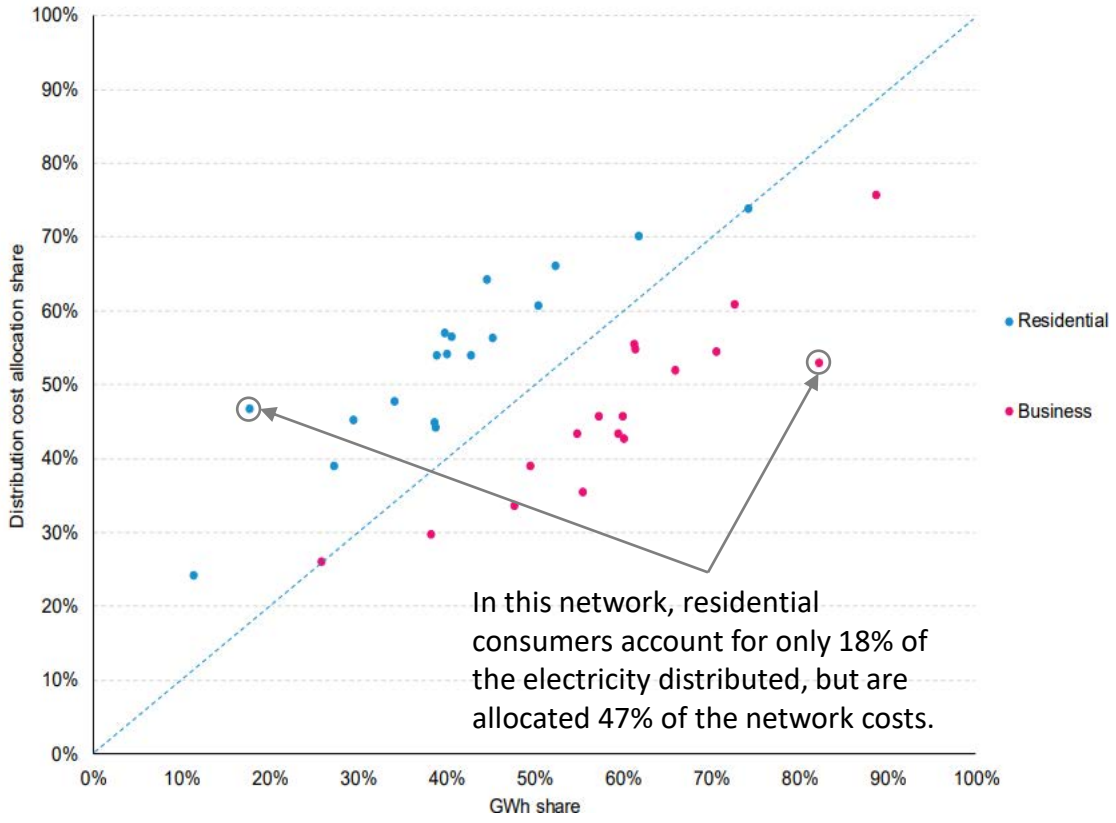
Electricity network cost allocation

- Electricity Price Review (EPR) identified that electricity distribution businesses (EDBs) are using peak demand metrics to allocate shared network costs which aren't driven by peak demand. Consequence is significant over-allocation to residential consumers
  - Concept analysis indicates residential electricity bills, on average, are between 9% and 18% higher than they would be if more appropriate cost allocation approaches used
- Shifting some network cost allocation away from residential to business consumers would increase business consumers' bills
- However, due to significant income-constraint-driven rationing by many residential consumers, and ability of business consumers to pass-on higher electricity costs, provisional analysis indicates that economic consequences of re-allocation from residential to business would be overall positive for NZ

Interpreting the graph

- Each pair of red and blue dots in the graph represents a network company. Each blue dot has a matching red dot (in an equal and opposite position across the 45-degree line)

Residential consumers pay more than their 'fair share' of network costs

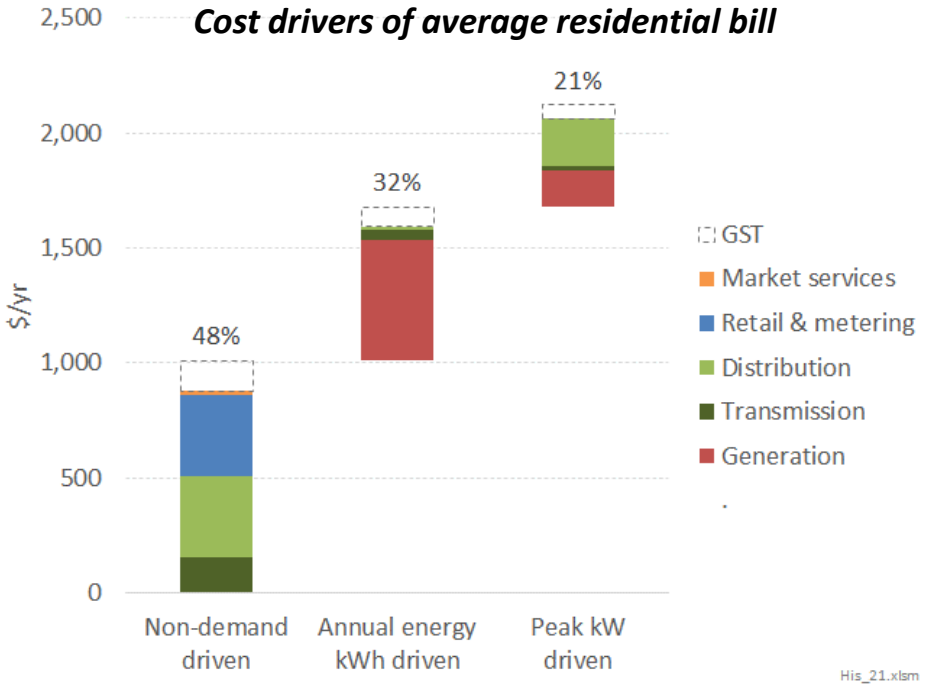


Source: Electricity Price Review

Fixed versus variable charges

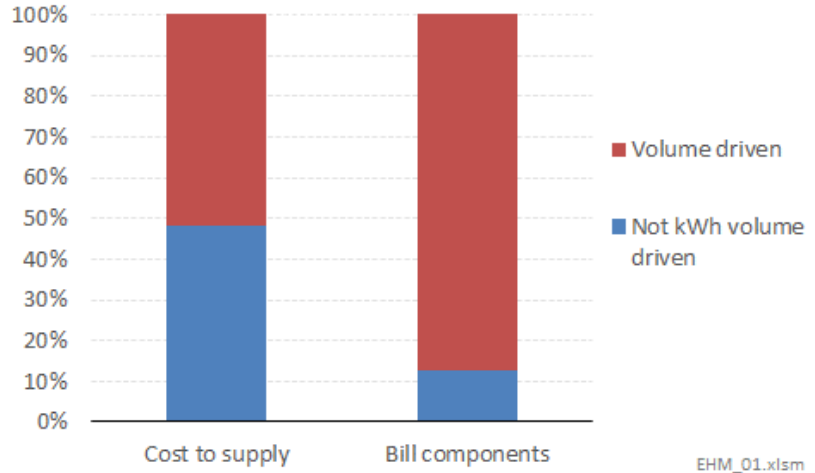
- On average, approx. 50% of costs of supplying electricity are driven by kWh volume of electricity. (Building more generators, higher capacity network cables and transformers). Remaining 50% of costs driven by number of customers, network coverage, and number of network assets (retail & metering costs, building network towers, poles etc.)
- An efficient tariff structure would recover 50% from a variable charge, and 50% from a fixed charge
- However, currently, networks typically over-variablise their 'standard' charges, and both networks and retailers are forced to over-variablise their costs due to low-fixed charge regulations
- Concept analysis indicates that over-variablisation is resulting in $/kWh usage charges being 40-90% higher than they should be
- Over-variablisation has significant negative consequences
  - Harms those facing greatest energy hardship (ie, having low incomes but high energy requirements)
  - Creates higher winter bills
  - Creates an incentive to under-heat homes to 'save' money
  - Makes it much harder to deliver energy-related income support proportional to need, as bills between consumers with similar incomes will vary significantly due to their energy circumstance
  - Dis-incentivises uptake of electric cars and heaters to replace fossil options

Cost drivers of average residential bill



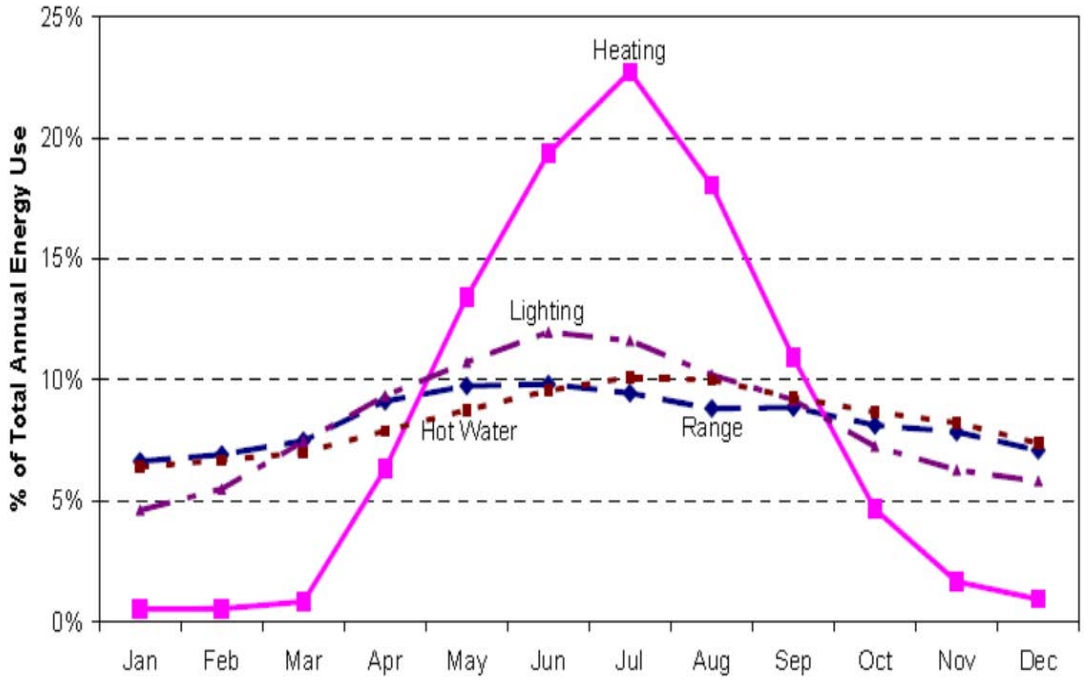
Source: Concept analysis of Transpower and Orion data

Comparison of cost drivers with average residential bill



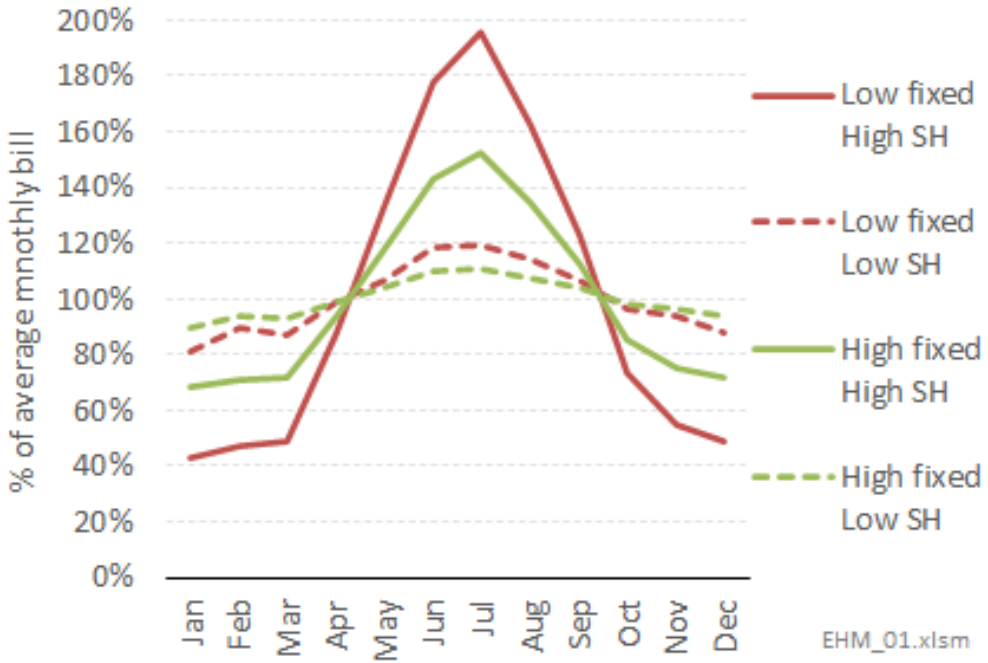
Those with a high space heating (SH) electricity requirement face much higher winter bills due to over-variablisation of fixed electricity supply costs

Space heating (SH) load is significantly greater in winter…



Source: BRANZ HEEP study

… meaning that those with high SH electricity requirements face much higher winter bills than they should, due to over-variablisation of supply costs

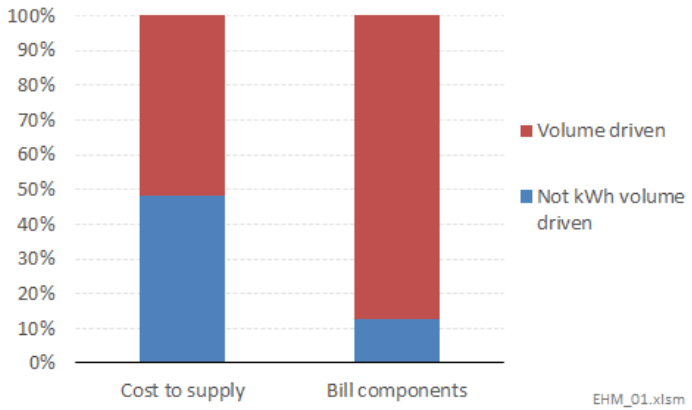


Source: Concept analysis, drawing on HEEP and EECA data

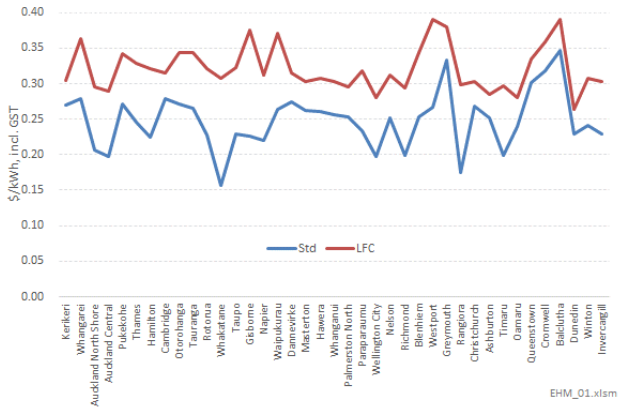
- From a social welfare perspective, this over-variablisation results in significant negative outcome:
  - Difficulty budgeting for income constrained households
  - A greater incentive for households to under-heat their homes to ‘save’ money

Current electricity supply arrangements makes it very hard to give income-based energy hardship support proportional to need

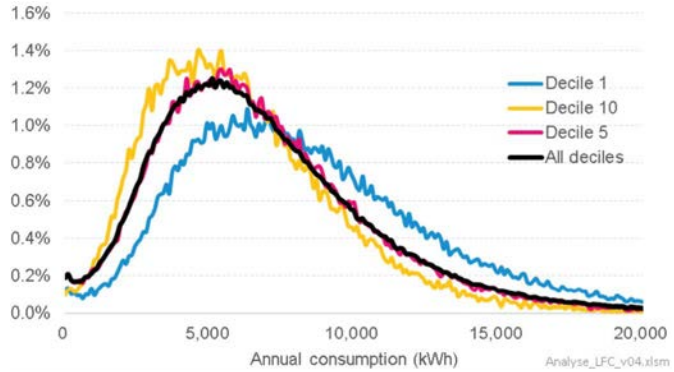
The proportion of costs recovered from volume-based 'variable' charges is much greater than the proportion of supply costs which are driven by volume



Coupled with significant variation in the level of variable tariffs…

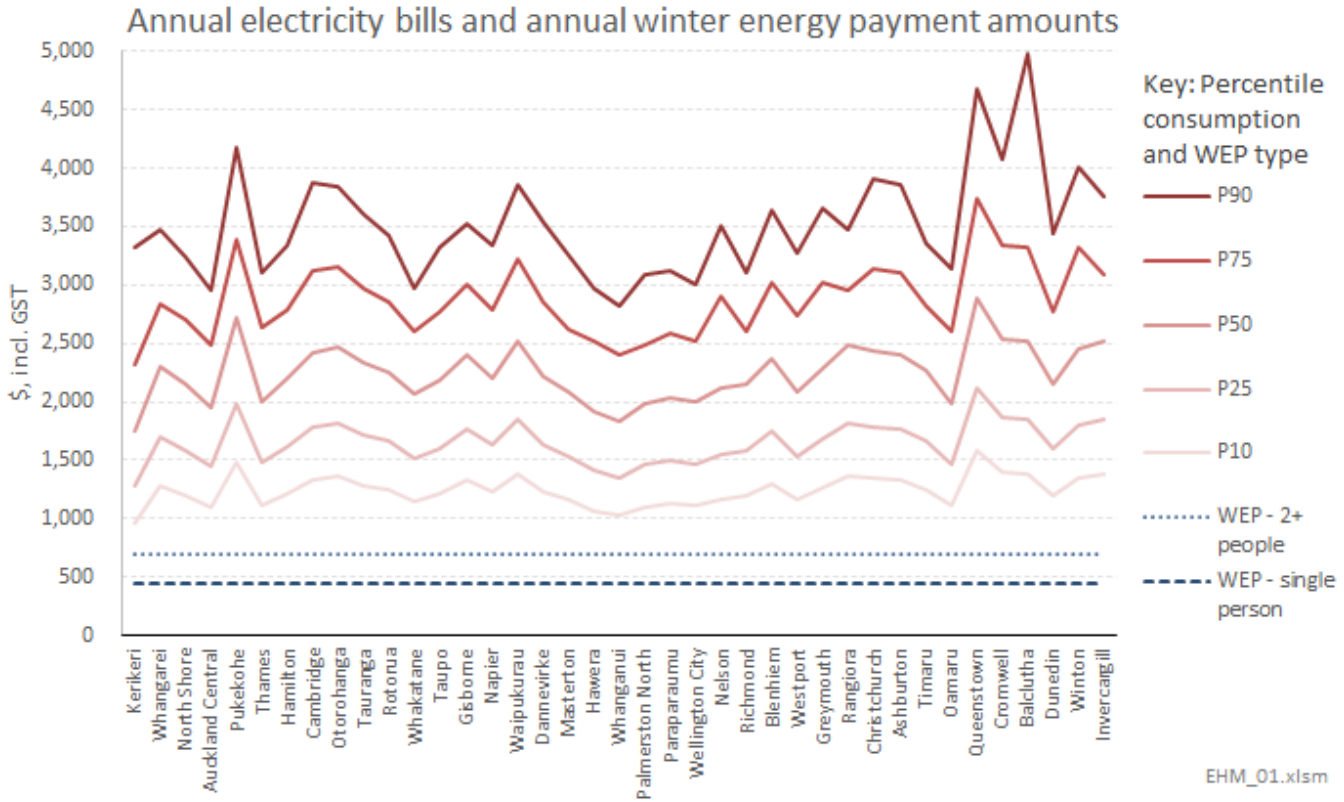


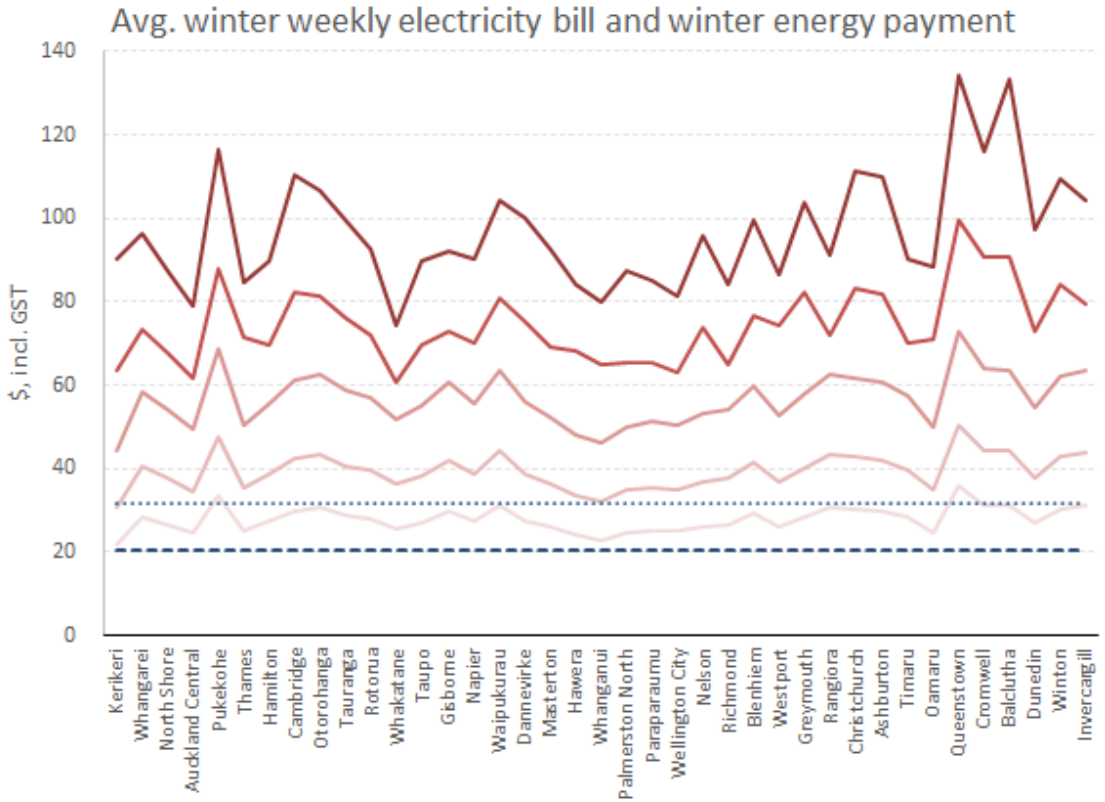
… and significant variation in the amount of required electricity…



… this gives much greater variation in consumers bills than should be the case. This poses real challenges to give energy-related income support proportional to need.

