Critically assessing energy hardship in Aotearoa New Zealand for strategising its eradication

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LUIZA FERNANDES BRABO

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Abstract

Energy hardship is a condition relating to the lack of energy access and affordability, with the latter being the most relevant aspect to New Zealand. It is estimated that hundreds of thousands of Kiwis are struggling with the condition, causing financial and health issues.

This doctoral thesis, with publications, uses transition management as the framework to guide the study towards answering the main research question: *What are the best interventions needed to eradicate energy hardship in Aotearoa?* The first step, (known as the strategic one, according to the transition management framework) was a systematic literature review conducted to understand the recent and relevant international literature on fuel poverty, energy poverty, and energy hardship, all terms that get used in the literature Additionally, semi-structured interviews were carried out with five energy experts in New Zealand to find patterns in their perspectives on the meaning of fuel poverty and energy hardship.

For the second step, tactical, sixteen people employed by sixteen organisations in Aotearoa participated in semi-structured interviews about their current interventions against energy hardship. The themes found in their responses were compared to the energy hardship framework proposed by the Ministry of Business, Innovation and Employment (MBIE) in 2021 to see if the interventions from the interviewed organisations were effective.

In the operational step, a quantitative study was divided into two parts: one survey with 773 customers from a low-cost electricity retailer (OurPower) in the Waikato region and another survey with 505 respondents in a nationally representative sample. Seventeen energy hardship indicators proposed by MBIE were used and correlated to household and dwelling characteristics and energy behaviours to understand better the causes and consequences of energy hardship in Aotearoa.

In the last step, reflexive, three follow-up surveys were conducted: one with organisations seeking feedback from their operations and plans, another with the nationally representative sample and the OurPower customers, which sought their opinions on survey rewards and other energy interventions they engaged in recently. All the follow-up surveys asked respondents about the role of each type of organisation (such as local government, national government, non-governmental organisations, and energy sector) in reducing energy hardship.

It was found that the best practices mostly related to reducing the energy bills of households. When linking the respondents' suggestions to the concept of energy democracy, it became clear that more democratic and decentralised decision making in the energy sector (e.g. community-owned infrastructure) can reduce energy costs, which is a priority for households. Increasing dwelling standards for insulation and overall energy efficiency and ensuring construction companies and landlords follow them is also of essential need. For Aotearoa to achieve energy wellbeing, we need to focus more on collaboration at the community level, not only the household level.

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This journey would not be possible without the constant support of my chief supervisor, Professor Eva Collins. She went above and beyond to guide me academically and guarantee that my mental, physical, and financial wellbeing were being taken care of during the process. I am genuinely forever grateful for that. I always feel inspired and energised after meeting with her, even after a tough and unproductive fortnight. I wish every PhD student had a supervisor like Eva! Now that this chapter is ending for me, I am very happy to consider her my friend.

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On a personal level, Alex deserves the most recognition for being my motivator during the best and worst times. It has not been an easy journey, and I acknowledge the sacrifices he made during this period for me to achieve this milestone. I will always be thankful for everything he has done. Now it is time for Alex and me to celebrate, and soon he will achieve the milestones he has been waiting for!

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Lastly, I am eternally grateful to my Aunt Anita and Uncle Joe for supporting my studies and needs for many years, and to my parents, Beth and Cleber, for raising me and loving me unconditionally.

Prologue

When I lived in Brazil, I never had to worry about the inability to obtain or afford energy services, as I was living comfortably with my parents in an urban area of São Paulo state. Still, blackouts occurred frequently in the country during my childhood, our rental house was draughty, there was no water heating system other than an electric showerhead, indoor temperatures were normally above 24 °C most of the year due to the lack of air conditioning, and they could get below 18 °C during winter because we also did not have a heater. Even though those conditions may sound really rough to people living in the Global North, our family was considered privileged for Brazilian standards.

Once I was living in the United States and no longer relying on my family to pay for the bills, things were different. The apartment I was able to afford in Florida was mouldy with extremely poor insulation and very humid. It had a central cooling and heating system, but it was inefficient and frequently broke down, raising the electricity bills and causing stress. The air conditioning had to be on virtually all the time because of the high temperatures in the region. However, I could not afford heating the few times of the year it was necessary. Even though I was already very aware of social issues and inequalities for a long time, living in those conditions as a master's student certainly further radicalised me.

Until then, my academic journey focused on researching biofuels and bioproducts from agro-industrial residues. However, I started becoming sceptical that climate change would be solved solely by technical and technological solutions, especially after seeing the increasing financial inequality worldwide and the connection with emissions. I was inspired by the works of the great radical minds of Dr Sabrina Fernandes and Dr Michael Löwy, and I wanted to connect my knowledge of energy and sustainability in general with social issues.

In December 2019, I was done with my master's. I emailed Eva to see if she would be interested in being my supervisor, which she luckily agreed to. At that point, I was thinking about focusing on the Waikato Wellbeing Project (especially about improving energy hardship in the Waikato region of Aotearoa New Zealand), but Eva and I eventually decided that looking into energy wellbeing projects nationally would be more exciting and useful.

By the time I was accepted into the programme, the COVID-19 pandemic had started, and the New Zealand borders were closed. Still, I decided to initiate my doctoral programme from a distance on 01 May 2020, International Workers' Day, and my grandmother Adelaide's birthday. At the beginning of my PhD, I was being super productive with all the time in the world provided by the lockdown, hyper-focusing on my research. But the death of two dear family members, financial difficulties, and extreme isolation exacerbated my mental health issues. I was tremendously depressed by the end of 2020 like I had never been. And for the first time, I understood what it was like to be a procrastinator. I am so grateful to Eva for being incredibly understanding and helping me get the mental health support I needed to finally feel better and defend my doctoral proposal. Around that time, I received my autism diagnosis, an incredible milestone in my life that helped me better understand myself.

Once my proposal was accepted, I started getting into the practical part of my study. I conducted a series of successful interviews and surveys with over a thousand Kiwis respondents before ever setting foot in Aotearoa. Even though I wanted to be in the country as soon as possible, I am very proud of my achievements, especially considering the difficult circumstances. Most importantly, I participated in meetings, workshops, and diverse events related to energy hardship minimisation in New Zealand since the beginning of my programme, and I genuinely felt like my opinions and research findings were valuable.

In August 2022, I was finally able to arrive in New Zealand. It has been truly amazing to be here in person to engage with organisations striving to achieve energy wellbeing and to finish my doctorate. I am very much looking forward to doing the best I can to improve the lives of Kiwis regarding their energy usage and wellbeing. This PhD journey gave me the skills and connections I need to facilitate this goal, and I am very thankful for it.

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Acronyms and abbreviations

- AFCP: After fuel costs poverty
- AHC: After housing costs
- ANOVA: Analysis of variance
- BHC: Before housing costs
- CI: Confidence interval
- EECA: Energy Efficiency and Conservation Authority
- EHEC: Energy Hardship Evaluation Consortium (posteriorly: Energy Wellbeing Evaluation Consortium)
- EHPS: Energy hardship point score
- ERANZ: Electricity Retailers' Association of New Zealand
- EU: European Union
- EU-SILC: European Union Statistics on Income and Living Conditions
- EV: Electric vehicle
- HHI: Healthy Homes Initiative
- kW·h: Kilowatt hour
- LED: Light-emitting diode
- LIHC: Low income high costs
- LILEE: Low income low energy efficiency
- MBIE: Ministry of Business, Innovation and Employment
- MIS: Minimum income standard
- NGO: Non-governmental organisation
- NZ: New Zealand
- NZD: New Zealand Dollar

- PC: Politically correct
- SD: Standard deviation
- SDG: Sustainable Development Goal
- UK: United Kingdom
- USA: United States of America
- USD: United States Dollar
- WKH: Warmer Kiwi Homes
- WMS: Waikato Management School

Chapter One – Introduction

Background

In 2015, the United Nations developed the Sustainable Development Goals (SDGs) to holistically address different aspects of sustainability, with 169 targets and 232 indicators to be achieved by 2030 (Ritchie et al., 2018). They are designed not only for global leadership and top policymakers - but also for researchers, educators, businesses, and the general public, as there is an emphasis on the need for partnerships and mutual co-operation (Ritchie et al., 2018).

The seventh SDG is to "[e]nsure access to affordable, reliable, sustainable and modern energy for all" (United Nations, 2021, p. 40) Even though it can serve as an international guideline towards the transition to renewables and greater access to energy services, experts criticised the SDGs as having broad and oversimplified goals, lack specificity regarding which actions should be taken, as well as not defining how they are going to be measured or who is responsible for implementing and monitoring the changes (Mair et al., 2018; Swain, 2018).

The United Nations has historically been connected to energy initiatives that were set to reduce carbon emissions and mitigate climate change, such as the construction of large hydropower dams in the Global South, but in a form that can be considered *carbon colonialism* (Erlewein, 2014). The North "offsets" its emissions (from its high levels of consumption) by creating low-carbon energy infrastructure in the South, resulting "in the exacerbation of one of the most problematic aspects of global warming: the asymmetries of causation and burden-sharing" (Erlewein, 2014, p. 149).

The United Nations has supported neoliberal approaches to *development*, including *sustainable development* approaches to energy transition. However, these tactics have led to

increased external debt and privatisation in the periphery of capitalism, resulting in austerity measures and financial hardship and higher energy tariffs that disproportionately affect vulnerable populations and worsen energy affordability issues (Kumi et al., 2013; Smith-Nonini, 2020; Vicente, 2007).

The concept of *fuel poverty* refers to the difficulty in being able to afford energy. *Energy poverty* can be a synonym (especially in the European Union), but it can also mean the inability to access energy (van de Graaf et al., 2016). Even though these concepts can be dissimilar in their contexts and may require different approaches for policymaking, both terms represent people not being able to have their basic domestic energy needs met (Li et al., 2014).

In the late 1980s, Brenda Boardman wrote a thesis defining fuel poverty as households spending over 10% of their income to keep their home sufficiently warm (Boardman, 1988; Stats NZ, 2017). Her book based on those studies, *Fuel poverty: from cold homes to affordable warmth*, highlights that the "inability to afford adequate warm [is] because of the energy inefficiency of the home" (Boardman, 1991, p. 219). Boardman considered how much a household *should* be spending on heating based on variables such as the size of the dwelling, and not how much it was actually spending (Boardman, 1991).

According to the World Health Organization, sufficiently warm means 21 °C in the living room and 18 °C in other occupied rooms (World Health Organization, 2007). Homes with inadequate infrastructure (including insulation and airtightness) and insufficient heating can result in frequent periods of low indoor temperatures (below 18 °C), associated with several health issues, such as cardiovascular and respiratory morbidity and mortality (World Health Organization, 2018). On the other hand, higher temperatures (above 24 °C), related to heat waves, have multiple health implications as well, including the intensification of pre-

existing medical conditions in children, such as kidney issues and diabetes mellitus (O'Sullivan & Chisholm, 2020; World Health Organization, 2018).

The definition of fuel poverty is contested because the metrics used in the founding definition (the 10% threshold) were focused on quantitative data on energy consumption and income (Baker et al., 2018). Baker et al. (2018), explained that this perspective is reflected by the initiatives which emphasise the reduction in energy consumption rather than seeing fuel poverty as a systemic problem with multiple social aspects associated with low incomes, high fuel costs, poor housing quality, building energy performance, debt, mental health, poor heating regime, poor indoor quality, poor physical health, and poor educational attainment. The authors argued that the goal should not only be to remove households from fuel poverty but to understand the related issues and risks beyond technical and economic perspectives to develop policies and interventions aimed at its prevention (Baker et al., 2018).

The context of energy unaffordability in New Zealand is discussed next, followed by the research questions, research paradigm, and theories used. Then, the thesis layout containing the research gaps is presented, finalised by the methods.

Context

In 2021, 82.1% of all electricity produced in Aotearoa New Zealand came from renewable sources, an increase from the previous year (Ministry of Business Innovation & Employment, 2022b). The country has a great renewable portfolio and several plans for cleaner production (i.e. electrifying the economy) (New Zealand Government, 2019b). The adoption of advanced renewable energy technologies is crucial for avoiding the climate catastrophe, however, without being aligned with social change, many people will still be deprived of their benefits and are disproportionally affected by externalities (Angel, 2016; Fairchild & Weinrub, 2017).

In Aotearoa, while virtually 100% of the population already has access to electricity (IEA et al., 2022), this data expresses physical access, not necessarily affordability, use of modern technology or reliability of the supply. In 2019, the Electricity Price Review report stated:

> More than 100,000 households are spending more than 10 per cent of their income on power [in the country]. By many definitions, that puts them in energy hardship. The signs of hardship are not difficult to find: cold, unhealthy homes, poorer health for occupants, scrimping on other essentials, and a greater likelihood of disconnection for non-payment of power bills. Worryingly, children are over-represented in households experiencing energy hardship.
>
> The causes include low household income, high energy needs, low awareness of tariff and payment options, inferior housing, and poor-quality heating and insulation. The solutions, like the causes, are to be found both within and beyond the electricity sector. Many of those in energy hardship receive some form of help, but it is neither enough nor sufficiently integrated (New Zealand Government, 2019a, p. 18).

In 2007, 44-year-old Folole Muliaga was using an electrically powered oxygen machine and passed away 2.5 hours after her electricity supply was disconnected due to the non-payment of a 168.40 NZD bill (O'Sullivan et al., 2012). Her tragic death had enormous media repercussions. However, a significant part of the coverage on the topic did not focus on the issue of energy unaffordability and its connectedness with other serious issues resulting from systemic poverty (O'Sullivan et al., 2012). Instead, there was strong victim-blaming, including fat-shaming (for Muliaga's health conditions), xenophobia (for being an immigrant and welfare-dependent), religious intolerance (for having given tithe to her church), and racism (for being Pasifika) (O'Sullivan et al., 2012).

A similar situation regarding the lack of understanding of the connection between the energy context and socioeconomic conditions can be observed in the case of the death of 5-month-old Roretana Holland in 2010 (Laugesen, 2011) as he:

> was found dead in the bed he was sharing with his four-year-old sister, at his parents' home […] The coroner for the case, Ian Smith, warned once more about the dangers of cot death when sleeping arrangements are shared. Social deprivation, smoking in the household and excessive alcohol consumption were all there. But one part of the deprivation picture the coroner didn't mention was why the children were sleeping together in the first place. The four children shared a bedroom because the family had only a single oil heater to keep warm (para. 1).

In 1999, 9-month-old Anthony Reihana Hoani died from asphyxiation caused by fire, as his family was using candles for three days since their electricity got disconnected due to a 297 NZD outstanding balance (New Zealand Press Association, 2000). These three tragic cases illustrate that Aotearoa's most vulnerable population have been dangerously struggling with being unable to afford energy expenses for decades.

Mrs Muliaga's death transformed the discussions regarding disconnections in New Zealand. The trend of domestic disconnections due to non-payment had an increase in disconnection rates caused by the retailers' tentative to reduce the increasing debt generated by non-payment after her passing in 2007 until 2014 (Electricity Authority, 2020). Then, there was a reduction in the number of disconnections as a consequence of "previous adverse publicity about rising disconnection rates and in response to a request from the Minister of Energy and Resources to retailers to review their processes for dealing with indebted customers" (Electricity Authority, 2020).

The Consumer Care Guidelines (effective from 2021), developed by the Electricity Authority, established that consumers who are medically dependent need to be identified not to be disconnected due to non-payment (Electricity Authority, 2021). In the same year, the Ministry of Business, Innovation and Employment (MBIE) released a document containing a framework that describes different facets of *energy hardship* in the country, as well as proposing a definition and indicators of the condition. After receiving feedback from a range of groups, energy hardship was established to be the opposite side of the spectrum of energy wellbeing, with it being officially defined as "[w]hen individuals, households and whānau are able to obtain and afford adequate energy services to support their wellbeing in their home or kāinga" (Ministry of Business Innovation & Employment, 2022a). This definition was the one adopted by this research.

There are energy efficiency programmes and other government assistance for alleviating energy hardship in New Zealand, including the Warmer Kiwi Homes (subsidy for insulation and heaters) and the Winter Energy Payment (additional payment to be used for heating during winter, given to those who receive government support) (Energy Efficiency and Conservation Authority, 2023; Work and Income NZ, 2023). In the first quarter of 2023, 8,715 electricity and gas hardship assistances were granted by the Ministry of Social Development, equivalent to 3,578,820 NZD (Ministry of Social Development, 2023). The five-year trend of electricity and gas hardship assistance granted per quarter and their total cost peaked in September 2019 (Ministry of Social Development, 2023).

Even though these programmes and assistance are crucial, they have not been sufficient to eliminate energy hardship in Aotearoa. In the country, old housing has been linked to energy inefficiency due to inadequate insulation (Lloyd, 2006), meaning they require higher energy consumption because of their poor ability to maintain indoor temperatures. All homes built after 1978 had to follow thermal building standards, including

mandatory insulation (Lloyd, 2006). Additionally, the 2008 changes in the building code resulted in new homes being 30% cheaper to heat due to the even higher insulation standards and mandatory double-glazing for windows (Laugesen, 2011). However, those changes are only benefitting those who are moving to a new dwelling, in addition to the fact that low-income households are typically renting (with an over-representation of children and the elderly in this type of accommodation), and they are less likely to use government subsidies to improve energy efficiency in the property they do not own (Barton, 2014; Laugesen, 2011; McKague et al., 2016).

Considering the complex and intersectional nature of energy hardship in Aotearoa and its interventions, the research questions asked by this study are presented next.

Research questions

The main research question of this study is *What are the best interventions needed to eradicate energy hardship in Aotearoa?* Furthermore, four sub questions were developed for the New Zealand context:

- *How does the MBIE concept of energy hardship compare to its international counterparts?*
- *What types of interventions exist to minimise energy hardship?*
- *What is the demographic of households in energy hardship?*
- *What socioeconomic issues relate to energy hardship?*

Research paradigm

Research paradigms can be defined as providing "the world of views that defines the nature of the world as well as the range of possibilities for its holders in relation to reality," meaning they present ontological, epistemological, and methodological facets (Asghar, 2013, p. 3121). The first one relates to the interpretation of reality, the second regards the

development of knowledge and its limitations, and the third one connects to the chosen methods and analyses (Asghar, 2013). According to DeCarlo (2018):

> [T]he critical paradigm posits that social science can never be truly objective or value-free. Further, this paradigm operates from the perspective that scientific investigation should be conducted with the express goal of social change in mind. Researchers in the critical paradigm might start with the knowledge that systems are biased against, for example, women or ethnic minorities. Moreover, their research projects are designed not only to collect data, but also change the participants in the research as well as the systems being studied. The critical paradigm not only studies power imbalances but seeks to change those power imbalances. (p. 147)

Critical theory, the one used in this study, has its roots in Western European Marxism and emerged with social movements, being defined by Bohman et al. (2019) as a theory which seeks to emancipate and liberate humans, explaining and transforming their realities by providing "the descriptive and normative bases for social inquiry aimed at decreasing domination and increasing freedom in all their forms" (para. 1). To be considered critical theory, it must 1) explain what is wrong in the current social reality, 2) characterise the transformative action, and 3) specify clear norms for criticism and change – meaning that critical theory emphasises the application of strategies for social transformation (Asghar, 2013).

The difference between traditional theory and critical theory is that the former represents the status quo and tries to understand the whole by summing the parts, whereas the latter sees tensions and contradictions as a consequence of the complex processes of interactions while seeking to emancipate human beings from conditions which enslave them (Bohman et al., 2019; González et al., 2001). Critical theory was also said to be "an essential

element in the historical effort to create a world which satisfies the needs and powers of men" (Horkheimer, 2002, p. 246), which relates to Engels and Marx's Thesis Eleven on Feuerbach, as "[t]he philosophers have only interpreted the world, in various ways; the point, however, is to change it" (Engels & Marx, 1976, p. 65).

From a critical perspective, injustice, exploitation, violence, and oppression are the obstacles that dehumanise people and prevent them from achieving freedom (Freire, 2005). As for oppression, it can be defined by Gruba-McCallister (2014) as a state and a process:

> The state is the result of victims of oppression being denied resources due to deprivation, exclusion, discrimination, and exploitation. The processes involved in oppression are institutionalized modes of behavior performed by individuals or groups who seek to dominate or control others in order to secure some advantage. (p. 1290)

Critical theory has a materialist ontology, with Stack (1998) affirming that according to materialism, "all entities and processes are composed of – or are reducible to – matter, material forces or physical processes. All events and facts are explainable, actually or in principle, in terms of body, material objects or dynamic material changes or movements" (para. 1). This means that this study will interpret reality as being caused only by material circumstances (such as energy hardship being result of material dynamics).

