Definition of Energy Vulnerability in New Zealand

Electricity Retailers' Association of New Zealand

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Energy Vulnerability in New Zealand

Introduction

The purpose of this report is to investigate the definition of energy vulnerability as a means to identify vulnerable households that require support to remain warm, dry and healthy in their homes. These households may be struggling in two ways:

- they are not receiving the benefits or services provided by energy, such as heating, hot water and lighting, at a level considered acceptable
- they are deprived of other goods and services because of their spending on energy.

Both types of deprivation have negative implications for the wellbeing of these households. This report looks to investigate how to identify the number of houses that require this support.

We are undertaking this work is to update the original Boardman (1991)[1] definition of energy vulnerability to overcome some of its shortcomings and focus on a smaller, high-priority group. Such an approach is intended to better support the wellbeing of energy vulnerable households. Accordingly, a risk factor analysis provides a more proactive approach by focusing on factors of vulnerability like income (ability to pay for energy), housing condition and the age of occupants (demand for energy). Issues such as late payments and disconnections are reactive indicators – they can indicate that households are already struggling – and can also arise for reasons other than energy vulnerability.

The body of this report outlines:

- the results of the risk factor analysis
- a brief description of the methodology used to reach these results
- an outline of the shortcomings of the traditional definition
- a conclusion.

The appendices include the detailed results of the literature review, a detailed methodology section and some more in depth analysis of the results.

Based on a risk factor analysis, 44,500 households are high-priority energy vulnerable

Our analysis indicates that there are approximately 44,500 households at a high-priority level of energy vulnerability in New Zealand. This analysis defines the high-priority group as households meeting the older, Boardman definition of energy vulnerability as well as demonstrating four or five out of five additional risk factors that contribute to being energy vulnerable. The older definition is that households spend more than 10 per cent of their income, after accounting for housing costs (AHC income), on energy.[2]

Our analysis into the number of energy vulnerable households within New Zealand is conducted at the Census Area Unit (CAU) level (See appendix 2 for the full methodology). The baseline 10 per cent definition calculation uses median household income information for each CAU from the 2013 Census.

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[1] Boardman, B. (1991). *Fuel poverty: from cold homes to affordable warmth*. London: Belhaven Press.

[2] Our analysis only includes electricity costs for energy costs. We have investigated the use of wider non-electricity energy costs (gas, wood etc.) but the data available is of lower quality than for electricity: it shows the incidence of households using gas etc. but not the amount used. By taking a national average usage and applying that to the households that use gas, results show that around 13% more households would be high-priority energy vulnerable. See Appendix 3 for a brief outline of this methodology.

The households within these CAUs are categorised into whether they are owner-occupied with a mortgage, owner-occupied without a mortgage or rented. Housing costs are then calculated dependent on the household tenure type and these costs are subtracted from income to find the AHC income for each CAU. The proportion of the AHC that is spent on energy, which is calculated with usage and residential pricing data, is then computed for each CAU. If a tenure type within a CAU spends more than 10 per cent of their after-housing cost income on energy then they are considered energy vulnerable under this baseline definition. The analysis then categorises these households into different priorities based on a risk factor analysis.

We have overlaid additional risk factors on the 10 percent income measure. The Australian Competition and Consumer Commission (ACCC)[3] highlight that energy vulnerable customers are not a homogenous group. A number of factors determine the barriers they face and their ability to respond to those barriers. The factors noted by the ACCC include:

- Language barriers
- Cultural background
- Health problems
- Family violence
- Low or irregular income
- Household structures
- Age and disability
- Low energy, financial, and/or numeracy literacy.

We selected five risk factors because, first, they provide a deeper understanding of the barriers that energy vulnerable people face, and second, there are adequate data sources (Census and Statistics New Zealand) from which to measure them. See Appendix 1 for a full list of all factors considered. The core areas considered are:

- Household income and expenditure measures that indicate potential flexibility to manage cash flows and cope with energy price rises and unexpected household costs [2, 4, 5, 6, 7, 8, 9, 10, 11]
- The age of occupants was selected because the very young and the elderly (9 years and under, and 65 years and over) may require warmer temperatures to maintain health, and may be at home for longer periods, therefore, giving rise to higher energy demands [2, 3, 4, 8, 9]
- The age of the house is a proxy for energy efficiency. Houses have differing levels of energy efficiency, and poor insulation and inefficient appliances are important contributors to energy vulnerability - particularly for those households with a high heating burden. [3, 5, 6, 7, 8, 9]

[3]Australian Competition and Consume Commission. (2018). *Restoring electricity affordability and Australia's competitive advantage: Retail Electricity Pricing Inquiry – Final Report*.

[4] Concept Consulting Group Ltd (2017). *Options for assisting customers in energy hardship*.
[5] Department for Business, Energy, & Industrial Strategy (England) (2018). Annual *Fuel Poverty Statistics Report*.
[6] Healy, J. (2017). *Housing, Fuel Poverty and Health: a pan-European Analysis*.
[7] Middlemiss, L. and Gillard, R. University of Leeds (2015). *Fuel poverty from the bottom-up: Characterising household energy vulnerability through the lived experience of the fuel poor*.
[8] Lawson, R. and Williams, J. University of Otago (2012). *The Nature of Fuel Poverty in New Zealand*.
[9] Statistics NZ (2017). *Investigating different measures of energy hardship in New Zealand*.
[10] Trinomics (2016). *Selecting Indicators to Measure Energy Poverty*.
[11] World Health Organization. (2011). *Environmental burden of disease associated with inadequate housing. Geneva: World Health Organization*.

Taking these categories, the specific risk factors included in the analysis are measured at the CAU level. That is, a risk factor is deemed to exist in a CAU where on average households:

- Spend more than ***twice the median*** proportion of AHC income on energy
- Spend ***more than 15 per cent*** of AHC income on energy
- Have a greater proportion of ***older houses***
- Have ***more younger children*** (9 years and under)
- Have ***more older residents*** (65 years and over).

High-priority households have multiple co-existing factors that contribute to energy vulnerability

Multiple factors appear to contribute to energy vulnerability. Figure 1 explores the additional risk factors for households meeting the baseline 10 per cent definition. It presents the risk factors that affect households in the identified CAUs. The most common number of risk factors is three. This highlights that of those households that meet the 10 per cent definition, the majority have a number of other factors that can contribute to energy vulnerability as well as just spending 10 per cent of AHC income on energy.