Variations in consumers' 'energy circumstance' means that the winter energy payment to households with similar incomes can range from being more than enough to completely inadequate

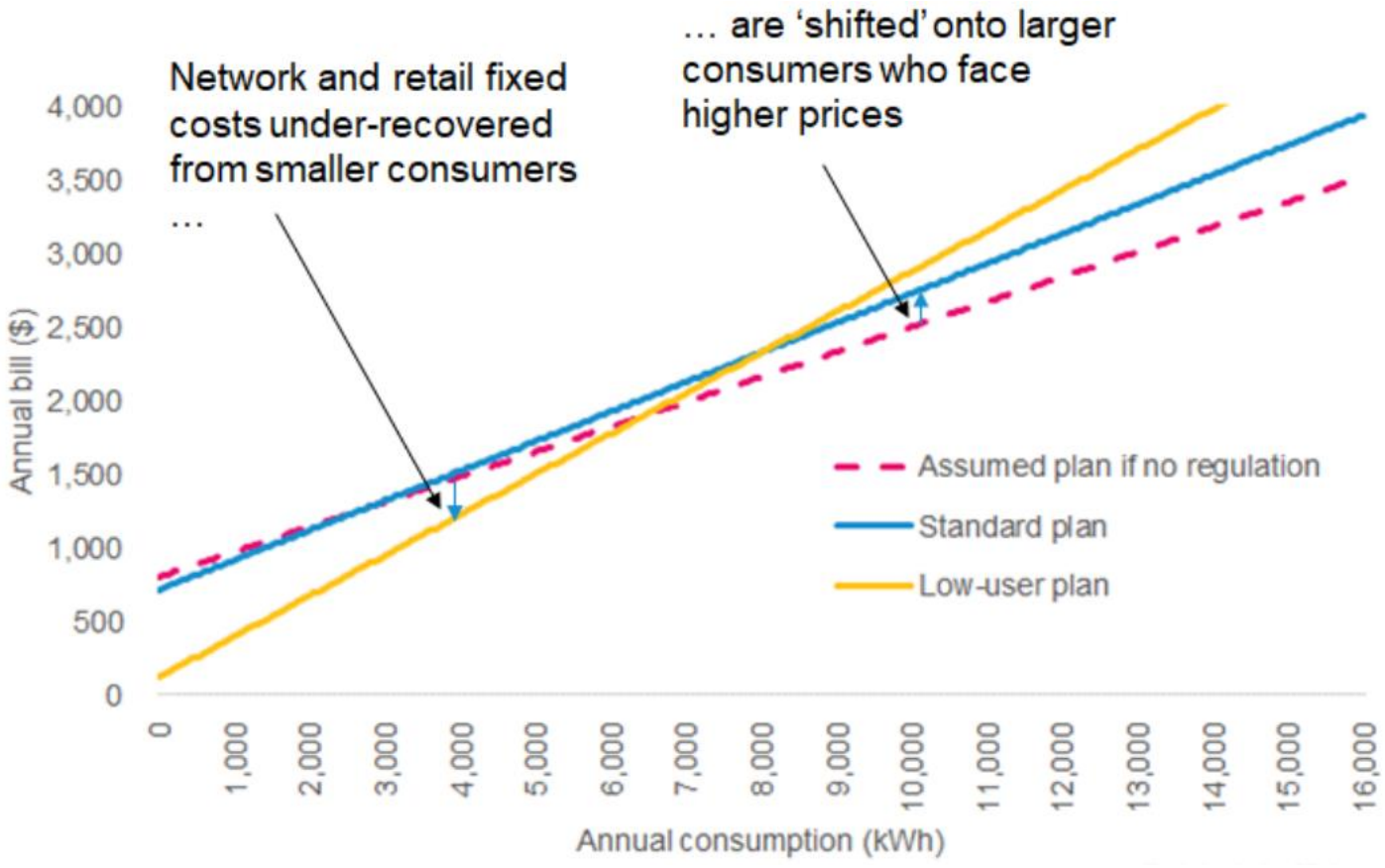




Source: Concept analysis, drawing on HEEP, EEUD, and MBIE data

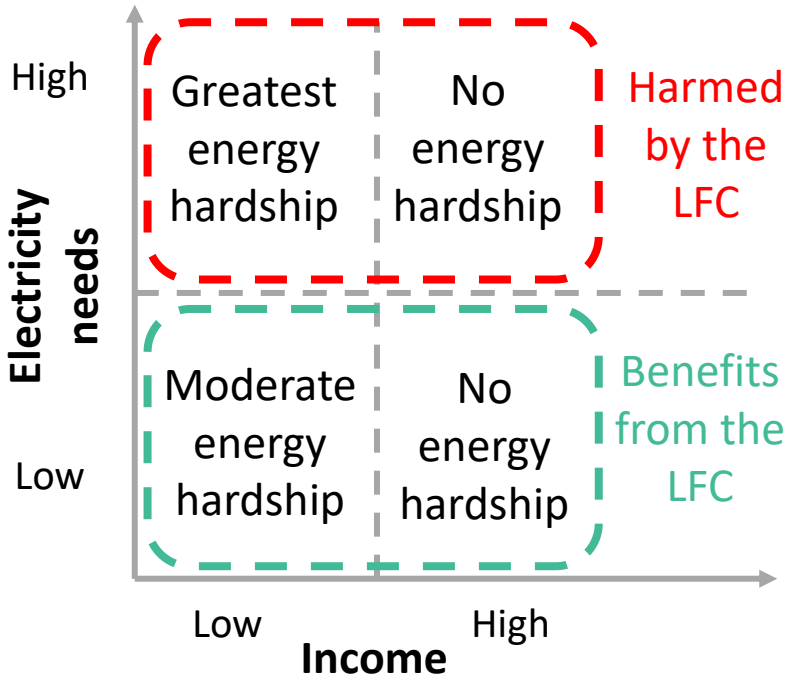
Depending on their energy circumstance, a low income household may be lucky enough to have electricity consumption close to the 10th percentile, but may also have the misfortune to be at the 90th percentile – particularly on a required energy basis

Removal of the low-fixed charge should benefit those who face greatest energy hardship



Source: Electricity Price Review, MBIE, 2018

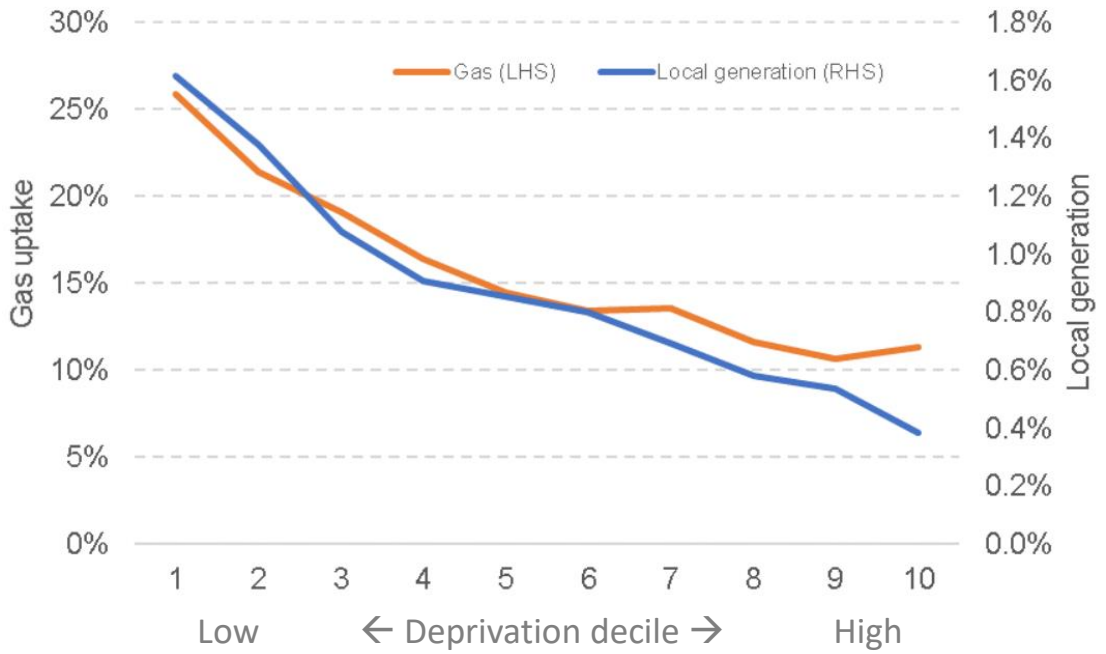
The LFC gives support in inverse proportion to need



In many cases the LFC transfers money from poor to wealthy

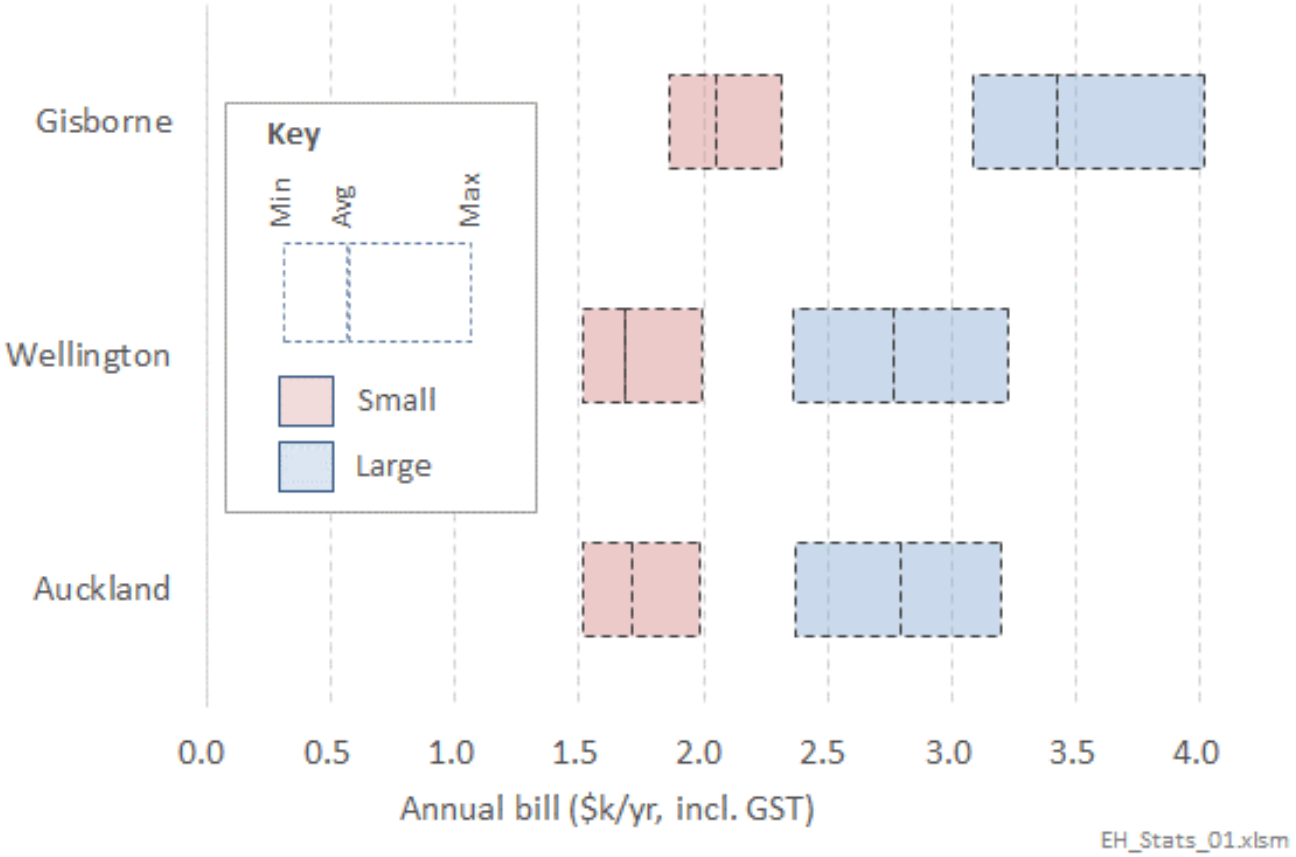
Flat versus time-of-use charges

- Historically, tariffs were ‘flat’ – ie, the same price throughout the day
- Electricity companies, supported by the Electricity Authority, are increasingly moving to more cost-reflective tariffs whose price varies between peak and off-peak periods (eg, the introduction of time-of-use tariffs)
- In general, this move is considered beneficial to low-income consumers
  - Low-income consumers tend not to have a consumption profile that matches the classic weekday morning and evening peak of most households. Their demand-weighted average price will therefore fall compared to flat pricing
  - Flat pricing is artificially rewarding rooftop solar, causing ‘cost-shifting’ between the solar ‘haves’ (predominantly wealthy) and ‘have-nots’ (predominantly poor). TOU pricing which defines middle-of-the-day as off-peak will not cause such cost-shifting. In Australia, this dynamic of non-cost-reflective tariffs is causing significant wealth inequalities, causing social welfare NGOs to push for tariff reform – which is being resisted by (solar-owning) ‘middle Australia.’
- The one area where TOU could cause issues, is if companies choose to introduce Summer/Winter pricing as well as within-day peak/off-peak
- ***Note:*** The gas line is included as the graph is a screen shot from the EPR report which was addressing issues relating to both gas and rooftop solar uptake.



There are many electricity tariffs to choose from, and significant variation in cost between the best and worst electricity tariff

Variation in electricity bills under different retailer tariffs for 'small' and 'large' residential consumers

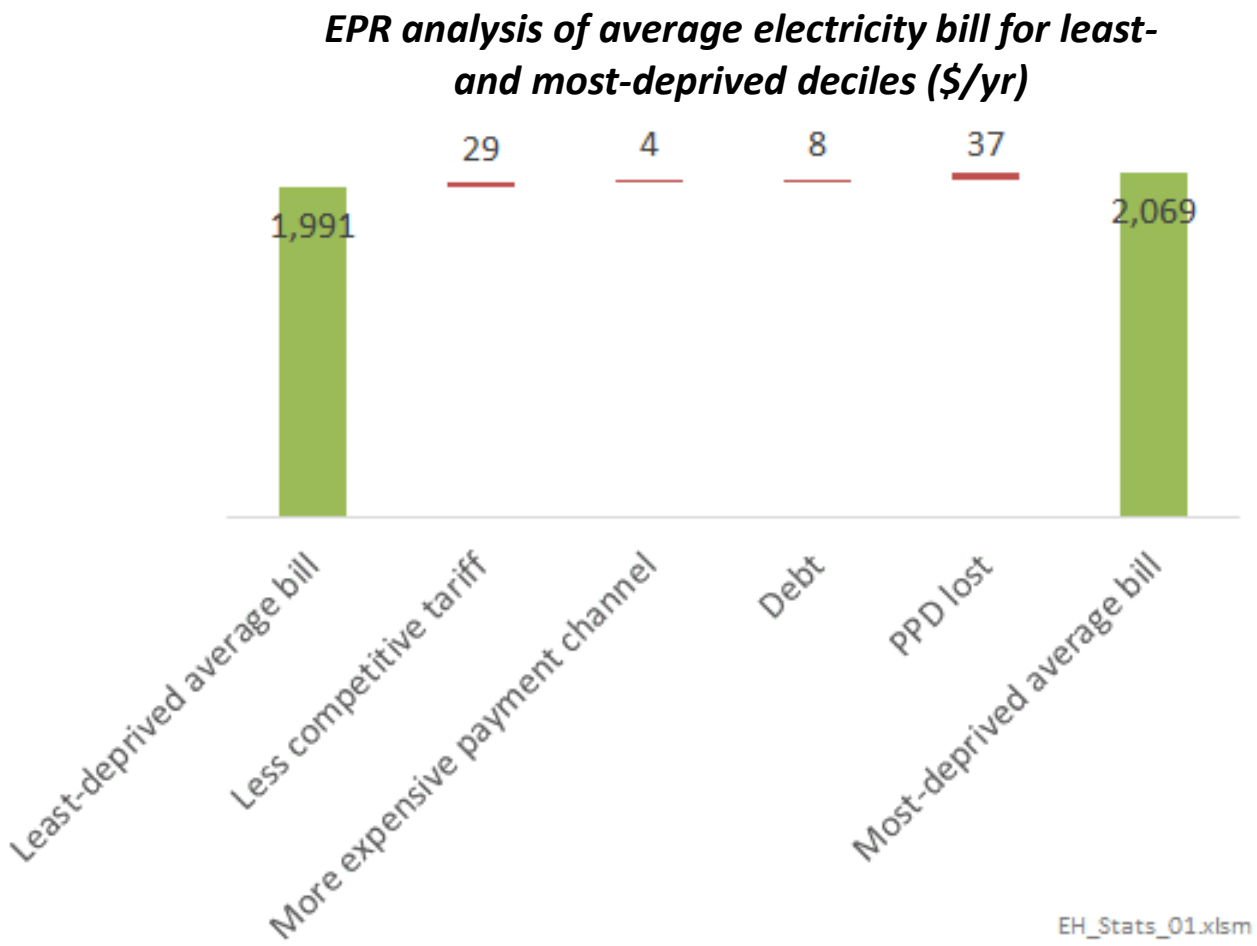


As shown in slide 34, Gisborne has higher residential electricity tariffs than Auckland and Wellington, principally due to higher network tariffs. Higher network tariffs likely due to some combination of higher underlying costs of provision per consumer, and Eastland Networks' approach to sharing network costs between residential and business consumers

- All tariffs for 3 network areas downloaded from Powerswitch at end of March '22
  - On average 44 different options for each network area
    - Different retailers
    - Different term deals for each retailer
    - Low-user and standard user options
- Bills calculated for every tariff for a 'small' (5,500 kWh/yr) and 'large' (10,000 kWh/yr) consumer
- Average range* between best and worst tariff:
  - $470 for small (26% of avg. tariff)
  - $870 for large (29% of avg. tariff)
- If term deals excluded, best tariff is higher price altering range:
  - $445 for small (24% of avg. tariff)
  - $730 for large (21% of avg. tariff)
- None of the best tariffs in either situation require direct debit or internet billing.
- Price range outcomes similar to that observed for Electricity Price Review

*Note: Assumes consumer is on correct low-user/standard tariff option. Being on the wrong tariff for size of consumption would increase this range further.

The Electricity Price Review (EPR) didn't find material evidence that it is only those who are most deprived who get the worst deals



- EPR analysed a year's worth of almost every electricity bill in the country, and correlated with meshblock deprivation deciles
- Although lots of consumers were on bad deals (and lots on good deals) there was only very minor statistical correlation that those who were in more deprived situations were on generally worse deals.
- The most statistically significant areas where those who were more deprived faced worse outcomes related to bad debt and prompt-payment discount (PPD) lost
- Following the EPR report recommendations, most (but not all) retailer have now stopped offering PPD

SECTION 2: COMPENDIUM OF PAST ENERGY HARDSHIP STATISTICS

Compendium Stories

- **Defining Energy Hardship**
  - Energy hardship is a component of general hardship and its prevalence linked to increasing costs of living (housing, food, etc.)
  - Those that are in energy hardship are more likely to be exposed to poor housing condition and associated costs (health, pharmaceuticals, etc.)

- **What do Kiwi's use energy for?**
  - Space heating and water heating dominate our energy use

- **House and Appliance Condition**
  - New Zealand still has a significant number of houses which are relatively poorly insulated and have inadequate heating
  - Data and studies suggest:
    - Rental properties are worse than owner-occupied
    - Low-income households are more likely to live in rental properties

- **Cost-Benefits of Interventions**
  - Living in cold, damp housing has been shown to cause significant human welfare costs
  - Various interventions to improve the situation have been shown to have positive benefits
  - Importantly, the benefits of interventions to improve house or heater efficiency are predominantly not reduced energy costs, but instead 'take back' benefits, whereby the same amount of money is spent on energy but delivers warmer, drier homes

- **Affordability and Accessibility // Knowledge and Navigation**
  - Households in energy hardship not only suffer from exposure to cold, damp and mouldy homes, but struggle to keep on top of bills and risk getting into debt, further exacerbating hardship
  - Energy hardship has existed for many years, likely impacting many households
  - Switching electricity plan/retailer can reduce costs but mistrust or fear of consequences makes some households reluctant

Notes on Compendium

- Use caution when interpreting and applying the findings of the reviewed literature. Some studies focus on a small number of households, particular locations or demographics and may have been conducted several years ago and/or use data that is several years old
  - These studies are included as they still show the value of interventions and give perspectives on the relative value of different interventions, etc.

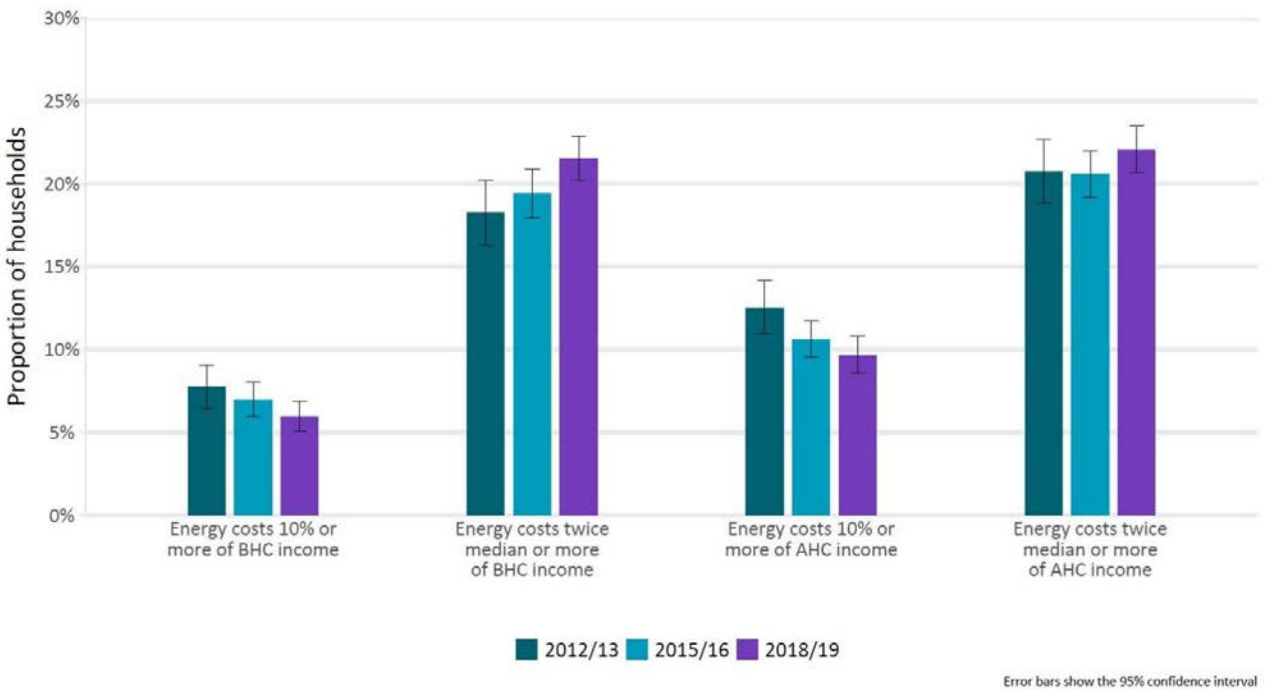
- The Compendium contains multiple studies that have found similar findings (e.g. retrofits for insulation typically achieves greater benefits than just heating). Given the focused approach in terms of number and locations of households of some studies, their inclusion is intended to give further confidence in the finding.