When using a critical paradigm, "[s]ubjectivist epistemologies and methodologies are also employed. Empirical material and theoretical arguments are evaluated in term of emancipatory implication" (Asghar, 2013, p. 3123). Subjectivism means that the interpretation of reality will be dependent on the researcher's perspective since she cannot be totally objective when creating a theory, as it simplifies the complexity of the data (Levers, 2013).

Social constructivism is a perspective which views that knowledge is a construction resulting from human interactions (McKinley, 2015). Even though critical theory shares a lot of similarities with a social constructivist paradigm, such as seeing the control of the research as a means for achieving emancipation and democracy, "[t]he aim of inquiry for critical theory involves social transformation and emancipation through critique, whereas, for constructivism, even though a normative dimension exists, the main objective involves understanding through reconstruction" (Howell, 2016, p. 31).

As critical theory deals with situations of power, its social aspect is essential for emancipatory change, which prioritises qualitative methods and mixed-method approaches (Asghar, 2013). The next section specifies the theories used, and how they relate to the methods.

Theory

Transition management is a policy-oriented framework chosen for this study, which characterises the "conscious effort to guide such transitions along desirable pathways", implementing changes by connecting multiple actors and working in a more democratic and flexible framework (Meadowcroft, 2009, p. 324). This framework encourages the diversity of opinions and testing different innovations and approaches to learn their potential and boundaries and aligns with the critical theory paradigm outlined above (Köhler et al., 2019; Meadowcroft, 2009).

Transition management involves the interconnection of multiple social and technical aspects of systems (in this case, energy) in order to steer long-term transformative change (Markard et al., 2012). This model was chosen due to the active engagement with the actors throughout the process, its flexibility, which allows the ability to re-direct future actions by collectively reflecting on the outcome of previous activities, as well as its normative aspect,

such as the opportunity of working with actors who are involved in ongoing initiatives and developing policies to eliminate energy hardship in the country, in addition to creating boundaries to protect the affected population and avoid the re-creation of the causal circumstances (Wittmayer et al., 2014). The transition management steps utilised in this research are detailed in the Methods section.

Additionally, energy democracy was also used in this study. This concept is based on three main goals for the energy sector: *resist* the current reliance on fossil fuels and corporate control, *reclaim* the democratic control that was lost due to privatisation, and to *restructure* the system by transitioning completely to renewables while ensuring social justice through job creation and universal access to energy (Angel, 2016; Burke & Stephens, 2017; Sweeney, 2012). This perspective, again aligned with the critical theory paradigm, is sceptical that technical and technological advancements alone can solve social and environmental issues related to energy (Fairchild & Weinrub, 2017). Instead, energy democracy is based on grassroot activism, partnerships, and other forms of direct participation (Fairchild & Weinrub, 2017).

In this research, energy democracy served as guidelines to propose non-reformist reforms to achieve energy wellbeing in Aotearoa based on the suggestions of Kiwi households and organisations working to minimise energy hardship in the country. The Methods section contains more on this.

The combination of a) critical paradigm with b) transition management framework and c) energy democracy concept was chosen for this work as a) critically understands a social issue (energy hardship) and develops strategies to improve it (Asghar, 2013), while b) relates to how these strategies can be applied (trying and learning) (Meadowcroft, 2009), and

c) explains what type of strategies can be used and what their goals are (resist, reclaim, and restructure) (Sweeney, 2012).

Thesis layout

This document is a doctoral thesis with publications. The thesis is structured as follows:

Chapter Two is a manuscript entitled, *Key Fuel Poverty Indicators and Variables: A Systematic Literature Review*, which compares indicators, definitions, and relevant themes on fuel poverty, energy poverty, and energy hardship. The observed gap was that publications comparing indicators and variables did not assess their frequency and trends. In addition, the systematic literature reviews did not consider important themes associated with energy unaffordability, such as home tenure, presence of children or elderly household members, health conditions, and food issues.

Chapter Three is a manuscript entitled, *Fuel Poverty or Energy Hardship? Analysing the literature, the proposed official definition, and the views of experts in Aotearoa New Zealand*, associating the concept of fuel poverty with the newly defined energy hardship by interviews, major literature sources, and the MBIE proposal document. In May 2020, when this study started, there was no consensus on the term used in Aotearoa (*energy hardship, fuel poverty,* or others), much less on how to officially define and measure the condition related to lack of energy affordability and access in the country. By the time Chapter Three was being developed, MBIE had already released its proposal document (Ministry of Business Innovation & Employment, 2021). The focus of the research pivoted to compare the differences between the new official definition and measures to ones used internationally, which had not been done previously.

Chapter Four is a manuscript named *Trends in Current Energy Wellbeing Interventions in Aotearoa New Zealand and the Energy Hardship Conceptual Framework.* It contains interviews about interventions on energy hardship minimisation interventions by sixteen employees of organisations and how they relate to the MBIE energy hardship framework. The gap explored in this chapter is the MBIE proposal, which did not include strategies for overcoming energy hardship. The knowledge of existing energy hardship mitigation projects and their operations and partnerships was limited, as well as their perspectives on energy hardship.

Chapter Five is a manuscript entitled, *The heat goes on: Simplifying the identification of energy hardship*. It contains the original surveys with OurPower customers and a nationally representative sample about their demographics and energy usage being associated with the MBIE energy hardship indicators. The examined gap was identifying those socioeconomic and demographic patterns for Kiwi households that were included in the MBIE indicators. Even though there is extensive literature on patterns for fuel and energy poverty, there were no studies specific for energy hardship using the MBIE indicators, considering their recentness.

Chapter Six is a manuscript entitled, *Empowering: Aiming for Energy Wellbeing and Democracy*. This last manuscript contains the findings of the OurPower and nationally representative follow-up surveys, in addition to the feedback survey from organisations, presenting the best practices found in energy hardship minimisation interventions, and making proposals for energy democracy and wellbeing in Aotearoa. The gap investigated in Chapter Six is the link between the New Zealand definition of energy wellbeing to the concept of energy democracy. This was used to propose interventions to eradicate energy hardship in the country, prioritising environmental and social issues.

Finally, Chapter Seven, the conclusion, details how the research questions are answered. The best practices and further suggested interventions for eradicating energy hardship in Aotearoa are highlighted. The theoretical and practical research contributions are discussed, as well as future research possibilities.

Methods

In this section, the methods employed in each manuscript are discussed according to the transition management framework. The components of the steps of transition management described by van de Kerkhof and Wieczorek (2005, p. 736) are shown below, with a summary on how they were developed in this research:

"(1) Organisation of a multiactor network (transition arena): problem definition; identification of stakeholders; establishment of preconditions for operation of the arena; definition of transition themes."

The first step is known as the strategic one (Loorbach, 2010). Chapter Two relates to the problem definition and definition of transition themes. A systematic literature review was performed by searching for definitions and indicators of fuel poverty, energy poverty, and energy hardship, only considering publications on energy affordability issues. The indicators and variables in the publications were identified and categorised, as well as their country of study, equivalisation of income, and use of actual or required energy expenditure. NVivo was used to find the presence of themes, such as home tenure, the presence of household members who are children or elderly, and food issues.

All the components of the first step were addressed by Chapter Three. Semi-structured interviews were carried out with five experts on energy unaffordability in Aotearoa with diverse backgrounds to compare their opinions and views on energy hardship *versus* fuel

poverty, relating them to the MBIE proposal and the literature. Questions included their perspectives on defining and measuring the issue, its causes, and associated conditions.

"(2) Development of sustainability visions: establishment and discussion of a common, long-term view and of differences in perception of the problem involved."

The second step of the transition management is also called the tactical step (Loorbach, 2010), which is covered in Chapter Four. Semi-structured interviews were carried out with sixteen Kiwi organisations having energy hardship minimisation programmes to identify patterns in their operations, perspectives, and gaps related to the MBIE energy hardship framework. Questions included the purpose for eradicating energy hardship, the goals of their projects, and their views on energy wellbeing.

"(3) Exploration of transition pathways (scenarios) through experiments and joint actions; development and implementation of effective instruments."

The strategic step is the third step (Loorbach, 2010). In Chapter Five, two surveys were conducted. One was with 773 customers of a social electricity retailer, OurPower, in the Waikato region. Another was with 505 respondents from a nationally representative sample. Both surveys contained virtually the same questions to understand their demographic and energy consumption, using the MBIE indicators to measure the severity of energy hardship. The surveys were conducted via Qualtrics, as well as the quantitative statistical analysis to relate the energy hardship indicators to other variables and simplify the identification of energy hardship.

OurPower respondents could enter a draw to win one month of free electricity as survey rewards, with five winners being selected. Through partnerships with organisations in Northland, Auckland, and Canterbury, respondents of the national survey who had five or more indicators could also obtain rewards. Those included energy advice, information on

energy efficiency services and eligibility for subsidies, and energy-related items, depending on the region and organisation.

"(4) Evaluation, learning and monitoring of the progress, intermediate goals, and learning effects; adjustment of the agenda and visions; preparation to the next transition round."

The final step of the transition management is known as the reflexive one (Loorbach, 2010). For Chapter Six, respondents of the OurPower and national survey were sent nearly identical follow-up surveys. Only 105 of the original OurPower survey and 69 of the original national survey responded to them. The questions included feedback on survey rewards, energy interventions the household was engaged since the previous survey, and suggestions on energy hardship minimisation interventions.

Additionally, a feedback survey was available to Kiwi organisations having energy hardship minimisation programmes. Interviewees of Chapter Four were invited to respond, as well as organisations that provided energy-related rewards in Chapter Five. Additionally, the survey was promoted by Energy Wellbeing Evaluation Consortium and during the 16th Otago Energy Research Centre Symposium. The feedback survey had sixteen respondents from the government, social businesses, non-governmental organisations, and energy companies. This survey asked respondents about the outcomes of their programmes and actions, as well as suggestions on energy hardship minimisation interventions.

All three surveys were conducted via Qualtrics, having quantitative and qualitative analyses. The best practices for minimising energy hardship were found, and the suggestions on interventions described by respondents were linked to the concept of energy democracy to propose radical solutions towards energy wellbeing in Aotearoa

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Chapter Two – Key Fuel Poverty Indicators and Variables: A Systematic Literature Review

Abstract

Fuel poverty is a condition associated with the inability to afford sufficient energy services in a home, especially heating. There is no single standardised process for defining or measuring fuel poverty. Each different method used in research or policy presents biases, resulting in different numbers of affected households with implications for interventions. This systematic literature review aims to summarise the patterns and trends in the indicators and variables of fuel poverty found in relevant publications, as well as the prevalence of associated issues. This study analysed the strengths and weaknesses of the key indicators and variables, showing their biases and opportunities for improvement. The eighty-four publications analysed were selected according to the most relevant results found on Google Scholar searching for definitions and indicators of fuel poverty/energy poverty/energy hardship. The prevalence of relevant themes was identified using NVivo. Understanding the background and the strengths and weaknesses of common indicators and variables of fuel poverty can help develop efficient and effective policies and interventions.

Introduction

Fuel poverty results from issues such as high energy prices, low wages, poor housing quality, and the use of old appliances (Boardman, 2013), and improving those issues is essential to protect vulnerable households (Chawla & Pollitt, 2013). In addition, fuel poverty can cause severe impacts on the affected households, including financial stress and damage to their physical and mental health (Baker et al., 2018). Unfortunately, there are no unified indicators or variables to measure fuel poverty (Barrella et al., 2021), and the chosen methods mainly depend on policy purposes and political processes (Boardman, 2013).

The literature on fuel poverty has many case studies, and novel metrics (Besagni & Borgarello, 2019; März, 2018; Pino-Mejías et al., 2018). Publications comparing indicators and variables do not assess their frequency and trends. Thus this study aimed to fill this gap. To the authors' knowledge, this is the first systematic literature review focused not only on the indicators, but also of household characteristics related to the issue of fuel poverty: home tenure, presence of household members who are children or elderly, associated health conditions, and food issues. A couple of articles published in 2021 discussed indicators and variables (Siksnelyte-Butkiene, 2021; Siksnelyte-Butkiene et al., 2021). However, they explore fuel and energy poverty and focus on composite variables and indexes.

This systematic literature review aims to present trends on how fuel poverty is defined and measured by specific variables and associated issues. The research questions for this study are: Which countries/regions lead the literature in fuel poverty? What are the predominant fuel poverty variables, and how do they relate to the perception of the issue? In our study, the trends observed can assist policymakers and researchers in comparing and selecting the indicators and variables focused on their particular priorities.

Methods

Search and selection criteria

A systematic literature review is a type of publication with specific and replicable criteria for selecting the pool of publications to be analysed to discuss the themes and patterns found in them (Levenda et al., 2021). The database used for this study was Google Scholar, and the following searches were performed in February 2023:

- *Fuel poverty definition* (about 807,000 results),
- *Fuel poverty indicator* (about 375,000 results),
- *Energy poverty definition* (about 2,780,000 results),

- *Energy poverty indicator* (about 1,130,000 results),
- *Energy hardship definition* (about 184,000 results), and
- *Energy hardship indicator* (about 83,500 results).

All the searches were sorted by relevance. Only the first twenty results of each search were selected, including grey literature. Several of the same results were shown using different search criteria. Removing duplicates and results not focused on energy affordability issues resulted in eighty-four publications (Appendix A).

Fuel poverty is the term created in the United Kingdom to refer to energy affordability issues from heating a dwelling, but it evolved beyond heating needs (Boardman, 2013). *Energy poverty* (mostly used in the European Union) can refer to fuel poverty, and it is a term that also relates to the struggles of less industrialised countries and their lack of modern energy infrastructure (Li et al., 2014), the latter not being within the scope of this study. *Energy hardship* was included as it is officially used in New Zealand to refer to the lack of obtaining and affording energy services (Brabo-Catala et al., 2022; Ministry of Business Innovation & Employment, 2022a).

Analysis

The selected articles were analysed to identify and categorise the fuel poverty indicators and variables used, as well as identifying the country of study, equivalisation of income, and use of actual or required energy expenditure. Materials without original research content (without actually calculating fuel poverty) had their indicators and variables selected according to the ones discussed in the text. Manuscripts that used an official indicator of fuel poverty were assumed to follow their specific guidelines.

The type of indicator used can be exactly as the reference mentioned (meaning that the authors calculated fuel poverty using the existing official protocol) or based on the

reference (meaning some minor modifications in variables but still strongly connected to the reference). A few articles use novel indicators, not falling into any selected types discussed in this paper. Additionally, most publications used more than one indicator to compare the results. This study focused on eight main types of indicators of fuel poverty:

- 10% - Essentially meaning that fuel poor households are those with energy expenditure above the threshold of 10% of their income (Boardman, 1991).
- 2x Mean - Fuel poor households are those with a share of energy expenses over income of at least two times the mean energy expenditure (Isherwood & Hancock, 1979).
- 2x Median - Fuel poor households are those with a share of energy expenses over income of at least two times the median energy expenditure (Isherwood & Hancock, 1979).
- Median/2 - Fuel poor households are those with a share of energy expenses over income of less than half the median energy expenditure (Rademaekers et al., 2016).
- After Fuel Costs Poverty (AFCP) - The main idea being that fuel poor households are those that fall below the poverty line after energy expenditure (Hills, 2011).
- Low Income High Costs (LIHC) - Can be summarised as fuel poor households being those with above-median energy expenditure and fall below the poverty line after that expense (Hills, 2012).
- Minimum Income Standard (MIS) - Can be shortened as fuel poor households being those that cannot afford energy expenditure after paying for other established basic expenses (Moore, 2012).

- Subjective - Fuel poor households are those that report being unable to pay their utility bills, having inadequate heating systems at home, or other subjective parameters relating to fuel poverty, often mixed with self-reported objective variables relating to housing quality (Healy & Clinch, 2002).

Authors considered the following variables selected for analysis to be relevant for measuring fuel poverty and discussing associated issues, and they are used for determining not only the prevalence of fuel poverty itself but also its risk. It is uncommon to define fuel poverty using a single variable. The variables selected for the analysis are:

- Ability to maintain home warm (subjective),
- Age of dwelling (objective),
- Age of household members (objective),
- Arrears on energy or other utility bills (subjective),
- Damp walls, floor, or foundation (objective),
- Dwelling type (objective),
- Employment status (objective),
- Fuel prices (objective),
- Income (objective),
- Leaking roof (objective),
- Rot on window frames or floor (objective),
- Size of dwelling (objective),
- Size of household (objective), and
- Tenure (objective).

Equivalisation means adjusting the income according to a household's composition (Hills, 2012). It was chosen as a category of analysis since the debate in the literature about whether income should be proportional to the number of household members as equivalising

or not presents biases on the number of households in fuel poverty as well as which groups are considered a priority for policies (Boardman, 2013). Additionally, some publications use both equivalised and unequivalised income for their calculations and discussions.

Actual or required energy expenditure was another category of analysis, as some manuscripts define fuel poverty using the household's actual expenses. In contrast, others use the required (estimated) energy costs according to characteristics such as their demographic conditions, housing characteristics and fuel prices in that region for that period (Antepara et al., 2020).

Themes

The selected articles were analysed using NVivo (March 2020 version) to identify topics found to be common or relevant (trends) to fuel poverty. The topics and keywords used for NVivo were the following (all of them selecting only valid results for the topic and allowing for synonyms):

- Children: *child children young baby infant kid*,
- Elderly: *elderly senior old pension retired retirement 60 65*,
- Food: *food foods feed eat meal meals meat protein cook cooking stove refrigerator freezer microwave*,
- Health: *disability ill infirm chronic handicap disorder sick health*,
- Tenure: *tenure tenant tenancy homeowner owner ownership landlord rental rent.*

Results

Area of analysis

Many publications considered multiple countries of analysis, mostly being Europe or the European Union (EU). The United Kingdom (UK, including England, Scotland, Wales, and Northern Ireland) was the most popular country, being analysed in 21.34% of the publications. Europe/EU was analysed in 15.48% of publications, and the USA in 14.29%. All the areas analysed in three or more manuscripts are in Table 1.

Table 1: Areas analysed in three or more publications.

Area	Number of publications	Percentage of total
UK	18	21.43%
Europe/EU	13	15.48%
USA	12	14.29%
Australia	12	14.29%
France	6	7.14%
New Zealand	4	4.76%
Germany	3	3.57%
Italy	3	3.57%
Spain	3	3.57%

Type of indicator

The prevalence of selected indicators can be seen in Table 2 below, with the subjective being the most popular one (60.71% of the publications), followed by the 10% indicator (59.52%) and the LIHC (38.10%):

Table 2: Prevalence of main types of indicators.

Indicators	Number of publications	Percentage of total
Subjective	51	60.71%
10%	50	59.52%

LIHC	32	38.10%
2x median	16	19.05%
MIS	11	13.10%
AFCP	7	8.05%
2x mean	5	5.95%
Median/2	5	5.95%

Type of variable

The top three objective variables were more frequent than the subjective ones (Table 3). The most popular objective ones were income (70.24% of the publications), equally followed by the size of household (51.19%) and age of household members (51.19%). As for the subjective variables, the ability to maintain the home warm (44.05% of the publications) had the same frequency as arrears on utility/energy bills.

Table 3: Frequency of selected variables.

Subjective variables	**Number of publications**	**Percentage of total**
Ability to maintain home warm	37	44.05%
Arrears on utility/energy bills	37	44.05%
Objective variables	**Number of publications**	**Percentage of total**
Income	59	70.24%
Size of household	43	51.19%
Age of household members	43	51.19%
Size of dwelling	26	30.95%
Fuel prices	22	26.19%
Dwelling type	20	23.81%
Damp walls, floor, or foundation	19	22.62%
Age of dwelling	16	19.05%
Employment status	16	19.05%
Leaking roof	13	15.48%

Rot on window frames or floor	12	14.29%
Tenure	6	7.14%

Equivalisation of income

Equivalisation, meaning making a household's income proportional to its composition, was not the most frequent way of considering income for calculating fuel poverty, being present in 47.62% of the publications (Table 4). The majority, 51.19% of the publications, opted for not equivalising incomes. Additionally, 29.76% of the publications did not consider income as a variable. Multiple publications used both equivalised and unequivalised incomes.