Figure 1 Distribution of scores by risk factor

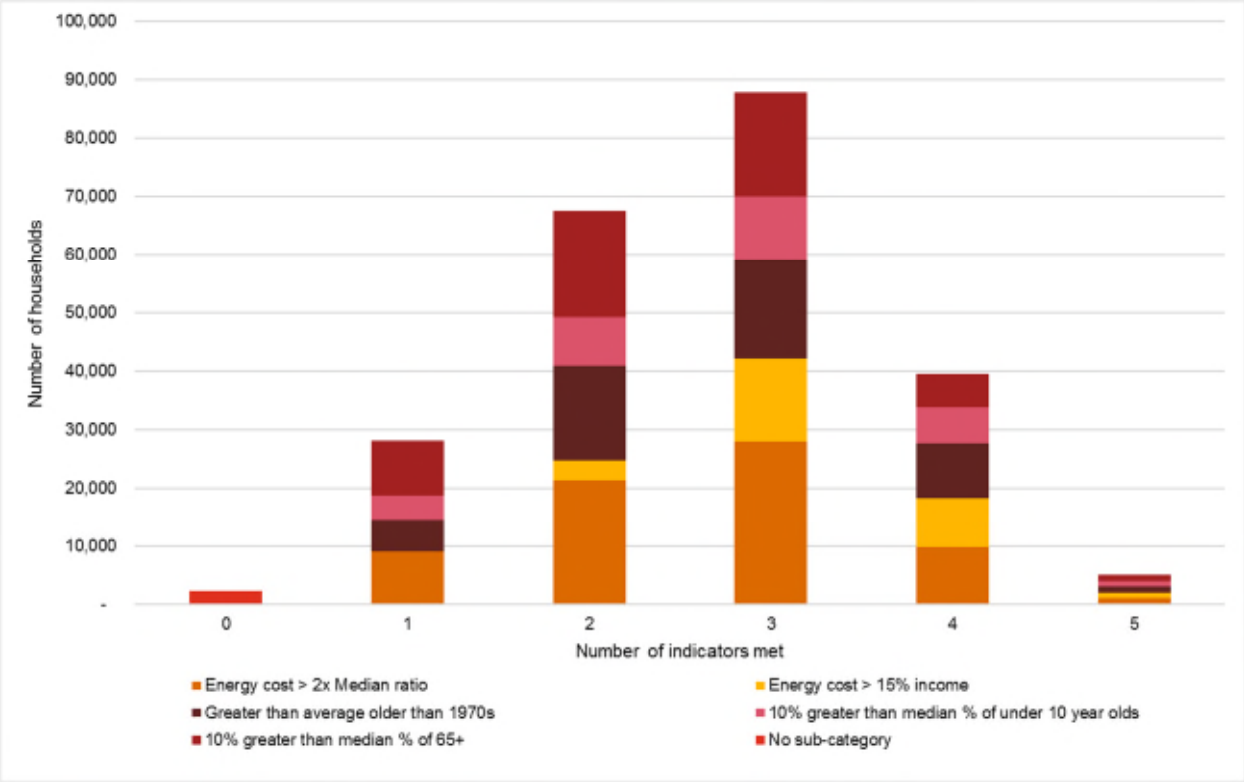


Table 1 shows the relative contribution of the risk factors to the risk factors scores: each number is the proportional presence of the risk factor amongst households studied, with proportions summing to 1.00.[12] The numbers and shading show that households most commonly have three coexisting factors, and that spending twice the median income, having an older house and elderly householders are more significant contributors to high-priority energy vulnerability. The sections below investigate these coexisting factors in more detail.

[12] Proportions in the table sum to 0.97, not 1.00, due to rounding.

Table 1 Relative contributions of risk factor to risk scores

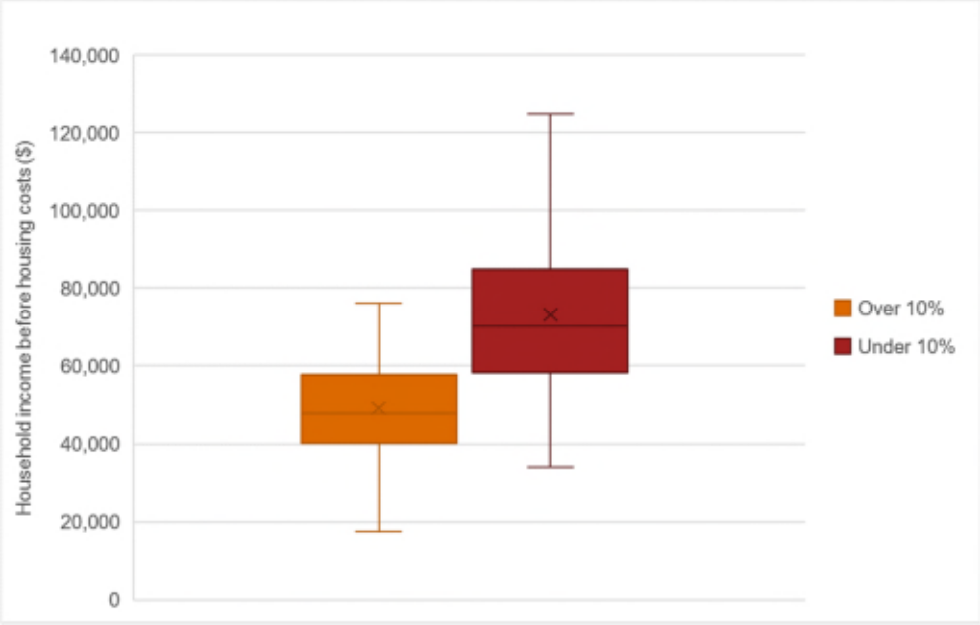
Score	0	1	2	3	4	5
Energy cost greater than twice median ratio	-	0.03	0.08	0.12	0.04	0.00
Energy cost greater than 15% income	-	-	0.01	0.06	0.04	0.00
Greater than average older than 1970s	-	0.03	0.06	0.08	0.04	0.00
10% greater than median number of under 10 year olds	-	0.02	0.04	0.05	0.03	0.00
10% greater than median number of people 65 and over	-	0.06	0.07	0.08	0.02	0.00
No sub-category	0.01	-	-	-	-	-

Income factors

Among households spending at least 10 per cent of AHC on electricity, nearly 40 per cent of them spend more than 15 per cent of AHC income on electricity. For this smaller group of households, energy expenses are a very significant proportion of household costs; these households are likely struggling to keep up with their bills. Income factors have the strongest impact on energy vulnerability in New Zealand.

As seen in Figure 2, the group of CAUs that exceed the 10 per cent of income threshold tend to have lower median incomes. The upper quartile of income for those households meeting the 10 per cent definition is below the lower quartile of those not meeting the definition. The comparison demonstrates the importance of low income as a factor in energy vulnerability.

Figure 2 Distribution of median incomes in CAUs for each energy to income ratio grouping



Household factors

Household factors in the analysis are the age of the house and the householders.

Age of dwelling

The literature indicates that older houses are more likely to be cold, damp and expensive to heat – leading to increased electricity costs to heat the house to suitable temperatures. This factor considers houses that were built in the 1970s or earlier as 'older', as insulation requirements were not in place until 1978.[13] Having a proportion of houses built in the 1970s or earlier, that is greater than the overall New Zealand median, indicates that there are vulnerable households within the CAU (See Appendix 2 for more details on the methodology).

Age of householders

Children and the elderly are more likely to be at home during the day, increasing energy use, and are more vulnerable to illness, so the consequences of poor heating are more serious. The two age groups that are considered the most vulnerable in our analysis are those under the age of 10 and those 65 years and over. Having a proportion of children and/or the elderly that is 10 per cent greater than the New Zealand median, indicates that there are vulnerable populations in the CAUs.

Market factors

To investigate the potential impact of one of the market factors that impact energy expenditure, we assessed the relationship between the network costs (lines changes) and energy vulnerability. From our source data we can see that in New Zealand, lines charges are on average approximately 40% of total retail energy cost. The analysis defines low, medium and high lines charges and looks at lines charges in the total population and the high-priority group. If the lines charge was above 14 cents in a CAU then this CAU was included in the high category for lines charges. If the lines charge was between 11 and 14 cents, the CAU was categorised as medium; the CAU was categorised as low if the lines charge was below 11 cents (see appendix 2 for the full line charge analysis methodology). Table 2 below provides the results.