- Some slides in the Compendium are repeats of those in the main report, but have been included again to enable a more coherent flow to each Compendium 'story'. These slides have a Repeat logo in the top right corner

Measures of energy hardship

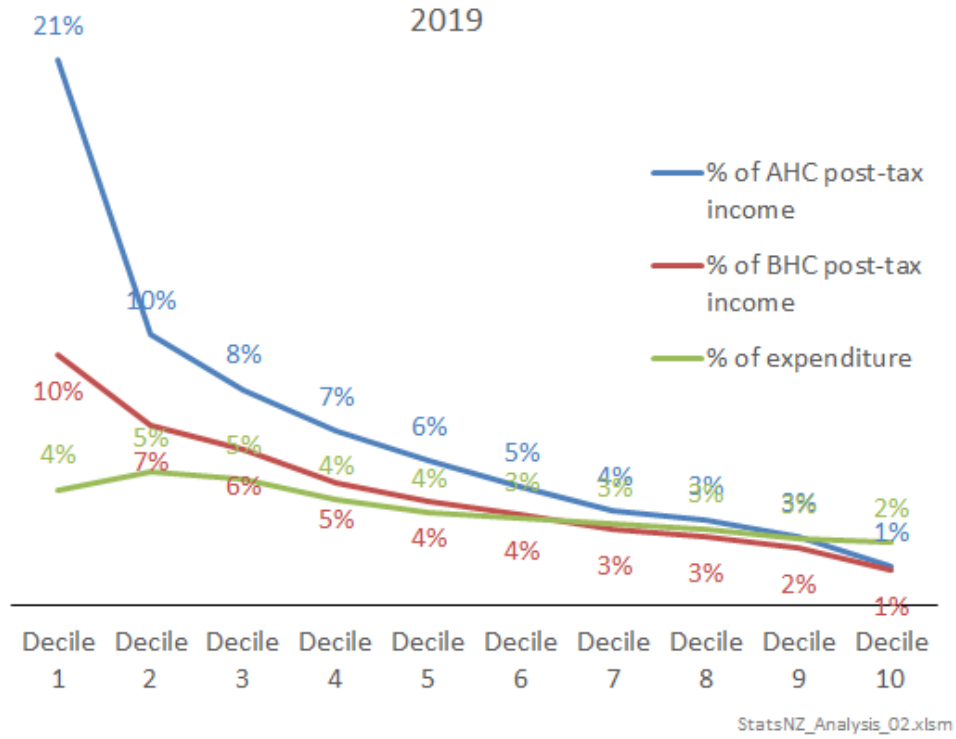
‘Objective’ measures of hardship compare spend on energy with overall expenditure and measures of income. Low-income households score worst on these measures

Energy hardship affects between 1-in-5 and 1-in-17 households, depending on which objective measure is used



Source: Appendix D of Defining energy hardship discussion document

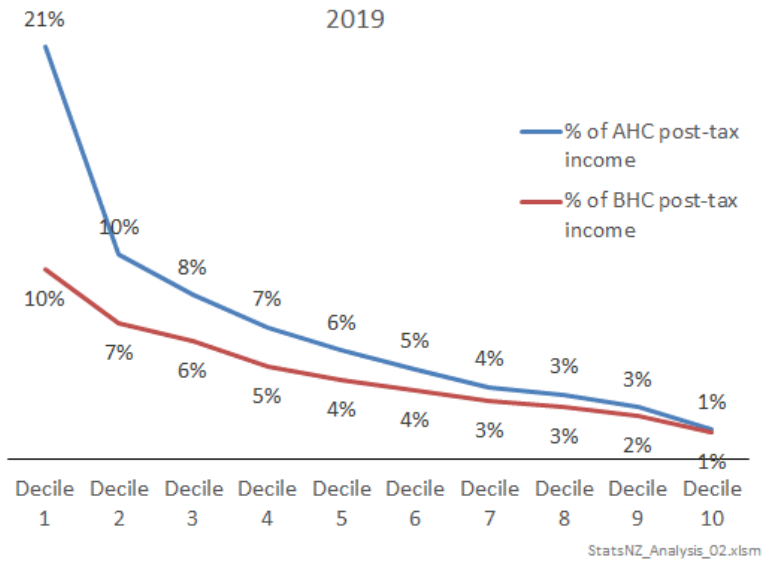
Low-income consumers score the worst on these objective measures

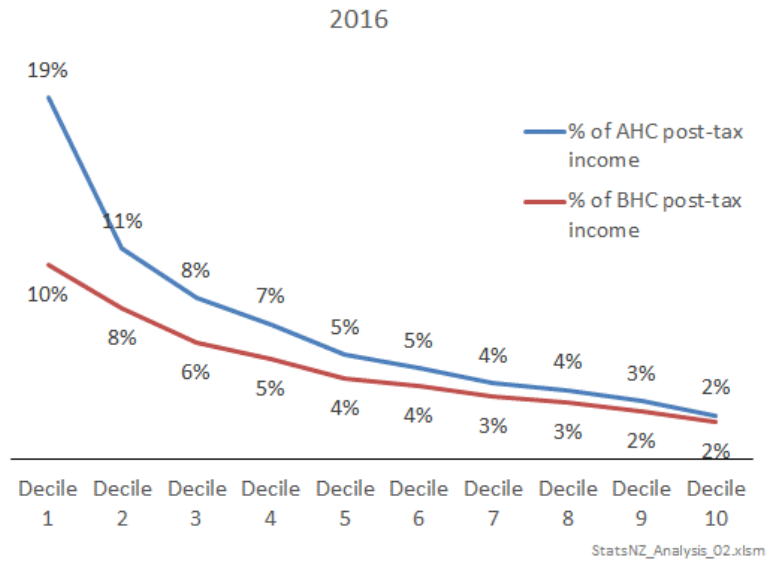


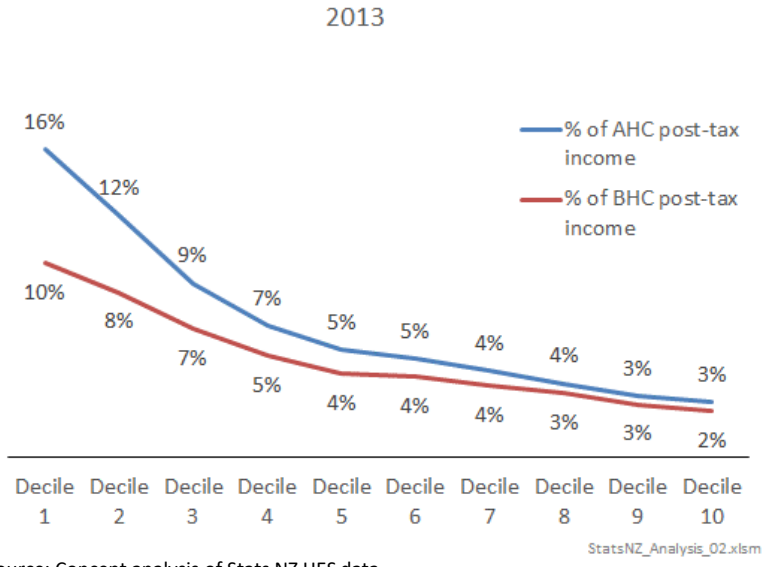
Source: Concept analysis of Stats NZ HES data

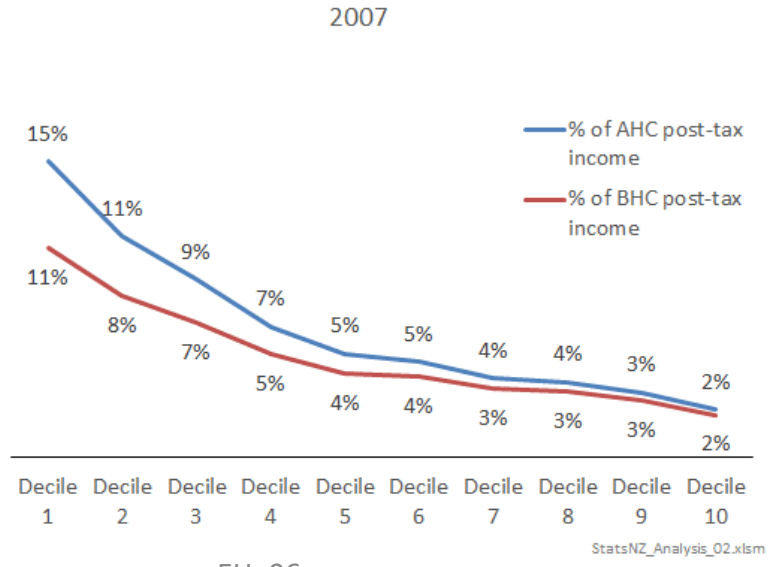
Increases in housing costs have progressively increased the proportion of households facing energy hardship using After Housing Cost measures

Energy costs as a proportion of income measures





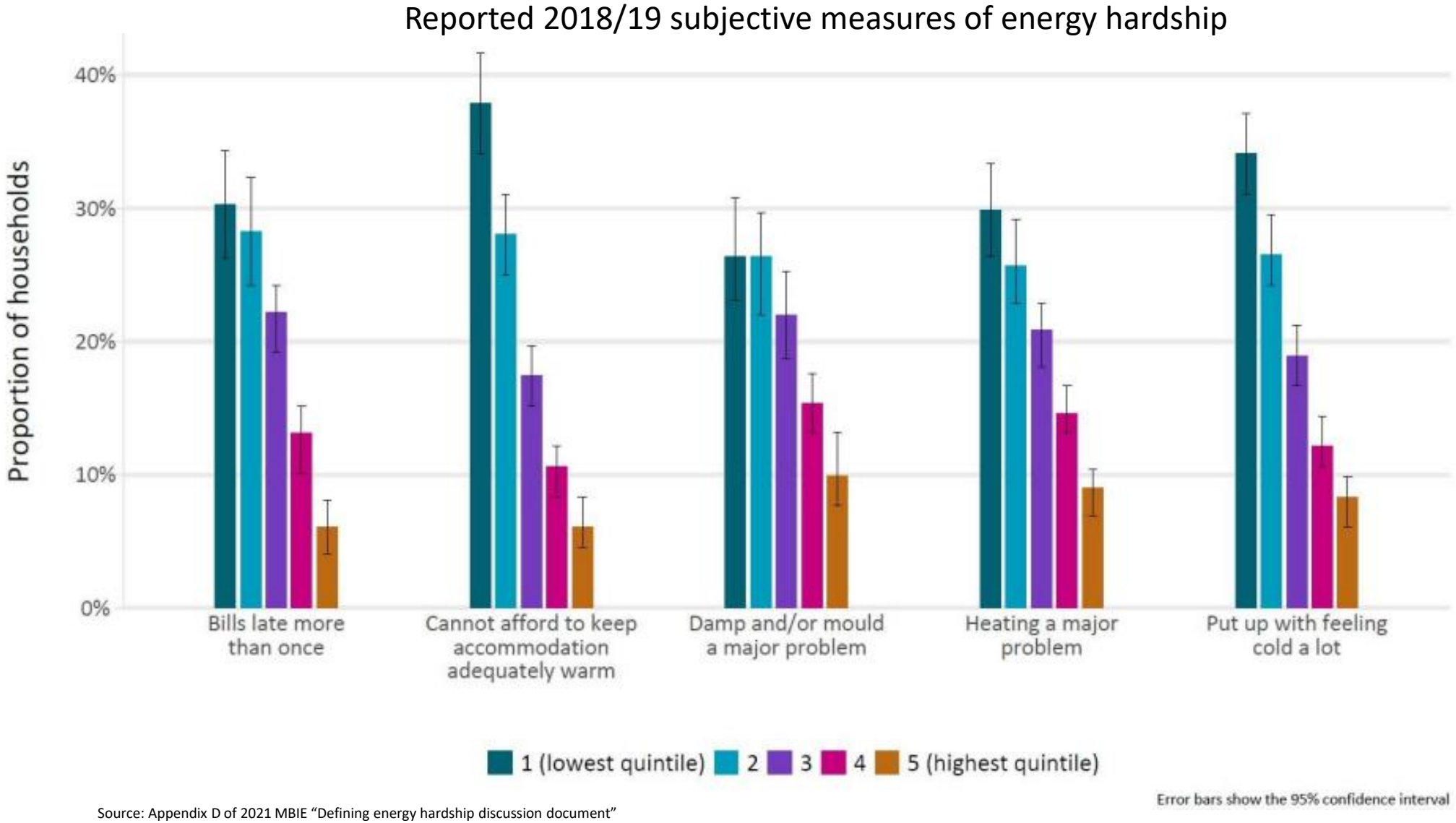




- Households are deemed to be suffering energy hardship if energy costs are greater than 10% of Before or After Housing Cost (B/AHC) income.
- Using observed energy spending, Average decile 1 household faces BHC energy hardship, and average decile 1 & decile 2 household faces AHC energy hardship.
- However, subjective measures (see next slide) indicate that significant proportions of households have insufficient income to adequately heat their home
- Amount of required energy to deliver adequate energy service levels would result in many more households spending more than 10% of the BHC or AHC income on energy

Source: Concept analysis of Stats NZ HES data

Almost 20% of households report having insufficient income to adequately heat their home



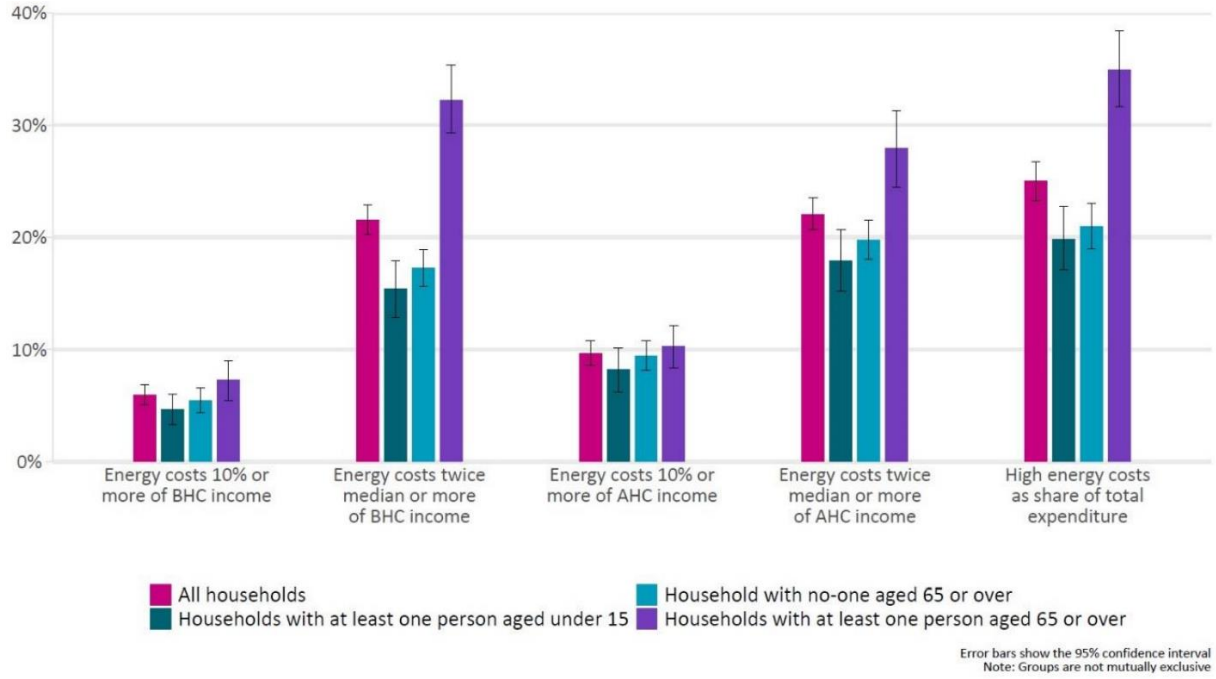
Source: Appendix D of 2021 MBIE "Defining energy hardship discussion document"

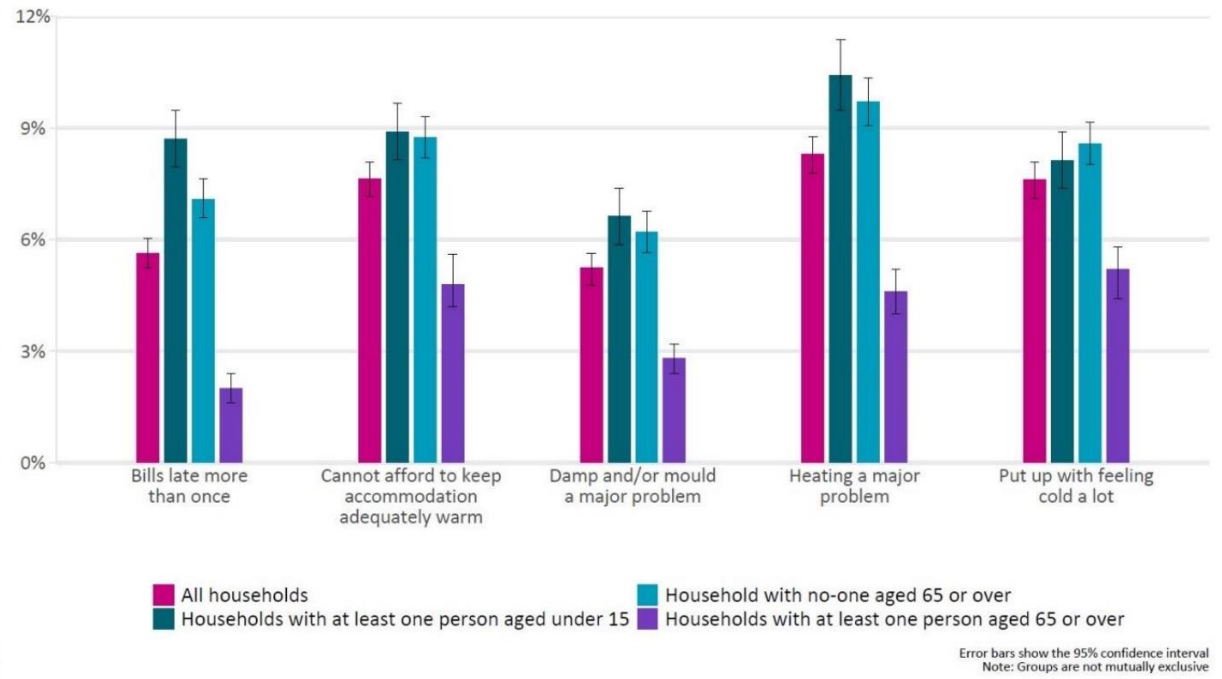
Examining outcomes for older New Zealanders reveals low income doesn't necessarily mean high energy hardship

Although older households are more likely to exhibit 'objective' measures of energy hardship…

… they are much less likely to be suffering 'subjective' outcomes such as inadequate heat or struggling with bills

2018/19 proportion of households



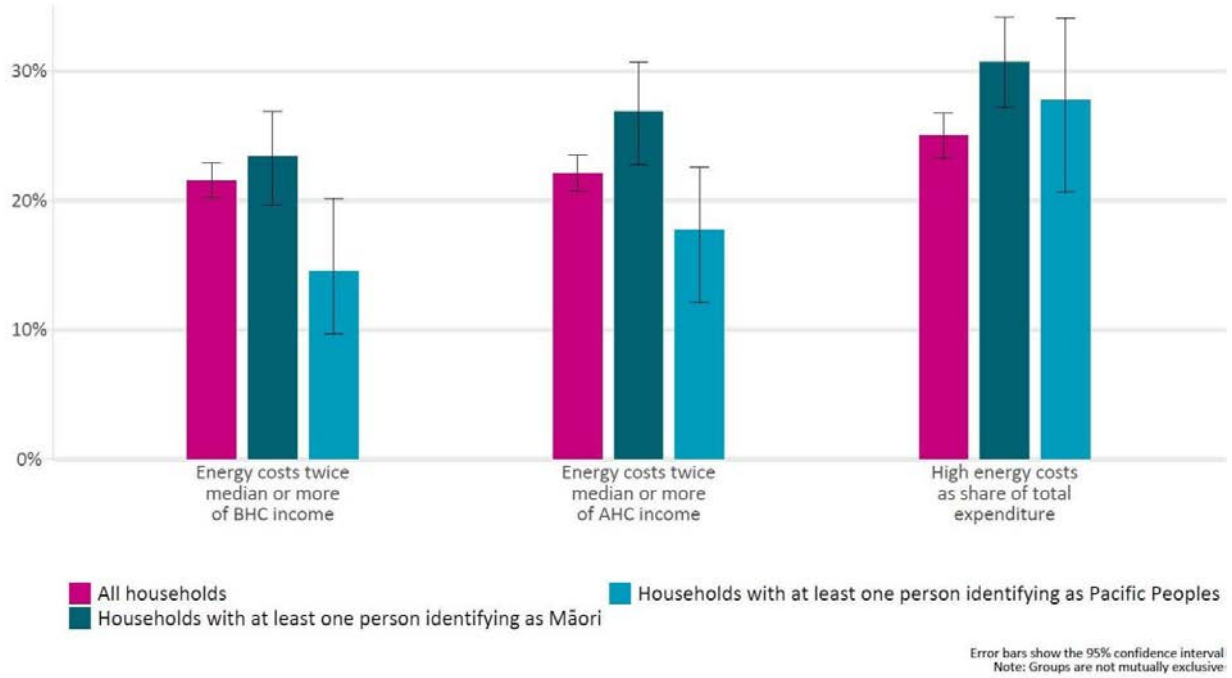


Source: Appendix D of Defining energy hardship discussion document

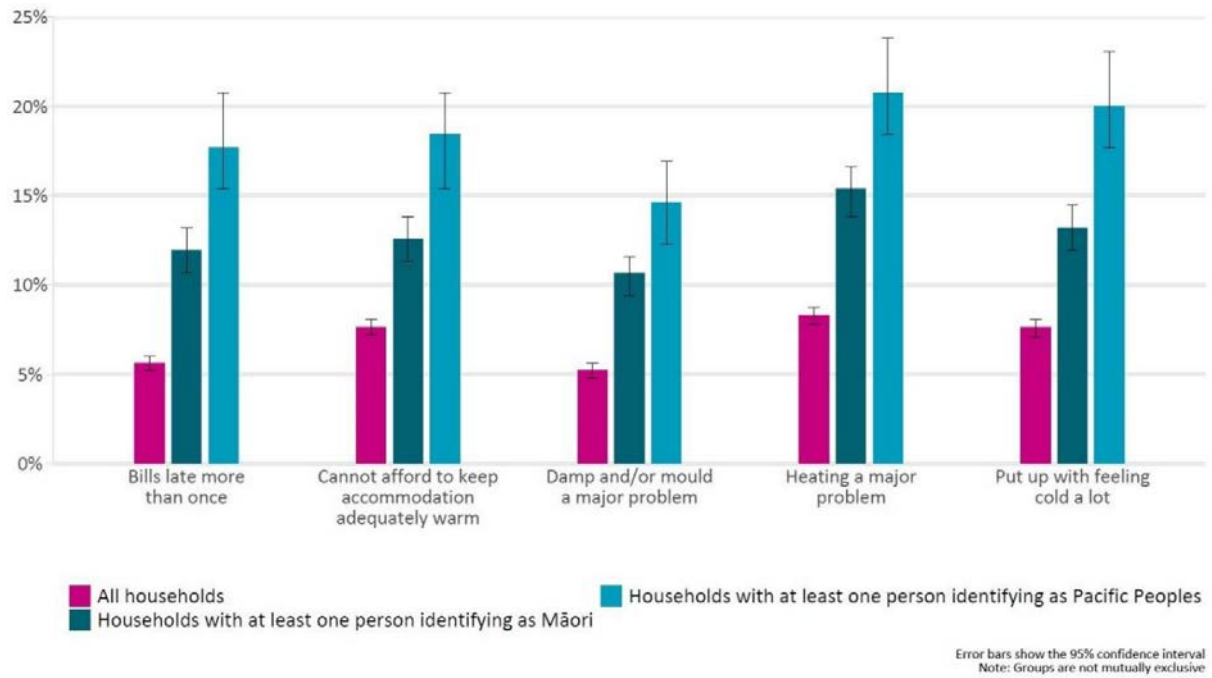
Households with Māori and Pacific peoples are more likely to experience subjective measures of energy hardship