Table 4: Presence of equivalisation of income.

Types of income	**Number of publications**	**Percentage of total**
Unequivalised	43	51.19%
Equivalised	40	47.62%
Not a variable	25	29.76%

Actual or required energy expenditure

The type of household energy expenditure can be seen in Table 5 below, with half of publications considering the actual energy expenditure used by a household:

Table 5: Type of energy expenditure.

Energy expenditures	**Number of publications**	**Percentage of total**
Actual	42	50.00%
Required	34	40.48%
Not a variable	26	30.95%

Key themes

Health impact was mentioned in 94.05% of the publications (Table 6), followed by food issues (85.71% of the publications). The ten most frequent exact words containing four or more letters were (descending order): *energy*, *poverty*, *fuel*, *households*, *income*, *household*, *health*, *policy*, *poor*, and *costs* (Figure 1). Words above 0.5% weighted percentage in the total text are shown in orange, those between 0.49-0.21% are shown in black, and words below 0.20% are shown in grey.

Table 6: Frequency of selected themes**.**

Topics	Number of publications	Percentage of total
Health	79	94.05%
Food	72	85.71%
Tenure	71	84.52%
Children	71	84.52%
Elderly	69	82.14%

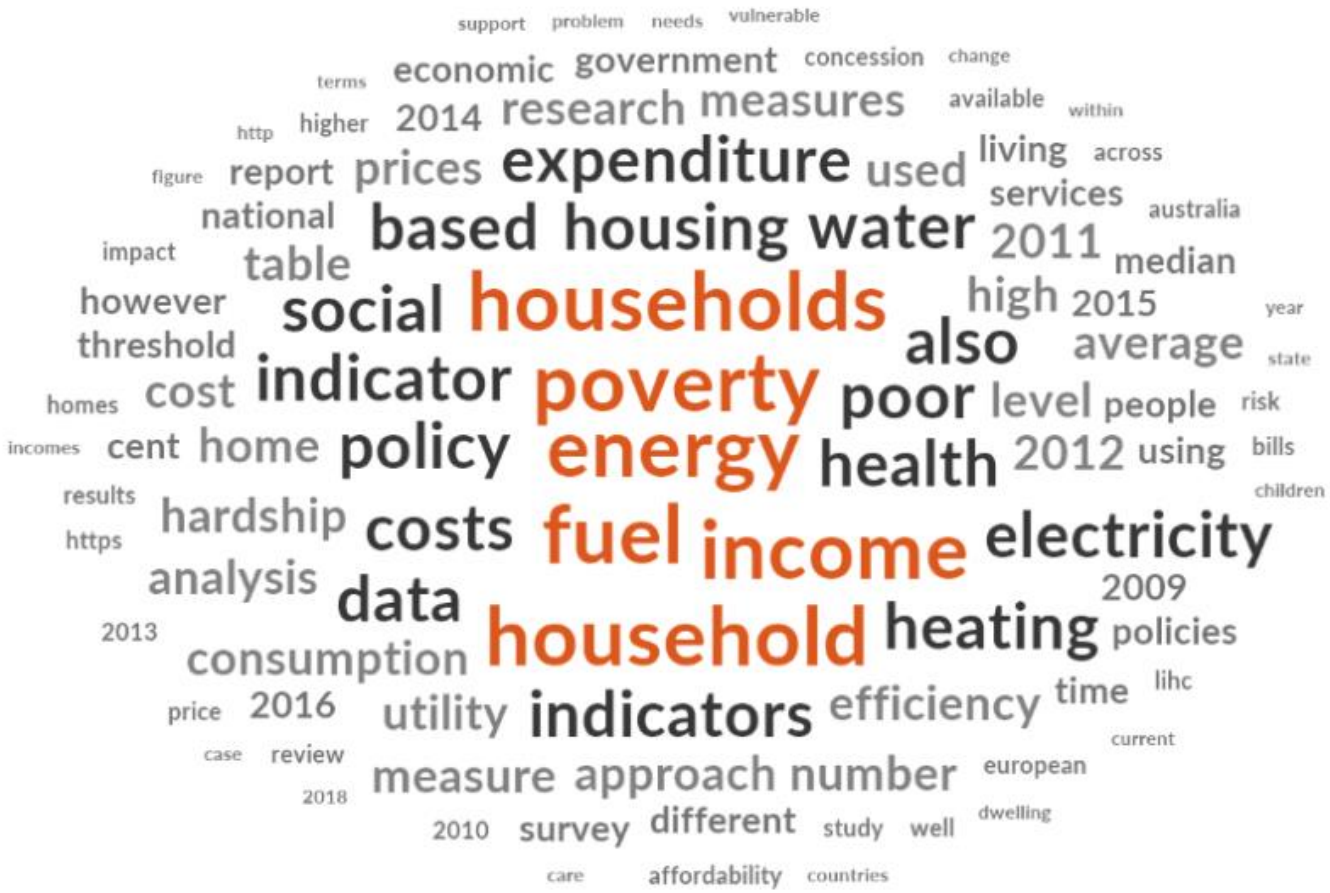

Figure 1: 100 most frequent exact words containing four or more letters.

Discussion

Influence of the UK and the EU

Fifty-two publications (61.90%) of the selected literature analysed and discussed fuel poverty in European countries. The UK has viewed fuel poverty as a social, public health and climate change issue for decades, and it is the place of origin for the term (Healy & Clinch, 2002). The country is still the primary reference in fuel poverty research and interventions (Mahoney et al., 2020; Primc et al., 2021), leading by a total of eighteen publications of a total of eighty-four which were selected for this study (21.43%).

England used the 10% indicator from 2001 to 2013, being substituted by the LIHC (Thomson et al., 2016), which was taken over by the Low Income Low Energy Efficiency Indicator (LILEE) in 2019 (Department for Business Energy & Industrial Strategy, 2021). Northern Ireland, Wales, and Scotland maintained indicators based on 10%, and those are still being used by the time this manuscript was written (Department for Communities, n.d.; Scottish Government, n.d.; Welsh Government, 2021). However, each devolved government has its own specifications, such as Scotland using MIS and considering a 20% threshold as a condition of extreme fuel poverty (Hinson & Bolton, 2021).

Other than the UK, the only European countries that have official indicators for fuel poverty are: France (six publications) (Ministère de la Transition écologique, 2023), Spain (three publications) (Ministerio para la Transición Ecológica, 2019), Ireland (Government of Ireland, 2021), Cyprus (Ministry of Energy, 2013), and Slovakia (National Council of the Slovak Republic, 2012). The discussions on domestic fuel affordability and access have been present in these countries and the EU since the early 2000s (Thomson et al., 2016).

In Oceania, Australia (twelve publications) does not have an official indicator for fuel poverty (also being called *energy poverty*, *energy hardship*, or even *energy stress*), and research commonly utilises data from the Household, Income and Labour Dynamics in Australia combined with objective and subjective variables to determine the prevalence of the issue (Australian Housing and Urban Research Institute, 2021; Awaworyi Churchill et al., 2020; Farrell & Fry, 2021). However, in New Zealand (four publications), the Ministry of Business, Innovation and Employment adopted a definition and indicators for *energy hardship* in 2022 (Ministry of Business Innovation & Employment, 2021, 2022a, 2022b).

The USA was present in many studies (twelve publications), often discussing health issues and ethnic inequalities (Hernandez, 2016; Hernandez & Siegel, 2019; Lewis et al., 2019). Still, the country does not have an official indicators of fuel poverty (Bednar & Reames, 2020). Other countries present in the selected publications were Bangladesh (one publication) and Japan (one publication), both not having official metrics for the condition.

Defining and measuring fuel poverty: biases and priorities

The 10% indicators

The 10% indicator was present in 59.52% of all publications selected in this study, having its roots in Boardman's 1991 publication, which was based on the excessive energy expenditure of English households with incomes in the three lowest deciles in 1988 (Boardman, 1991). Boardman was responsible for drawing attention to poor housing quality as the main cause of fuel poverty, highlighting the importance of investing in energy efficiency to reduce required energy expenditure – meaning that homes would be warm without spending much money (Boardman, 1991).

The main advantage of using the 10% indicator is being easy to calculate and communicate. However, it has been criticised for being outdated and region-specific (since it

is based on data from England in 1988) (Belaïd, 2018; Berry et al., 2016; Liddell et al., 2012). Moore (2012), Hills (2011) and others also affirmed that Boardman's indicator does not exclude households who have high incomes and those likely to be living in inefficient dwellings, having high energy needs (e.g. large households, presence of elderly or members with disabilities), and/or overusing energy (relating to wasteful habits) to surpass the 10% threshold. On the other hand, many people who are low-income and struggling with affording essential energy services may not be recognised as fuel poor because they do not reach the 10% mark (Legendre & Ricci, 2015). Another issue is being oversensitive to changes in fuel prices (Romero et al., 2018).

The LIHC indicator

In this study, thirty-two publications (38.10%) used LIHC. Even though the LIHC indicator may seem simple, identifying those thresholds can be tricky (Romero et al., 2018): the income is calculated after subtracting housing and modelled energy costs, and it is equivalised (Hills, 2012). The first threshold is 60% of the median equivalent income (Hills, 2012). The second threshold is the median equivalent energy expenditure of all households (Hills, 2012). Moore (2012) highlighted some issues with the LIHC, such as:

- Overlooking poorer households living in small and inefficient dwellings,
- Making fuel poverty eradication challenging to achieve for those who have low incomes and high energy expenditure, and
- Concealing the increase of fuel costs on its affordability while not reflecting fuel costs of low-income housing and its energy efficiency upgrades.

It was estimated that roughly five million English households were fuel poor in 1996, decreasing to about two million in 2001, and increasing to approximately four million in 2010, all utilising the 10% indicator (Hills, 2011). However, using the LIHC changes those

figures by around two million in those three years (Hills, 2011), showing that changing the indicator of fuel poverty and the associated variables can drastically alter the number of affected households.

Romero et al. (2018) state that Hills's LIHC indicator has the advantage of considering not only the energy costs threshold but also an income threshold, but it is overly complex and not transparent. They argue the indicator identifies and isolates its causes and effects when analysing time series is challenging due to its double-relative nature and the difficulty in identifying which households can overcome fuel poverty by solely reducing their fuel expenditure. Moore (2012) added that its transparency issues are primarily due to equivalising energy expenditure and that setting a threshold for energy expenditure at the median (even though the energy efficiency of the housing stock is low) automatically excludes people from receiving assistance (Moore, 2012). Middlemiss (2016) notes that with LIHC fuel poverty started being considered an issue that can be at most minimised, while in the past the goal was to fully eradicate it (Middlemiss, 2016).

The subjective indicator

In the selected literature, most of publications (60.71%) included subjective fuel poverty variables. Indicators that use subjective variables through surveys and interviews have the benefit of considering the lived experience of the people struggling with fuel poverty, providing a human perspective on the issue (Mould & Baker, 2017). The consistency of subjective variables can be an advantage: the same SILC questions have been asked to all the EU-28 member nations since 2010 (Thema & Vondung, 2020). However, cultural and behavioural differences can create biases in their responses to subjective questions, making it difficult to do a cross-country analysis (Atsalis et al., 2016; Bosch et al., 2019). In addition, many people do not consider themselves fuel poor using subjective variables even though

they could be classified as so according to objective variables, and vice-versa (Atsalis et al., 2016).

The MIS indicator

In this study, eleven publications (13.10%) used the MIS indicator, being based on absolute poverty (Moore, 2012). Moore (2012, p. 22) affirms that the MIS indicator "would be readily translatable to other countries with different incomes and minimum living costs, provided that required fuel costs rather than actual fuel expenditure can be determined", which has been done successfully (Barrella, Romero, & Mariño, 2022).

An advantage of MIS is seeing fuel poverty as a condition connected to other material deprivations that originates from economic poverty, allowing better understanding of the level of vulnerability of affected households (Moore, 2012; Romero et al., 2018).The main challenge when using MIS is measuring the minimum income standard, which each region should define to minimise oversimplifications. In addition, choosing what to be included as essential needs is not purely objective (Moore, 2012; Romero et al., 2018).

The AFCP indicator

Seven publications (8.05%) in the selected literature used the AFCP indicator. According to Hills (2011), this is based on modelling the energy needs of a household based, then subtracting required expenses from their income to see if it would be considered in financial poverty after energy costs. The threshold for poverty can either be the poverty line (60% of median household income) or a determined MIS (Hills, 2011). For this study, all the publications that used MIS as a parameter for measuring fuel poverty were considered as using the MIS indicator.

A benefit of using AFCP is that it can include low-income households with low energy requirements as fuel poor, which is not the case for LIHC, even though those

households are more vulnerable to the condition (Castaño-Rosa et al., 2019). Due to its focus on monetary variables (income, energy expenditure and a poverty threshold), AFCP minimises energy efficiency (which is a driver of fuel poverty). Consequently, this indicator makes it harder to distinguish between economic and fuel poverty itself, being a "sophisticated way of measuring the extent of poverty" (Hills, 2011, p. 123).

The median and mean indicators

The 2x median and 2x mean expenditure on fuels are similar indicators found in sixteen publications (19.05%) and five (5.95%), respectively. They are based on the pioneering work by Isherwood and Hancock (1979), which was an influence on Boardman (1991) and her 10% indicator, since 10% was connected to the median household energy expenditure and income in 1988 (and being comparable to the averages from the poorest 30% in that year in England) (Hills, 2011).

2x median is considered better than 2x mean since the outliers are minimised (Biermann, 2016). Both the 2x median and 2x mean are traditionally based on actual energy expenditure, whereas the official 10% indicator is based on modelled energy needs (Hills, 2011). Additionally, due to its relative nature, changes in energy prices are underestimated when using the two 2x indicators (Hills, 2011). Not fixing the 10% threshold would be more logical and appropriate to use updated data on income and energy expenditure for current and future measures of fuel poverty (Hills, 2011).

The median/2 indicator was found in five publications (5.95%). This indicator was created to see hidden fuel poverty, meaning that a household is forcefully self-rationing energy due to fuel unaffordability to economise their energy expenditure - so that spending is lower than the half of the median energy expenditure (Meyer et al., 2018; Rademaekers et al., 2016). Median/2 does not need complex calculations for the required energy needs (as it uses

actual consumption) while also acknowledging that the consumption does not reflect that the needs are met (Castaño-Rosa et al., 2019; Rademaekers et al., 2016). Like MIS, hidden fuel poverty indicators are also connected to material deprivations (Antepara et al., 2020; Castaño-Rosa et al., 2019; Meyer et al., 2018).

However, the median/2 indicator only makes sense to indicate fuel poverty in low-income households, especially those who live in inefficient dwellings and/or have to choose between heating or eating (Castaño-Rosa et al., 2019; Rademaekers et al., 2016). Otherwise, households living in extremely efficient dwellings could be categorised as fuel poor according to the median/2 indicator (Antepara et al., 2020; Thomson & Bouzarovski, 2018).

Variables: identifying vulnerability

Legendre and Ricci (2015) emphasised that it is challenging to rely on a single variable to identify all households struggling with maintaining their homes at adequate temperature levels, which can be expanded to general energy use to provide essential services in a household. Variables can measure the causes or consequences of fuel poverty (Boardman, 2013). Causes can be associated with income, geographic region, household structure, dwelling characteristics, fuel type used, fuel cost per unit, and water and space heater characteristics (Baudu et al., 2020; Boardman, 2013; Fahmy, 2011). Consequences can be behaviour and habits of household members, health conditions, and the presence of dampness, leaks and mould (Ginestet et al., 2020; McKague et al., 2016).

Of the variables highlighted in this study, income (70.24% of publications) the size of the household (51.19% of publications), and age of household members (51.19% of publications) were the most common ones. These three are objective variables that are connected to the causes of fuel poverty, helping identify vulnerable households. As for the household size, it can be used to equivalise the household's income and estimate their energy

needs (Tirado Herrero, 2017). Most indicators of fuel poverty are income-based (e.g. MIS, 10%, LIHC, AFCP) with 70.24% of publications using income-related variables. Some indicators rely on variables associated with economic aspects to determine risks (e.g. variables such as the ability to afford warmth), which is indirectly related to income. The age of household members is associated with the equivalisation of income and estimating energy needs (Boardman, 2013).

The presence of elderly members in a household was cited in 82.14% of the selected publications, as they are associated with higher thermal energy consumption, higher health issues and vulnerability to them, lower incomes and living in under-occupied homes and are considered a vulnerable group to fuel poverty (Besagni & Borgarello, 2019; Boardman, 2013). The presence of children was referenced in 84.52% of the publications, as they are also more vulnerable to health conditions associated with fuel poverty, and the situation is aggravated if they live with a single parent, being associated with lower-income households (Boardman, 2013).

Boardman (2013) also noted that considering income before or after housing affect fuel poverty numbers, as the former will be biased in favour of (mostly homeowning) pensioners, whereas the latter sets households with children as the priority. Equivalisation of income (present in 47.62% of publications) will favour larger households. However, using unequivalised income (51.19% of publications) does not acknowledge that larger households have higher non-fuel expenses, leaving them with less money to afford their energy needs (which are already higher) (Burlinson et al., 2018; Fahmy, 2011).

Other objective variables highlighted in the selected publications that relate to the causes of fuel poverty and are connected to household characteristics are employment status (19.05% of publications) and home ownership or rental (7.14% of publications). The

unemployed and the retired have lower incomes and spend more time at home, resulting in higher energy needs (Belaïd, 2018; Boardman, 2013; Chaton & Gouraud, 2020). As a topic, tenure was mentioned in 84.52% of publications, as renters are over-represented as fuel poor households due to less disposable income after housing costs (Belaïd, 2018; Gouveia et al., 2022), poor energy efficiency (Boardman, 2013), and inability to retrofit the dwellings due to not being the property owners nor having the financial means, even though they are the ones who pay the energy bills and are directly affected by fuel poverty (Barton, 2014).

Fuel prices (26.19%), size of dwelling (30.95%), dwelling type (23.81%), and age of dwelling (19.05%) are objective variables relating to the causes of fuel poverty, which are also used to determine energy needs and convert it into required expenditure.

The two subjective variables analysed in this study can be summarised as the ability to maintain the home warm (44.05% of publications) and arrears on utility/energy bills (44.05% of publications), all relating to consequences of fuel poverty. They are a reference to the popular EU-SILC variables (Thema & Vondung, 2020). Even though subjective variables highlight households' difficulties concealed by using expenditure-based indicators of fuel poverty, some people may minimise their struggles due to feelings such as embarrassment and pride associated with their cultural background (McKague et al., 2016; Waitt & Harada, 2019).

Food was a topic mentioned in seventy-two materials (85.71%) studied in the selected publications, showing a strong connection between food insecurity and fuel poverty, known as the *heat or eat dilemma*. Some households actively (and dangerously) reduce energy consumption to afford food, while others cut back on food (especially fruits and vegetables) to afford their energy bills (Llorca et al., 2020; McKague et al., 2016). Limited income is a cause of fuel poverty, whereas the coping mechanisms mentioned are consequences.

Variables of fuel poverty or its risk explicitly relating to food (e.g. EU-SILC question about the ability “to afford a meal with meat, chicken, fish or vegetarian equivalent every second day” (Bosch et al., 2019, p. 1386)) can be beneficial for finding vulnerable households.

Food insecurity also relates to fuel poverty as disconnected (including self-disconnected) households lose their ability to use their appliances, with spoiled food being a health hazard and undesired expense to already vulnerable households (McKenzie, 2013). Additionally, food costs must also be part of the MIS calculation (Moore, 2012).

The remaining variables analysed in this study also relate to the consequences of fuel poverty but are objective: damp walls/floor/foundation (22.62% of publications), leaking roof (15.48% of publications), and rot on window frames/floor (14.29%). These variables relate to the dwelling and are strongly connected to the presence of mould due to poor housing quality (Ginestet et al., 2020).