Table 2 Lines charge categories

Lines charge category	***Charge (per kWh)***	***% of households in each category, total population***	***% of households in each category, high-priority group***	***High-priority incidence compared to total population incidence***
Low	Under 11 cents	18%	5%	0.3×
Medium	11-14 cents	72%	73%	1.1×
High	14 cents +	10%	22%	2.2×

Table 2 indicates that high-priority groups have a larger tendency to be located in geographic areas with high lines charges. However, this needs to be seen in the context of high lines charges often applying in remote and/or low population density areas. Such areas also tend to display higher rates of poverty and deprivation, which are more important factors in the question of energy vulnerability.

The 10 per cent definition is not a consistent metric and does not highlight those most in need

The 10 per cent definition of energy vulnerability developed by Boardman in 1991 – spending at least 10 per cent of income on energy – identifies households that spend a larger than usual proportion of their income on energy. This definition is a useful starting point for discussion and focuses on the affordability issues associated with energy vulnerability. However, there are issues with this definition that the prioritisation exercise carried out for this report is working to overcome.

1 The population that are deemed to be energy vulnerable by this definition is often ***too large to be provided targeted assistance***. In addition, the definition does little to describe the

[13] BRANZ. (2018). Insulation. Retrieved from https://www.renovate.org.nz

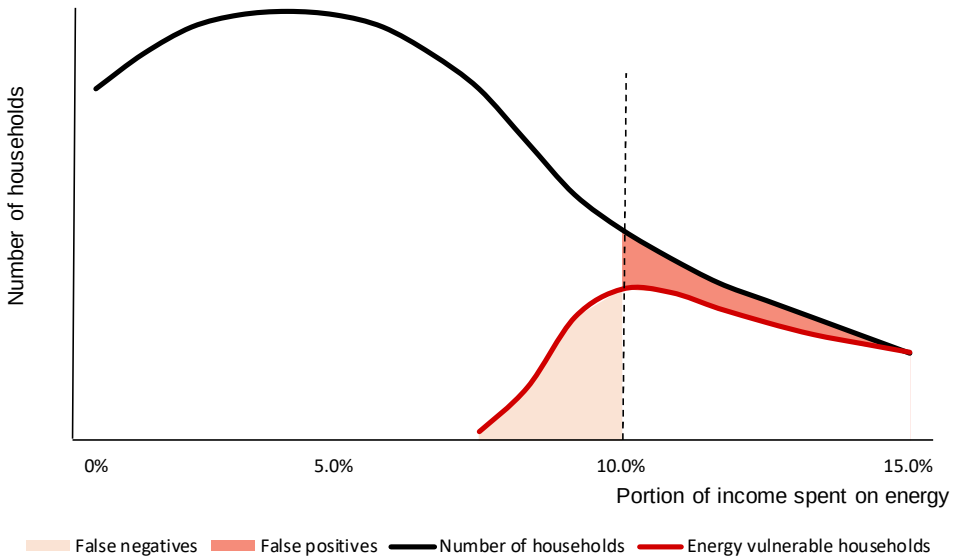
characteristics of these households. It is then difficult to design an intervention that can help this large and unknown group.

2 The total number of households in the category is ***sensitive to the measurement methodology***. We reviewed three previous pieces of research attempting to measure the number of energy-vulnerable households in New Zealand using the 10 per cent definition.[14] The research has found that 10 per cent to 25 per cent of households, or roughly 155,000 to 390,000 households, meet the definition depending on analytical choices of the researchers. This is a broad range of potentially energy vulnerable households considering each analysis is using the same base definition.

3 A significant number of households are ***clustered around 10 per cent of AHC income*** spent on energy. Therefore, the number of households in energy vulnerability can change materially with small changes in the 10 per cent threshold level. For example, our analysis found that moving the benchmark of energy vulnerability from 10 per cent of AHC income to 11.4 per cent, reduced the number of households meeting the definition by more than 20 per cent. Importantly, 11.4 per cent is twice the median proportion of AHC income spent on energy, which is a common alternative to the 10 per cent measure.

4 The 10 per cent cut-off generates ***false negatives and false positives***, as shown in Figure 3 below. False positives include households with high levels of income and housing debt, leaving comparatively low levels of disposable income, as well as households that choose to run luxury appliances or facilities, such as heated swimming pools. False negatives are households that are under-heating their homes by taking economising measures in order to meet other costs or needs. By using a strict cut-off we include the false positive group, which are not deprived or vulnerable, and we miss the under-heating false negative group which are of concern. Taking a prioritisation approach helps to remove the false positives from our group. Although the approach does not help identify specific households in the false negative group, the CAU-based approach does focus on energy-vulnerable areas and may therefore include households that are rationing their energy spending.

Figure 3 Households by portion of income spent on energy (illustrative only)



For a more in-depth discussion of the 10 per cent definition and its shortcomings, please see Appendix 1.

[14] Lloyd (2006), Howden-Chapman, et al. (2012), Statistics New Zealand (2017).

Conclusion

The risk factor analysis in this report indicates that 44,500 households are high-priority energy vulnerable. This group spend a significant amount of their AHC income on energy, and have old houses and higher than average proportions of children and elderly people in the region. This is a smaller group than that delivered by Boardman's 10 per cent definition. The co-existing factors demonstrated by these households allows us to better describe these households and better target an intervention to support them.

There are various limitations that must be understood alongside this analysis:

- We have relied only on publically available data. We have not included any industry data about energy usage or payment information, or confidential datasets from government sources. The short timeframe for the analysis did not allow for the use of this data.
- Some of the data used is becoming out of date. As the 2018 Census data is not yet available we could not use this information, but this data would be a useful update to the analysis.
- We have only measured energy costs using electricity and have not used other sources of energy such and wood, gas and solar. This is due to a lack of usage data at the regional level; see Appendix 3 for more information about this.
- It is likely that households could move in and out of energy vulnerability through time as their circumstances change. This analysis does not specifically take into account the transience of this group. However, we do look at the regional indicators rather than the experience of specific households at a point in time, which could help overcome this.

There are two main areas of subsequent work that could follow this analysis:

- This analysis highlights a need for a targeted and tailored intervention for energy vulnerable households, starting with the high-priority group.
- This work also illustrates a need for more consistency in the measurement of energy vulnerability in New Zealand. Consistency is likely to come from improved data at the household level, potentially from Census data. A useful starting place would be the Statistics NZ Integrated Data Infrastructure (IDI). We can be clearer about the size and location of this population when a better quality data set is used to form the basis on the analysis.

Appendix 1: Literature review

Definition

The motivation for defining energy vulnerability comes from the understanding that some households experience less heating and other energy services at a level that is considered too low. This situation occurs when three dimensions interact: household characteristics, household circumstances and energy factors. The dimensions can be represented by a diagram, as shown in Figure 4 below.