2018/19 proportion of households

Objective measures



Subjective measures

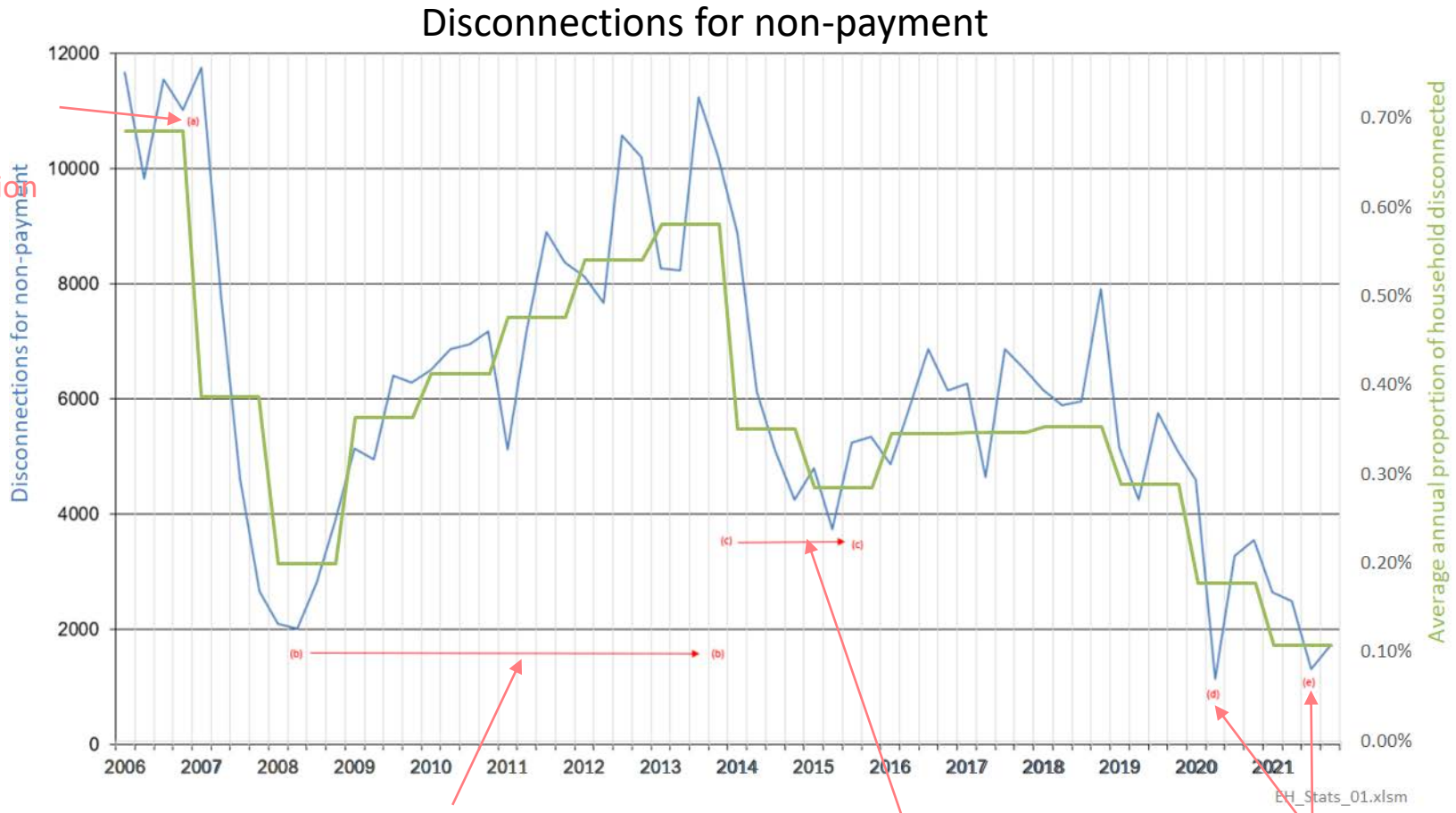


Source: Appendix D of Defining energy hardship discussion document

- Pasifika report lower-than-average incidences of objective measures, but much higher than average subjective measures
- This is the inverse relationship to that for older households (on previous slide)
- This highlights the challenge of using energy expenditure-based measures of energy hardship

Disconnections have fallen materially since the levels seen 15 years' ago

Medically dependent consumer dies after disconnection



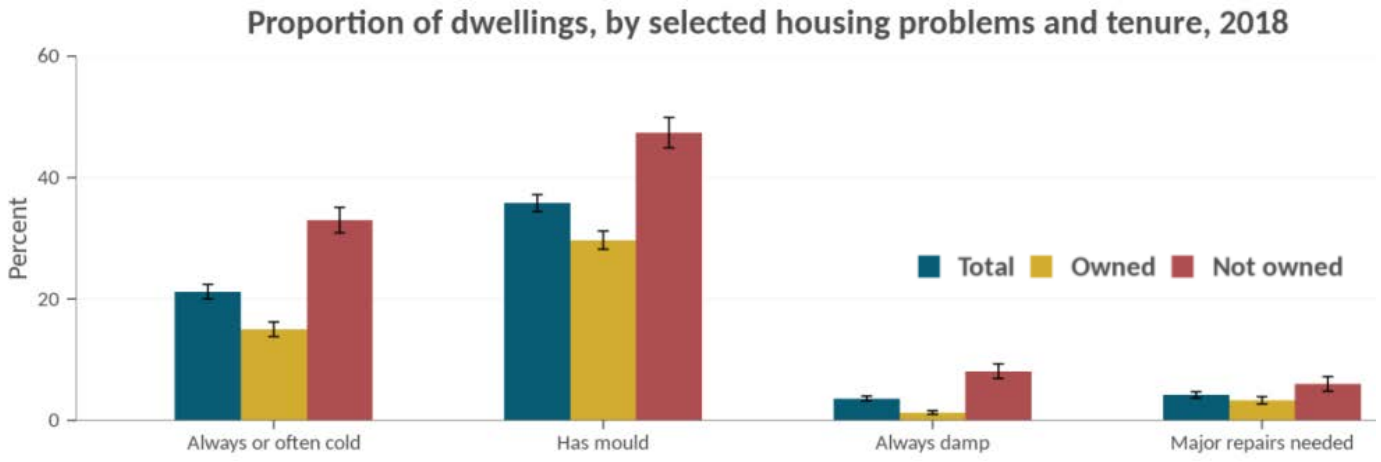
Retailers re-start using disconnection to manage bad debt. Bad debt trebles by Q3 2013

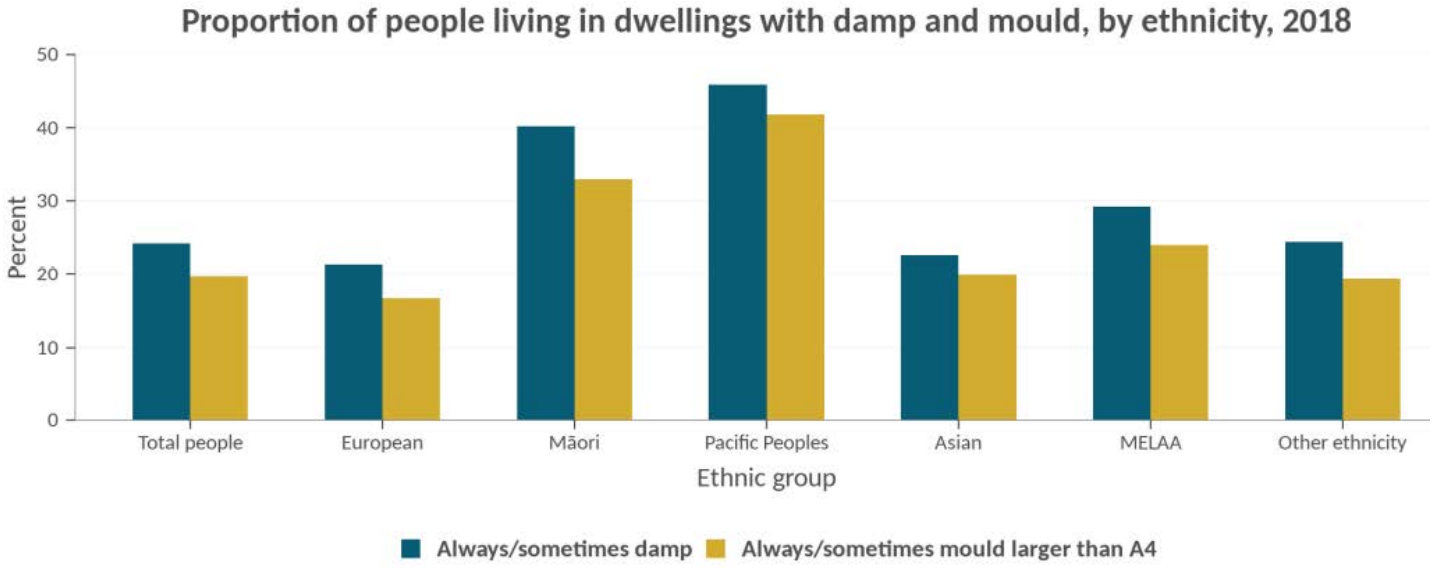
Retailers review disconnection practices following request from Minister of Energy

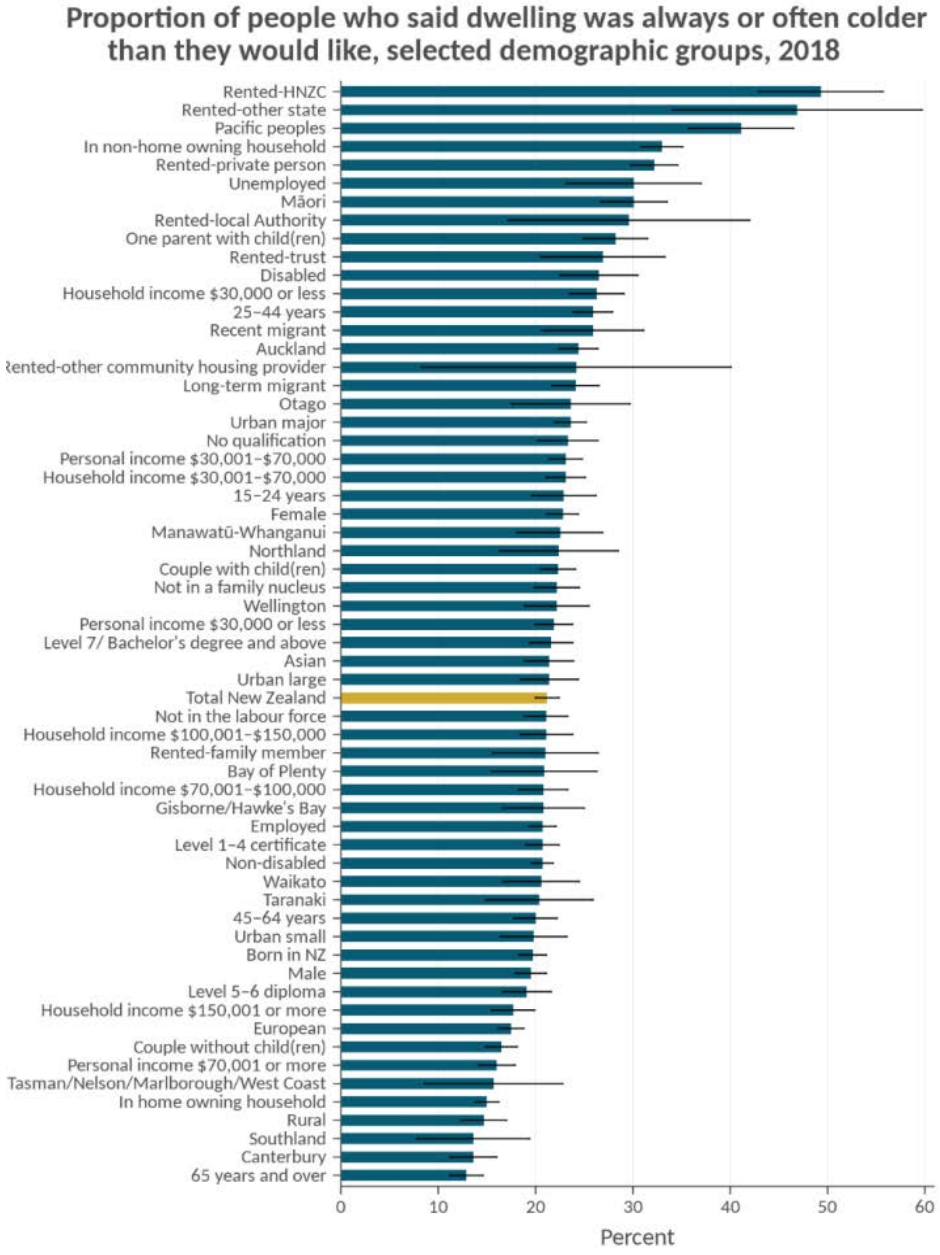
Disconnection suspensions during Covid lockdowns

Source: Electricity Authority plus additional Concept analysis

Coldness, damp, and mould are issues for a significant proportion of houses. Rental properties, Māori & Pacifica, and low-income households are over-represented in these situations





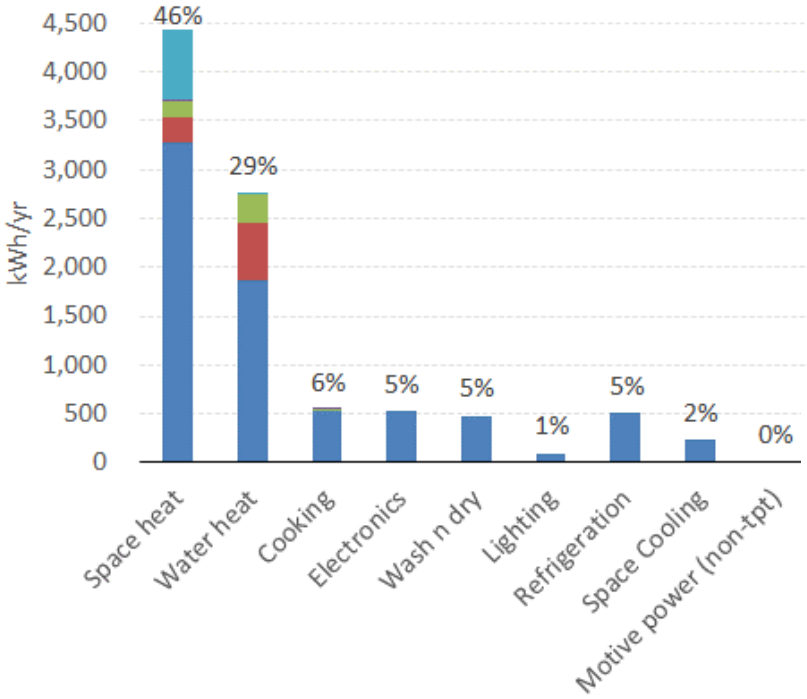


Source: "Housing in Aotearoa", Stats NZ , 2021

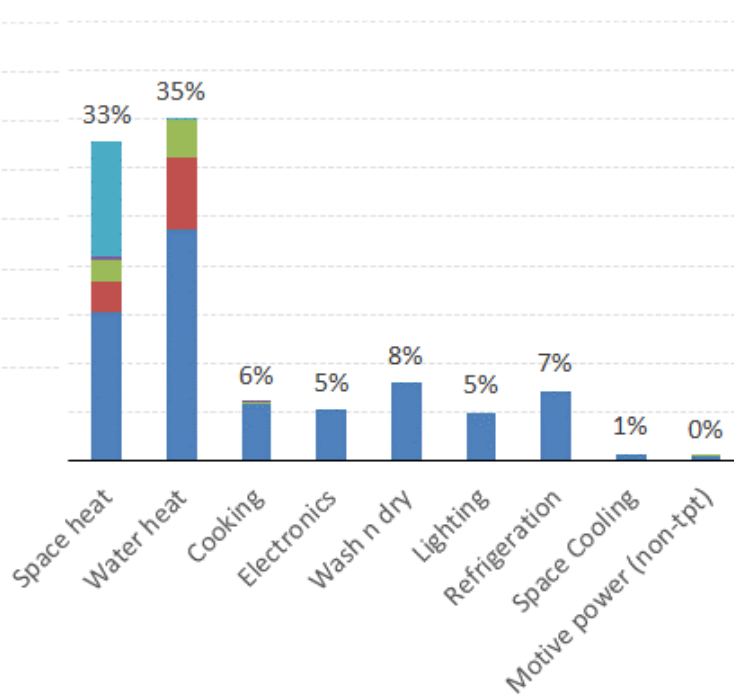
What do Kiwi’s use energy for?

What does the average Kiwi house use energy for?

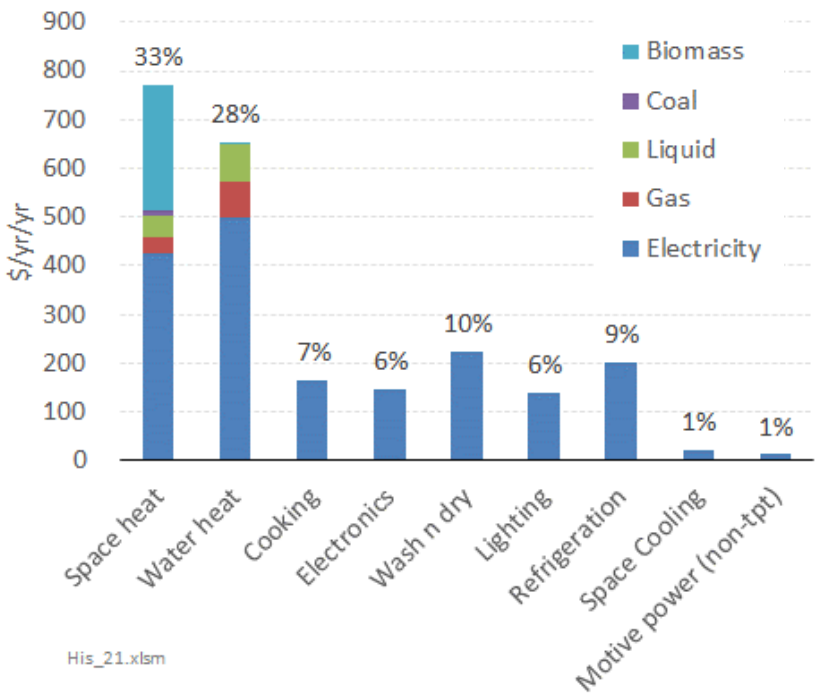
Useful energy



Delivered fuel



Cost



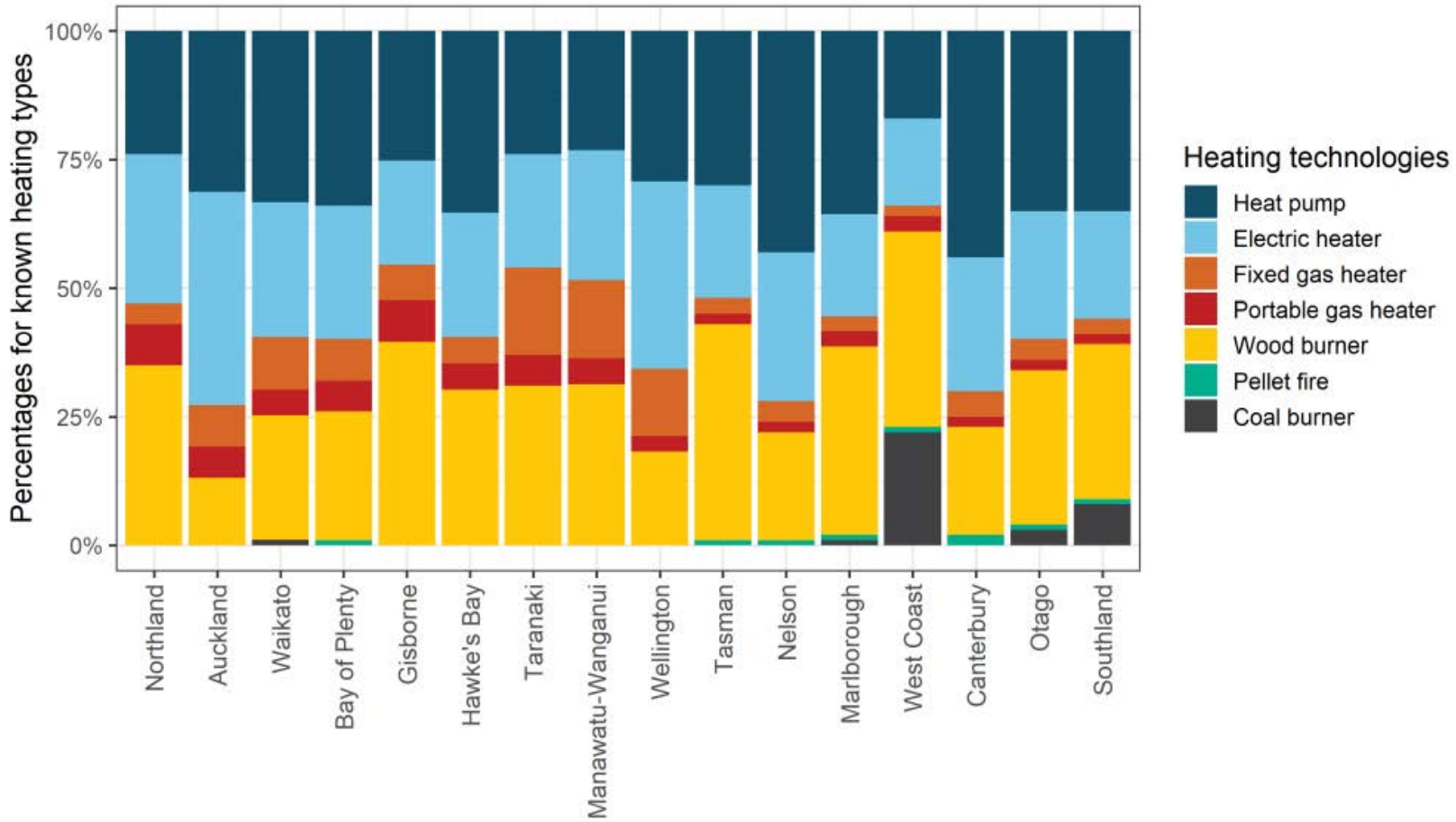
- Space heating an important focus area
  - Significant cost component
  - Major consequences from under-heating
  - Major opportunities for efficiency improvements (insulation & heater)
  - Significant area for decarbonisation
  - Largest variation between consumers

- Notes:
  - Difference between useful energy and delivered fuel due to appliance efficiencies
  - Water heating has lower-cost electricity