Health was mentioned in seventy-nine publications from the selected literature (94.05%), as being in fuel poverty can create health issues, aggravate existing ones, or even cause death due to issues such as inappropriate indoor temperatures, presence of mould, household members unable to use electricity-powered life support equipment, and negatively impacting mental health and wellbeing of household members (Awaworyi Churchill et al., 2020; Ginestet et al., 2020; Simshauser et al., 2011; Teli et al., 2015). These issues are even more severe in vulnerable household members who are elderly, children or have a disability or chronic illnesses, which are also associated with lower income and/or higher energy needs (Boardman, 2013; Snell et al., 2015).

Estimating energy expenditure or accepting self-rationing?

Forty-two publications (50.00%) in the selected literature used actual energy expenditure as a variable, while thirty-four publications (40.48%) used required energy expenditure.

Some of the variables highlighted in the selected publications include fuel prices (26.19% of publications), size of dwelling (30.95% of publications), dwelling type (23.81% of publications), and age of dwelling (19.05% of publications). Fuel prices associated with the physical characteristics of the dwelling (and where it is located geographically), space heating/cooling systems, and water heaters (including the type of fuel used) are part of the calculation required for energy expenditure. However, the household structure also needs to be considered.

The size of the household (51.19% of publications) and age of household members (51.19% of publications) are considered to determine the household's energy needs. The Organisation for Economic Co-operation and Development developed an equivalisation scale that is often used to equivalise energy needs: 1 consumption unit for the first adult in a household, 0.5 consumption unit for each additional person who is at least fourteen years old, and 0.3 consumption unit for each person who is younger than fourteen years old (Berry et al., 2016; Chaton & Gouraud, 2020).

Employment status (19.05% of publications) is also an important factor: households with at least one member frequently staying at home (e.g. retired and unemployed) will have a different heating regime compared to all members being away from home for work or school, with the former situation usually set at sixteen hours of daily heating while nine hours is considered the standard (for the latter) (Boardman, 2013). In addition, under-occupation

can be considered for the heating regime: in that case, half the space of the dwelling should be heated (Boardman, 2013).

Using the amount of money or energy unit (e.g. kW·h) actually consumed by the household is straightforward, being significantly easier to obtain this data than estimating the required energy needs by using household and dwelling aspects. However, this does not necessarily represent how much the household *should* be consuming to maintain proper temperature levels and meetings other basic energy needs (Boardman, 2012, 2013).

The average energy expenses can be based on year-round data from households or only the months with increased consumption (summer and/or winter) (Waddams Price et al., 2012). Moore (2012) also suggested that the monthly income associated with the seasons should also be adopted. As mentioned previously, using median values of energy expenditure instead of the mean to compare households has the advantage of being closer to the typical use by households since the mean is more affected by outliers (Moore, 2012).

To avoid neglecting the issue of under-consuming energy due to self-rationing when using actual energy expenditure values, the analyst should consider including some well-established subjective variables or others that can measure energy practices and coping mechanisms of households can be beneficial (McKague et al., 2016). Unfortunately, subjective variables relating to energy behaviour are less likely to be representative of a whole region. Using the median/2 indicator in addition to questions about the dwelling quality and household income can also help in those situations when the required energy values are not available (Barrella, Romero, Linares, et al., 2022; Thomson & Bouzarovski, 2018). Other supporting indicators (e.g. excess winter mortality) can be used as well (Palma & Gouveia, 2022).

Even though self-rationing is a known phenomenon, using the actual energy expenditure was found to be more common than required energy expenditure, probably due to the former data being easier to be obtained rather than calculating the latter. All indicators and variables of fuel poverty itself or its vulnerability have strengths and weaknesses, focusing on specific facets of the issue. As Boardman (2013, p. 34) stated, “the method chosen and the groups prioritized are a political, not academic, decision.”

Conclusion

This study is a systematic literature review of relevant publications on fuel poverty to analyse their key indicators and variables, discussing patterns in the themes explored in those publications and the reasoning behind their chosen methods for measuring fuel poverty. Findings showed that the UK and EU predominate fuel poverty research and policies, with the subjective, the 10%, and the LIHC indicators being the prevalent ones. Variables relating to the household composition and structure were the most frequent, with fuel poverty being considered a social and health issue.

Novel indicators are also encouraged by the authors to suit the specific needs of each case. The authors propose a combination of different household, dwelling, and economic variables to see the multiple facets of fuel poverty. Indicators and variables that can adapt to future changes and identify the severity of fuel poverty should also be prioritised.

This study intends to help researchers, policymakers, and other groups involved in mitigating fuel poverty choose variables that prioritise the most underprivileged groups, understanding that their choices can overlook certain essential aspects of the issue. The authors suggest that future research and interventions use a combination of both objective and subjective variables to create a more holistic view of fuel poverty as it can minimise biases against certain affected groups.

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Chapter Three – Fuel Poverty or Energy Hardship? Analysing the literature, the proposed official definition, and the views of experts in Aotearoa New Zealand

Abstract

Fuel poverty is a serious condition in New Zealand, caused by the inability to afford sufficient energy services and resulting in detriment to health and wellbeing. Inconsistent ways of describing and measuring fuel poverty affect the perception and depth of the issue and the proposed interventions. This article analyses the proposed definition and indicators of energy hardship developed by the Ministry of Business, Innovation and Employment, in addition to the literature and the perspectives of five New Zealand experts. Findings suggest that the proposed energy hardship description and measures are well-aligned with the recommendations given by the interviewed experts and the literature findings on fuel poverty, which bodes well for effective interventions to minimise the issue.

Introduction

In 2017 it was estimated that over 100,000 households in New Zealand struggled to afford energy services (New Zealand Government, 2019; Statistics New Zealand, 2017), representing approximately 6% of all New Zealand households in that year (Statistics New Zealand, 2017, 2020). Fuel poverty can cause severe health and wellbeing repercussions, mainly associated with insufficient heating (Baker, Mould and Restrick, 2018). Consequently, fuel poverty was one of the main topics explored in the final report of the Electricity Price Review in 2019 (New Zealand Government, 2019). One of the report's recommendations was to define the issue in order to standardise its measurement, align it with other frameworks (such as the Wellbeing Budget and child poverty measures) and evaluate progress. Unfortunately, there is no standard definition or set of indicators of fuel

poverty internationally; however, some countries adopt standardised official ones according to their priorities and context (Boardman, 2013; Thomson, Snell and Liddell, 2016).

This study analysed the issue of fuel poverty in New Zealand from three different perspectives to find the best practice for the definition, leading to meaningful indicators. The first was an analysis of the international and national literature on fuel poverty, including journal articles, reports, websites, and books. In addition, the proposed definitions and measures contained in the Ministry of Business, Innovation and Employment (MBIE) discussion document Defining Energy Hardship (Ministry of Business Innovation and Employment, 2021) were evaluated.

Finally, the views of five experts on fuel poverty in New Zealand were solicited. The experts had diverse backgrounds, including academia, government, an energy company, an independent consultancy, and a non-governmental organisation (NGO). Four of them were selected for being currently engaged in regional and national energy hardship projects, with three participating in the Energy Hardship Forum organised by MBIE in March 2021. Additionally, one expert was chosen for having produced a significant study on fuel poverty in New Zealand. The initial contact was made via email, and the interviews were carried out via Zoom in 2021.

Experts were asked about eight critical areas relating to fuel poverty, which are discussed below in comparison with the MBIE discussion document and the literature:

differences between fuel poverty and energy hardship

- who are the actors engaged with initiatives on fuel poverty in Aotearoa?;
- how is it defined?;
- how is it measured?;
- how can current definitions and indicators be improved?;

- what are the causes of fuel poverty?;
- other issues associated with fuel poverty; and
- the reason behind eradicating fuel poverty.

Fuel poverty versus energy hardship

Isherwood and Hancock first used the term fuel poverty in 1978 (Liddell et al., 2011). It is the primary term used in the United Kingdom and Ireland (leading countries in fuel poverty research and policies) (Bouzarovski and Petrova, 2015; Li et al., 2014). The term energy poverty is often used in the European Union to denote energy unaffordability, even though it can be considered a different issue, relating to the lack of access to modern energy infrastructure (Li et al., 2014). Both energy and fuel poverty can have overlapping causes, resulting in similar outcomes, and often coexist (Li et al., 2014).

In the MBIE discussion document, the term energy hardship is used for both affordability and availability issues, even though the former is considerably more relevant to Aotearoa, which is this article's focus. The selected experts for this study were asked if they saw a difference between the terms fuel poverty and energy hardship. According to three experts, fuel poverty and energy hardship have been used interchangeably in New Zealand. However, three experts believe that energy hardship can be considered a broader term associated with vulnerabilities related to the issue.

Three experts associated the term poverty with economic poverty, which connects to income as an indicator and cause. However, the overlap between fuel poverty and economic poverty depends on the definitions and indicators chosen for those two conditions (Boardman, 2013). For example, some fuel poor households are more affected by poor housing quality, home under-occupancy, and/or having high energy expenditure rather than having low incomes (Hills, 2011; Legendre and Ricci, 2015).

Three experts said that the term poverty has a negative connotation, and that can push people away from seeking assistance, with one stating: ‘We’ve gone the hardship way because we try to be probably PC [politically correct], but whether that’s right or wrong, I don’t know.’ Two experts believe that fuel poverty can be specifically associated with petrol for fueling a car. However, transportation fuel is not traditionally included in fuel poverty discussions (Mattioli, Lucas and Marsden, 2017), and it was not included in the proposed MBIE definition.

Actors involved with fuel poverty in Aotearoa

Experts were asked what groups of actors are involved with the issue of fuel poverty in New Zealand. All emphasised the importance of the government managing the problem, mentioning agencies such as MBIE, the Energy Efficiency and Conservation Authority, the Ministry of Health, the Electricity Authority and Kāinga Ora.

Four experts said that energy companies, especially retailers, are also responsible for preventing fuel poverty. NGOs and community groups were highlighted by four experts, including curtain banks, financial mentoring services, and charities. Three experts mentioned landlords, as they are responsible for ensuring that the quality of the housing they provide is up to health and efficiency standards; failing to do so results in increased energy consumption and extenuating health concerns for the tenants (Ambrose and McCarthy, 2019).

It is crucial to create protections for vulnerable populations, such as disabled people, the elderly and young children (O’Meara, 2015), and the commitment from various organisations can be more efficient in targeting those groups. None of the experts believed that a single actor should be responsible for fuel poverty mitigation initiatives, with one saying:

> And I think an advisory board, again ... from all the different organisations, not only the main one set, that looks at [it] from a very different angle, how their particular organisation can help minimise this for people. Looking at the context of the people, the cohorts that we often don't think about, like we talked about, the sick and the disabled and elderly... So I think it's a lot of different interventions at different stages but underlying it all is a strong political commitment from all the parties working together and also changing the lens that we look at it through: energy is a basic right in order for us to improve the quality of life and drive that [equality].

Defining fuel poverty

Experts were asked how they define fuel poverty. Three of them associated fuel poverty with the inability to afford energy services connected to health, quality of life, safety, and comfort. This is similar to Lewis's 1982 definition of fuel poverty as 'the inability to afford adequate warmth in the home' (Lewis, 1982, p.1). Even though affordable warmth is still an essential component of modern concepts of fuel poverty, it is generally accepted that fuel poverty comprises a household's energy use for its overall everyday needs in its dwelling, such as electricity, firewood, and cooking gas (Simshauser, 2021).

One expert responded that they were satisfied with the proposed MBIE definition. It considers that energy hardship is a continuum, with energy wellbeing at the other end of the spectrum. Energy wellbeing is expressed as a condition in which 'individuals, households and whānau are able to obtain adequate energy services to support their wellbeing in their home or kāinga' (Ministry of Business Innovation and Employment, 2021, p.vii). The proposed definition includes various energy services but excludes transportation fuel (Ministry of Business Innovation and Employment, 2021). It also acknowledges cultural differences in living arrangements in Aotearoa, which is highly relevant, as Māori whānau traditionally

consist of various family units (Boulton et al., 2021), and they are over-represented in fuel poor homes (O'Sullivan et al., 2017; Teariki et al., 2020).

In 1991, Boardman defined 'fuel poor' as having energy expenditure above 10% of the household's income (Boardman, 1991), which was referred to by one expert:

> We define that as spending more than 10% of your wage, in a month, on energy or fuel. That is how we defined it. Whether I agree with that or not, but that is what we are defining it as at this current stage.

However, Boardman considered the estimated energy expenditure required to supply the household's needs (Boardman, 1991, 2013). Considering actual expenditure instead of required expenditure ignores the issue of self-rationing energy consumption due to limited financial resources, meaning that many homes can be experiencing the harmful effects of under-consuming energy without being considered in fuel poverty (Lacroix and Chaton, 2015). Indicators of fuel poverty are discussed further in the following section.

Measuring fuel poverty

The MBIE document proposes a set of indicators that includes both objective and subjective indicators, with the primary ones being: the proportion of income after housing costs spent on energy being two times the median or more; putting up with feeling cold frequently; and the presence of dampness and mould problems. The interim indicator for energy consumption is based on actual expenditure, as the indicators for estimating energy needs (e.g., dwelling and household characteristics) have not been established yet.

With subjective indicators, the danger of overlooking self-rationing is minimised (Lawson, Williams and Wooliscraft, 2015). Furthermore, capturing the lived experiences of fuel poverty can be extremely valuable in understanding and improving the associated

systemic issues; looking solely at technical aspects gives a limited perspective on the causes and consequences of the problem (Mould and Baker, 2017).

Experts were asked how they would measure fuel poverty. Two of them discussed specific household needs and vulnerabilities, as some groups, such as disabled people and children, may require higher temperatures at home, due to their higher sensitivity to the effects of energy deprivation (McChesney, 2013; Snell, Bevan and Thomson, 2015). One of those experts also emphasised the need to model the household's required energy consumption based on the characteristics of its dwelling and the energy efficiency of its appliances. In England, the Standard Assessment Procedure has been used to measure the energy efficiency of a dwelling, and the required energy consumption for a household is based on that thorough assessment of their home (Department for Business Energy and Industrial Strategy, 2021).

One expert stated that including subjective parameters is important. Subjective indicators are commonly associated with the surveys used for the European Union Statistics on Income and Living Conditions, which ask households questions such as, 'Can your household afford to keep its home adequately warm?' (Thema and Vondung, 2020). That parameter is also a secondary indicator included in the MBIE discussion document.

Another expert said that in their organisation, income and actual energy expenditure are the only parameters used (based on Boardman's definition) and that 'low socio-economic' people are targeted. Using the 10% definition has the benefit of it being relatively easy to obtain data on the income and expenditure of a population (through reports from energy retailers, census data, or by conducting surveys), being simple to calculate on small and large scales, and not depending on comparisons with other households' data (since it is an absolute measure) (Moore, 2012; Romero, Linares and López, 2018). However, the 10% threshold

was based on data from 1988 in England, associated with the poorest 30% of the population and their energy expenditure (Liddell et al., 2012), meaning it is region-specific and outdated. Some authors also argue that Boardman's definition overestimates the importance of energy prices (Moore, 2012; Romero, Linares and López, 2018).

One expert associated fuel poverty with being denied the right to energy, which they represented as missing bills and disconnections, saying that those households need immediate support. Data on the prevalence of missing bills and disconnection can be obtained from energy retailers or self-reported through surveys. For example, Thomson and Snell (2014) conducted an online survey in Europe that included the questions: 'In the last 12 months, how often was your household unable to pay energy bills on time?' and 'In the last 12 months, has your household's energy supply been disconnected because of unpaid bills?' MBIE proposes to use 'Could not pay electricity, gas, rates, or water bills on time (more than once)' as a secondary indicator (Ministry of Business Innovation and Employment, 2021, p.35).

One expert declared their preference for a multi-indicator approach and a sum of indicators:

> If a household ticks the box on, say four out of four, or about four out of six, they would be regarded to be in severe energy hardship. And if they maybe did two or three, that would be moderate and maybe just zero or one, they probably would not be considered to be in any major risk category. So I think, their approach is not without its own problems, because depending on the indicators that you choose and your approach to how you add indicators together and how you group them, if you have two indicators that are quite similar, you may actually tend to weight your indicator, sorry, your approach to energy hardship, according to those two indicators, which

start to dominate the way in which you see energy hardship, even though you've got this multi-indicator approach.

This type of approach has been used not to identify fuel poverty as an absolute condition but to identify risks and severity (Bosch et al., 2019; März, 2018), which can help prioritise certain groups and create appropriate interventions for each one (Healy and Clinch, 2004). This relates to MBIE's continuum of energy hardship and energy wellbeing.

Improving existing definitions and indicators of fuel poverty

Experts were asked if they had issues with the current ways of defining and measuring fuel poverty, and how they would improve them. Common fuel poverty definitions include: 10% of income going on energy expenditure (Boardman, 1991); energy expenditure being more than twice the median (Isherwood and Hancock, 1979); and energy expenditure above the median and households falling below the poverty line after that expense (Hills, 2012). Income, age and number of household members, types of fuel used, presence of insulation, and ability to afford heating are some indicators used for measuring fuel poverty (Boardman, 2013).

Three experts highlighted the importance of considering the physical characteristics of the dwelling. Understanding the energy practices of the household – e.g., hours of heating; temperature (Stephenson et al., 2010) – was brought up by two of them. These types of indicators can help estimate the household's required energy expenditure (Boardman, 2013). However, as observed above, at the time of writing MBIE had not yet established indicators for estimating energy needs.

The use of both subjective and objective indicators was emphasised by two experts. The MBIE document considers that both primary and secondary indicators include subjective and objective parameters. Two experts highlighted the issue of under-consuming energy

(especially for heating) to save money, which is a common problem in New Zealand (McKague et al., 2016). Indicators such as 'Put up with feeling cold to keep costs down a lot' and 'Not heating own bedroom in winter' relate to this issue (Ministry of Business Innovation and Employment, 2021, pp.33, 35).

Two experts felt that the definition should be broader rather than more specific, aligning with the energy wellbeing spectrum (Ministry of Business Innovation and Employment, 2021). One expert talked about having flexibility in the indicators but not in the definition:

> I think the indicators should always be open to review. It's a combination of determining whether they are still relevant to the way we define energy hardship and/or whether we have now better information, which enables us to tweak indicators or to change them or to add new indicators in, because we're basing it now on better and newer information. So, yeah, I think that's where I would prefer the review and change comes in. That's more at the indicator level. I think we should try and set a definition that is not going to be too changeable over time.

Using the capabilities perspective was highlighted by one expert:

> [My previous work used] the Bouzarovski and Petrova definition, which is more based around their inability to access or afford, but focusing more on the capabilities of households by doing that, are they being deprived of participating in something as a result of that? So I really liked that definition, and I think that issues with the other ones were their focus on participation in society, the capabilities, which they lack had they spent that amount on energy, for example. So I think a definition is going to be very hard. Like I said, it's very contextual, but around those capabilities and participation should be taken into account.

The capabilities concept says that fuel poverty is caused by the lack of opportunities (referred to as capabilities) to fulfil needs and desires (referred to as functionings) that are powered by energy, associating energy with wellbeing (Bouzarovski and Petrova, 2015; Day, Walker and Simcock, 2016). According to Day, Walker and Simcock, '[p]romoting capabilities maximises opportunities, but leaves the individual free to decide what kind of life they value' (p.258). This framework significantly relates to energy wellbeing in the MBIE document.

Causes of fuel poverty

The experts were asked what causes fuel poverty. The literature attributes the issue to the energy efficiency of appliances, dwelling quality, household needs and income, and energy prices and sources (O'Sullivan and Viggers, 2021). Problems with the quality and the increasing costs of housing were discussed by four experts. Energy prices were seen as a cause by four experts. Earning a low income was mentioned by four experts as well.

Lack of economic resources not only makes it challenging to afford energy costs; it also correlates with renting instead of owning the property, living in low-quality housing, being unable to perform or pay for energy efficiency retrofits and home repairs, being food insecure, and delaying medical care (Barton, 2014; Cook et al., 2008; Healy and Clinch, 2004; McKague et al., 2016). The overlap between households earning low incomes and households being in fuel poverty in the United Kingdom was discussed by Boardman (2013):

> in 2006, 89 per cent of the fuel poor (2.1 million) were in the 30 per cent of households with the lowest incomes ... There are virtually no fuel poor households above median income, although some are only just below, in the fourth and fifth deciles. (Boardman, 2013, p.31)

Still on the financial aspect, the case of predatory loans was brought up by one expert, who had organised focus groups to discuss energy issues:

> One of the other major areas they brought up is irresponsible lending that's related to energy debt. So, someone might go out and get a high-cost loan to pay off an energy debt, which ultimately compounds their hardship over time. So, they become less and less likely to be able to pay because of the pressure put on them. They took out a loan that was unsuitable, and the responsible lending laws did not protect them from getting this predatory lending. Also, just that generally that irresponsible lending puts people into poverty in the first place.