Figure 4 Energy vulnerability definition dimensions

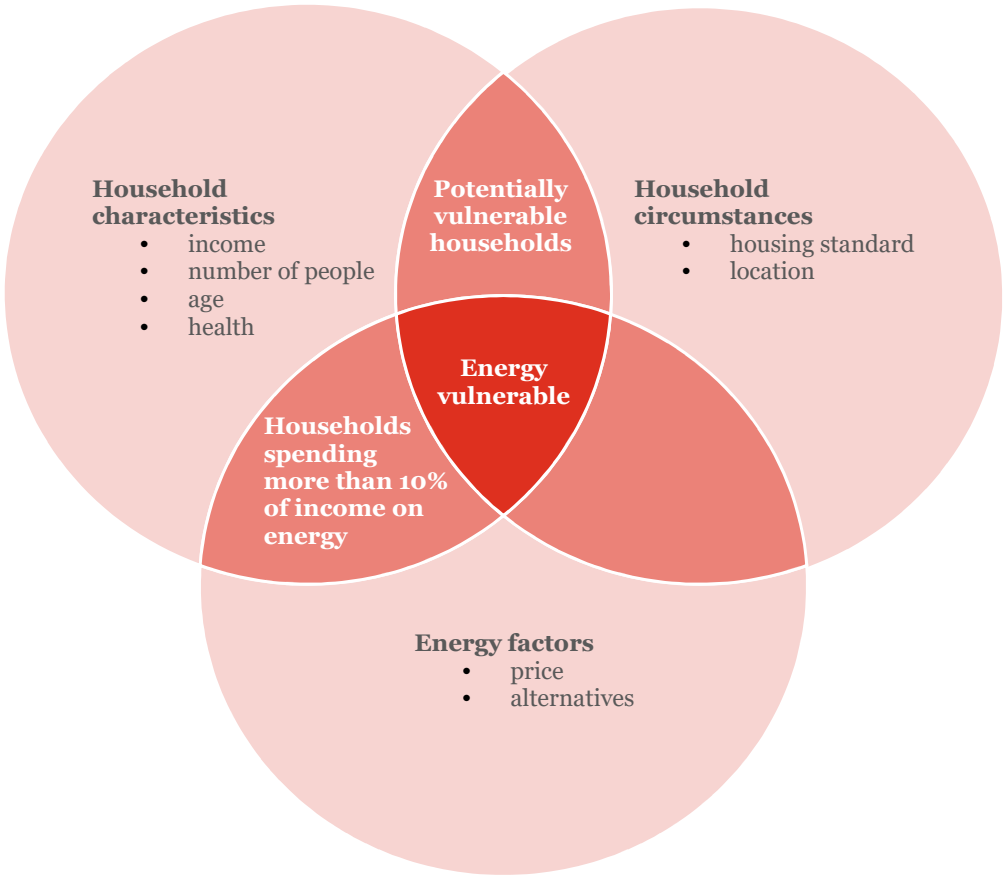


Figure 4 above helps make explicit the point made by the Australian Competition and Consumer Commission (ACCC),[15] that energy-vulnerable customers are not a homogenous group. A number of factors determine the barriers they face and their ability to respond to those barriers. These factors (which fit into the household characteristics and household circumstances dimensions of the above diagram) include:

- language barriers
- cultural background
- health problems
- family violence

[15] In its report: *Restoring electricity affordability and Australia's competitive advantage: Retail Electricity Pricing Inquiry – Final Report*, June 2018

- low or irregular income
- household structures
- age and disability
- low energy, financial, and/or numeracy literacy.

There is no universally accepted definition of energy vulnerability, either in NZ or internationally. The ACCC report considers two forms of energy vulnerability that often overlap:

- where a consumer who, due to personal circumstances, is unable to meet or is at risk of being unable to meet the cost of electricity supply and, as a result, is at risk of experiencing detriment to their well-being and standard of living
- where a consumer faces additional barriers to engaging with the retail electricity market (such as language barriers, cultural background, and/or low energy, financial and/or numeracy literacy).

Many definitions do not focus on people's experiences but on other metrics that are easier to measure. A common definition of energy vulnerability from Boardman (1991) is:

> *A fuel poor household needs to spend 10 per cent or more of its income on energy services, particularly for warmth.*

By itself, this definition may:

- include false positives – households with high levels of income and debt, leaving comparatively low levels of disposable income, and/or that choose to run luxury appliances/facilities, such as heated swimming pools
- exclude false negatives – households that take economising measures to reduce expenditure on energy in order to meet other costs/needs.[16]

In addition, we should consider the extent of households captured by a definition. If a definition captures a large portion of the population, that could be indicative of broader, systemic issues that are wider than the energy sector. Those issues may be better addressed in some other way than focusing specifically on energy vulnerability.

The 10 per cent definition may be a useful starting point. Additional criteria can then be used to reduce false positives and false negatives highlighted in Figure 3.

Additional criteria to identify at-risk customers

Energy vulnerability is complex because its causes affect households in different ways. Low incomes can lead to energy vulnerability, but not all low-income households are necessarily energy-vulnerable. As a result, the simple definition should be expanded in two ways:

- additional criteria can help identify those customers who are experiencing deprivation, either in terms of services from energy or in other ways
- treating energy vulnerability as a spectrum recognises that there are degrees of deprivation.[17]

[16] The risk of the 10 per cent of income measure both including non-vulnerable households, and excluding vulnerable households, was noted by Rob Lawson and John Williams, University of Otago: *The Nature of Fuel Poverty in New Zealand*.

[17] As the Concept Consulting Group Ltd noted in their November 2017 report: *Options for assisting customers in energy hardship – Prepared for the Electricity Networks Association*, "…the situation is more a continuum than a binary condition: some households face extreme hardship, while for others their hardship, while material, is less severe or is intermittent", at p. 12.

The most important risk factors as highlighted by the literature were:

- Household income and expenditure measures indicate potential flexibility to manage cash flows and cope with energy price rises and unexpected household costs [2, 18, 19, 20, 21, 22, 23, 24, 25]
- The age of occupants was selected because the very young and the elderly (9 years and under, and 65 years and over) may require warmer temperatures to maintain health, and may be at home for longer periods, therefore, giving rise to higher energy demands [2, 3, 4, 8, 9]
- The age of the house (built prior to 1970) was selected as a proxy for energy efficiency. Houses have differing levels of energy efficiency, and poor insulation and inefficient appliances are important contributors to energy vulnerability - particularly for those households with a high heating burden. [3, 5, 6, 7, 8, 9]

Taking these categories, the specific risk factors included in the analysis are measured at the CAU level. That is, a risk factors is deemed to exist in a CAU where on average households:

- Spend more than ***twice the median*** proportion of AHC income on energy
- Spend ***more than 15 per cent*** of AHC income on energy
- Have a greater proportion of ***older houses***
- Have ***more younger children*** (9 years and under)
- Have ***more older residents*** (65 years and over).
- Table 3 sets out a list of additional criteria that we have considered using in our risk analysis but did not select for various reasons.