Source: Concept analysis drawing on EECA Energy End-Use Database data

Wood burners are significant sources of heating, outside the main urban areas

Main type of heating reported in 2018 census

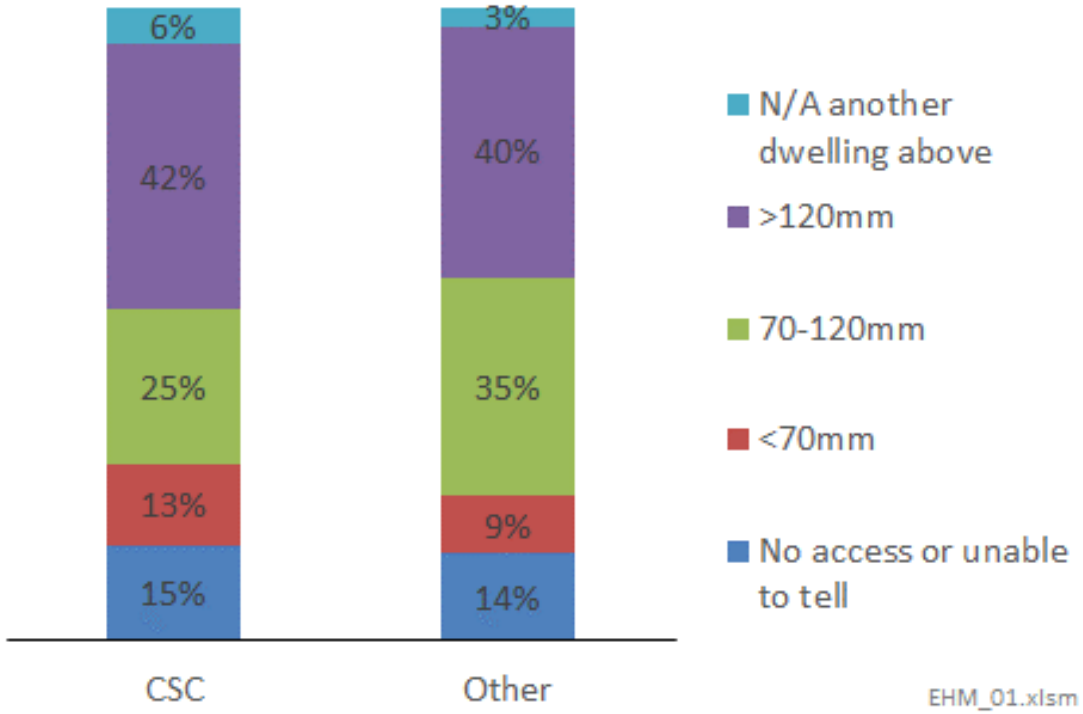


Source: "Residential energy use in TIMES-NZ 2.0", EECA

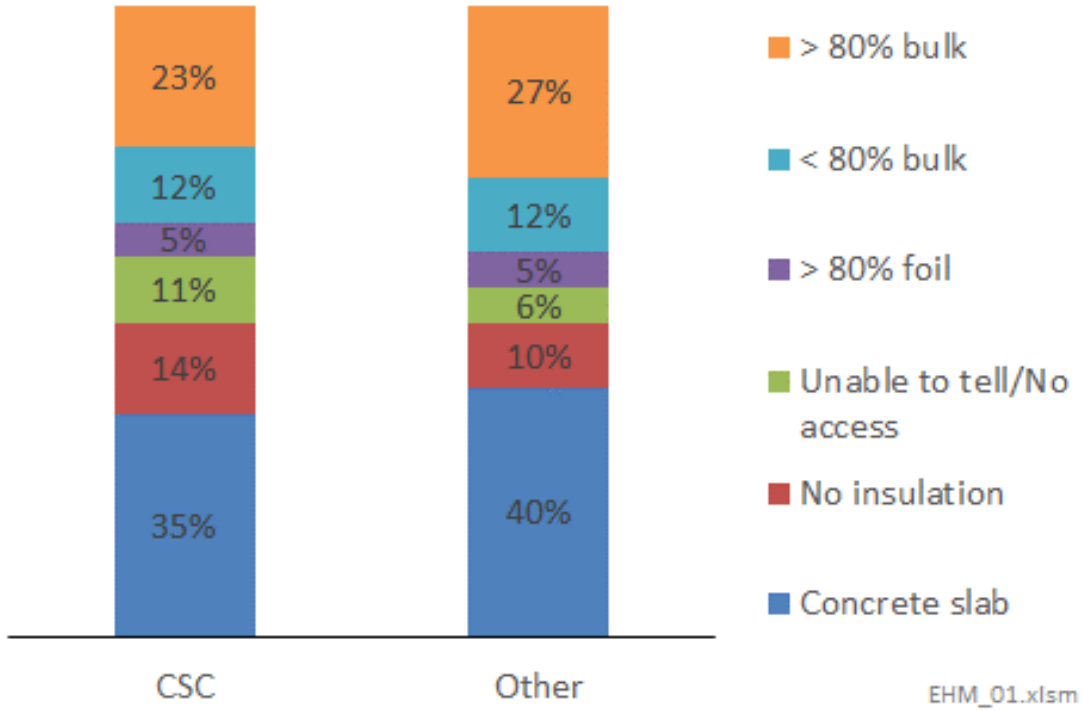
House & appliance condition

A significant proportion of houses have roof and floor insulation that is below current standards

Roof insulation



Floor insulation

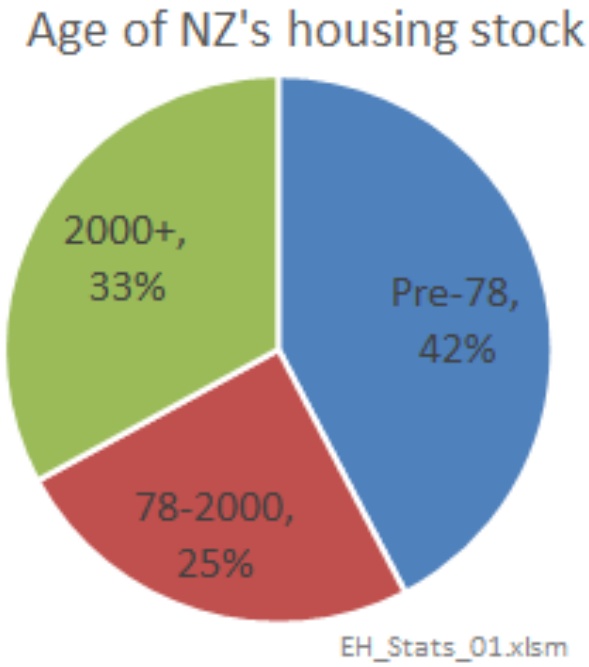


Source: Concept analysis of BRANZ Pilot housing survey data

- Although past insulation programmes have improved matters, there are still significant numbers of properties where insulation can be improved

A significant proportion of houses have wall, windows, and draught-stopping that is below current standards

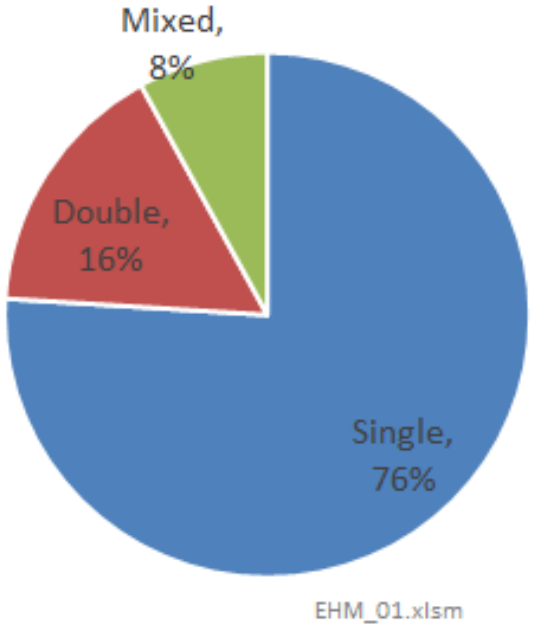
Wall insulation – inferred from house age



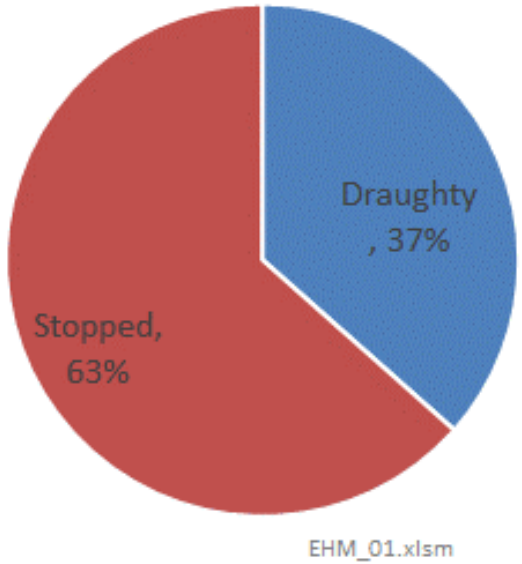
Source: Concept analysis of Stats NZ "Housing in Aotearoa" data

Age of house is likely to be a reasonable proxy for level of wall insulation. Insulation standards introduced in 1978, and increased in 2000

Windows

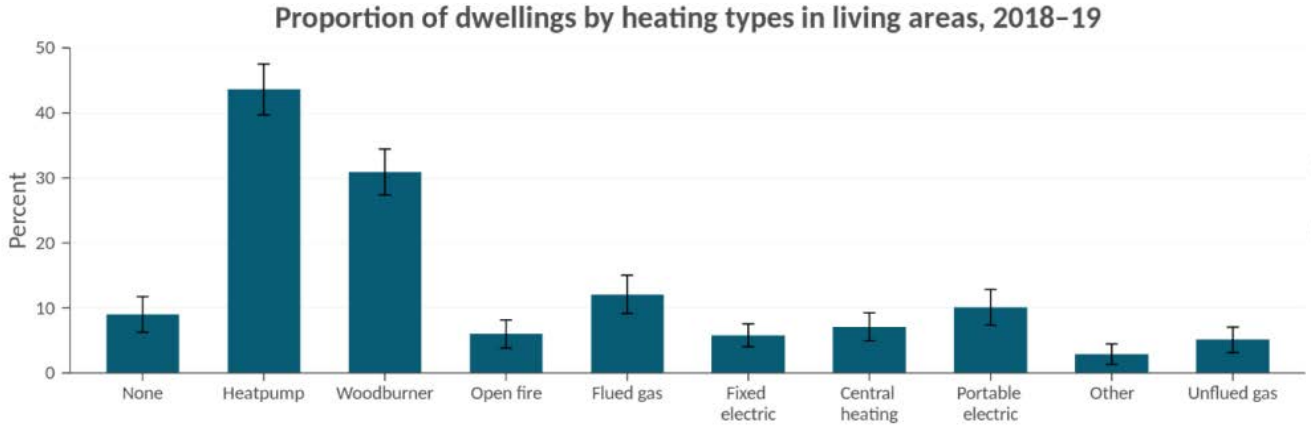


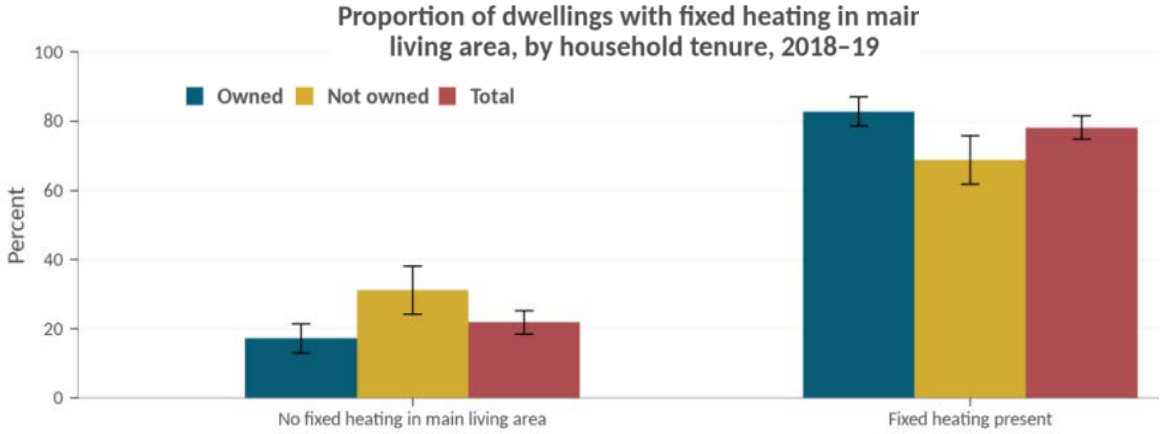
Draughts

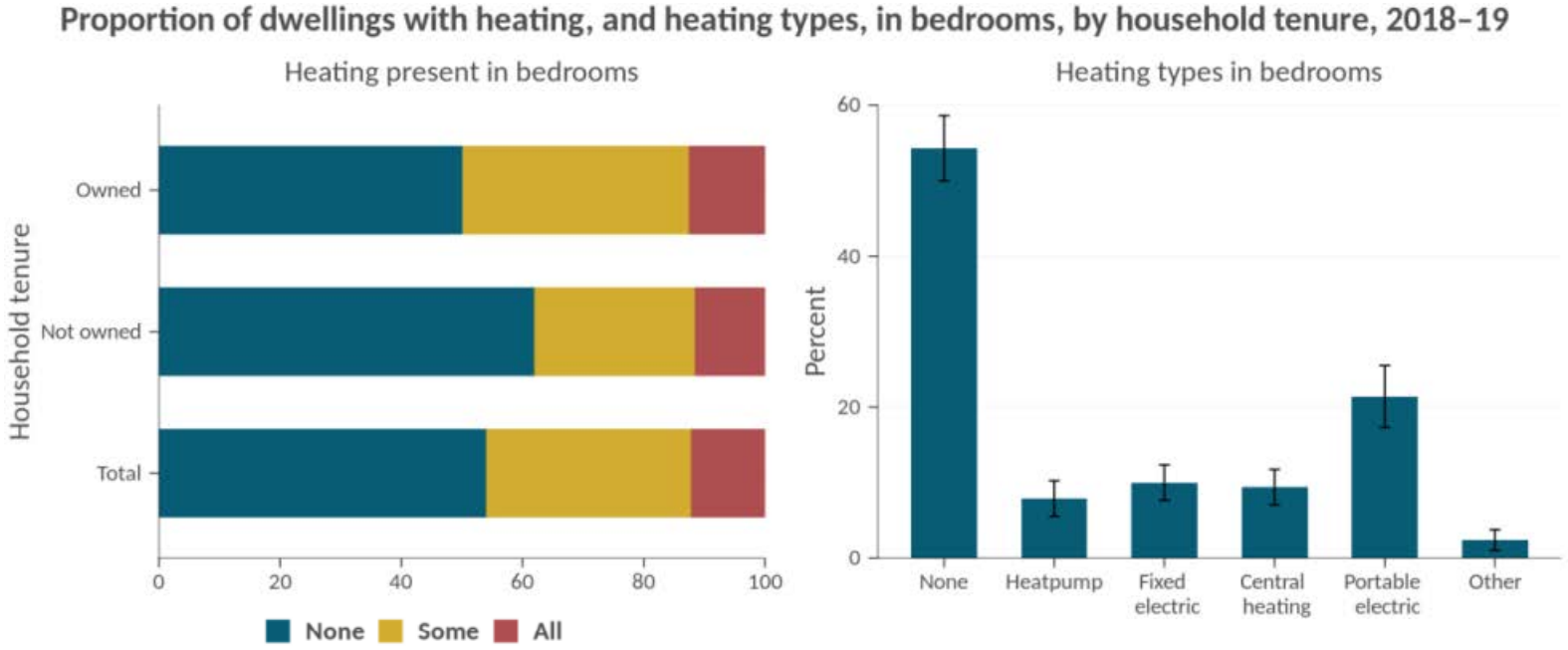


Source: Concept analysis of BRANZ report "Assessing the condition of New Zealand housing: Survey methods and findings"

Rental properties are less likely to have heaters in bedrooms, and much less likely to have fixed heaters in living areas







Heating demand is much greater with insufficient insulation

- This study modelled the heating demand for a model dwelling intended to represent 1940-1960 State houses in Auckland for increasing levels of insulation and indoor temperatures of 20 °C
- Given the variation in required heating demand across New Zealand (refer to slide 24), the impact of insulation in other regions would be even more significant
- Refer to *Modern Housing Retrofit: Assessment of Upgrade Packages to EnerPHit Standard for 1940–1960 State Houses in Auckland (Leardini & Manfredini, 2015)*

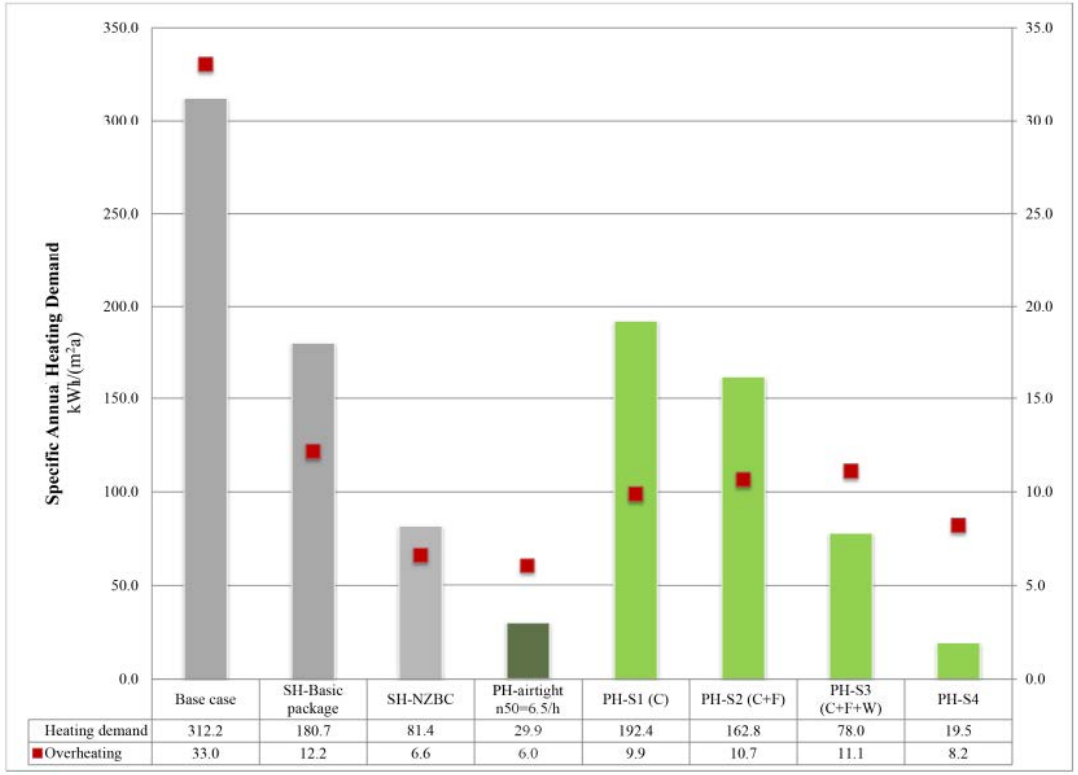
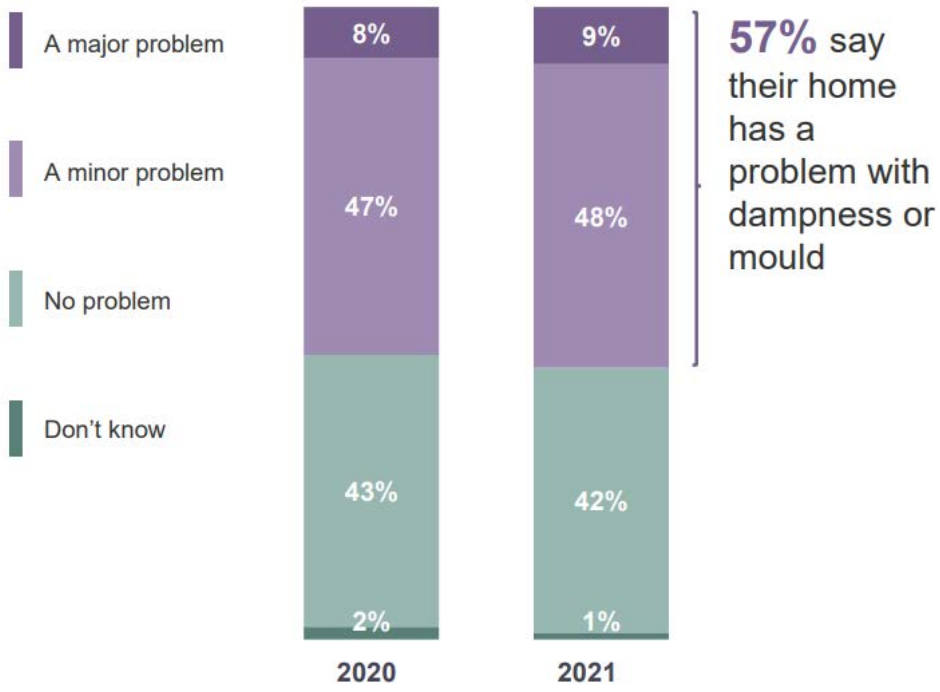


Figure 5. Comparison of specific annual heating demands (kWh/(m²a)) and overheating time (%) of the base case and different retrofitting packages.