Three experts mentioned the lack of information, meaning households having difficulty understanding their bills and finding the best and cheapest energy plans. Increasing energy awareness and literacy have also been addressed by MBIE in their discussion document, relating to improving understanding of energy habits and how the energy retail sector operates.

Other issues associated with fuel poverty

Fuel poverty is associated with several adversities, such as issues related to health, housing, finances and structural racism (McKague et al., 2016; O'Sullivan, Howden-Chapman and Fougere, 2012). Experts were asked about the non-causal issues associated with fuel poverty. Food insecurity associated with fuel poverty, known as the 'heat or eat dilemma' (choosing food over energy payments or vice versa (Cook et al., 2008)), was discussed by four of them.

Health issues were the initial concern in early fuel poverty discussions (relating to insufficient heating) (Boardman, 1991), and they were brought up by three experts. Fuel poverty is associated with cardiovascular and respiratory morbidity and mortality (World

Health Organization, 2018), as well as mental health issues (Baker, Mould and Restrick, 2018). In addition, one expert mentioned domestic violence. A 2021 study in Australia found that being fuel poor increases the chances of experiencing physical violence, and that the mechanisms of influence are social capital, psychological distress and substance use (Hailemariam, Sakutukwa and Yew, 2021).

Two experts cited the educational attainment of the household, which can also be affected by the stress caused by financial issues associated with fuel poverty (Baker, Mould and Restrick, 2018). Additionally, a study from France demonstrated that households with greater educational attainment are at minimal risk of being in fuel poverty, due to earning higher incomes (Legendre and Ricci, 2015). In Aotearoa, Māori and Pasifika groups present lower educational attainment and incomes than the Asian or white populations (Ministry of Social Development, 2016).

Cultural and behavioural aspects were cited by two experts. One noted that combining energy advice with budgeting advice has become an important strategy for managing fuel poverty. Educational attainment and energy habits are correlated with service literacy and household circumstances and practices, facets of energy wellbeing mentioned by MBIE. They may result in inefficient energy use and more expensive or inappropriate plans.

One expert discussed an issue associated with pre-payment, which is more costly and less convenient than regular plans, but used by many low-income households (O'Sullivan, Howden-Chapman and Fougere, 2011): 'I'm particularly very concerned about pre-pay metering or pre-pay use and how that would be a safe reconnection, whereas there are requirements around checking things like the oven off and heaters are off before reconnecting on post-pay.' A study showed that Māori and Pasifika households using pre-payment presented higher odds of being self-disconnected compared to non-Māori and non-Pasifika

households (O'Sullivan et al., 2013). Ethnicity was discussed by two experts, as Māori and Pasifika populations are over-represented in fuel poor homes (O'Sullivan et al., 2017; Teariki et al., 2020), as are refugees.

One expert acknowledged the issue of household crowding, which disproportionately affects Pasifika, African, Māori, Asian and Latin American populations (Statistics New Zealand, 2018). According to the MBIE document, the 'three most challenging housing issues for Māori are that homes are cold, mouldy and in urgent need of repairs' (p.9), with an unequal representation of Māori and Pasifika children being hospitalised due to those circumstances.

Ethnicity on its own is not a cause of fuel poverty, but systemic racism exacerbates material differences between different ethnicities that relate to the causes of fuel poverty (e.g., inferior housing quality and income). Approaches aiming to eradicate the issue must acknowledge cultural and language barriers that ethnic minorities have to face regarding energy services. Similar to the New Zealand context, African-American households are more likely to live in energy inefficient homes and present higher fuel poverty rates than Asian or white households in the United States (Lewis, Hernandez and Geronimus, 2019; Wang et al., 2021).

It is about wellbeing

The selected experts were asked about the purpose of eradicating fuel poverty. Increasing happiness and wellbeing were brought up by all of them. The MBIE document affirms that '[l]iving in energy hardship affects the quality of life of the household and impacts their wellbeing physically, mentally, and socially' (Ministry of Business Innovation and Employment, 2021, p. 8). Four experts talked about achieving a more equitable society.

Four experts talked about economic reasons, as solving fuel poverty will increase disposable income in the affected households and financial savings for the government. A study estimated that poor housing conditions (e.g., damp, cold, mould, crowding) cost 141 NZD million annually in hospitalisations (Riggs et al., 2021). There is a strong association between poor dwelling conditions and poor health in children (Howden-Chapman, Baker and Bierre, 2013). Positive health impacts were mentioned by four experts, and an improvement in children's lives was mentioned by two, with one saying:

> People's health and wellbeing are affected, but we know that there's people who are hospitalised and children every year with housing-related illnesses. So the Ministry of Health, in combination with academic researchers, have looked at things. They've got a category of housing sensitive hospitalisations. And so they've actually been able to kind of calculate the financial cost as well to the country or people living in really inadequate housing. That's damp, cold and mouldy. So, things like fever, asthma, bronchitis, et cetera.

One expert mentioned environmental benefits associated with higher energy efficiency (e.g., replacing older appliances and installing insulation), which requires less energy and thus results in fewer emissions. While not detailed in the MBIE discussion document, the framework is also connected to the Climate Change Response Act 2002 (Ministry of Business, Innovation and Employment, 2021, p.8). In addition, as the seventh United Nations Sustainable Development Goal is to 'ensure access to affordable, reliable, sustainable and modern energy for all' (United Nations, 2021), fuel and energy poverty actions are essential for a socially, environmentally, and economically sustainable future.

Conclusion

The MBIE discussion document of November 2021 advanced thinking and policy on defining energy hardship in Aotearoa New Zealand, a condition that includes both fuel and energy poverty. The proposed definition of and indicators for energy hardship and energy wellbeing consider multiple facets of insufficient energy consumption in the country, and are adequate and well-aligned with five experts' opinions and the literature. Even though the primary focus of this article and the MBIE document is fuel poverty (relating to energy affordability), as it is the predominant issue in this country, the terms energy hardship and fuel poverty are not synonyms. Properly estimating the energy needs of households, considering the needs of the households and the dwellings where they live, is an important step for the future, as selecting the proper indicators is crucial for identifying the presence and depth of fuel poverty. The government, energy companies, landlords and NGOs need to work together to target vulnerable groups for efficient interventions necessary to eliminate the issue in this country. When this article was written, MBIE was seeking public feedback on its discussion document. Eradicating fuel poverty is of critical concern, considering the potential improvement in the health and wellbeing of New Zealanders, as well as the environmental and financial benefits.

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Chapter Four – Trends in Current Energy Wellbeing Interventions in Aotearoa New Zealand and the Energy Hardship Conceptual Framework

Abstract

Energy hardship in Aotearoa New Zealand is characterised by inadequate access to modern energy services and energy unaffordability, linked to social marginalisation, limited incomes, and inefficient dwellings. In response to this challenge, the Ministry of Business, Innovation and Employment proposed a conceptual framework, definition, and indicators of energy hardship in 2021. We interviewed sixteen employees of New Zealand organisations to identify patterns in their operations, perspectives, and gaps related to the energy hardship framework. The primary intervention objective was to enhance thermal comfort in homes, with energy awareness and literacy being the most common intervention type. While the interventions predominantly focused on the household level, it will be necessary to address the root causes of Aotearoa's energy hardship, including financial poverty, substandard housing, and an undemocratic energy sector. The energy hardship framework captures the critical dimensions of fuel and energy poverty and can serve as a valuable tool for organisations worldwide.

Introduction

Fuel poverty started as a concept relating to the inability to afford sufficient indoor heating (Boardman, 1991). In 2022, fuel poverty can be more broadly described as the inability to afford adequate energy services since having fuel access is vital for maintaining basic human needs (e.g. lighting, food preservation and preparation, water heating, and indoor cooling) (Bosch et al., 2019).

Fuel poverty is the most relevant component of energy hardship in New Zealand (also known as Aotearoa), considering that struggling with energy bills is more frequent in the

country than lacking access to energy infrastructure (Ministry of Business Innovation & Employment, 2021), a condition often called energy poverty (Li et al., 2014). It is estimated that over a hundred thousand Kiwi households struggle with energy hardship (New Zealand Government, 2019). Energy hardship can result in adverse health outcomes and even deaths (Ingham et al., 2019; O'Sullivan et al., 2011, 2012).

There is no standardised definition or metrics for fuel or energy poverty (Lapillonne et al., 2019), and some countries such as England (Department for Business Energy & Industrial Strategy, 2021a) and France (Chaton & Gouraud, 2020) have established their own parameters. The English housing context and energy prices influenced how fuel poverty is seen and described in research and policies (Boardman, 2013; Department for Business Energy & Industrial Strategy, 2022). The main strategy used in the country to mitigate the issue has been energy efficiency (Boardman, 2012; Department for Business Energy & Industrial Strategy, 2021b). Since England is a pioneer in fuel poverty investigation and strategy, influencing other nations to adopt similar views on the causes and potential solutions to fuel poverty (Mahoney et al., 2020; Primc et al., 2021) . Still, this is a limited perception of a complex issue that cannot rely only on technical and technological improvements (Baker et al., 2018).

In 2021, the New Zealand Ministry of Business, Innovation and Employment (MBIE) released a document containing a proposed framework that describes different facets of energy hardship in the country (illustrated in Figure 2 below) (Ministry of Business Innovation & Employment, 2021). MBIE solicited feedback from the public and experts regarding its proposal document (Ministry of Business Innovation & Employment, 2021), with forty-four out of fifty-three stakeholders agreeing or strongly agreeing with the framework (Ministry of Business Innovation & Employment, 2022b).

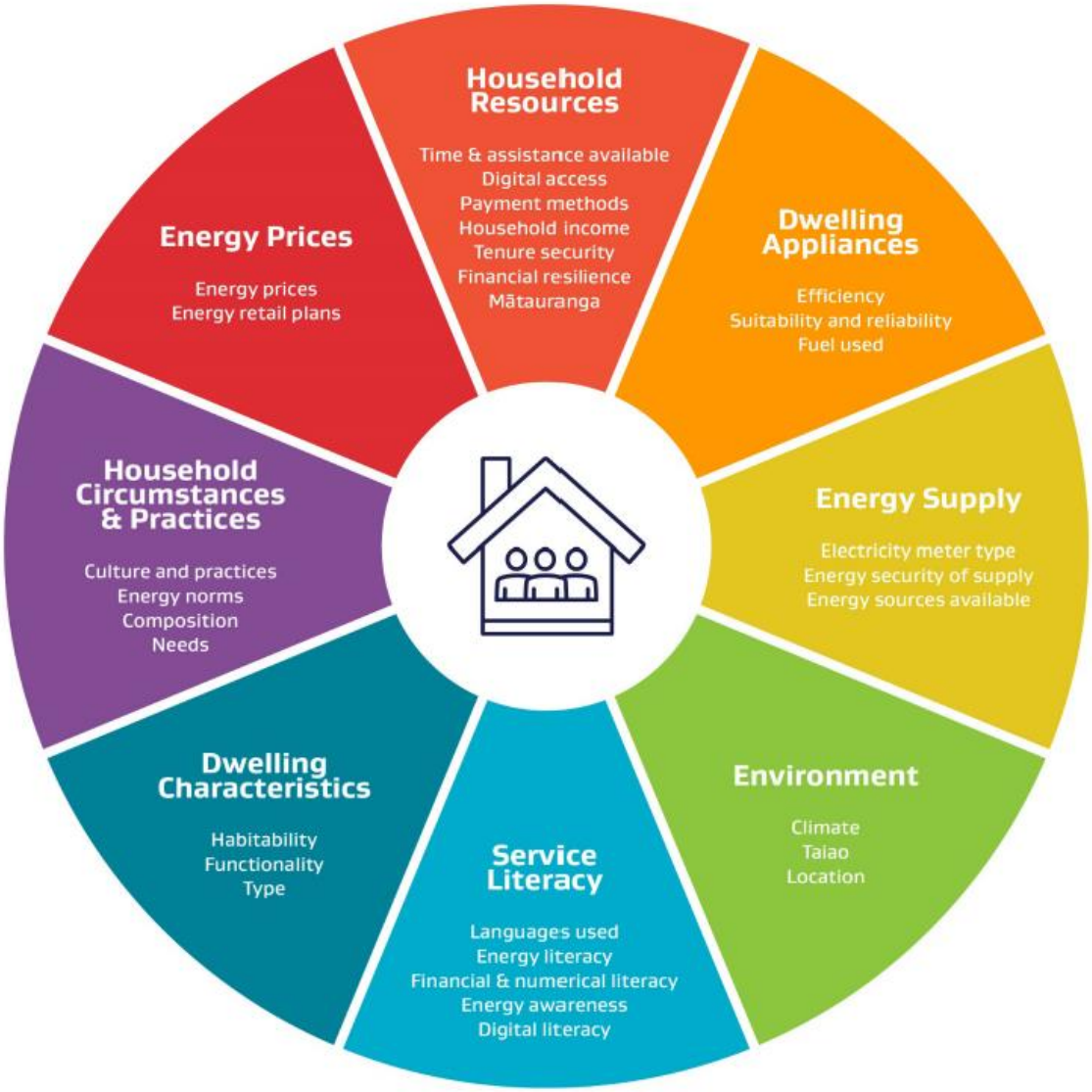

Figure 2: Energy hardship conceptual framework proposed by MBIE (Ministry of Business Innovation & Employment, 2021).

The MBIE document included also proposed metrics of energy hardship (Ministry of Business Innovation & Employment, 2021). In 2022, MBIE adopted an official definition for its antonym, energy wellbeing: “When individuals, households and whānau [extended family] are able to obtain and afford adequate energy services to support their wellbeing in their home or kāinga [Māori settlement]” (Ministry of Business Innovation & Employment, 2022a).

However, the proposal did not contain strategies for overcoming this complex condition. We still have limited knowledge of how current energy hardship mitigation projects in Aotearoa operate, what their perspectives on the issue are, and how they relate to each other. In 2019, the New Zealand Government emphasised the need for cross-sector collaboration to reduce energy hardship (New Zealand Government, 2019). Considering the complexity of the condition, we analysed if the current energy hardship interventions in New Zealand are broad enough in their actions to significantly impact the condition. The goal of this study is to assess whether the interventions of sixteen organisations working to minimise energy hardship were effective based on the MBIE framework and offer policy suggestions to optimise them.

To our knowledge, this is the first research article using the energy hardship conceptual framework proposed by MBIE. We believe this thorough framework that includes economic, social, and environmental aspects is not only useful for the Aotearoa context, as it can easily be applied to international scenarios with minor modifications. The examples of interventions, their patterns, strengths, and limitations described in this study can be useful for policymakers worldwide dealing with energy and fuel poverty.

Methods

Are current energy hardship interventions from sixteen organisations in Aotearoa sufficiently diversified in their actions to have a significant impact on the condition according to the MBIE framework? To answer our research question, a qualitative approach was used. Semi-structured interviews were conducted with sixteen individuals, each representing a different New Zealand organisation, to understand their energy hardship mitigation projects. The goal of the interviews was to understand the operation of the interviewees' energy hardship projects, as well as their views on energy hardship in Aotearoa.

The New Zealand organisations working on energy hardship reduction represented by the interviewees can be divided into the following categories: social businesses (n=4), the government (n=4), and non-profits (n=8). The range of operations of those organisations varied from municipal (n=1) to national (n=8), with several being regional (n=7). Interviewees were selected from participation in energy hardship events and recommendations by important actors (including snowball sampling). Semi-structured interviews were carried out from April to July 2021.

Interview questions were elaborated to find patterns and gaps in the interviewees' projects relating to their frameworks, issues encountered, plans for the future, and perspectives of energy hardship in New Zealand. The questions can be found in Appendix B. Interviews were carried out via Zoom (recorded and transcribed) and email exchange as needed.

Even though we tried to get as many relevant organisations as possible to participate in the interview process, we acknowledge that those sixteen organisations do not represent the totality of interventions being carried out in the country (since projects in the South Island and interventions focused on the Māori were underrepresented in our interviews).

We used the software NVivo and hybrid coding for the interview transcripts and emails, summarising the findings by each question. Section 3. Results presents a summary of the interview responses. The energy wellbeing and hardship conceptual framework developed by MBIE (Ministry of Business Innovation & Employment, 2021) was utilised to group the codes into the themes associated with energy hardship found in the interviewees' responses, as presented in the discussion. Some themes will be mentioned by multiple respondents, and respondents will often talk about many themes in each answer, meaning the sum of n will not be necessarily equal to sixteen.

We chose this framework not only due to its relevance to the New Zealand context, but also it captures the diverse facets of energy hardship which include an intersection of economic, social, and environmental elements. Through the framework, we were able to characterise the interventions and see their patterns of action and interconnectedness, while also proposing actions to fill the observed gaps based on the mechanisms recommended in two major policy documents relating to energy hardship in Aotearoa: the MBIE's proposal document (Ministry of Business Innovation & Employment, 2021) and the Electricity Price Review (New Zealand Government, 2019).

Results

The interview findings are summarised below. Major findings include that the government has a strong influence on projects, even when they are carried out by social businesses or non-profit organisations. Additionally, the interviewees often explored poor housing quality and low incomes as causes of energy hardship. Teaching households about energy consumption was the most common intervention adopted by the interviewed organisations.

Major actors in Aotearoa

Aiming to determine who are the most influential groups, we asked the interviewees which New Zealand organisations they saw as major actors working towards energy hardship minimisation and eradication. The most popular responses were community organisations (n=6), Ministry of Health (n=6), MBIE (n=6), and budget advisors (n=6) as presented in Figure 3 below. Only actors cited by at least two interviewees were included (EECA = Energy Efficiency and Conservation Authority).

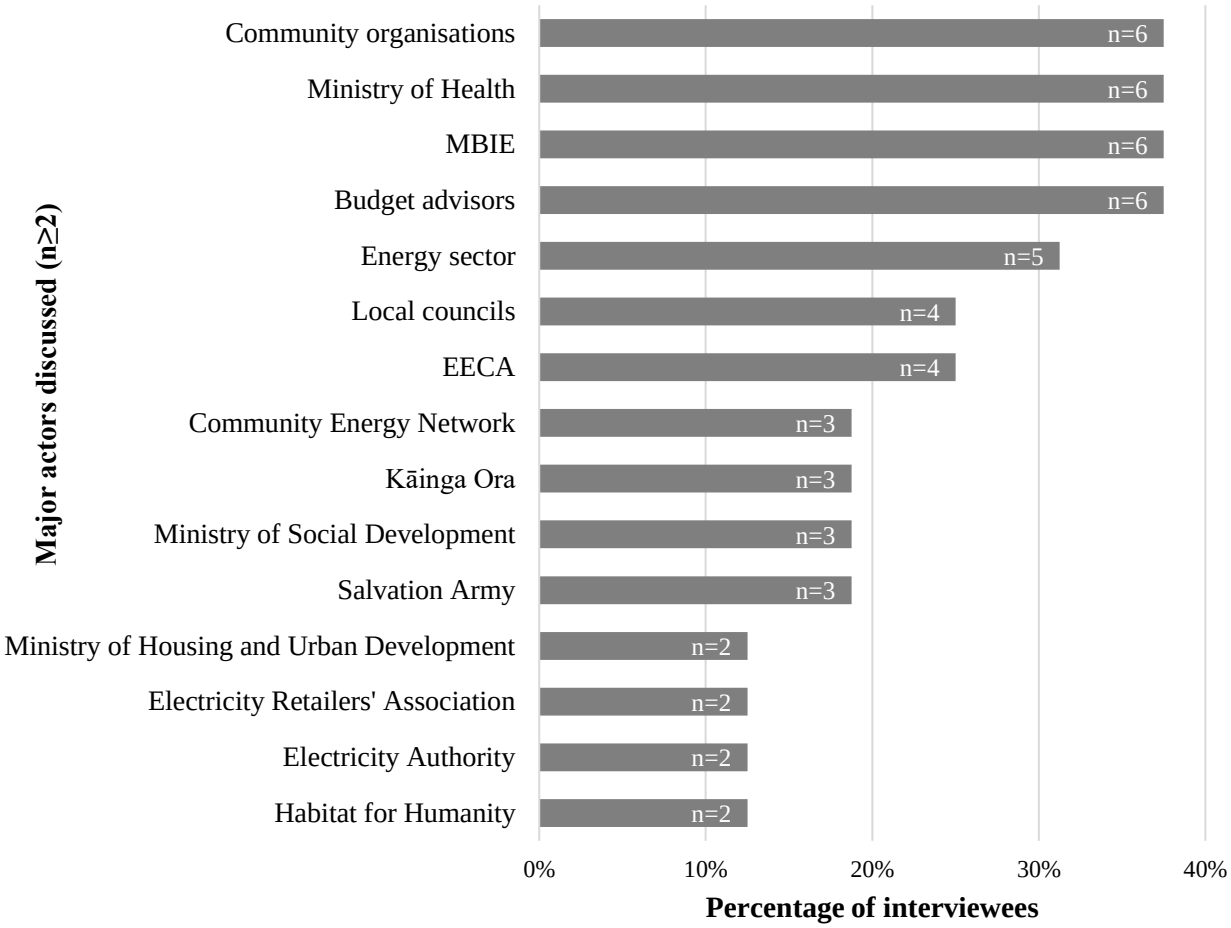

Figure 3: Major actors for eradicating energy hardship in Aotearoa according to the interviewees.