[18] Concept Consulting Group Ltd (2017). *Options for assisting customers in energy hardship.*
[19] Department for Business, Energy, & Industrial Strategy (England) (2018). Annual *Fuel Poverty Statistics Report.*
[20] Healy, J. (2017). *Housing, Fuel Poverty and Health: a pan-European Analysis.*
[21] Middlemiss, L. and Gillard, R. University of Leeds (2015). *Fuel poverty from the bottom-up: Characterising household energy vulnerability through the lived experience of the fuel poor.*
[22] Lawson, R. and Williams, J. University of Otago (2012). *The Nature of Fuel Poverty in New Zealand.*
[23] Statistics NZ (2017). *Investigating different measures of energy hardship in New Zealand.*
[24] Trinomics (2016). *Selecting Indicators to Measure Energy Poverty.*
[25] World Health Organization. (2011). *Environmental burden of disease associated with inadequate housing. Geneva: World Health Organization.*

Table 3 Risk factors found in the literature, not used in the analysis

Criteria	*Relevance*	*Reason not selected*
Geographic location	Is relevant to climate, whether alternative fuel sources are available, and regional variance in energy prices	We did not select this measure as household location was already taken into account in measuring household expenditure on energy, with regional variance in energy demand and cost already included in our assessment
Warmth of houses	Is based on World Health Organization guidelines of 21 degrees Celsius in living rooms and 18 degrees Celsius in bedrooms, and is relevant to whether households are receiving benefits provided by energy at a level considered acceptable	We did not select this measure as the data source (Census dwelling file) was not specific enough to assess actual room temperature
Housing ownership	Indicates the potential ability to improve housing condition	We included renting/ownership information in calculating housing costs, but have not captured this criterion as a standalone risk factor because we are unable to quantify what the effect might be due to a lack of research rather than data
Number of household members	The more people, the greater the demand for energy (when compared with household income, indicates the ability to meet energy needs).	We did not include this because a strict household size measure would not take into account, for example, people living alone on a small income that could also be energy vulnerable. In addition, the measure would be closely linked to the household energy use so should be captured in the energy use figures. And finally, we have included a metric for high levels of children and older people which should go some way to identifying the larger, inter-generational households.
Employment status	Indicates potential difficulty meeting energy costs (due to low income), potential for greater energy demand (due to people being at home for longer periods), and potential long-term vulnerability (due to people receiving welfare perhaps not experiencing much income growth and, therefore, potentially being more vulnerable to rising energy prices)	We did not select this measure as we were unable to quantify what the employment status effect might be, beyond the income and expenditure measures already included in our assessment
Health conditions/ disability	May indicate a need for warmer indoor temperatures for people to maintain health, and which may be associated with lower income due to prolonged illness, and may give rise to higher energy demand through people spending time at home for longer periods and/or needing additional health-related services that require energy	We did not select this measure as we did not have access to an adequate data source on the number of people in an area with health/disability conditions

Large energy bill	May indicate high-energy needs and difficulty meeting those costs/other needs and/or vulnerability to energy price rises	We did not select this measure as we did not have access to the industry database containing information on energy bills. We also consider the vulnerability this measure is aimed at is already adequately captured in the income and expenditure factors included in our assessment
Abnormally low energy bill	May indicate energy vulnerability due to households taking economising measures, such as not heating the house	We did not select this measure as we did not have access to the industry database containing information on energy bills, and consider this measure might capture too many false positives, such as where households have installed photovoltaic solar panels, or where households are only present for certain times of the year
Pre-paid energy accounts	May indicate little scope within a household budget to cope with higher energy usage or rising prices	We did not select this factor as we did not have access to the industry database containing information on energy bills
Late and/or manual energy bill payment	May indicate difficulty meeting energy costs within normal or agreed timeframes	We did not select this measure as we did not have access to the industry database containing information on energy bills
Energy has been disconnected	Indicates difficulty meeting the cost of energy	We did not select this measure as we did not have access to the industry database containing information on energy bills
Single-parent families	Such families are overrepresented in energy vulnerable households	We did not use this measure as we consider single-parenthood is correlative with lower income and higher costs/needs, rather than directly causative of energy vulnerability. We consider where such single-parent households suffer energy vulnerability, they will be captured by the criteria we have used in our assessment of household income, number of occupants, and age (and health status) of occupants

Appendix 2: Methodology

Our quantification of the number of energy vulnerable households in New Zealand uses the total households data recorded in the 2013 census as the base population[1]. The analysis is conducted at the Census Area Unit (CAU) level, of which there are 2,012. Where data is reported at territorial authority or regional level, it is assumed that the associated values can be applied to all CAUs within the territorial authority (TLA) or region. The energy vulnerable households calculation uses 2018 values, however where 2018 data is not available the data is converted to 2018 values using relevant inflation rates. The households are divided up into three different tenure types: rentals, owner occupied with mortgage and owner occupied without a mortgage. These different household cohort groups are calculated separately and then combined for the final output.

The 10 per cent definition methodology

1. **Household income data**

   The median household income data for each CAU is collected using the 2013 census data.[26] For CAUs where the median income data was censored, the average New Zealand income from the non-censored areas is applied. The median income data is inflated to 2018 values using the salary inflation rate, which is based on the change in average weekly earnings from 2013 quarter two to 2018 quarter two.[27] Net median income is then calculated by deducting the 2017-2018 IRD tax rates.[28,29]

2. **Housing Costs**

   Prior to calculating the proportion of income spent on energy, housing costs are deducted from net median income. The housing costs that are calculated depend on the tenure of each of the households. Households in each CAU are divided into whether they are rented, owner-occupied with a mortgage or owner occupied with no mortgage based on the 2013 census data.[26] It is assumed that of all households that are owner-occupied, 50 per cent have a mortgage.

   Rental costs:
   For rented households, the housing costs are rent payments. Average weekly rent data by TLA is sourced from the Ministry of Business, Innovation and Employment (MBIE)[30] and the average of the last 12 months (in the year ending June 2018) is calculated.

   Base ownership costs:
   For owner-occupied households there are a number of housing costs associated with owning a home. These include property rates, building-related insurance and other housing costs. This cost data is sourced from 2016 Statistics NZ data[31] and inflated to 2018 dollars based on relevant inflation rates for the different cost components. The annual housing ownership costs are calculated as being $7,003. This is adjusted for each region based on the regions housing affordability index.[32]

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[26] Statistics New Zealand. (2014). 2013 Census meshblock dataset [Data file]. Retrieved from http://archive.stats.govt.nz/

[27] Statistics New Zealand. (2018). Average Weekly Earnings (Employees) by Industry (ANZSIC06) and Sex (Qrtly-Mar/Jun/Sep/Dec) [Data file]. Retrieved from http://archive.stats.govt.nz

[28] Inland Revenue Department. (2018). Income tax rates. Retrieved from https://www.ird.govt.nz

[29] Concept Consulting Group Ltd (2017). *Options for assisting customers in energy hardship.*

[30] Ministry of Business Innovation and Employment. (2018). Mean rents by TA [Data file]. Retrieved from https://www.mbie.govt.nz

[31] Statistics New Zealand (2018). Household expenditure statistics: Year ended June 2016 [Data file]. Retrieved from https://www.stats.govt.nz

[32] Squires, M. & Mee Chin, F. (2018). Home Affordability Report: Quarterly Survey June 2018, Vol 28. No.2.

Mortgage costs:
Those households that are classified as owner-occupied with a mortgage have mortgage payments in addition to the ownership related costs mentioned previously. Mortgage payments for these households are calculated based on the assumption that the mortgage is 60 per cent of the house sale price, has 25 years remaining and is paying a mortgage rate of 5.8 per cent, which is based on RBNZ data.[33] The sale price data is recorded by TLA and is sourced from MBIE.[34]

3. **Household energy costs**

Energy cost calculations include electricity data from the Electricity Authority[35] and lines charge and retail price data from MBIE.[36] The average electricity pricing data is provided for lines companies in different towns and cities. These are then matched to mesh blocks and regional IDs using Electricity Authority data.[37] Each region's average unit price for electricity is applied to the CAUs within that region. The electricity usage data from the EA is the average residential electricity consumption (kWh) calculated from the year ending 31st of December 2017.[35] The electricity price data and the electricity consumption data is multiplied together to obtain the average annual energy costs per household by CAU.