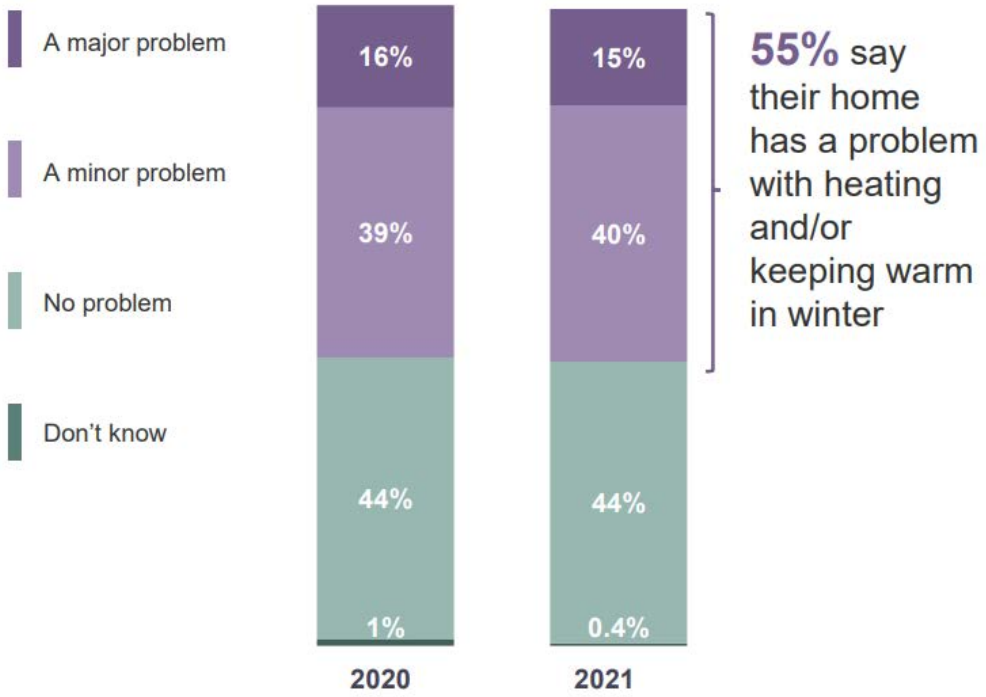
Scenario	Description
Base Case	As Built – no insulation
SH-BP	Basic Package
SH-NZBC	Insulated to Building Code
PH-airtight	PH-S4 + Building Code Airtightness
PH-S1	Ceiling
PH-S2	PH-S1 + Floor
PH-S3	PH-S2 + Wall
PH-S4	PH-S3 + Window / Airtightness

Renters have difficulty with dampness or mould and staying warm

Dampness or Mould



Heating and/or keeping warm in winter



- These are from the survey results from Wave 2 of the landlords and renters survey, conducted in August 2021 (Wave 1 was done in 2020)
- Surveyed renters were in privately owned dwellings
- 1600 renters were surveyed: 799 were from Wave 1 and 801 were new respondents
- Refer to *Health Homes Guarantee Act Monitoring Topline Report (MoHUD, 2021)* for more results and profile statistics of the renters sample

Temperature comfort is subjective but limiting heating due to cost is consistent across warmer and colder climates in New Zealand

- The interim evaluation of Warmer Kiwi Homes examined a variety of impacts from installing heat pumps in the living area of the homes. These included:
  - energy use change with the heat pump and variation between locations,
  - temperature and relative humidity,
  - occupant wellbeing and behaviour before and after installation, and
  - household condition

- 127 households were surveyed across Auckland/Waikato (65), Wellington (37) and Christchurch (25)

- Auckland/Waikato had the largest proportion of households whose homes were always too cold in winter even though it is in a warmer climate that Wellington and Christchurch
  - However the proportion of those who limit heating to saving on electricity bill is consistent across the country

- Refer to *Motu / Fyfe et al. (2022) Warmer Kiwis Study: Interim Report – An impact evaluation of the Warmer Kiwi Homes programme* for details of the survey group

Figure 3.3: House too cold in winter (percent)

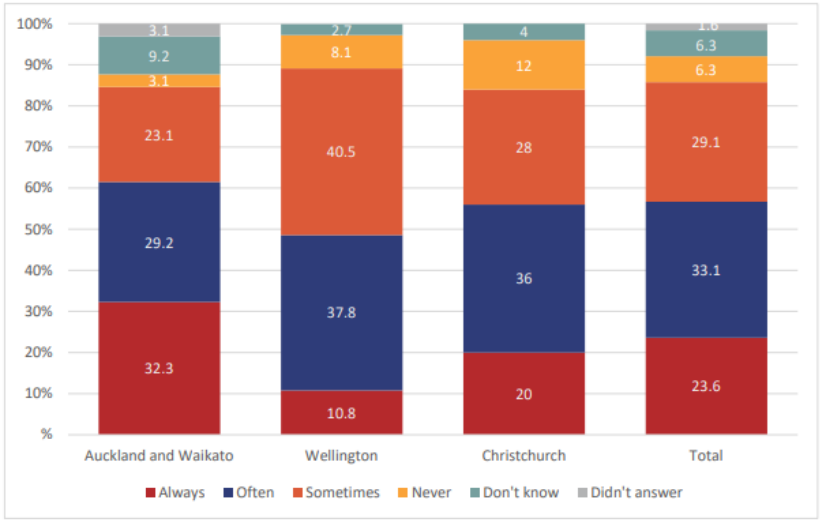
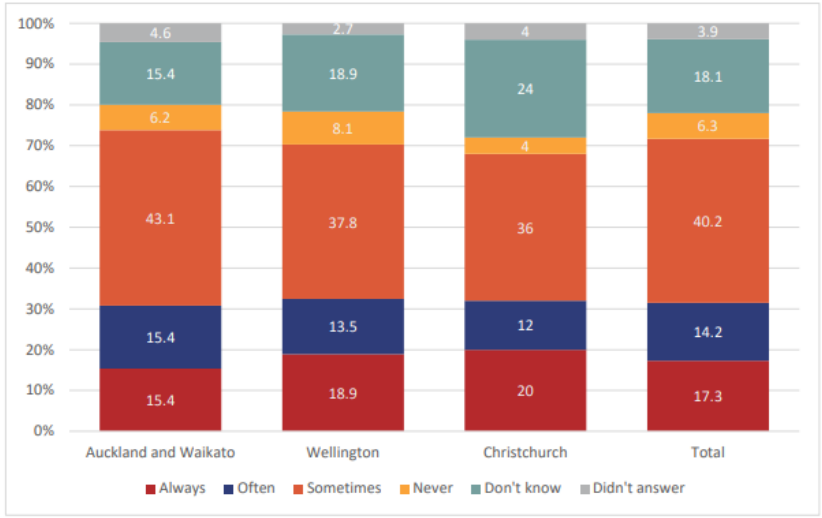
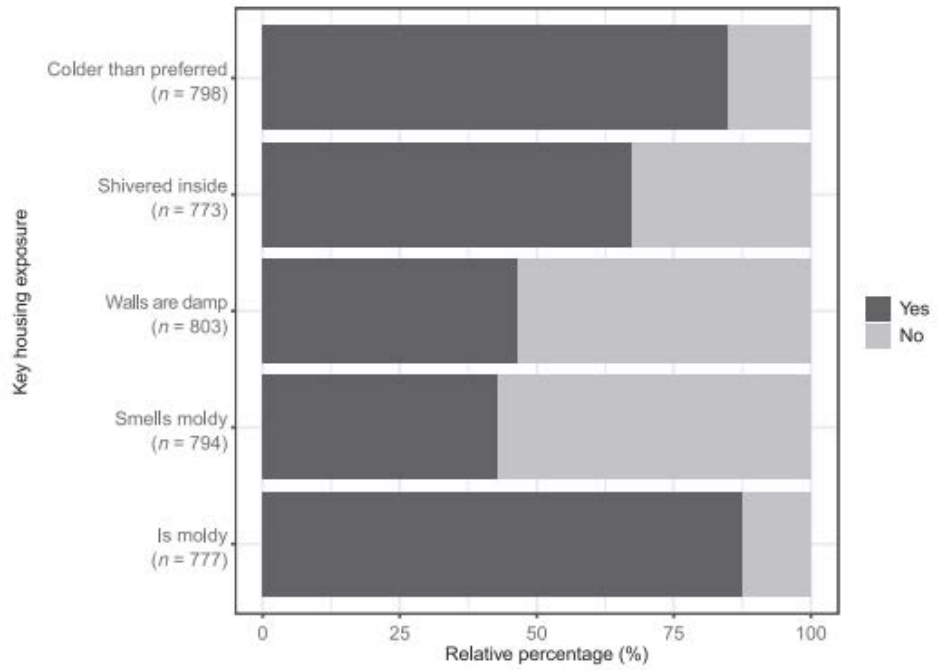


Figure 3.4: Limit heating due to cost (percent)



There are a variety of measures to improve housing conditions – Some are harder to deliver than others

- Well Homes is one of the Healthy Homes Initiatives for the Wellington region
  - This involves housing assessments and support to improve housing conditions for households with low income, Community Services Card holders, suffering a housing related issue, are pregnant or a new parent
- Pierse et al. (2020) examined 895 referrals over a 30-month period up until June 2018 who had received an assessment and at least one intervention recorded.
- The tables below present the housing condition responses from participants (left) and spread of identified needs and delivery of interventions
- Refer to *Well Home Initiative: A Home-Based Intervention to Address Housing-Related Ill Health (Pierse et al., 2020)*



Participants' reports of exposure to cold, damp and mould, and ability to the home at the time of assessment (Figure 1 from report)

Table 2. Areas Where Need Identified, the Intervention Pathways and Delivery.

Intervention area	Need identified (count and percentage out of all clients)	Action attempted (count and percentage out of households where need identified)	Intervention delivered (count and percentage out of those where action attempted)
Mold	836 (93.4%)	777 (92.9%)	774 (99.6%)
Beds	222 (24.8%)	222 (100%)	185 (83.3%)
Bedding	389 (43.5%)	389 (100%)	374 (96.1%)
Insulation	426 (47.5%)	172 (40.4%)	66 (38.4%)
Carpets	112 (12.5%)	76 (67.9%)	27 (35.5%)
Curtains	377 (42.1%)	355 (94.2%)	260 (73.2%)
Heating	751 (83.9%)	609 (81.1%)	568 (93.3%)
Ventilation	636 (71.1%)	217 (34.1%)	41 (18.9%)
Draughts	738 (82.5%)	472 (64.0%)	468 (99.2%)

Table 3. Percentage of Well Homes Households for Which Other Interventions Were Pursued, and the Proportion Delivered.

Intervention area	Needed (count and percentage)	Delivered interventions (and relative percentage, out of those where action attempted)
Minor repairs	285 (31.8%)	96 (33.7%)
Referral for social housing relocation	198 (22.1%)	22 (11.1%)
Referral for private/community housing relocation	12 (1.3%)	0 (0.0%)
Health referral	69 (7.7%)	56 (81.2%)
Social referral	176 (19.7%)	142 (80.7%)
Support with power bills	134 (15.0%)	128 (95.5%)
Injury prevention measures	92 (10.3%)	81 (88.0%)

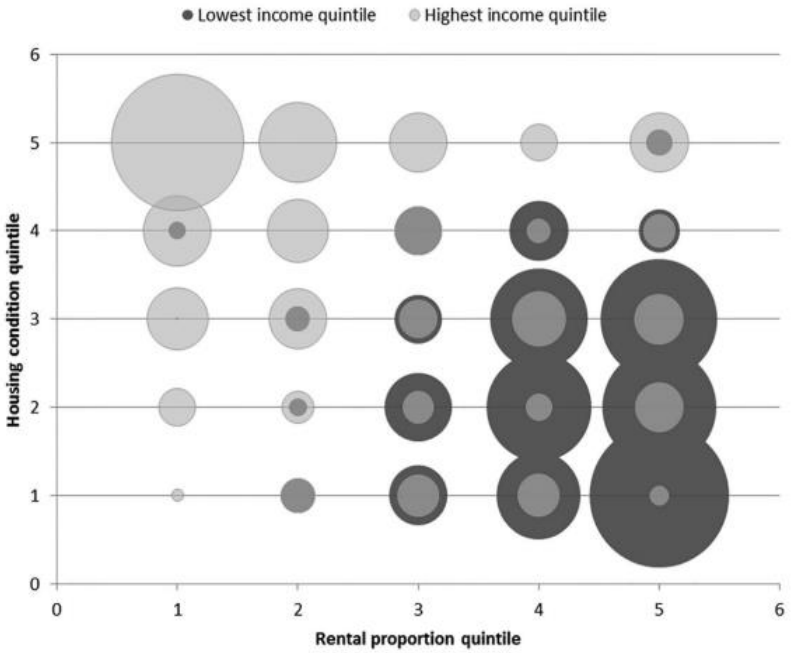
Those on lower incomes typically rent and their dwellings are in worse condition…

- Telfar Barnard et al. (2020) studied the relationship between income, dwelling condition and tenure at a Census Area Unit (CAU) level. They used data from:
  - Ministry of Health (2003-2009),
  - 2006 StatsNZ Census data, and
  - Other sources to examine the hospitalisations due to housing and how housing condition and tenure were related.
  - The CAU had approximately 2000 people each and there were 1927 CAUs total in New Zealand (2006)

Table 2. Dwelling Condition, Rental Proportion, and Census Area Unit Income.

Income quintile	Mean dwelling condition	Mean rental proportion
1 (higher income)	2.10	0.27
2	2.05	0.29
3	2.01	0.29
4	2.01	0.33
5 (lower income)	1.92	0.44

Table Notes:
- Housing Condition scale: 1 = *worse condition* to 5 = *better condition*
- Rental Proportion: 1 = *fewer rentals in CAU* to 5 = *more rentals in CAU*
- Table 3: Bolded values are statistically significant ($p < 0.05$)



Study population distribution by housing condition and rental proportion quintiles, for the highest and lowest income quintiles – circle width indicates number of population (Figure 1)

… hence they are at a higher risk of housing related hospitalisations…

- For each Census Area Unit, Telfar Barnard et al. (2020) categorised hospitalisations into three housing related and a non-housing groups. These were:
  - WIH: Winter impact hospitalisations
  - PAHHE: Potentially avoidable hospitalisations, children health experts
  - MoH: Ministry of Health specified
- Bolded values are statistically significant ($p < 0.05$)

Table 1. Hospitalization Rates by Category.

	Hospitalization rate per 1,000 people per year		
Hospitalization category	All ages	0-4 years	65+ years
WIH	26.78	80.54	95.21
PAHHE	16.21	70.44	31.55
MoH	5.93	27.67	18.65
Non-housing sensitive	63.01	45.83	138.98
Total hospitalizations	98.09	138.95	250.74

Table 3. All-Age Hospitalization Risk Ratios by Housing Condition and Rental Proportion.

Variable (quintile)	Winter	PAHHE	MoH	Nonhousing
Housing condition				
1	**1.06**	**1.09**	**1.13**	**1.06**
2	**1.04**	**1.04**	1.00	**1.08**
3 (baseline)	1.00	1.00	1.00	1.00
4	1.00	0.99	**0.98**	0.99
5	**0.89**	**0.88**	**0.84**	0.98
Rental proportion				
1	**0.82**	**0.82**	**0.80**	**0.90**
2	**0.89**	**0.89**	**0.88**	**0.93**
3 (baseline)	1.00	1.00	1.00	1.00
4	**1.14**	**1.13**	**1.14**	**1.07**
5	**1.51**	**1.54**	**1.59**	**1.32**

- Refer to *Renting Poorer Housing: Ecological Relationships Between Tenure, Dwelling Condition, and Income and Housing-Sensitive Hospitalisations in a Developed Country (Telfar Barnard et al., 2020)*

… which indicates the value of targeted interventions based on income, tenure and age

- Risk Ratios indicate the risk of an event if exposed to a condition:
  - =1: No difference
  - >1: Increased risk
  - <1: Decreased risk
- There is a strong relationship between the risk of hospitalisation and income, particularly for households with young children
- For elderly, the risk of hospitalisation is largely reduced by having sufficient income to cover heating costs

Table 4. All-Age Hospitalization Risk Ratios, Full Model.

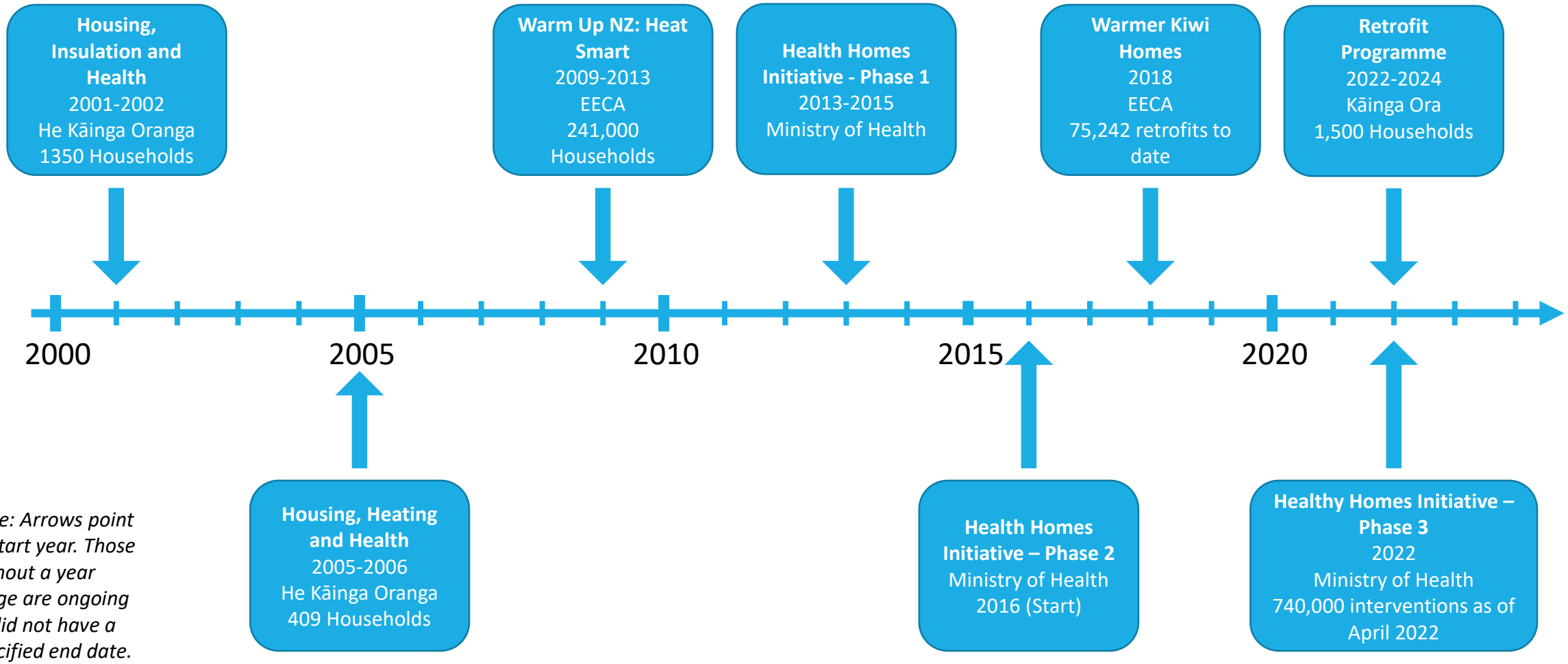
	Age-group											
	All ages				0-4 years				65+ years			
Variable (quintiles)	Winter	PAHHE	MoH	Nonhousing	Winter	PAHHE	MoH	Nonhousing	Winter	PAHHE	MoH	Nonhousing
Housing condition												
1	0.98	1.00	1.02	1.02	1.00	1.03	**1.18**	1.00	**0.86**	**0.84**	**0.83**	**0.84**
2	1.01	1.00	**0.95**	**1.06**	1.01	1.02	1.06	1.02	**0.89**	**0.85**	**0.82**	0.90
3 (baseline)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	**1.06**	**1.05**	**1.06**	1.02	1.04	1.04	**1.10**	1.02	1.06	1.02	1.02	1.04
5	1.04	1.02	**1.02**	**1.06**	1.09	1.09	**1.12**	**1.10**	1.08	1.05	1.03	**1.16**
Rental proportion												
1	1.03	1.03	1.02	1.03	**1.15**	**1.12**	1.01	**1.15**	0.96	1.00	1.00	0.98
2	0.99	0.99	1.00	0.98	1.06	1.04	1.03	1.06	0.94	0.95	0.98	0.93
3 (baseline)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	**1.09**	**1.08**	**1.07**	**1.05**	0.97	0.97	1.00	0.96	**1.16**	**1.17**	**1.16**	**1.15**
5	**1.41**	**1.43**	**1.42**	**1.30**	**1.11**	**1.13**	**1.22**	0.98	**1.60**	**1.72**	**1.74**	**1.52**
Income												
1	**0.76**	**0.79**	**0.77**	**0.86**	**0.88**	**0.85**	**0.74**	0.98	**0.80**	0.88	**0.87**	**0.84**
2	**0.83**	**0.85**	**0.83**	**0.88**	**0.91**	**0.90**	**0.85**	1.00	**0.85**	0.90	0.90	**0.87**
3 (baseline)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	**1.26**	**1.28**	**1.29**	**1.17**	**1.27**	**1.29**	**1.32**	**1.16**	**1.16**	**1.17**	**1.18**	**1.11**
5	**1.48**	**1.54**	**1.70**	**1.20**	**1.61**	**1.66**	**1.92**	**1.28**	**1.19**	**1.21**	**1.24**	1.02

Note. Housing condition: 1 = *worse condition* to 5 = *better condition*; rental: 1 = *fewer rentals* to 5 = *more rentals*; income: 1 = *higher income* to 5 = *lower income*. Results control for age and annual average minimum temperatures. Values in bold are statistically significant ($p < .05$). PAHHE = subset of potentially avoidable hospitalization; MoH = Ministry of Health.

Cost-benefits of interventions to improve house condition and heating type

Intervention Timeline

- There have several interventions assisting households with retrofits of insulation, heating or both. The timeline below presents some of the research-based and public investment programmes
- For reference, there are an estimated 1,865,300 households (occupied dwellings) in New Zealand (StatsNZ, March 2021)



Note: Arrows point to start year. Those without a year range are ongoing or did not have a specified end date.

Summary of past studies with Benefit:Cost ratios

Study	Intervention	Delivered to	Benefit cost ratio	Benefit Types
Housing, Insulation and Health (Chapman et al., 2009)	Insulation	Households with at least one person with respiratory disease symptoms, and low-income homes	1.87	Reduction in hospitalisation, GP visits, days off school/work, energy savings and GHG emissions
Housing, Heating and Health (Preval et al., 2010)	Heating	Basic insulation installed, had a unflued gas heater or plug-in electric heater, and child aged 7-12 with asthma showing symptoms within 12 months	1.09 if invention was targeted 0.31 if untargeted	Health related, caregivers savings and energy related savings
Warm Up NZ: Heat Smart (Grimes et al., 2012)	Insulation and heaters	Homeowners with Community Services Card (CSC) Landlords with CSC holding tenants Other houses built prior to 2000	3.9 (2.6 – 4.6)	Reductions in energy costs, CO_2 emissions costs, hospitalisation and pharmaceutical costs and mortality. Increase in producer surplus
Auckland Council Retrofit Your Home Financial Support Programme (Auckland Council, 2014)	Insulation, heating	Auckland residents with homes built before 2000	Social Rate of Return Ratio: 3.1 (considers social, environmental and economic benefits)	Increased satisfaction with living situation, educational achievement and efficiency when working from home; Quality for life, life expectancy for those in cold/damp housing; Improved family relationships. Reductions in electricity usage/costs, time on maintenance and cleaning,

Summary of past studies with Benefit:Cost ratios

Study	Intervention	Delivered to	Benefit cost ratio	Benefit Types
Healthy Homes Standards Cost-Benefit - New Zealand Institute of Economic Research (2018)	Insulation, heating, draught stopping, ventilation, moisture ingress, drainage	Rental stock (574,000 dwellings)	*Insulation*: 1.50 to 1.54 *Heating:* 18 °C target - 1.30; 20 °C target - 1.26 *Ventilation*: 0.04 to 0.05 *Draught Stopping:* 0.28 °C increase - 1.00; 1 °C increase- 3.37	Reductions in health costs, energy costs, CO_2 emissions and mortality. Increase in producer surplus
Healthy Homes Initiative – Interim Report (Pierse, White and Riggs, 2019)	Insulation, Curtains, Beds/Bedding, Minor Repairs, Floor covering, ventilation, heating	2013/2015: Low-income families with children at risk of rheumatic fever, living in crowded households 2016: Pregnant, low-income with children (0-5) either (1) hospitalised with a specified housing-related condition, or (2) two social investment risk-factors apply	1.54 (calculated with available information, not explicitly stated in the report)	Reduction in hospitalisations, GP visits, pharmaceutical costs,
Warmer Kiwi Homes Evaluation (Grimes and Preval, 2020)	Insulation (floor and ceiling), heating	Disadvantaged neighbourhoods, homeowners holding Community Services Card	4.66	Reductions in hospitalisation costs, pharmaceutical costs, caregiver time, days of school/work and GP visit costs

Benefit per Household Summary

Study	Main Benefit	Net/Gross	Annual Benefit per household (rounded)
Housing, Heating and Health (Preval et al., 2010)	Reduced total energy costs	Gross	Heating ($2006) Total Energy: 25.53 Total CO_2 Emissions: 1.6 Electricity: -10.51 Elec. based CO_2 Emissions: -0.38
Warm Up NZ: Heat Smart (Telfar Barnard et al., 2011)	Reduced mortality	Gross	Participants with CSC Insulation: $818 (95% CI: $205, $1272) Heating: $9.27 Participants without CSC Insulation: $227 (95% CI: $11, $388) Heating: $0
Healthy Homes Standards Cost-Benefit - New Zealand Institute of Economic Research (2018)	Reduced health related costs	Net	Insulation: $676 – $724 Heating: $273 - $294 Ranges are due to different levels of retrofit

Note cost have not been adjusted. Included studies are those that explicitly stated per household benefit
CI: Confidence Interval

Evaluations of previous intervention programmes have shown the benefits of housing retrofits

- Warm Up NZ: Heat Smart (WUNZ: HS) started in 2009 providing funding for insulation and cleaning heating
- Telfar Barnard et al. (2011) presents an evaluation of WUNZ: HS, in particular the changes in incidence and costs of health services, pharmaceutical usage and mortality, the common benefits of intervention cost examined by cost-benefit studies
- The study matched dwellings that received insulation or heating retrofits (46,655 houses, 7/2009 to 5/2010) to similar dwellings with similar characteristics, and linked health data to the dwellings anonymously and compares the groups.
  - Benefits included reductions on medical visit, days off school or work, caregiver costs.
- The table below (page 48) presents the annual health-related benefits (savings) per household in WUNZ: HS
  - A significant proportion of the benefits is from reduced mortality
  - The study differentiates between households with and without Community Services Cards (CSC) with greater benefit when CSC holders receive the intervention.
  - Lastly, benefits from insulation retrofits are significantly greater than heating retrofits.