Energy hardship definition and indicators

To determine which components of energy hardship are used to identify the condition, we asked the interviewees if their organisations used specific definitions and indicators. Even though only a couple (n=2) of the interviewees reported following strict definitions and indicators, energy hardship was associated with financial issues for most of them (n=10), as seen in Figure 4 below.

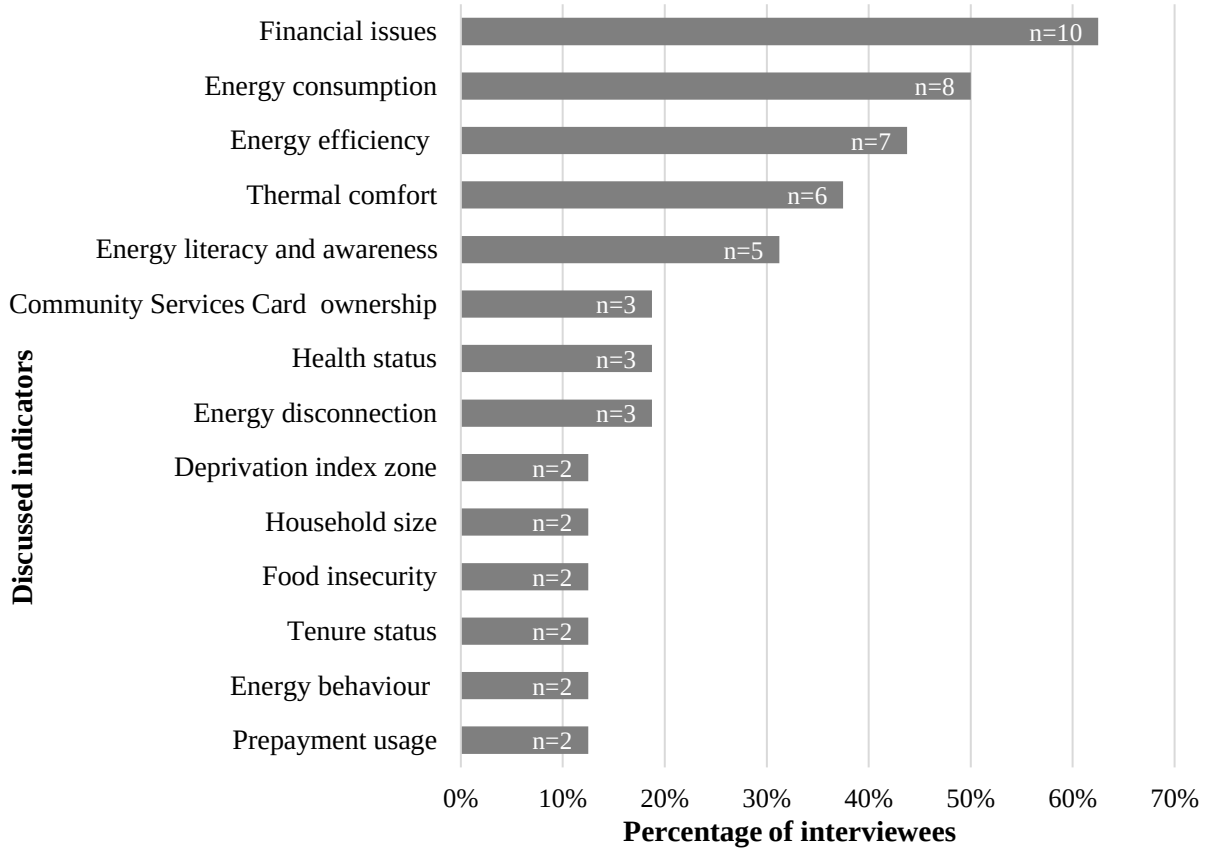

Figure 4: Types of energy hardship indicators used by the interviewees.

Purpose of eradicating energy hardship

To understand the values and priorities of the organisations, we asked the interviewees about the purpose of eradicating energy hardship. Improving health and wellbeing was the major reason discussed by interviewees (n=13). Common responses included achieving equity through social justice (n=8), improving the thermal comfort of households (n=7), ameliorating the lives of children (n=6), as well as providing financial savings to the government and households (n=6). Interviewees also explored topics such as making Māori lives better (n=2), protecting the elderly (n=1), adapting and mitigating climate change (n=1), reducing work absence (n=1), guaranteeing food security (n=1), having the ability to afford transportation costs (n=1), and reducing domestic violence (n=1).

Project description

Interviewees were asked to provide a brief description of their energy hardship projects with the purpose of understanding the types of interventions utilised by them. As presented in Figure 5 below, the most common topic was increasing energy literacy and awareness (n=11).

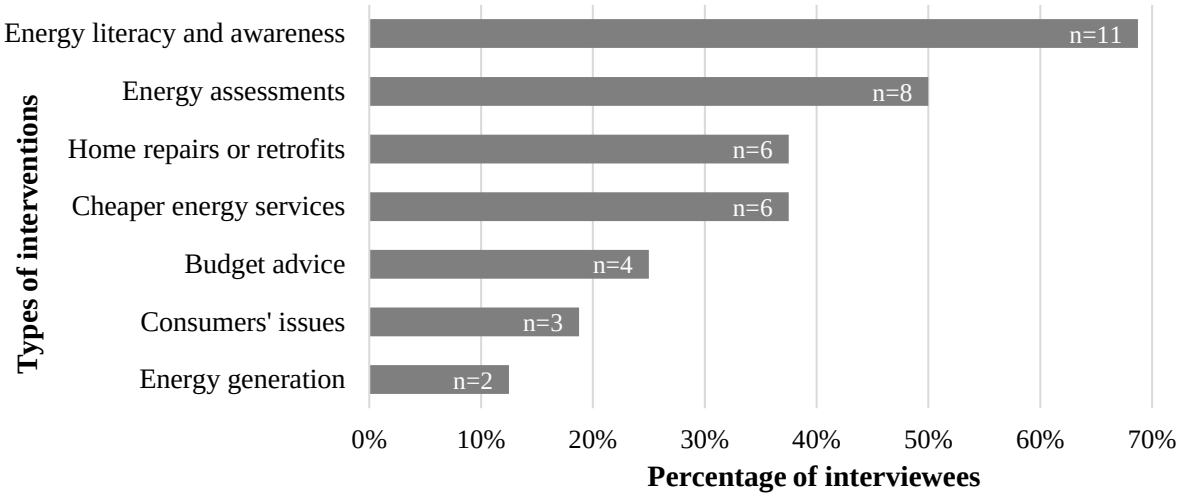

Figure 5: Types of energy hardship interventions adopted by the interviewees.

Project goals

We also wanted to comprehend what the projects described above were trying to achieve through their interventions. When asked about the main goals of the projects, interviewees frequently discussed enhancing thermal comfort at home (n=10). Figure 6 below shows the goals discussed by the interviewees.

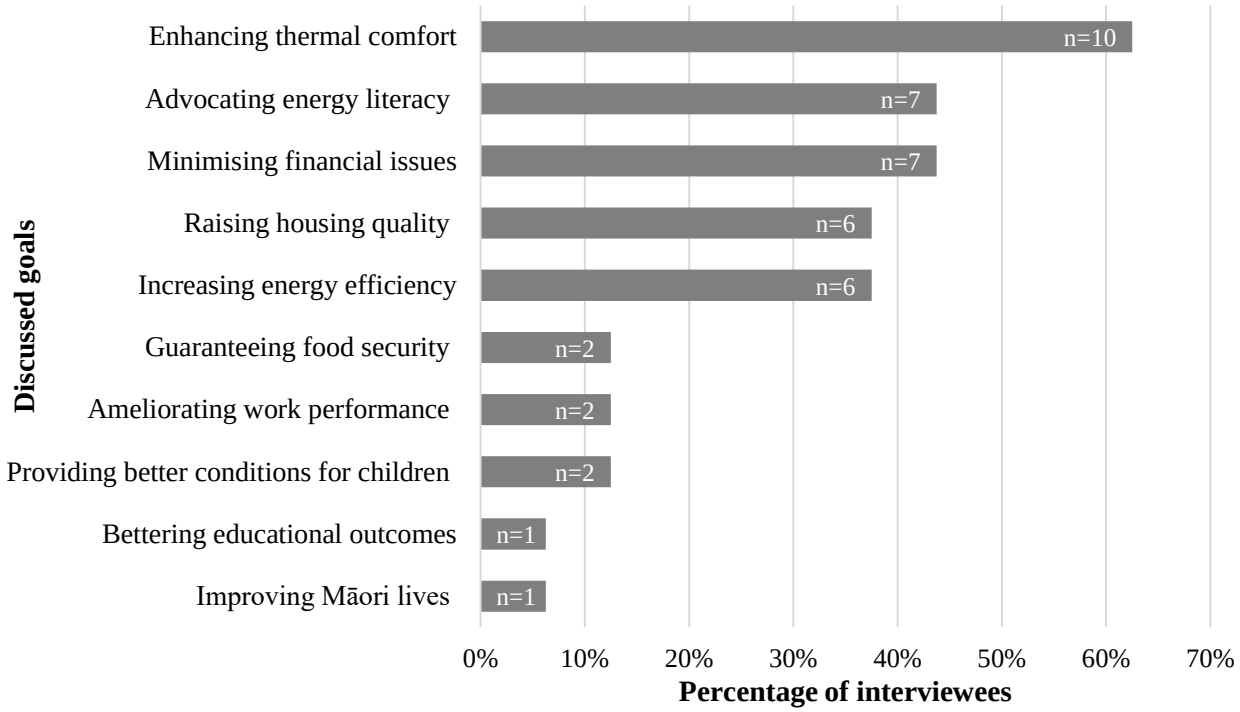

Figure 6: Project goals discussed by the interviewees.

Project target public

In order to see patterns in characteristics of the public benefiting from energy hardship interventions, we asked the interviewees about the target public for their projects. As presented in Figure 7 below, most of the responses were associated with sociodemographic characteristics of the target households: being low-income (n=9), having health conditions or disabilities (n=5), and being Māori or Pasifika (n=4).

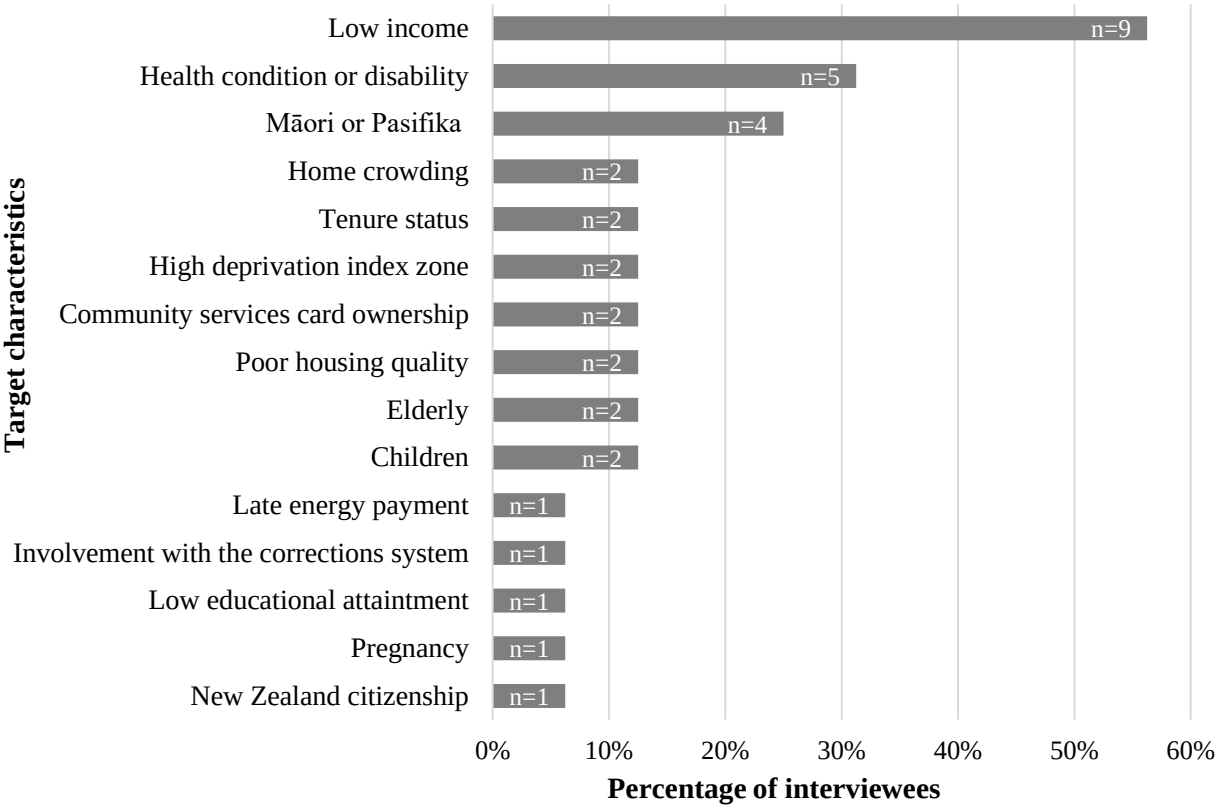

Figure 7: Characteristics of target public of projects discussed by the interviewees.

Project promotion

Considering that the types of intervention and their audience vary depending on the project, interviewees were asked how they reach out to their target public. Responses included the partnerships with other organisations (n=14), making use of advertisement (n=9), using social media to promote the projects (n=6), joining radio shows (n=4), participating in events (n=4), and relying on word of mouth of the users (n=2).

As for the partnerships mentioned, the main ones discussed were community groups (n=8), government agencies (n=8), energy companies (n=5), and health organisations and providers (n=5). Furthermore, educational organisations such as academia, schools, and libraries were mentioned by a few interviewees (n=3).

Cost to public

To understand the financial responsibility of those inventions, we asked the interviewees about what they charged the public. The most frequent answer was that the service was completely free (n=9). A few interviewees (n=4) explained that it could be free (depending on criteria such as the type of intervention and available funding from other partners), but the subsidy was often 80-90% of the costs. A couple of interviewees (n=2) reported having rates that are below market prices. One interviewee did not clarify.

Project funding

Knowing that subsidies for energy hardship projects are common, the interviewees were asked about their sources of funding for the projects. The government was cited by the majority of interviewees (n=12). Government institutions included the Ministry of Health (n=4), the Energy Efficiency and Conservation Authority (n=4), local city councils (n=3), MBIE (n=3), Ministry of Social Development (n=1), and the Electricity Authority (n=1). After the government, other mentioned sources of funding were the organisations' own budgets (n=6), trusts (n=5), philanthropy (n=4), and energy companies (n=4).

Project collaborators

Interviewees were asked to name their projects' collaborating organisations with the purpose of seeing their interconnectedness. Most projects (n=14) mentioned non-profit organisations and trusts, with the Electricity Retailers' Association of New Zealand being the most cited (n=5), followed by the Sustainability Trust (n=4), curtain banks (n=3), and churches (n=3). Government entities were regularly cited (n=9), predominantly being the Ministry of Health (n=7) and the Energy Efficiency and Conservation Authority (n=5). Some interviewees (n=5) talked about partnerships with energy companies, with the same number (n=5) making references to Māori organisations, as well as research institutions such as the

Building Research Association of New Zealand (n=5). Social enterprises (not including trusts) were less commonly discussed (n=4).

Comprehensive interventions

Considering the complexity of attempting to eradicate energy hardship, we asked the interviewees about large-scale interventions (beyond the capacity of their projects) necessary to eradicate energy hardship. The majority of interviewees discussed raising and ensuring housing regulations (n=10), as shown in Figure 8 below.

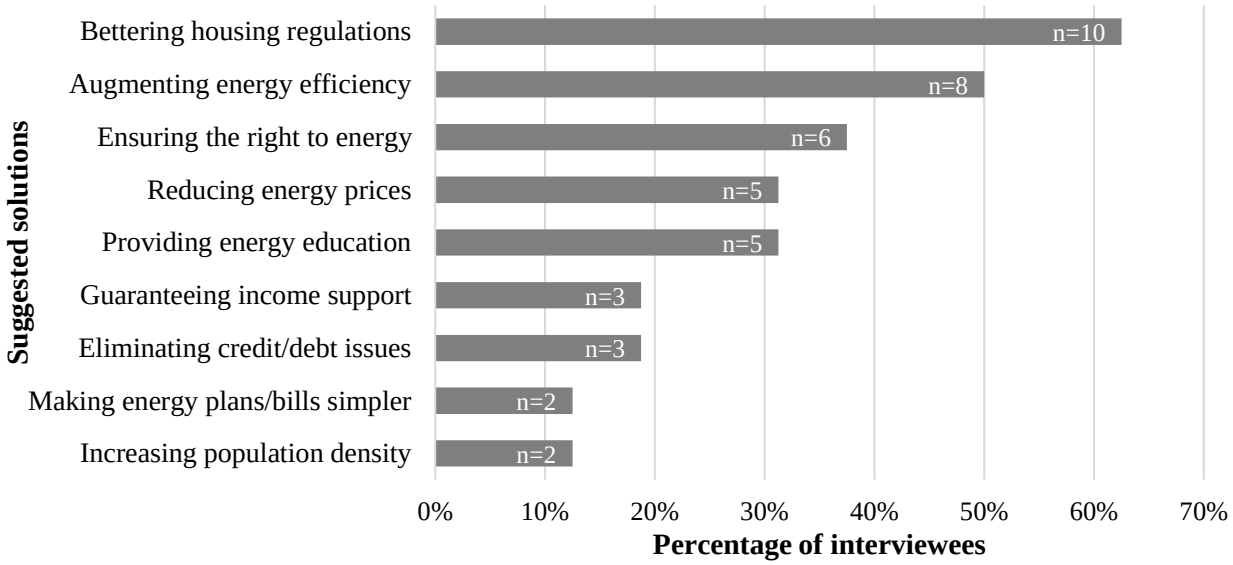

Figure 8: Large-scale interventions suggested by the interviewees.

Project next steps

Interviewees were asked about the next steps of their own projects to understand potential expansions of their scopes. The most frequent topics found were related to increasing the number of people the project serves (n=11), strengthening partnerships with other organisations (n=7), providing energy literacy and awareness (n=5), and gathering data and surveying (n=5). Less common topics included improving housing quality (n=4), obtaining more funding (n=4), ensuring Māori rights (n=2), ensuring consumers' rights (n=2), reducing disconnections (n=2), and producing energy locally (n=2).

Project issues

We wanted to understand the barriers encountered by the interviewees, and thus we asked them about their predominant issues in their projects. The main issue reported was guaranteeing sufficient funding (n=7). Other responses included poor housing conditions in Aotearoa (n=6), sociocultural barriers (n=6), ensuring co-operation between energy hardship actions (n=3), the lack of support for tenants and domestic energy consumers (n=3), and high energy pricing (n=3).