The household energy costs are taken as a proportion of household income after housing costs. If the proportion of net income that is spent on energy is greater than 10 per cent for a tenure type within a CAU, then this group of households is counted as being energy vulnerable under this definition.

The risk factor analysis

The risk factor analysis builds on the 10 per cent income based approach, by adding in additional factors that would increase the likelihood of households being energy vulnerable. The sections below outline how we measured the risk factors.

Energy cost factors

The data used in calculating the two additional energy cost measures are the same as under the 10 per cent income approach outlined above.

- **Two times the median:** For this factor, the median percentage of after-housing cost income spent on energy costs is calculated for the whole sample. The median percentage is 5.57 per cent is multiplied by two to get the threshold percentage of 11.14 per cent. If a tenure type in a CAU has an average proportion of after-housing cost income spent on energy costs greater than 11.14 per cent, then they get a point for this factor.

- **Fifteen per cent of income:** This income factor has a higher threshold of 15 per cent of after housing cost income spent on energy. In order for a tenure type of households within a CAU to meet this threshold, they will have also had to pass the previous two income factor thresholds.

Figure 5 below shows the cumulative distribution of energy cost to income ratios for all households under analysis. The dashed lines indicate the proportion of total households that have an energy cost to income ratio at different factor levels.

[33] Reserve Bank of New Zealand. (2018). Mortgage Rates: Key graph data [Data file]. Retrieved from https://www.rbnz.govt.nz

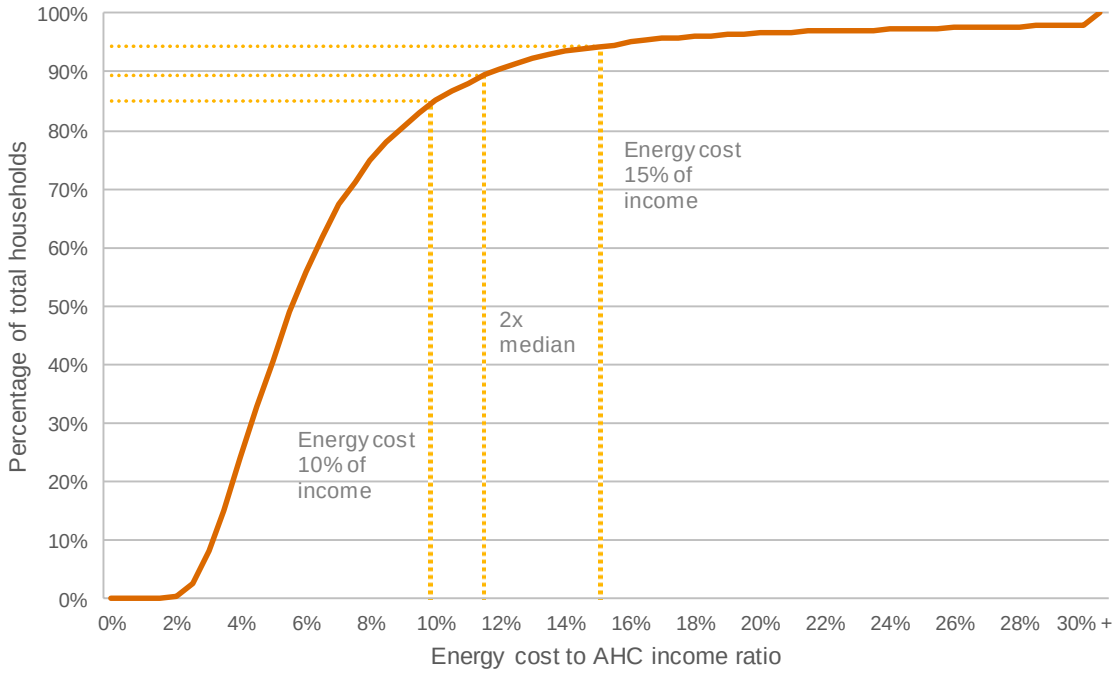
[34] Ministry of Business Innovation and Employment. (2018). All Dashboard Data: TA [Data file]. Retrieved from https://www.mbie.govt.nz/

[35] Electricity Authority New Zealand. (2018). Residential consumption [Data file]. Retrieved from https://www.emi.ea.govt.nz

[36] The electricity price data from MBIE was provided by the client

[37] Electricity Authority New Zealand. Network regions to meshblocks mapping [Data file] Retrieved from https://www.emi.ea.govt.nz/

Figure 5 Distribution of households by per cent of AHC income spent on energy



Age of housing stock factor

Age of housing stock data has been sourced from Quotable Value (QV), which allocates the households within an area to the decade in which they were built. The areas within this data are matched to CAUs where possible. The QV data separates the houses into owner occupied, not owner occupied and tenure unspecified however for our calculations sum these to get a total for each CAU. These householders are then divided into three building periods, those built from 1870 to 1970, 1980s to 1990s and 2000s to 2010s (inclusive ranges).

The proportion of households that were built in each period is calculated for each of the CAUs and for New Zealand as a whole. The proportion of New Zealand houses built in each period can be seen in Table 4, with 60 per cent of all New Zealand households being built in the 1970s or earlier.

Table 4 Age of houses in the QV data set

	Unclassified	*1870s-1970s*	*1980s-1990s*	*2000-2010s*
Number of Households	37	806,020	318,165	218,621
Proportion of Households	0.003%	60%	24%	16%

The proportion of New Zealand houses built in the 1970s or earlier (60 per cent) is the threshold level for the age of housing stock factor. If the proportion of households that are built in the 1970s or earlier is greater in an individual CAU than for New Zealand as whole, then it is given a point towards the priority rating.

Age of householder factors

Under 10 years old

Census 2013 data on individuals includes the number of children that are nine years of age and under within a CAU.[26] In order to use this as a factor, the proportion of each CAUs population that is aged nine and under is calculated, as well as for the overall New Zealand population. The 2013 proportions are used to represent 2018. Using these calculations, the median percentage is calculated as being 13.6 per cent. If the percentage of the population that is under 10 years of age by any CAU is 10 per cent greater than the median, then it is given a point towards the priority rating.

65 years and over

The number of people within a CAU that are 65 and over is also sourced from the census 2013 data on individuals.[26] The methodology for this factor is the same as for the previous age factor. If the percentage of a CAUs population that is 65 years and over is 10 per cent greater than the median (13.1 per cent) then it is given a point towards the priority rating.

Priority rankings

- The CAUs and the households within them are allocated to a priority level depending on how many risk factors they demonstrate. The main focus in the body of the report is the 'priority one' households. In order for the households to be counted as a priority, they must first meet the energy cost greater than 10 per cent of income threshold. Each factor that is demonstrated is counted as one point then classified using the following scale:

- Priority one – Households in CAUs that score highly across the factors (four or five of the factor thresholds exceeded). This includes CAUs that are likely to include the most energy vulnerable households.