Household type	Benefits	Insulation	Heating
All households	Hospitalisation and pharmaceutical use related benefits calculated in present Study	$64.44 (total hospitalisations) + $11.04 (total pharmaceuticals) = **$75.48**	**$0.00**
	Additional benefits imputed from previous Studies	**$47.75**	**$4.64**
	Value of reduced mortality	**$439.95 (95% CI $0.00 – $765.84)**	**$0.00**
	SUM OF HEALTH BENEFITS	**$563.18 (95%CI $123.23 - $889.07)**	**$4.64**
Households that participated in WUNZ:HS programme as Community Services Card holders	Hospitalisation and pharmaceutical use related benefits calculated in present Study	**$109.80** (total hospitalisations)	**$0.00**
	Additional benefits imputed from previous Studies	**$95.49**	**$9.27**
	Value of reduced mortality	**$613.05 (95% CI $0.00 - $1,067.16)**	**$0.00**
	SUM OF HEALTH BENEFITS	**$818.34 (95% CI $205.29, $1,272.45)**	**$9.27**
Households that participated in WUNZ:HS programme as non-Community Services Card holders	Hospitalisation and pharmaceutical use related benefits calculated in present Study	**$11.04** (total pharmaceuticals)	**$0.00**
	Additional benefits imputed from previous Studies	**$0.00**	**$0.00**
	Value of reduced mortality	**$216.38 (95%CI $0.00 - $376.66)**	**$0.00**
	SUM OF HEALTH BENEFITS	**$227.42 (95% CI $11.04 - $387.70)**	**$0.00**

- Refer to *The impact of retrofitted insulation and new heaters on health services utilization and costs, pharmaceutical costs and mortality – Evaluation of Warm Up New Zealand: Heat Smart (Telfar Barnard et al., 2011)* for more details on the cohort, estimates and assumptions.

Insulation improvements can significantly reduce hospitalisation costs, particularly for those 65+

- The Housing, Insulation and Health Study examined the cost-benefit of retrofitting insulation in low-income communities and households that had at least one person with respiratory disease symptoms
  - ~1350 households where the houses were built before 1978 (when insulation requirements came in)
  - The study was carried out over 2001-2002
  - Baseline and follow up data was collected during winter in both 2001 and 2002 respectively
  - The intervention group's homes were insulated after 2001 winter and the control group's homes were done after 2002 winter
- The costs was that of the insulation retrofit and benefits were health gains (reduced GP visits, hospitalisations, days off school/work), energy and associated greenhouse emissions savings (electricity and gas use reductions)
  - Cost of retrofit: NZ$2001 1800 (ex. GST)
  - 30 years lifetime
- The study found that the cost-benefit ratio was approaching 2
  - Reduced hospitalisations is the largest benefit, driven by the reduction in admissions for the 65+ group
  - The change in GP visits incurs a negative benefit is potentially due to issues in data collection

Table 6 Economic value of total benefits (cost savings, NZ$*) over a 30-year horizon

Benefit	Change in GP visits	Reduced hospital admissions	Reduced days off school	Reduced days off work	Energy savings	CO_2 savings	Total benefits
Present value of benefits (NZ$) per household (at 5% discount rate)	[165]	2231	242	179	786	100†	3374
Present value of benefits (NZ$) per household (at 7% discount rate)	[133]	1801	196	145	635	81†	2857

Square brackets indicate negative saving.
*NZ$1 = £0.29 or US$0.42 at 2 January 2002. †Valued at NZ$30/tonne.

- Refer to *Retrofitting houses with insulation: a cost-benefit analysis of a randomised community trial (Chapman et al., 2009)*

Significant social and living environment benefits can result from investment in insulation and heating

- The Auckland Council in 2014 conducted a study on an insulation and heating investment programme and determined a Social Return on Investment (SRoI) ratio of 3.1 (see table below)
- Cost-Benefit analysis is typically focused on economic value whereas SRoI includes the value of social benefits.
- The social benefits and proportion of the value gained from the insulation and heating investment programme are shown in the pie chart
  - The inclusion of social benefits in the evaluation expands the view from the typical approach of savings gained from reductions in hospitalisation, mortality and GP visit costs and days off school/work
  - A significant contributor is the increase in living situation satisfaction given a warm and healthy home.
- Refer to *Auckland Council Retrofit Your Home Financial Support Programme: A Social Return on Investment (SRoI) Evaluation (Auckland Council, 2014)* for more detail

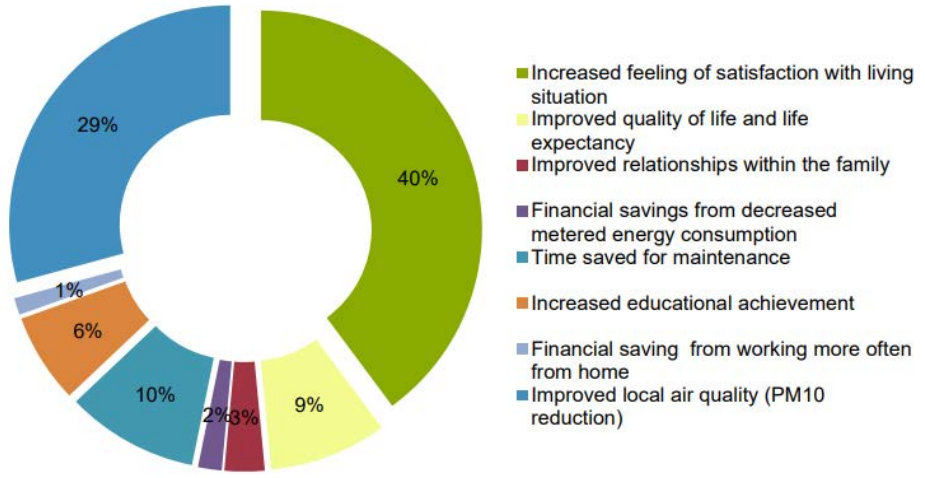
Table A: SROI ratio

Stakeholder	Total value	Present value
Occupiers of RYH homes	$16,259,186	$15,668,047
Occupiers of RYH homes who are students	$1,765,529	$1,648,300
Occupiers of RYH homes who are in paid employment working from home	$335,946	$313,640
Auckland residents	$7,810,249	$7,291,658
Total	$26,509,803	$24,921,646

Total value of inputs	$8,038,559
Net present value (present value minus inputs)	$16,883,086
SROI ratio	**3.1**

RYH: Retrofit Your Home

Figure B: Proportion of aggregated value created by each outcome



The calculated benefits can have a sizable variation across benefits and study parameters

- Grimes and Preval (2020) present the Phase 1 evaluation of *Warmer Kiwi Homes (WKH)* programme which included a cost-benefit analysis built on the *Warm Up NZ: Heat Smart* programme work and recommendations to fill evidence gaps
- Table 5 (page 30) presents the benefit:cost ratios under various sensitivities – a simplified version is below
  - Primary model assumptions: 4% discount rate, 30-year insulation life, 10-year heating appliance life
  - Being consistent with other studies, the majority of the expected benefits are from reductions in mortality
  - The expectation is that when households are equipped with better heating, their overall energy use increases (shown by negative energy savings for heating
- Refer to *Warmer Kiwi Homes Evaluation 2020: Phase 1 (Grimes and Preval, 2020)*

	Resource costs adjusting for deadweight cost of taxation ($ mil.)	NPV ($ mil.)							BCR
		Heater maintenance costs	Mortality benefits (insulation)	Other health benefits (insulation)	Other health benefits (heating)	Energy use savings (insulation)	Energy savings (heating)	Total of benefits	
Primary model	67.2	0.0	255.5	43.5	2.7	11.8	-0.6	312.9	4.66
Additionality of 50%	50.8	0.0	170.4	29.0	1.8	7.9	-0.4	208.6	4.11
Additionality of 100%	83.5	0.0	340.7	58.0	3.5	15.7	-0.8	417.2	4.99
60% of households have CSC	67.2	0.0	222.1	37.1	2.5	11.8	-0.6	272.9	4.06
100% of households have CSC	67.2	0.0	289.0	49.9	2.8	11.8	-0.6	352.9	5.25
Lowering lifespan of insulation to 15 yrs	67.2	0.0	164.3	28.0	1.7	7.6	-0.6	201.0	2.99
Pharmac estimate per life yr gain ($45,000)	67.2	0.0	65.6	43.5	2.7	11.8	-0.6	123.0	1.83
Maintenance costs: $20 p.a. per heater	67.2	0.2	255.5	43.5	2.7	11.8	-0.6	312.7	4.66

The benefits of investing in solely heating are narrow unless targeted and the full range of benefits are realised

- Preval et al. (2010) evaluated the cost-benefit of upgrading heating and emphasised the value of targeting the intervention to asthmatic people. The scenarios they considered were:
  - Scenario A (targeted approach) assumes that an intervention type household, with a high proportion of asthmatic household members (1.44 asthmatic children)
  - Scenario B (untargeted approach) predicted benefit of intervention for a household with average New Zealand asthma rates (15.1% - taken from another source)
- As seen in the table below, the only instance of a worthwhile ratio was when all benefits were considered and when the intervention was targeted at asthmatics which is contrasted by insulation's relatively significant benefits as seen from other studies

Table 5
Net present value (NPV) of installing intervention heaters, over 12-year horizon (5% discount rate).

	Cost of initial purchase and installation ($)	Health savings ($)	Caregiver savings ($)	Total energy related savings (cost and CO_2) ($)	NPV ($)	Benefit–cost ratio
Health related benefits only						
Scenario A	2430	820			−1610	0.34:1
Scenario B	2430	171			−2259	0.07:1
Health related benefits and caregiver savings only						
Scenario A	2430	820	1589		−21	0.99:1
Scenario B	2430	171	353		−1906	0.22:1
Health related results, caregiver savings, and total energy related savings						
Scenario A	2430	820	1589	240	219	1.09:1
Scenario B	2430	171	353	240	−1666	0.31:1

- Refer to *Evaluating energy, health and carbon co-benefits from improved domestic space heating: A randomised community trial (Preval et al., 2010)*

Warm, dry and healthy homes prevent a sizeable number of hospitalisations and reduce the severity of those that still occur

- Healthy Homes Initiative has evolved over time:
  - Initially targeted low-income families with children at risk of rheumatic fever (Dec 2013 to Mar 2015)
  - Expanded in 2016 to provide warm, dry and healthy housing for select at-risk households
  - In 2021, the Government announced additional funding to expand the programme
- The initial analysis covers the 1608 referrals during the second phase and has a significant proportion of Māori (55.2%) and Pacific (36.6%)
- As seen in the table below, the Healthy Homes Initiative was estimated to avoid $30 million in costs, with around 2/3 due to reduce hospitalisations

Table 1: Health Care Costs Averted by the Healthy Homes Initiative

Types of Costs Averted	#	Cost per Unit	Years Post-Intervention			
			Year 1	*Year 2*	*Year 3*	Total Years 1-3
Hospitalisations	1,533	4,090	6,269,579	*5,914,697*	*5,579,903*	17,764,178
Hospitalisations -- Reduced Severity	6,101	541	3,302,906	*3,115,949*	*2,939,575*	9,358,431
GP Visits	9,443	80	755,440	*712,679*	*672,339*	2,140,458
Pharmaceutical Dispensings	8,784	8	74,225	*70,023*	*66,060*	210,308
Total			10,402,150	*9,813,349*	*9,257,876*	29,473,374

Note: All costs are extrapolated out using prevented healthcare events in a single year after intervention.

- Refer to *Healthy Homes Initiative Outcomes Evaluation Service - Initial analysis of health outcomes (He Kainga Oranga and Motu, 2019)*

Reducing energy costs is not a key benefit, rather they are realised through resultant benefits in health and other areas …

- Grimes et al. (2012) compiled the results from various studies on the Warm Up New Zealand: Heat Smart Programme and produced a cost benefit analysis
- The table below shows the summary of the costs and benefits
  - Additionality is the number of homes that would engage in insulation and heating retrofits with the intervention programme in place that would otherwise not occur
  - The 'Low', 'Central' and 'High' scenarios had 36%, 74% and 113% addition homes retrofitted

Table 30 Present Value of Total Costs and Benefits ($ million)

Additionality:		Central		Low	High
Discount rate:	4%	2.5%	8%	4%	4%
Costs					
Admin costs	23	24	22	23	23
Deadweight costs of tax	51	52	49	58	44
Installations - insulation	173	176	165	83	263
Installations - clean heat	85	87	81	41	130
Sub-total	332	339	317	205	460
Benefits					
Energy	17	21	10	8	26
Health	1,266	1,541	816	608	1,926
Sub-total	1,283	1,562	827	616	1,951
Net Benefits	951	1,224	510	411	1,492

- Refer to *Cost Benefit Analysis of the Warm Up New Zealand – Heat Smart Programme (Grimes et al., 2012)*

… and in fact net energy consumption across all regions (i.e. all climate zones) would increase due to retrofits

- Across all regions, insulation reduces electricity consumption while clean heating increases consumption, exceeding the reduction of insulation
- Note that "Other" refers to reticulated gas

Table 8 Impact on Annual Energy Consumption of Treatment by Region (kWh/house)[1]

	Insulation			Clean heating		
	Electricity	Other	All metered	Electricity	Other	All metered
NZ	-70.2	18.7	-51.5	144.6	-78.8	65.9
Northland	-2.3	30.5	28.2	119.0	3.7	122.6
Auckland	-12.0	28.4	16.4	135.4	-25.5	109.9
Waikato	-66.0	18.8	-47.3	152.1	-83.2	68.9
Bay of Plenty	-85.7	14.3	-71.4	166.2	-108.6	57.6
Gisborne	-42.7	23.2	-19.5	139.8	-52.4	87.5
Hawke's Bay	-83.9	16.1	-67.8	151.1	-96.3	54.9
Taranaki	-108.7	11.8	-96.8	161.7	-128.1	33.5
Manawatu-Wanganui	-87.0	15.4	-71.6	155.5	-103.8	51.7
Wellington	-77.2	17.9	-59.3	141.1	-80.9	60.2
Marlborough	-64.9		-64.9	143.3		143.3
Nelson	-58.1		-58.1	135.4		135.4
Tasman	-81.1		-81.1	136.8		136.8
West Coast	-120.4		-120.4	150.7		150.7
Canterbury	-99.1		-99.1	140.9		140.9
Otago	-111.0		-111.0	159.9		159.9
Southland	-92.8		-92.8	188.0		188.0

[1] measured over period from July 2009 to November 2010 – months with 2 records are averaged, eg (July 2009 + July 2010)/2 etc

Source: Grimes A, Young C, Arnold R, Denne T, Howden-Chapman P, Preval N and Telfar-Barnard L (2011) Warming Up New Zealand: Impacts of the New Zealand Insulation Fund on Household Energy Use

Standards targeting heating appliances capable of providing a healthy temperature in living rooms have substantial benefit – these reduced when applying such targets to bedrooms

- New Zealand Institute of Economic Research conducted a cost-benefit analysis of the healthy home standards, covering a wider range of retrofits than other studies, as well as considering temperature targets for heating
- The Healthy Homes Standards address deficiencies in the rental stock (574,000 dwellings)
- Subsequent options increase the level of the standards required – see pages 1 to 3 for specific details

Table 1 Summary of results

Present values discounted over 15 years at 4%

Measure	Number of houses affected	Aggregate net benefits PV$'000	Net benefit per house affected PV$	Net benefit per total rentals PV$	Cost per house affected PV$	Reliability of data: Low/Medium/High
Insulation Option[1]2: Upgrade insulation less than 2001 requirement to meet 2008 requirement – minimum houses affected	10,000	7,240	724	13	1,340	Medium-High
Insulation Option 2: Upgrade insulation less than 2001 requirement to meet 2008 requirement – maximum houses affected	70,000	50,677	724	88	1,340	Medium-High
Insulation Option 3 Upgrade insulation less than 2008 requirement to meet 2008 requirement – minimum houses affected	80,000	54,064	677	94	1,340	Medium-High
Insulation Option 3: Upgrade insulation less than 2008 requirement to meet 2008 requirement – maximum houses affected	190,000	130,029	684	227	1,340	Medium-High
Heating Option[2] 2: capacity to achieve 18 °C in Living rooms only	179,071	168,507	941	294	2,800	Medium-High
Heating Option 2: capacity to achieve 18 °C in Living rooms and Bedrooms	250,444	156,849	876	273	2,889	Medium-High
Heating Option 3: capacity to achieving 20 °C in Living rooms only	285,219	169,513	594	295	2,087[3]	Medium-High
Heating Option 3: capacity to achieve 20 °C in Living rooms and Bedrooms	411,170	163,333	573	285	2,195	Medium-High
Draught stopping[4]: stop gaps or holes of 3mm or greater	172,200	94,787	548	164	232	Medium
Ventilation – Install mechanical extraction fans in bathrooms	252,560	-54,550	-216	-95	216	Low-Medium
Ventilation – Install mechanical extraction fans in kitchen	212,380	-68,313	-322	-119	322	Low-Medium
Moisture ingress[5] Option 2 – Install subfloor vents to meet specified standard	47,986	-35,057	-731	-66	731	Low-Medium
Moisture ingress Option 2 – Install moisture barrier to meet specified standard	143,959	-76,762	-533	-52	533	Low-Medium
Moisture ingress Option 2 – combined installation of moisture barrier and vents to meet specified standard	191,946	-111,820	-583	-195	583	Low-Medium

- Refer to *Healthy Homes Standards: Cost Benefit Analysis of proposed standards on rental home insulation, heating, ventilation, draught stopping, moisture ingress and drainage (NZIER, 2018)*

Summary of Temperature Studies

- **Lloyd and Callau (2006)** ***Monitoring of Energy Efficiency Upgrades in State Houses in Southern New Zealand***
  - Study targeted Dunedin, Gore and Invercargill
  - Interventions were ceiling insulation, subfloor insulation (aluminium foil), hot water cylinder insulation, draught stoppers in Housing New Zealand Co. housing
  - 0.4 °C average annual temperature increases post-upgrade; 0.6 °C in winter months
  - Still poor temperature results in houses:
    - Average indoor – 14.9 °C living areas, 13.4 °C bedrooms
    - Sub 12 °C still occurred for 48% of occupants (minimums were around 5 °C)

- **Howden-Chapman et al. (2008)** ***Effects of improved home heating on asthma in community dwelling children: randomised controlled trial***
  - Intervention: non-polluting home heater
  - Lung function improvement was not significant
  - Intervention group had 1.8 (95% CI: 0.11 to 3.13) fewer days off school, 0.4 (95% CI: 0.11 to 0.62) fewer visits to the doctor for asthma, 0.25 (95% CI: 0.09 to 0.32) fewer visits to pharmacist plus other quality of life improvements (feeling healthier, less wheezing disrupted sleep, night time coughing.
  - 1.1 °C increase in living room, 0.57 °C in child's room

- **Pierse et al. (2013)** ***Modelling the effects of low indoor temperatures on the lung function of children with asthma***
  - Presents the relationship between low indoor temperatures and lung function (peak expiratory flow, forced expiratory volume)

Housing conditions such as cold temperatures, dampness or mouldiness and crowding gives rise to substantial hospitalisations and health-related costs

- Riggs et al. (2021) estimates the number of hospitalisations, costs and deaths due to cold housing, damp or mouldy housing and overcrowding.
- Three sets of data were collected:
  - Proportion of the population exposed to the studies household risk factors in New Zealand homes (NZ based studies)
  - Data linking health disorders with exposure to risk factors (e.g. asthma with damp or mouldy housing). Sourced from NZ and international studies. Health disorders included Rheumatic Fever, Chronic Obstructive Pulmonary Disease and Pneumonia. Note that a health disorder is not necessarily linked to each housing condition
  - Outcome measures (hospitalisations, deaths). Conditions applied to count these measures for robustness and double counting
- The table below presents the results of the study
  - The value of a statistical life used was 4.2 mil (June 2017)
  - The large ranges are mainly due to uncertainty in whether exposure to a risk factor causes the health disorder
  - The bracketed ranges are the 95% Confidence Interval range

- The study shows that damp or mouldy housing is the housing condition that imposes the greatest risk of a health condition and resulting impact.
- This does not necessary indicate a sole priority for interventions as housing conditions are related (cold housing with dampness and mould) and further, exposure to multiple health conditions or factors increase the risk of a health condition (WHO, 2018)