Thinking about the issues mentioned earlier, interviewees were asked if they would make any changes to the programme design if they were aware of what they currently know. Half of the interviewees (n=8) responded they would not or probably would not make any changes. Having the flexibility to adapt and evolve the programme according to the circumstances was discussed by the majority of interviewees (n=12). Making changes relating to communication and interaction (with customers and other collaborators) was unfrequently mentioned (n=4), as well as stating that the programmes are executed at a slow pace (n=3). Other less mentioned topics included dissatisfaction with political and policy changes (n=2) and the need to consider cultural aspects of communities (n=2).

Future of energy wellbeing

Finally, interviewees were asked about their view of a future without energy hardship since it can guide planning and outcomes. Most of them said it would be better in terms of health and wellbeing (n=12), as well as financially (n=10). Other topics included more happiness (n=7), better lives for children (n=5), improved educational outcomes (n=5), a more even playing field for all (n=4), increased resilience to climate change (n=3), higher use of self-generated energy (n=2), better food security (n=2), and less addiction (n=1).

Finally, the codes of all questions explored above were grouped into themes according to the MBIE's energy hardship conceptual framework (Ministry of Business Innovation & Employment, 2021), which are described next.

Discussion

Since energy hardship is a complex issue with multiple interconnected causes and consequences, are the current interventions in Aotearoa sufficiently diversified in their actions to have a significant impact on the condition? What else can be done to improve those actions? We analysed the responses of the sixteen interviewees according to the proposed energy hardship framework presented in the 2021 document released by MBIE.

We found that the interviewees presented several forms of approaches and were well interconnected with one another. The focus of most interventions related to energy citizenship. Using tactics that emphasise household-centred behavioural change and energy efficiency, this concept concentrates on promoting energy awareness and literacy for consumers (Wahlund & Palm, 2022). While this is an extremely important short-term approach (especially for households that are currently struggling), it does not solve the overarching issues of poor housing and insufficient incomes in New Zealand. Large-scale solutions that are heavily dependent on government's efforts are needed in in Aotearoa to guarantee energy wellbeing through energy security, environmental sustainability, and energy equity.

Service literacy

According to the MBIE document (Ministry of Business Innovation & Employment, 2021), service literacy is a component of energy hardship due to the following elements:

- Energy literacy (knowing about the energy sector),

- Energy awareness (understanding and optimising domestic use of energy),
- Digital literacy (using technology to compare plans and manage energy use),
- Financial and numerical literacy (understanding bills and comparing plans), and
- Language used (communicating effectively with the provider).

The lack of service literacy can be originated from issues such as insufficient knowledge on the part of the customers and incompetence of the energy retailers when promoting services and communicating with customers. Less informed clients can be victims of misleading marketing practices from retailers and often end up having suboptimal plans (e.g. paying more than other options and having worse services) due to obscure language (Willand & Horne, 2018).

Of those interviewees that considered making changes to their programme design, making changes relating to communication and interaction was mentioned by a majority of them (n=4). Clear communication using simple terms benefits transparency and trust, which can dimmish plan and payment issues with customers.

Service literacy was the predominant theme relating to the type of service offered by the projects, which included increasing energy literacy and awareness (n=11), performing budget advice (n=4), and handling consumers' issues (n=3). The quote below represents an organisation that has service literacy as its main approach to minimising energy hardship, which involves assisting customers (including digital and energy literacy issues) to make sure they get the best plan for their needs:

> We also, as part of that service, have a call centre where people can call up and it's particularly relevant to people in hardship because they may not have a computer or may not have digital literacy. Or may just not have enough knowledge of the electricity industry to feel confident. And so we have a number they can call, and we

will talk people through the site, walk them through it, or answer any questions they might have.

Additionally, the most frequent responses regarding major actors working towards energy wellbeing in Aotearoa included budget advisors (n=6). Since financial and numerical literacy is needed to make plan comparisons, budget advisors have an important role in guiding vulnerable customers to make the best energy decisions for their budget.

Educational efforts on service literacy are being offered to adults in New Zealand as requested, however, policies should be focusing on the following areas:

- Standardising energy plans and payment options to make comparison easier, by making "distributors offer retailers standard default terms for network access" (New Zealand Government, 2019, p. 35). However, we discourage putting the full responsibility on the customers to avoid being "tricked" into a bad plan by making them learn about literacy, numeracy, technology use, and knowledge of energy production and consumption is more resource-intensive and time-consuming to themselves and the organisations,
- Penalising energy retailers for engaging in misleading marketing tactics to attract clients and/or deliberately obfuscating details of their plans, services, and bills (e.g. prompt payment discounts as highlighted by the Electricity Price Review) (New Zealand Government, 2019, p. 27), and
- Maintaining *ad hoc* specialised assistance, especially for groups such as the elderly, people with learning disabilities, and non-native English speakers, as well as identifying their barriers (Ministry of Business Innovation & Employment, 2021, p. 45).

Summarising, service literacy skills are essential for consumers to critically analyse the options and make informed decisions for themselves. Multiple organisations in Aotearoa are handling those issues directly with domestic costumers, but policies that hold the energy

sector accountable for simplifying and making their plans and bills more transparent are needed.

Energy prices

The facet of energy prices has two components, as proposed by the Ministry of Business Innovation & Employment (2021):

- Pricing of all types of fuels (considering their daily, seasonal, and geographic variations), and
- Energy retail plans (including their details such as bundling and discounts).

Energy prices are vital components for determining fuel poverty. Boardman (2013) established that a threshold of 10% of income spent on required energy services could be used to indicate fuel poverty, being the official definition of the condition in England from 2001 to 2013 (Thomson et al., 2016). When asked about identifying energy hardship, a minority of interviewees (n=4) referred to the Boardman's definition, with one interviewee actually using it in their organisation. Nevertheless, that interviewee and other two criticised the use of the 10% definition, with one affirming that "the sort of the 10% of income measure is just totally irrelevant [to the New Zealand context]". The 10% definition has received critiques for reasons such as being outdated and region-specific, considering it is based on 1988 data from England (Belaïd, 2018; Berry et al., 2016; Liddell et al., 2012).

In September 2021, Kiwi households paid about 0.197 USD per kW·h, with the global average being 0.135 USD per kW·h (Global Petrol Prices, 2022). New Zealand had the 38th most expensive energy for domestic consumers compared to other 146 countries, being cheaper than Australia but costlier than Sweden, the USA, and Canada (Global Petrol Prices, 2022). When we asked interviewees about their project approaches, promoting cheaper energy services (n=6) was one of the most common responses. Meanwhile, reducing energy

prices to domestic costumers (n=5) was discussed as a larger-scale solution to energy hardship that is not comprised by the interviewees' own projects.

Curiously, another suggestion beyond the scope of the projects was increasing population density (n=2), as that could reduce costs associated with electricity distribution and petrol use. Having the ability to afford transportation costs was mentioned by only one interviewee as a reason for eliminating energy hardship - despite transportation rarely being present in fuel poverty discussions (Berry et al., 2016; Mattioli et al., 2017).

In essence, New Zealand has above-average electricity costs and we believe that policies focused on reducing them will certainly mean less financial burden to Kiwi households. However, the Electricity Authority stated that they do not recommend setting a price cap, as they prefer a market competitiveness approach at the moment (New Zealand Government, 2019, p. 31). About a third of the interviewees were engaged in interventions relating to less costly energy services, mostly through promoting cheaper plans. Lowering the energy prices can also be achieved through even urban planning prioritising population density, as rural households have more difficulty in accessing electricity and may pay more for the service (Ministry of Business Innovation & Employment, 2021). As proposed by MBIE (2021, pp. D-15), a new threshold needs to be established to identify energy hardship in Aotearoa, since using the 10% definition does not capture the reality of households.

Energy supply

In the MBIE document (Ministry of Business Innovation & Employment, 2021), energy supply is composed of:

- Type of energy meter used (e.g. use of smart meter),
- Security of energy supply (i.e. stability of energy delivery), and
- Sources of energy available (e.g. connection to electricity and gas grids).

New Zealand is considered a country with high energy equity, security and sustainability mainly due to its high use of renewable energy production (World Energy Council, 2021), especially considering the use of hydropower and geothermal for electricity (Ministry of Business Innovation & Employment, 2022d). Even though more than 98% of Kiwis have access to electricity (Stats NZ, 2018), there is no connection to the natural gas grid in the South Island (Ministry of Business Innovation & Employment, 2022c), a region with lower temperatures (National Institute of Water and Atmospheric Research, n.d.). Relying on alternative such as coal and firewood to supply domestic energy needs can be dangerous for the health of household members, especially children (Tin Tin et al., 2016).

The interviews showed that the organisations working on energy hardship projects are frequently connected to the energy industry in Aotearoa. Interviewees affirmed that MBIE (n=6) and the energy industry (n=5) were considered major actors working to reduce energy hardship. The Electricity Retailers' Association of New Zealand (n=5) and energy companies (n=5) were occasionally mentioned as partners of projects. Additionally, the partnership with energy companies (n=5) were a main way of the projects to connect with the target audience, and also a source of funding for some of them (n=4).

However, when asked about the type of approach used by the project to minimise energy hardship, providing energy generation (n=2) was rarely discussed, same as stating that producing energy locally (n=2) as next step of the project. Interviewees unfrequently stated that a future with energy wellbeing means higher use of self-generated energy (n=2), with one showing their support for locally produced energy that is also community-owned by stating "I'd like to see the Waikato people own their own generation instead of the generation as owned by the big corporate". The interviewees show that organisations often prefer to partner up with existing companies to increase energy wellbeing, but hardly through supporting energy generation as part of their actions.

Policies aiming to increase local energy production can diversify the grid, increase supply stability, and reduce costs associated with distribution (Walker, 2008), as well as minimise the use of alternative and unsafe fuels. Even though most energy hardship projects are not focusing on energy production, creating decentralised renewable power plants can be an extremely useful tool for achieving energy wellbeing in Aotearoa (Ministry of Business Innovation & Employment, 2021, p. 18; New Zealand Government, 2019, p. 63). Transferring the decision-making to the domestic energy consumers through measures such as community ownership of power plants means a more democratised energy sector focused on the community's needs (Burke & Stephens, 2017).

Dwelling appliances

The Ministry of Business Innovation & Employment (2021) proposed that the dwelling appliances facet of energy hardship is composed of the following elements:

- Energy efficiency of appliances (i.e. how the energy requirement to perform compares to other appliances of the same type),
- Appliances suitability and reliability (i.e. using the proper dependable appliance for each context), and
- Fuel type used by the appliances (e.g. natural gas and electricity).

Appliances that are old and misused by households are not only hazardous to them but are also wasteful in terms of energy and money (Boardman, 2013). Promoting energy efficiency in appliances has been a common action to reduce fuel poverty, primarily considering its cost/benefits to the health sector (Howden-Chapman et al., 2011). Despite not being innovative and being able to change due to political volatility, green subsidies that can be used to fund energy efficient appliances can promote energy democracy (Burke & Stephens, 2017).

Energy efficiency (n=7) was a frequent indicator used to measure energy hardship. Half of the interviewees discussed offering home energy assessments (n=8) as a project tactic. Increasing energy efficiency was a frequent response (n=8) to potential large-scale energy hardship interventions beyond their projects, and the most popular response regarding the main goals of the projects (n=6). One interviewee stated that they emphasise the financial savings of using energy efficient light bulbs to the public, since the topic is crucial to most households: "You could save the money. If you install an efficient light, you can make that [amount of] money a year and that sort of thing".

The Energy Efficiency and Conservation Authority (n=5) was occasionally reported by interviewees as a partner of their projects, also being cited as source of funding by some of them (n=4). EECA was also indicated as a major actor regarding energy hardship eradication (n=4). Their programme named *Warmer Kiwi Homes* is an example of green subsidy. Warmer Kiwi Homes not only offers subsidies for efficient heaters - it also includes home insulation subsidies (Energy Efficiency and Conservation Authority, 2023).

While promoting the financial and health benefits of energy efficient appliances for domestic consumers is important and has been done, even the poorest households should be able to have them (New Zealand Government, 2019, pp. 64, 68). Without subsidies, only the wealthiest households can invest in appliances that are costlier upfront but present reduced costs of operations, worsening energy equity. The process for obtaining those subsidies needs to be simple, well publicised, and as cheap as possible to assist all New Zealand households.

Dwelling characteristics

The elements that compose dwelling characteristics according to the Ministry of Business Innovation & Employment (2021) are:

- Dwelling type (e.g. standalone house, ground-floor apartment),

- Dwelling functionality (i.e. if the dwelling attends to the needs of the residents), and
- Dwelling habitability (i.e. if the dwelling is a healthy and secure shelter).

Energy efficiency also relates to how materials, design, and location affect the thermal envelope of a home. Home performance assessments (i.e. energy audits) look at both housing quality and the efficiency of relevant appliances (particularly relating to indoor heating/cooling and water heating) (Sharma et al., 2021). Housing issues such as poor insulation and airtightness may result in higher energy expenses, low indoor temperatures, leakages, presence of mould, and health issues (Boardman, 2013; Ingham et al., 2019).

The most discussed goal of the projects included enhancing thermal comfort at home (n=10) and improving housing quality (n=6) being a common response as well. A majority of interviewees also considered ensuring adequate housing regulations (n=10) as necessary to achieve energy wellbeing, being beyond the capacity of the projects.

Poor housing conditions in New Zealand (n=6) was frequently considered a main issue found in the projects. Meanwhile, households living in poor housing conditions (n=2) were referred to by a minority of interviewees as the target of the projects. Some interviewees highlighted providing home repairs or retrofits (n=6) as a description of the service provided by their projects. The following quote describes one intervention type performed by the project, including aspects of both appliances and dwelling characteristics, since these aspects are closely connected:

> Our assessors who will go out and do the in-depth assessments on a range of different energy efficiency, housing quality, and social and health needs and provide that assistance, and they also do the smaller measures and there might be other staff who might go in and deliver curtains, or hang curtains for the household, make curtains,

> our curtain bank will make curtains and then our heating and insulation staff will go and do proper assessments at the property and then deliver, install the insulation, heating, ventilation depending on the particular programme or what the house needs.

A few interviewees cited the Building Research Association of New Zealand (n=4), Sustainability Trust (n=4), and curtain banks (n=3) as partners of projects. Kāinga Ora (n=3) and the Community Energy Network (n=3) were described as important actors working towards energy wellbeing.

Housing quality in New Zealand is considered poor, especially in terms of thermal insulation (Howden-Chapman et al., 2011; Lloyd, 2006). To improve that, building standards should be enforced (Ministry of Business Innovation & Employment, 2021, p. 16), but for all types of living situations with periodical inspections. Subsidies such as Warmer Kiwi Homes and home energy assessments need to be guaranteed to improve housing conditions. Without emphasis on bettering housing issues in the country, most efforts against energy hardship will be in vain.

Environment

The environmental aspect of energy hardship contain:

- Location (e.g. region where the household lives and position of the dwelling),
- Climate (i.e. weather patterns in specific places, including abnormalities caused by anthropogenic activity), and
- Taiao (i.e. Māori framework that connects environmental wellbeing to human wellbeing) (Ministry of Business Innovation & Employment, 2021).

The energy needs of Kiwi households need to consider their location and climate, as those can greatly differ (Lloyd, 2006). Considering that climate change affects the patterns in

temperature, precipitation, and sea level (IPCC, 2022), the interconnectedness between society and the environment are a major component of planning a future of energy wellbeing.

Still, environment was not a frequent theme discussed by interviewees. Only one interviewee brough up the Māori perspective on the interconnectedness of human and the environment. Increased resilience to climate change (n=3) was not often discussed as a component of a future without energy hardship, whereas adapting and mitigating climate change (n=1) was rarely explored as a reason for eliminating the issue in the first place. One interviewee discussed a future of energy wellbeing with benefits relating to climate change resilience which include more protection against extreme weather phenomena:

> Going back to climate change a hundred percent more adaptable to what's going to happen there, whether that's a physical impact, you know, like storms and droughts and what have you, or a social one like economics…

In the Electricity Price Review and the Defining Energy Hardship documents, environmental aspects are present but are not the main focus (Ministry of Business Innovation & Employment, 2021, p. 18; New Zealand Government, 2019, pp. 63-68). Housing efforts for reducing energy hardship needs to make use of durable construction materials and appliances, not only for resilience against impact in case of extreme weather phenomena but to reduce the frequency of replacement. Planned obsolescence is resource inefficient and exacerbates environmental issues related to greenhouse gases emissions and waste management. Regulations need to be in place to avoid active degradation of products while making it easy for consumers to fix products, replace broken components, and properly dispose non-functional items beyond repair. This also means financial savings for households, especially when associated with reducing energy use and emissions through

product design and energy aware habits. Large-scale retrofits can not only alleviate energy hardship for households but also diminish climate change (Lund et al., 2021).

Climate change mitigation and adaptation intervention also need to include decentralised renewable energy systems and demand-side management to increase energy security with lower environmental impacts and costs (IPCC, 2022). Additionally, transportation is becoming more relevant in energy hardship discussions due to its impact on households' finances (Berry et al., 2016) and also the increasing use of electricity as fuel (Mattioli et al., 2017). Higher investments in public transit systems (prioritising low or no emissions vehicles) can stimulate energy and mobility justice (Sareen et al., 2022). Still, transportation was barely mentioned in the Electricity Price Review and was stated to be out of scope in the Defining Energy Hardship proposal, with both documents discussing personal electric vehicles (Ministry of Business Innovation & Employment, 2021, pp. 13, 43; New Zealand Government, 2019, pp. 32, 57, 65, 68).

While only a few interviewees associated energy hardship with environmental issues, those aspects should not be overlooked. We are living in times of climate crisis, and energy interventions are the key to minimising its catastrophic consequences (IPCC, 2022). Environmentally-conscious energy hardship actions can include policies focused on different areas: urban planning, energy management, housing and product regulation, green design, and energy awareness promotion.

Household circumstances and practices

The proposed components of a household circumstances and practices associated with energy hardship are:

- Household composition (e.g. number of members, age, health status),

- Household energy needs (i.e. required energy consumption relating to its composition),
- Household culture and practices (i.e. the influence of their background and habits on energy), and
- Household energy norms (i.e. what is perceived as normal in terms of energy use and thermal comfort) (Ministry of Business Innovation & Employment, 2021).

Energy hardship if greatly influenced by the composition of a household and how they interact with energy use in their dwelling (Boardman, 2013). Certain characteristics can make the household more vulnerable to energy hardship due to their increased energy needs, such as the presence of children, disabled people, and the elderly (O'Meara, 2015). Households' backgrounds can reinforce ideas such as normalising enduring cold indoors and creating coping mechanisms (McKague et al., 2016).

A household's energy consumption was brought up by half of the interviewees (n=8) as an indicator used to identify energy hardship. A few interviewees mentioned the association between energy and health (n=3) when discussing indicators. Low-income New Zealanders who have a Community Services Card (access to subsidised healthcare) may qualify as in energy hardship according to some interviewees (n=3), but this criterion was criticised by one of them (n=1).

The next step of their projects frequently discussed increasing the number of people the project serves (n=11), strengthening partnerships with other organisations (n=7), and gathering data and surveying (n=5).

> So we'll be asking people questions about their behaviour around how they use their heaters and the rest of the house. And we'll also be asking them about their wellbeing and how that's changed. So that is going to give us lots of new information.

The quote above is part of a response about the next steps of a project. It talks about gathering data and surveying households on their actual energy use, energy behaviour, and wellbeing impacts. While the MBIE document proposed the actual energy use of a household as an indicator, they indicated it to be a temporary solution until defining how to estimate its energy needs (Ministry of Business Innovation & Employment, 2021, pp. 33-34).

Some interviewees reported that the target public of their projects included having health conditions or a disability (n=5) and being Māori or Pasifika (n=4). Health organisations and providers (n=5) were often considered as partners that help the organisations to reach out to the target public. Interviewees frequently affirmed that promoting health (n=6) was a main goal of their projects.

The Ministry of Health (n=4), local city councils (n=3), and the Ministry of Social Development (n=1) were identified as sources of funding of some projects, with the Ministry of Health being a collaborator of several projects (n=7). Interviewees also brought up other partnerships, such as with Māori organisations (n=5), social enterprises (not including trusts) (n=4), and churches (n=3). Some of the groups viewed as the main actors working towards energy wellbeing by the interviewees were the Ministry of Health (n=6), community organisations (n=6), local councils (n=4), the Ministry of Social Development (n=3), and Salvation Army (n=3).