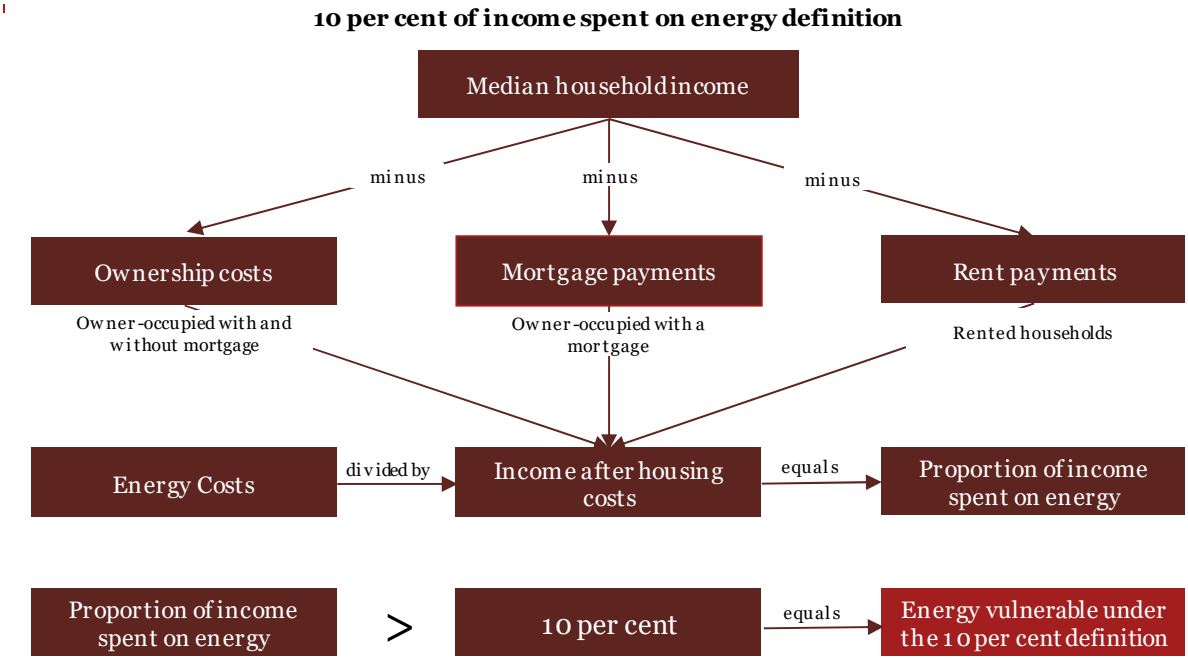
- Priority two – Households in CAUs that score moderately across the factors (three or more factor thresholds exceeded)

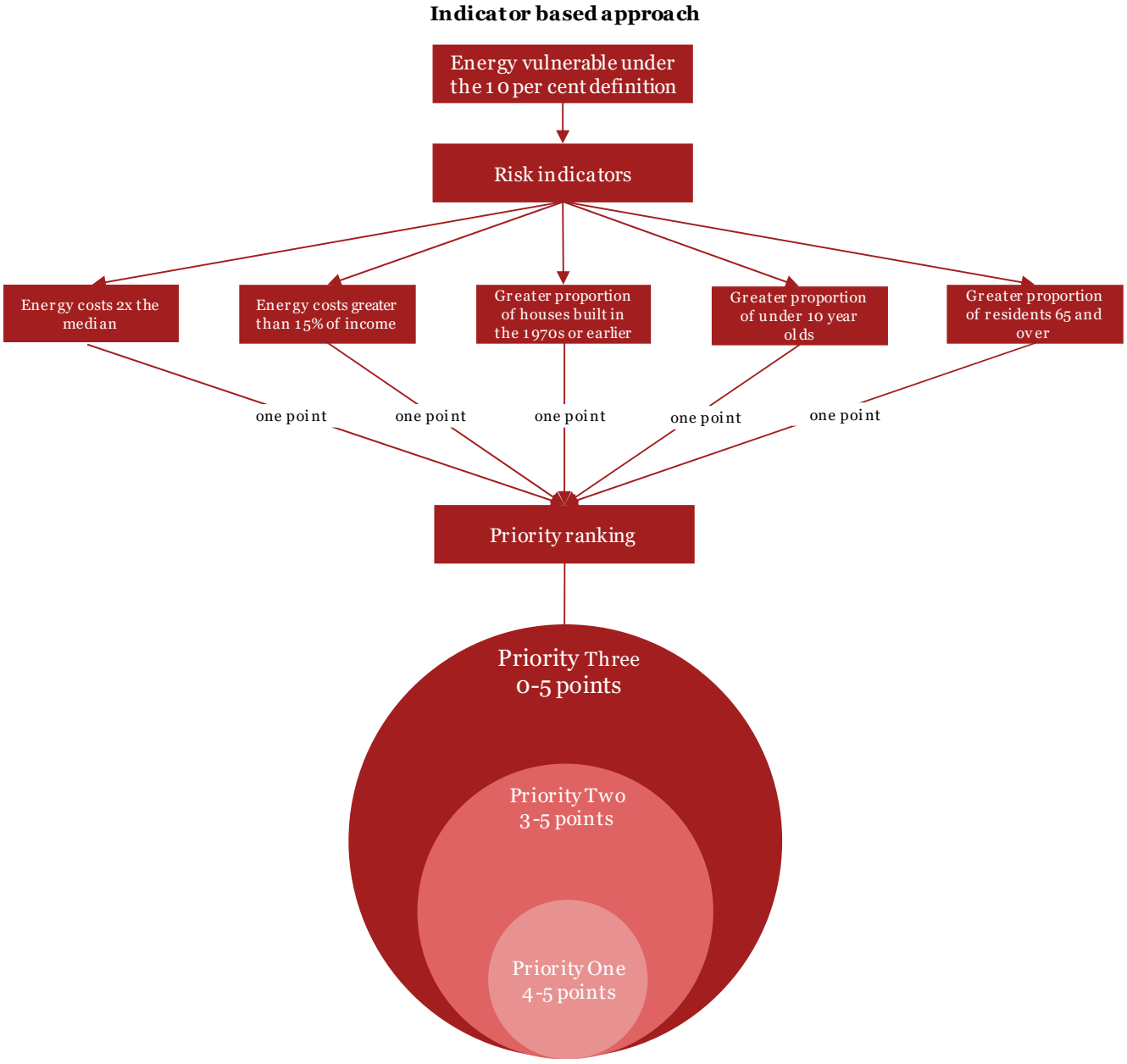
- Priority three – All households in CAUs that meet the 10 per cent definition. Households that are only in priority three and not two and one are those that meet 0-2 risk factors.

This approach considers additional factors that can amplify a household's energy vulnerability. The priority three group includes all those that meet the 10 per cent of income measure as a starting point. Priority one and two have narrower criteria and reduce the size of the energy vulnerability cohort to include those cohorts which have even higher risk of being energy vulnerable.

Figure 6 below illustrates the methodology for both the 10 per cent definition and the risk factor analysis.