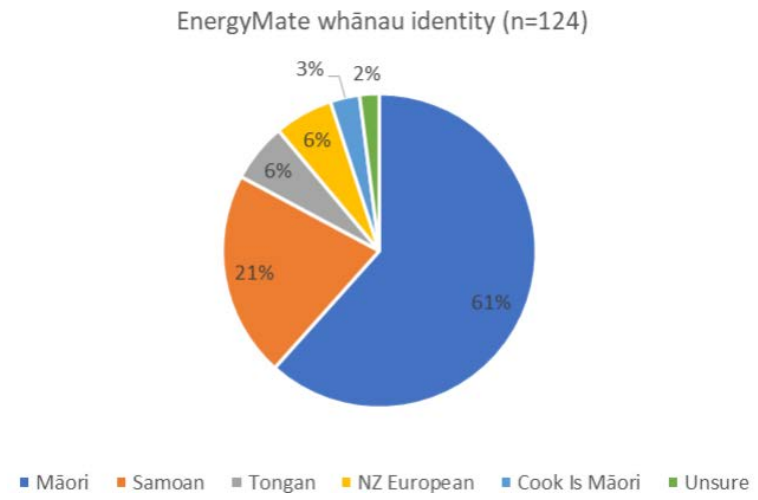
Housing Condition	Hospitalisations Instances	Hospitalisation Cost – All Hospital (NZ$2017 mil.)	Deaths (# / year)	Mortality Cost (NZ$2017 mil.)
Cold housing	625 (328-1115)	2 (1.05-4.3)	15.9 (3.3-36.9)	67
Damp or mouldy housing	6276 (4171-8622)	36 (24.26-48.85)	144.7 (97.8-197.5)	608
Household Crowding	526 (9-1814)	(0.96-4.53)	1.4 (1.0-1.8)	6

- Refer to *Environmental burden of disease from unsafe and substandard housing, New Zealand, 2010-2017, Riggs et al. (2021)* for specific study details and data sources

Affordability & Accessibility // Knowledge & Navigation

Of those in or at risk of energy hardship, many are likely under pressure to pay bills, in debt and be exposed to cold, damp and mouldy homes

- EnergyMate is a cross-sectoral project being led by Electricity Retailers' Association of New Zealand (ERANZ) to address energy hardship. It is supported by a range of electricity market participants (mostly retailers) and government institutions
  - The project realises this through home visits conducted by EnergyMate coaches in which they increase whanau's energy literacy (e.g. understanding electricity bills), assess whether there are easy improvements to the household's appliances for heating, lighting and hot water and connect them to local providers of the interventions
- Kelly (2019) presents the results of the first stage of the pilot in which EnergyMate coaches conducted 147 visits to 124 whānau homes in Porirua, Rotorua and South Auckland by November 2019.
  - Although the results do not provide extensive coverage of New Zealand, they do show the value of increasing energy literacy and the delivery through home visits.
  - Given EnergyMate is for whānau that need this support, it provides some insight into situations faced by others in or at risk of energy hardship
- Details of visited homes:
  - Private Rental: 40%; Housing New Zealand: 39%; Owner-Occupiers: 19% (do not sum to 100%, reason not stated)
  - The pie chart shows the identities of the whānau (Figure 3 from the report)
- Key results:
  - 20% were on pre-pay plans and 79% have weekly budgets for electricity.
  - 21% have experienced difficulty paying electricity bills in the previous 1-9 months and 7% *always do*; 8% had been disconnected in the last six months
  - At the time of the report, 24% were in debt to their current retailer with $403 on average owing
  - Mould is a concern for 39%, and 51% have inefficient or no heating; 36% had inadequate insulation or were unsure
- Note that ~90% of the 124 whānau provided responses for the above results
- Refer to *ERANZ EnergyMate Pilot – Monitoring and Evaluation Report (Kelly, 2019)*



Face-to-face consultations assist greatly in increasing the communities knowledge to manage energy hardship

- EnergyMate's Phase 2 involved 319 homes visits across eight community hui over the period August 2020 – 31 May 2021
  - Kaitaia, South Auckland, Hawera, Levin & Otaki, Christchurch, Dunedin, Rotorua and Petone
  - Note that COVID-19 impacted the project's delivery

- 90% of whānau "agreed EnergyMate was very helpful in providing new knowledge or reminders of what they should be doing for energy efficiency"
  - Changes included switching to LED lighting (85%), boiling less water in the kettle (61%) and shorter showers (45%)

- EnergyMate providers enabled whānau to get further support
  - 60+% were referred onto other services including budget services (22%); Health Homes Initiative (11%); and Curtain banks (13%)

- EnergyMate also received bills from some participants, and they were able to gauge whether whānau were in debt
  - 457 bills collected over the 12 months prior to EnergyMate's visit showed customers were in debt 20% of the time. This reduced by 35% shown by the 470 bills received in 12 months after the visit with 13.3% customers being in debt
  - The average debt 12 months prior to the visit was $146 which reduced to $51 for the 12 months after the visits
  - 18% of households were on the wrong plan which reduced to 8% post-visit

- 226 whānau responses produced the statistics above

- Refer to *EnergyMate Phase 2 Evaluation Report (Kelly, 2021)*

The costs of meeting the Healthy Homes Standards will impact renters' housing costs in contrast to the grant-based interventions typically targeting owner-occupiers

- As a part of NZIER's cost-benefit analysis, they highlight the impact of rental tenant's disposable incomes assuming a 15 year cost recovery period

Table 22 Annualised and weekly costs of measures per property

Annualised over 15 years at 4% real interest rate

GST exclusive	Annual $	Weekly $	Affected rental properties
Insulation Options	$130.23	$2.50	10,000-190,000
Heat Option Living rooms only	$274.18	$5.27	285,219
Heat Option Bedrooms	$28.33	$0.54	125,951
Ventilation – Window stays	$25.67	$0.49	143,500
Ventilation – Mechanical bathroom fans	$16.35	$0.31	252,560
Ventilation – Mechanical kitchen fans	$19.67	$0.38	212,380
Moisture ingress Option 2 – Subfloor vents	$166.30	$3.20	47,986
Moisture ingress Options 2 and 3 – Barrier	$60.71	$1.17	353,354
Draught stopping – Option 2	$9.75	$0.19	126,280

- Refer to *Healthy Homes Standards: Cost Benefit Analysis of proposed standards on rental home insulation, heating, ventilation, draught stopping, moisture ingress and drainage (NZIER, 2018)*

Energy hardship has been a long standing problem in New Zealand

- Howden-Chapman et al. (2012) estimate the number of household in "fuel poverty" in 2008
  - The definition of fuel poverty used was:

    A household would need to spend more than 10% of its income on all household energy requirements (excluding transport), to achieve a defined indoor thermal comfort level. This comfort level includes living temperatures of 21 °C and bedroom temperatures of 18 °C.

- This study also highlights the locational variation in required heating energy

Table A1
Proportion of households in potential fuel poverty in selected New Zealand cities.

Location	Heating energy ***needed*** (kWh/y)	Other electricity used (kWh/y)[a]	Total energy cost at 21c per kWh	Income thresholds (household income), to avoid fuel poverty	% of city population in potential fuel poverty	Number of households 2008	Number of households in potential fuel poverty 2008
Auckland	4000–6000	5500	$2000–$2400	$20,000 $24,000	14	386,000	54,000
Wellington	8000–13,000	5900	$2900–$3900	$29,000 $39,000	24	133,000	32,000
Christchurch	11,000–15,000	6200	$3600–$4400	$36,000 $44,000	40	134,000	54,000
Dunedin	13,000–16,000	6600	$4100–$4750	$41,500 $47,500	47	44,000	21,000

All dollar figures are NZ dollars.

[a] The higher values for cooler climates reflect higher losses for hot-water heating.

- Refer to *Tackling cold housing and fuel poverty in New Zealand: A review of policies, research, and health impacts (Howden-Chapman et al., 2012)*

Owner-occupiers have greater ability to improve their homes but home ownership among younger people, and Māori, Pasifika is decreasing

- Johnson et al. (2018) present a stocktake of New Zealand's housing, which highlights home ownership and rental proportion by ethnicity and age

FIGURE 1.2: PROPORTION OF PEOPLE IN HOUSEHOLDS THAT DID NOT OWN THEIR DWELLING BY ETHNICITY – 1986 TO 2013[12]

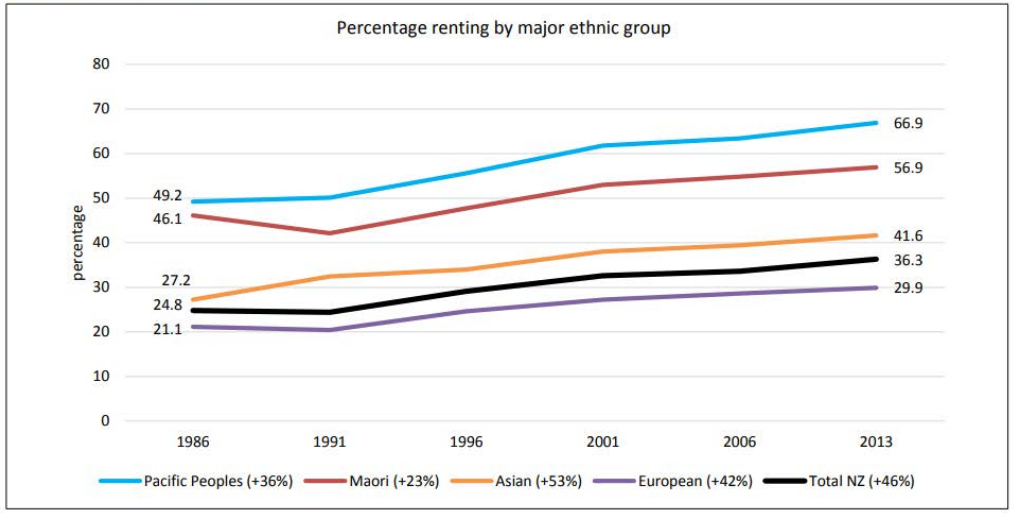


FIGURE 2.2: INDIVIDUAL HOME OWNERSHIP RATES BY HIGH-LEVEL ETHNIC GROUP – 2001 TO 2013[24]

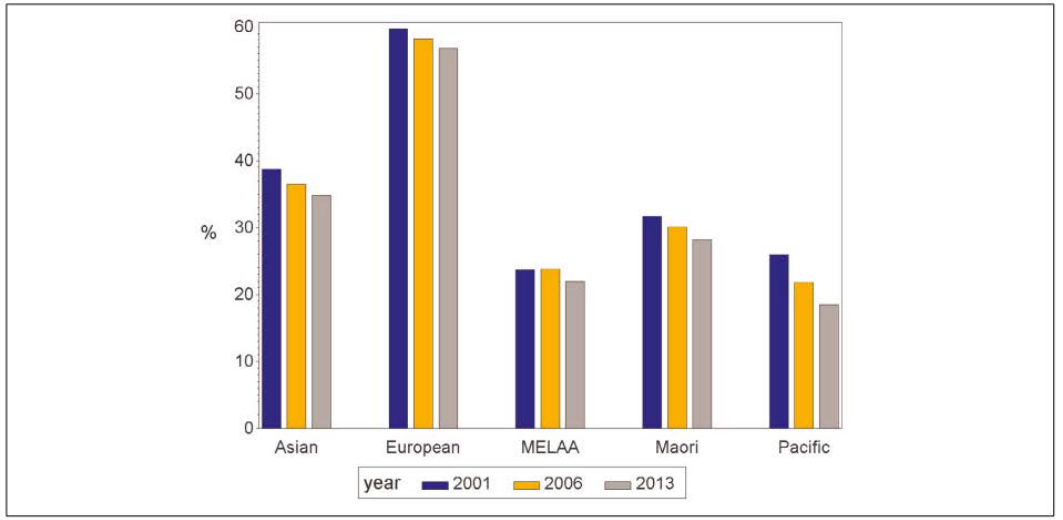
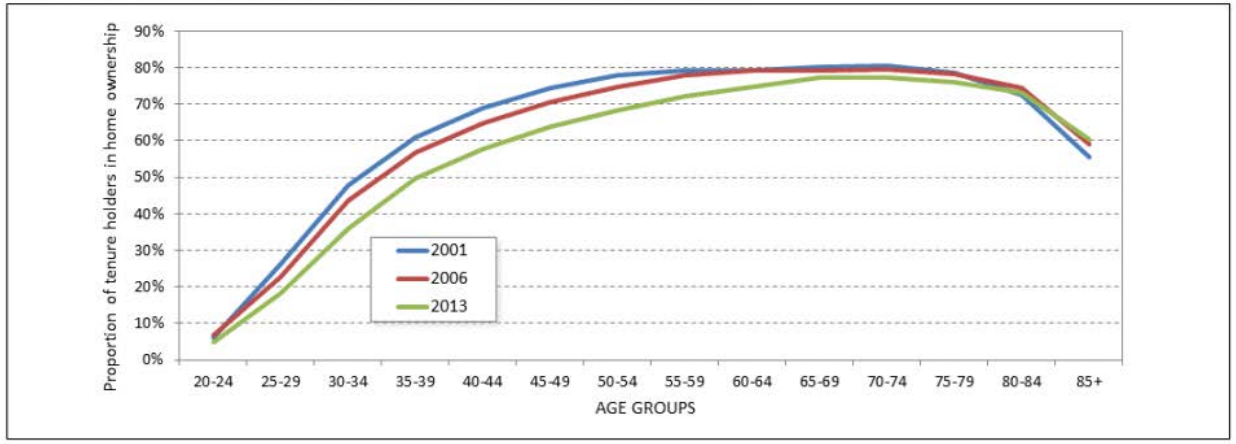


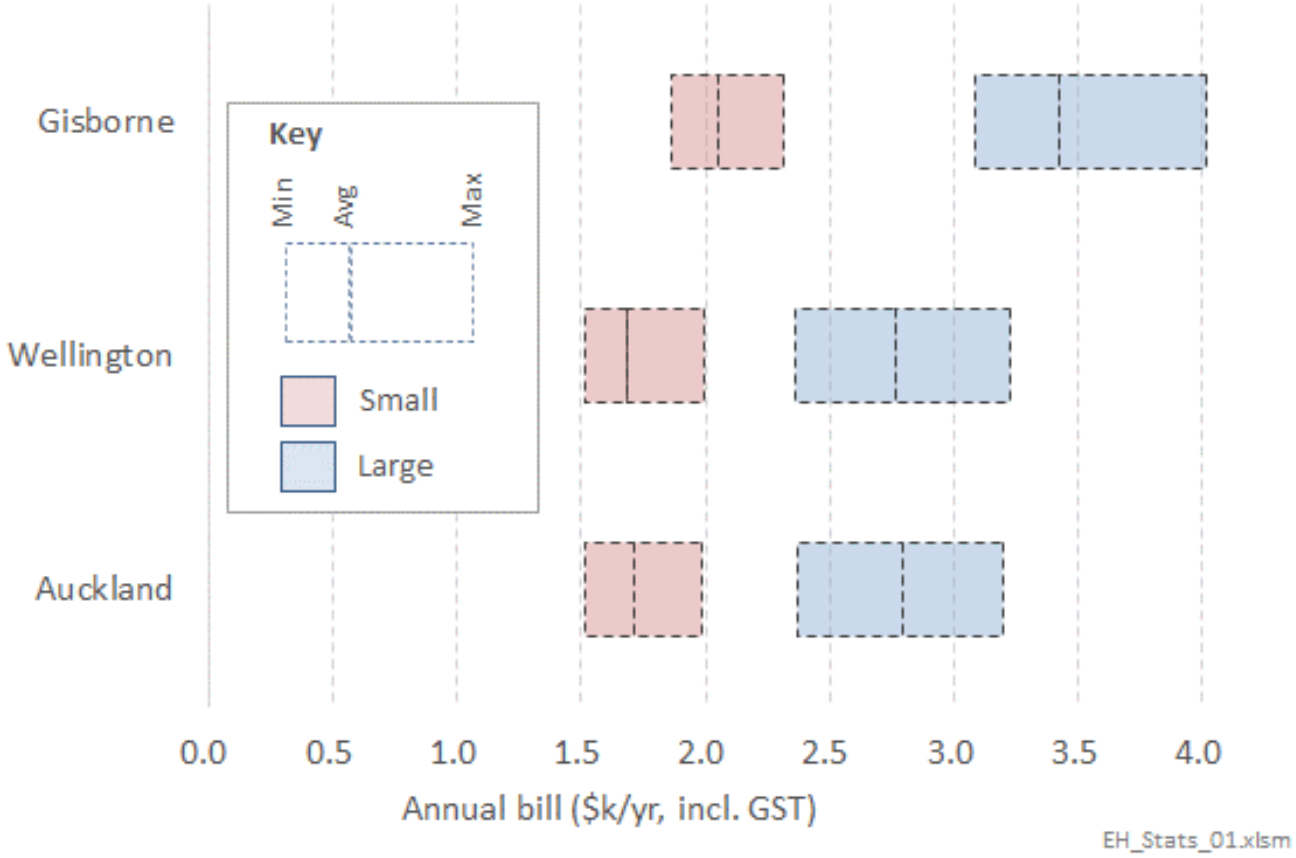
FIGURE 2.3: HOME OWNERSHIP RATES BY AGE – 2001 TO 2013[25]



Refer to *Stocktake of New Zealand's Housing (Johnson et al., 2018)*

There are many electricity tariffs to choose from, and significant variation in cost between the best and worst electricity tariff

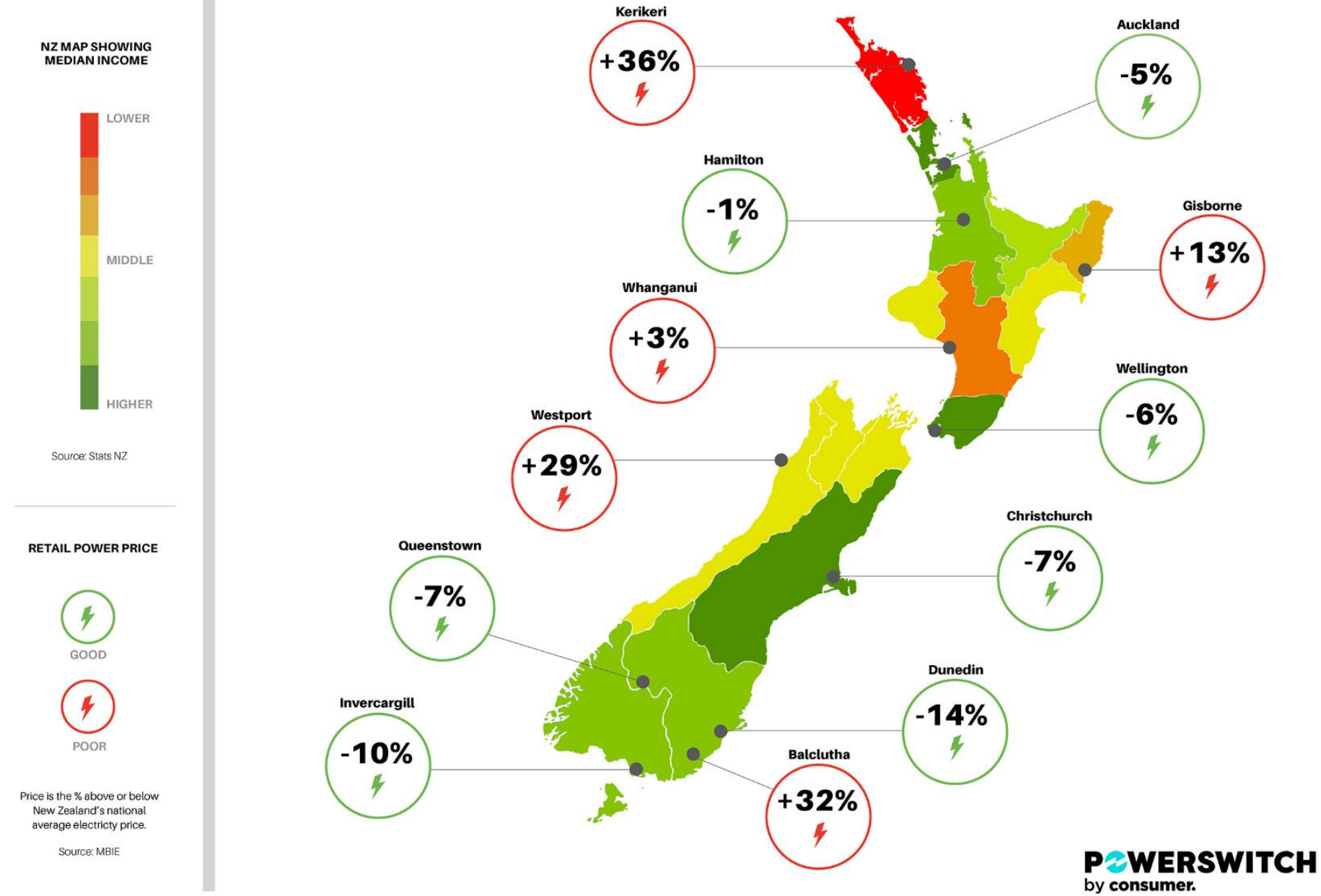
Variation in electricity bills under different retailer tariffs for 'small' and 'large' consumers



- All tariffs for 3 network areas downloaded from Powerswitch at end of March
  - On average 44 different options for each network area
    - Different retailers
    - Different term deals for each retailer
    - Low-user and standard user options
- Bills calculated for every tariff for a 'small' (5,500 kWh/yr) and 'large' (10,000 kWh/yr) consumer
- Average range* between best and worst tariff:
  - $470 for small (26% of avg. tariff)
  - $870 for large (29% of avg. tariff)
- If term deals excluded, best tariff is higher price altering range:
  - $445 for small (24% of avg. tariff)
  - $730 for large (21% of avg. tariff)
- None of the best tariffs in either situation require direct debit or internet billing.
- Price range outcomes similar to that observed for Electricity Price Review

*Note: Assumes consumer is on correct low-user/standard tariff option. Being on the wrong tariff for size of consumption would increase this range further.

Regions outside of major centres have to pay higher retail electricity prices and have lower average incomes – Provided by Consumer NZ



Switching electricity plan could improve the situation of those in energy hardship. However some are afraid to engage in the switching process

- Through the Powerswitch tool that ConsumerNZ develop and operate, they found that the average savings available by switching to lower-priced retailer or plan is around $400
  - However, some consumers are reluctant to switch due to confusion, mistrust and fear of the consequences

- ConsumerNZ conducted an annual survey of electricity consumers. In 2021, they found that:
  - Energy costs are a major concern for 26% of households,
  - 18% have trouble paying their power bills,
  - One in ten consumers said they had been refused service from a power company due to previously missed payments, and
  - 13% indicated they have had to cut back on heating due to cost concerns

- Note that no details on the survey's sample were provided

About Concept Consulting Group Ltd (www.concept.co.nz)

Concept is one of New Zealand's applied economics consultancies. We have been providing high-quality advice and analysis for more than 20 years across the energy sector, and in environmental and resource economics. We have also translated our skills to assignments in telecommunications and water infrastructure.

Our strength is from combining economic & regulatory expertise with deep sector knowledge and leading quantitative analysis.

Our directors have all held senior executive roles in the energy sector, and our team has a breadth of policy, regulatory, economic analysis, strategy, modelling, forecasting, and reporting expertise. Our clients include large users, suppliers, regulators, and governments – both in New Zealand and the wider Asia-Pacific region.

Disclaimer

Except as expressly provided for in our engagement terms, Concept and its staff shall not, and do not, accept any liability for errors or omissions in this report or for any consequences of reliance on its content, conclusions or any material, correspondence of any form or discussions, arising out of or associated with its preparation.

The analysis and opinions set out in this report reflect Concept's best professional judgement at the time of writing. Concept shall not be liable for, and expressly excludes in advance any liability to update the analysis or information contained in this report after the date of the report, whether or not it has an effect on the findings and conclusions contained in the report.

This report remains subject to any other qualifications or limitations set out in the engagement terms.

No part of this report may be published without prior written approval of Concept.