Figure 6 Methodology for energy vulnerability definition calculation





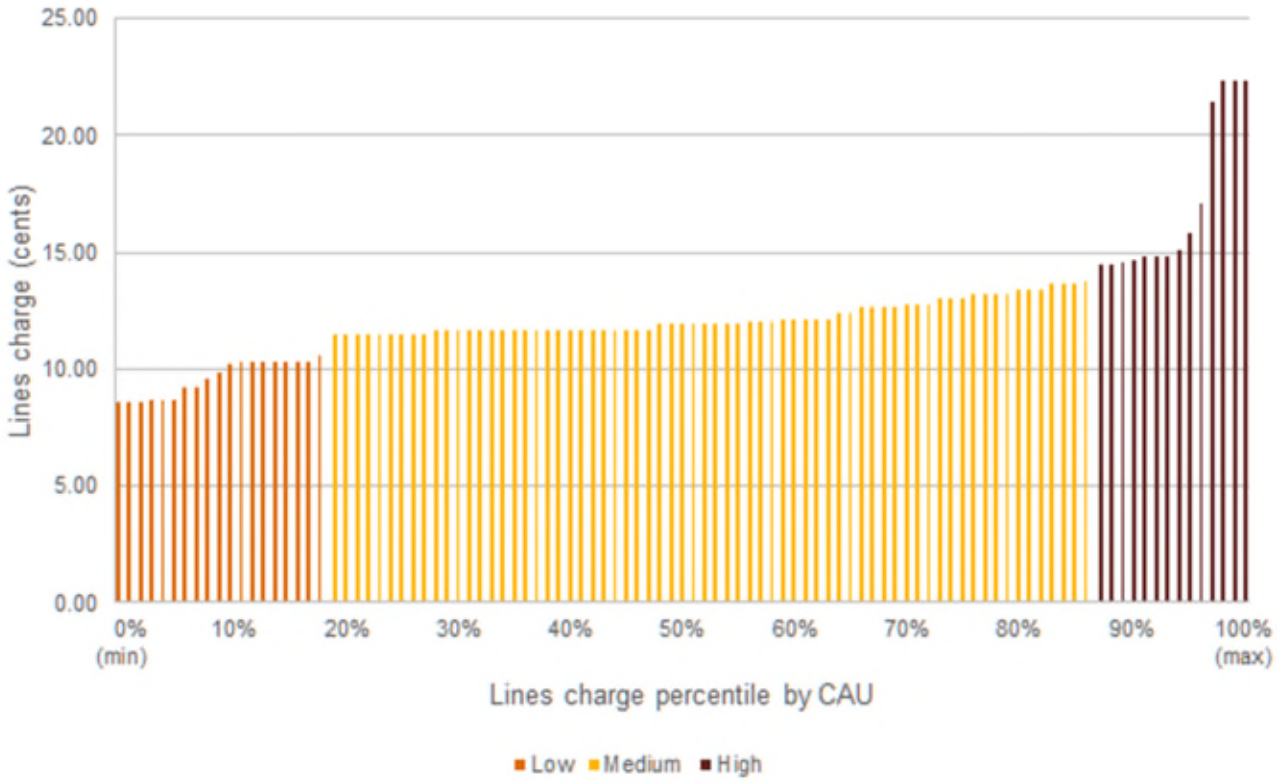
Lines Charges methodology

MBIE provides lines charge pricing data by meshblock. We averaged the lines charges across the meshblocks within a CAU to get each CAU's average lines charge. In addition to using the lines charges to calculate the proportion of income spent on energy, we completed a more in-depth analysis of the data. Lines charges vary across CAUs, with there being nearly a 15 cent difference between the CAU with the lowest lines charge and that with the highest line charge. This results in households within some CAUs being faced with a higher electricity cost compared to other households in CAUs where the lines charges are not as high. The lines charges per CAU were plotted on a chart in order to understand the spread of lines charges across CAUs. The CAUs were then classified into whether they are a faced with a Low, Medium or High lines charge as follows:

- High - lines charges that are over 14 cents per kWh
- Medium - lines charges between 11 and 14 cents (inclusive) per kWh
- Low - lines charges that are less than 11 cents per kWh.

Figure 7 below shows the CAU lines charges graphed by percentile, with the colours indicating the Low, Medium and High lines charge categorisations.

Figure 7 Lines charge categorisation



Appendix 3: Non-electricity energy cost discussion

Our primary analysis of energy vulnerable households looks exclusively at the amount of electricity used when determining the energy cost to income ratios. This ignores expenditure on other forms of energy. In New Zealand, a number of homes use alternative forms of energy to power and heat their homes, with the leading alternative being natural gas. We investigated including these other energy sources in the total energy costs for each region.

Usage and pricing data for alternative energy sources is required to expand the definition of total energy costs. We were able to identify data that could be used to roughly reflect regional mains and bottled gas usage, however reliable and useful data for other energy costs (eg diesel, solar, wood) could be not found. For this reason, for our core analysis has looked only at electricity but for a scenario analysis, the definition of total energy costs was expanded to include gas usage. This makes up a considerable portion of non-electricity usage and goes a reasonable way in aligning the total energy cost definition with actual total costs. In addition, having regional data would enable a distribution of costs that better reflected the actual geographically variable usage patterns.

Methodology

The 2016 Household Economic Survey (HES) provides an average weekly household expense attributable to gas energy costs. We can convert this figure to an annual expense, which gives the national average annual gas expense for the year ending June 2016. The result indicates that the average New Zealand household spent $145.60 on gas power for that year. Scaling this up to the total number of households in our analysis gives a total national spend of approximately $226m.

At this point, the total spend is in 2016 dollars and requires price adjustment to estimate the value for 2018. MBIE publishes national average pricing data for different sources of power. We used the change in the national average natural gas price (2016: 13.84c/kWh, 2017: 12.81c/kWh) of -7 per cent to deflate the total cost to 2018 dollars. Following the above steps, the total national spend on residential gas power is calculated as approximately $209m. This is then to be distributed among households that use gas power.

The 2013 Census includes a question pertaining to the availability of different heating sources for each dwelling in New Zealand. Unfortunately the data can only indicate whether or not a dwelling ever uses a particular heat source but does not provide any information about usage. This means, as an example, a household may have a gas heater installed but generally rely on an electric heat pump for heating. This level of detail is not captured in the Census data. However, we can make a broad assumption that all houses that report gas heating in the Census spend the same amount on gas. At an aggregate level, this allows us to apportion the total gas cost by region, using the prevalence of gas heating systems as a proxy for gas usage.

To incorporate regional variation in gas consumption, we counted the number of households in each CAU that indicated they ever used mains and/or bottled gas as a heat source. We then took this count as a percentage of the total households in New Zealand with these factors. The total national cost of $209m was then distributed to each CAU based on this percentage. The gas cost per CAU was then added to the existing electricity cost to give the total energy cost for each CAU.

Results

Incorporating the gas component into total energy costs increases the number of households that could be considered energy vulnerable, as the total amount of money spent on energy is increasing. The number of high-priority energy vulnerable households spending more than 10 per cent of their AHC income on energy increases from approximately 44,500 to 51,000 (a 13 per cent increase).

The methodology used to calculate these updated household counts rely on data that does not directly measure usage for a CAU, and so relies on a number of assumptions to estimate the total amount spent on gas. The assumptions required to estimate this figure, using the available data, lack the robustness necessary to enable the inclusion of the gas component in the formal analysis, therefore it has been kept separate from the core analysis.

Appendix 4: Restrictions

This Report has been prepared solely for the Electricity Retailers' Association of New Zealand for the purposes stated herein and should not be relied upon by any other party and for any other purpose. We accept no liability to any party should it be used for any purpose other than that for which it was prepared.

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The statements expressed herein have been made in good faith, and on the basis that all information relied upon is true and accurate in all material respects, and not misleading by reason of omission or otherwise.

The statements expressed in this report are based on information available as at the date of the report.

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We reserve the right, but will be under no obligation, to review or amend our Report, if any additional information, which was in existence on the date of this report, was not brought to our attention, or subsequently comes to light.

This Report is issued pursuant to the terms and conditions set out in the Contract for Services with Contact Energy Limited dated 30 August 2018.

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