Improving health and wellbeing was a reason for eradicating energy hardship by the majority of interviewees (n=13). Other responses included achieving equity through social justice (n=8), ameliorating the lives of children (n=6), making Māori lives better (n=2), protecting the elderly (n=1), and reducing domestic violence (n=1). Most interviewees imagined better health and wellbeing (n=12) in a future without energy hardship, with some

also stating more happiness (n=7), improved educational outcomes (n=5), better lives for children (n=5), and a more even playing field for all (n=4).

In Aotearoa, the health sector collaborates with organisations that provide home energy assessments to discuss energy habits and potentially offer assistance regarding repairs and retrofits. Health and social services need stronger collaboration with energy providers to guarantee adequate service to vulnerable customers and enforcing the Electricity Consumer Care Guidelines (Electricity Authority, 2021; Ministry of Business Innovation & Employment, 2021, pp. 4, 10, 37). Households in vulnerability should also be priority for grants and subsidies such as the Warmer Kiwi Homes. However, programmes should also be available for those who are not New Zealand citizens and those who do not own their homes.

Household resources

The Ministry of Business Innovation & Employment (2021) considers seven factors when discussing household resources associated with energy hardship:

- Digital access (i.e. having a phone, computer, and internet connection to manage energy issues and communicate with service providers),
- Payment methods (e.g. internet transfer with discounts, direct debit, credit card with extra fees, prepayment credits bought at a dairy),
- Mātauranga (i.e. Māori perspective on the world and resource use),
- Time and assistance available (i.e. time availability to manage energy and potential support from organisations or family members),
- Tenure security (e.g. private rental, social housing, homeownership),
- Household income (i.e. household money earned by all applicable sources, including benefits and assistance), and
- Financial resilience (e.g. debt, savings).

Fuel poor homes are often overrepresented by tenants earning low incomes (Fahmy et al., 2011). Unfortunately, tenants and landlords have antagonistic interests. Many tenants live in poor quality housing, and they do not have the right to make upgrades or retrofits to reduce their energy consumption (Barton, 2014). Meanwhile, the landlords can be uninterested in doing so without enforced regulations since they do not pay for the energy bills (Barton, 2014).

Another issue is the persistent lack of access to modern energy infrastructure, resulting in the hazardous, tedious, and lengthy task of frequently obtaining fuels (Li et al., 2014). This requires time, tools, and potentially, access to use the land and its resources in the case of biomass. Lack of knowledge about sustainable biomass extraction can result in environmental degradation (González-Eguino, 2015). Solid fuels (e.g. firewood, charcoal, pellets) are very energy inefficient (Li et al., 2014), are often more expensive than modern fuels (González-Eguino, 2015), and can also cause serious respiratory issues when utilised indoors (World Health Organization, 2018).

Interviewees frequently associated ensuring the right to energy and ending disconnections (n=6) as necessary interventions beyond the scope and capacity of the projects, as well as creating more income support (n=3) and eliminating bad credit and debt issues for costumers (n=3). The quote below explores how financial issues exacerbate energy hardship by creating barriers to receive assistance:

> …make it important that consumers have rights underlying issues with lack of income that most people, even on a benefit income or below the poverty line… may have issues with debt collection that are getting in the way of them receiving the benefit.

When asked about indicators of energy hardship, most interviewees (n=10) associated the condition to financial issues, meaning the major indicator reported related to household

resources. Additionally, interviewees infrequently cited disconnections due to lack of payment (n=3), the use of deprivation index (socioeconomic deprivation profile on specific areas) (n=2), and food insecurity (n=2). One interviewee discussed the need for fuel associated with cooking, and another one explored the incapacity to afford food after energy expenses. Additionally, tenure was discussed by a couple of interviewees (n=2).

Low-income households (n=9) were reported as the target public of the projects by a majority of interviewees. The two most popular responses regarding the next steps of the projects were augmenting the number of people the project serves (n=11) as making partnerships with other organisations stronger (n=7), which relate to assistance available to households.

Whereas most projects cost nothing to the public (n=9), the predominant issue found in the projects was guaranteeing sufficient funding for the projects (n=7). The government is the main source of funding of projects, and the second most cited group that promotes them. Community organisations were considered the major partners that reach out to the target public, as well the major actors responsible for eradicating energy hardship in Aotearoa. As for general collaborators of the projects, non-profit organisations and trusts were the main groups reported by the interviewees.

Household resources is a complex facet of energy hardship, and a major focus of the projects represented by our study. Interventions to ameliorate the material conditions of households require efforts from multiple organisations, primarily the government. Further actions needed to solve the resource issues from its root causes must include ensuring living wages and guaranteeing the rights of tenants. Without removing the reasons that create material deprivation, all interventions will be suboptimal.

Conclusion

The main goal of this study was to assess whether the interventions of sixteen organisations working to minimise energy hardship covered all facets of energy hardship described on the MBIE framework. Our study showed that the interventions are diversified in their foci and well connected. However, the environmental facet of energy hardship is the most overlooked, meaning there is a need to integrate energy rights actions with environmental justice. Furthermore, while most energy hardship projects work with individual or household-level interventions (e.g. teaching about energy use), a myriad of large-scale interventions and policies are crucial to eradicate the condition by improving housing, income, and energy security.

The Electricity Price Review and the Defining Energy Hardship documents show that New Zealand already considered the main policies that are needed to fill the gaps that exist with the current interventions, but the complexity of many of them means they are not fully implemented yet. Still, our methods of analysis of the interviews, the MBIE framework, and the documents allowed us to highlight which specific areas need extra attention from the government to cover the issue at the moment, as well as includes suggestions that have not been included in those documents.

Summarising, what has been done is very important to avoid the short-term effects of energy hardship in vulnerable households. However, energy hardship will only cease with a significant restructure of those larger systems, showing the importance of using the MBIE framework to acknowledge all the facets of the issue. Such framework is comprehensive and can still be relevant to international contexts with minor modifications.

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Chapter Five – The heat goes on: Simplifying the identification of energy hardship

Abstract

Energy hardship affects over 6% of households in New Zealand, defined as the inability to afford and obtain energy services. In late 2021, the Ministry of Business, Innovation and Employment proposed 26 indicators to identify energy hardship. However, this study aimed to explore the leading causes and consequences of energy hardship in the following year, including relevant variables not included in the proposed indicators. A survey of 1278 Kiwi respondents was conducted to understand their demographic and energy consumption patterns. Using 17 of the proposed indicators, the severity of energy hardship was measured and related to other important variables. Results showed that energy unaffordability, poor housing quality, and choosing between food expenses or energy bills were the main drivers of energy hardship. Consequences included feeling cold due to restricted energy consumption and accumulating energy debt. This study provides valuable insights to simplify the identification of households experiencing energy hardship and highlights the main areas of focus for policy development aimed at eradicating this problem.

Introduction

The residential electricity demand has increased in New Zealand (Ministry of Business Innovation & Employment, 2022c), as well as its costs (Ministry of Business Innovation & Employment, 2022e). While virtually all homes in the country are connected to the electricity grid (IEA et al., 2022), the South Island (where roughly a quarter of the population lives (Environment Canterbury Regional Council, 2021)) has some particularities compared to the North Island, including no access to the gas grid (Ministry of Business Innovation & Employment, 2022d), colder average temperatures (National Institute of Water and Atmospheric Research, 2010), lower-income households (Stats NZ, 2018b), and higher

usage of biomass and coal for heating (Ministry of Business Innovation & Employment, 2022c; Stats NZ, 2018c).

It is estimated that over a hundred thousand households in New Zealand are unable to have adequate access to energy, corresponding to more than 6% of all households (New Zealand Government, 2019; Stats NZ, 2020). The country has poor housing quality, mainly relating to insufficient thermal insulation, (Butler et al., 2003; Howden-Chapman et al., 2021; Lloyd, 2006) and a high number of excess winter deaths (Davie et al., 2007). In 2019, The New Zealand government released a document entitled, *Electricity Price Review*, which contained recommendations for understanding and minimising energy hardship in the country (New Zealand Government, 2019).

Energy hardship includes the lack of both affordability of energy access and of sufficient modern energy infrastructure (New Zealand Government, 2019) . The former issue is the most relevant to New Zealand, and it relates to the concept of *fuel poverty* used in the United Kingdom and *energy poverty* used in the European Union.

Two years after the Electricity Price Review, the Ministry of Business, Innovation and Employment (MBIE) proposed a definition and indicators to identify energy hardship in the country (Ministry of Business Innovation & Employment, 2021). After consultation with the general public and experts, the condition is considered to be one extremity of a spectrum (not a binary condition), with the opposite end being *energy wellbeing*, officially defined as "[w]hen individuals, households and whānau [family, extended family, or community living together] are able to obtain and afford adequate energy services to support their wellbeing in their home or kāinga [Māori settlement]" (Ministry of Business Innovation & Employment, 2022a).

The twenty-six MBIE energy hardship indicators were developed by a multidisciplinary team, which also received external feedback, focus on the three main origins of this condition: income, housing quality, and energy costs (Ministry of Business Innovation & Employment, 2021), including objective and subjective measures. We wanted to analyse the patterns in households that present those indicators to prioritise them, leading to simpler detection methods.

What are the common causes and consequences of energy hardship in Aotearoa [New Zealand]? To find the answer, we collected responses from a total of 1278 respondents (one from a nationally representative survey and another survey with customers of a social retailer) to identify common trends in energy hardship. We identified what issues are pushing households into energy hardship, as well as the results of the condition. Our findings can be used to create interventions to minimise both the causes and consequences of energy hardship.

In the next section, we describe the methods used for carrying out a regional and a local survey and their data analyses, followed by our survey findings. Subsequently, we discuss our survey results and its implications regarding energy hardship policies, being summarised in the conclusion.

Methods

To understand the severity of energy hardship, survey questions were related to the indicators proposed by MBIE (Ministry of Business Innovation & Employment, 2021) (see Appendix C for survey questions and Appendix D for MBIE indicators). Each MBIE indicator used was considered to be equal to one point on the energy hardship point score (EHPS) of each respondent. The higher the score, the further the respondent is from energy wellbeing. Other questions relating to issues associated with energy hardship were based on

additional literature (Boardman, 1991; Healy & Clinch, 2002; Hills, 2012; McKague et al., 2016; Mould & Baker, 2017; Thema & Vondung, 2020; Thomson & Snell, 2014; Waddams Price et al., 2012).

All survey questions were tested and analysed by professionals from fourteen different organisations, including government agencies, energy companies, non-profits, and research companies. Those professionals provided feedback on the survey itself, its delivery, and potential rewards. Ethics approval was provided in May 2022.

The first survey was sent to 2736 clients of the low-cost electricity retailer OurPower (Waikato region, North Island), which was selected because it is the retail brand of WEL Networks – a community-owned distribution company (OurPower, 2023). WEL Energy Trust holds 100% of the shares of WEL Networks, investing millions of NZD annually on grants for community projects and energy efficiency in the Waikato region (OurPower, 2023; WEL Networks, 2023).

From 20 June 2022 to 10 July 2022, we obtained 983 responses. Of those, 773 of those considered valid responses (completed the survey). The survey was shared via email from OurPower to their clients, and the email highlighted the survey reward: five respondents would be selected by draw to win one month of free electricity. Respondents were asked if they were interested in potentially receiving rewards, and those that said that were interested also agreed to respond to a follow-up survey in December 2022.

The second survey contained virtually the same questions as the first one, except for details relating to being an OurPower client, rewards, and correcting wording for clarity. Another modification was adding the answer option: *Do not know or prefer not to answer* rather than letting respondents skip questions. The second survey was shared via email by the data company Dynata, to a database of potential respondents (at least eighteen years old and

responsible for making decisions regarding energy) as a nationally representative sample. Sample quotas based on region and ethnicity were used to ensure the final valid sample is representative of the New Zealand population, with gender and age not being considered as the responses represent the whole household. From 7 to 19 September 2022, we obtained 559 responses, and 505 of those were considered valid responses.

Besides OurPower, we were able to partner up with three local organisations to provide survey rewards: Habitat for Humanity in Northland and Auckland (non-governmental organisation), Northpower in Northland (community-owned electricity distributor), and Orion in Canterbury (community-owned electricity distributor). Orion was the only organisation located in the South Island (see Figure 9 below for reference).

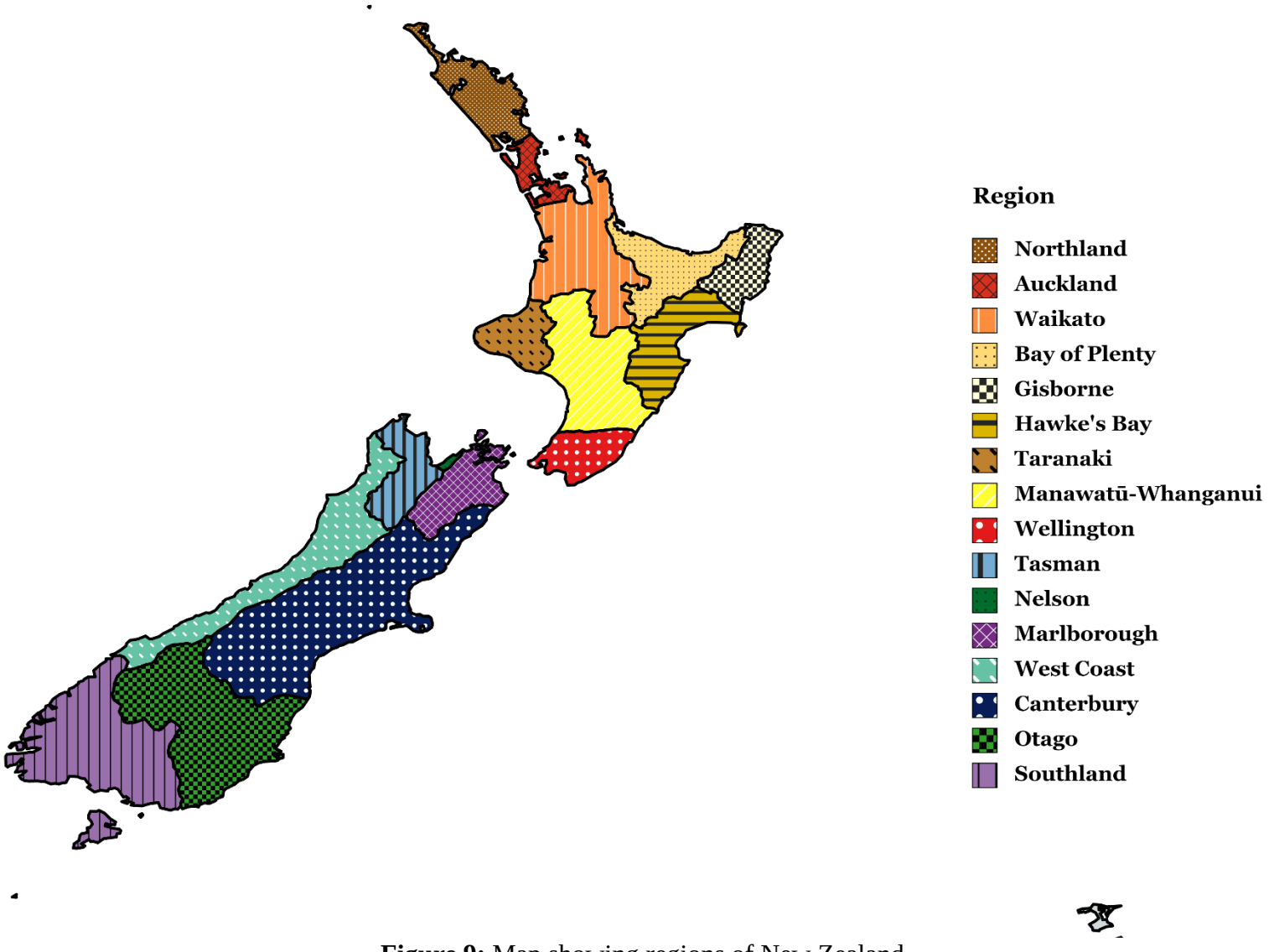

Figure 9: Map showing regions of New Zealand.

At the end of the second survey, if respondents with five or more EHPS in the mentioned regions, they were able to agree to obtain survey rewards. Rewards included energy advice, information on energy efficiency services and eligibility for subsidies, and energy-related items (e.g. education booklets, heaters, blankets, hot water bottles, draught stoppers, condensation squeegees, hygrometers, insulating curtains, and mould cleaning kits). Respondents who stated to be interested in potentially receiving rewards likewise agreed to respond to a follow-up survey in December 2022. Both surveys were conducted via the Qualtrics XM platform (Provo, Utah, USA) version June-December 2022.

Nine MBIE indicators were excluded due to access to electricity supply already being fully present in the OurPower survey (*no access to electricity supply*), overlap of indicators (*dampness and/or mould problems - major*), moving line nature (*proportion of AHC* [after housing costs] *household income spent on domestic energy costs twice the median or more (moving line)*, *proportion of BHC* [before housing costs] *household income spent on domestic energy costs twice the median or more (moving line)*, and *absolute domestic energy expenditure half the national median or less (moving line)*), ambiguous phrasing of question (*indoors always colder than would like in winter*), and respondent confusion when reporting their incomes (*proportion of AHC and BHC household income spent on domestic energy costs twice the median or more (moving and fixed lines*)) as well as whether they have an account with a financial institution and are connected to the electricity grid (*no access to financial institution account* and *no access to electricity supply*) (Ministry of Business Innovation & Employment, 2021).

Variables were classified as a cause of energy hardship according to O'Sullivan and Viggers (2021, p. 65) if they related to “housing quality, appliance efficiency, energy source and price, and occupant needs and income”, and the remaining variables were set as

consequences. However, some issues can be both a cause and consequence and consequence of energy hardship, depending on the circumstances (Baker et al., 2018).

The statistical analysis to measure the strength of the relationship between the indicators used and other issues related to energy hardship were performed through Qualtrics. We analysed answer options separately, allowing the relationship between EHPS and variables to be used independently in further studies and policies, without being attached to all other variables.

When relating the EHPS with a group comparison of more than three or more options at a time, we used a more robust version of ANOVA, the one-way ANOVA test using Welch's F-test, as it can be used for both parametric and non-parametric data that does not have equal variance. For comparing EHPS with another group of unequal sample size and variance (comparing two options at a time, e.g. Māori selected and Māori unselected), two-tailed Welch's t-tests were used as they analyse the possibility for a substantial difference in means in either direction. However, if the distribution was not normal, sample size was too small, or if there were outliers, the t-test had to be ranked. When comparing EHPS to groups with data using exact numerical values, we used Pearson’s r correlation for those with parametric data with high sample sizes and scalar or interval nature. Otherwise, Spearman's ρ ranked correlation was used for groups with non-parametric data, ordinal nature, and regardless of having a normal distribution or high sample size.

P-values and effect sizes of all analyses were used to determine which characteristics are the most relevant for determining if a Kiwi household is in energy hardship (p-value to see if there is a statistically relevant relationship between each variable and the EHPS, and the effect size to describe how strong the variable is). Additionally, a confidence interval (CI) of 95% was adopted for this study.

Due to the known inequality in material conditions, we hypothesised that some groups would be overrepresented in households in energy hardship: Māori, Pasifika, disabled people, tenants, residents of the South Island, and people with lower educational attainment (Ambrose & McCarthy, 2019; Brabo-Catala et al., 2022; Butler et al., 2003; Clark et al., 2021; Lloyd, 2006; McKague et al., 2016; Stats NZ, 2018a). We also had also expected to see that affected households to have inferior health outcomes (Davie et al., 2007; McKague et al., 2016; O'Sullivan et al., 2016; Tin Tin et al., 2016).

Results

Energy hardship point scores

Overall, the national survey respondents presented lower EHPS compared to OurPower respondents (Table 7 below). In both surveys the respondent distribution based on EHPS points was positively skewed (Figure 10 below), with OurPower respondents being more predominant after EHPS>5.

Table 7: Comparison of energy hardship point scores between OurPower and the national survey (SD=standard deviation).

Survey	Total (n)	Mode	Median	Average	CI	SD
OurPower	773	2.00	4.00	3.97	3.78 to 4.17	2.8
National	505	2.00	3.00	3.30	3.08 to 3.51	2.5

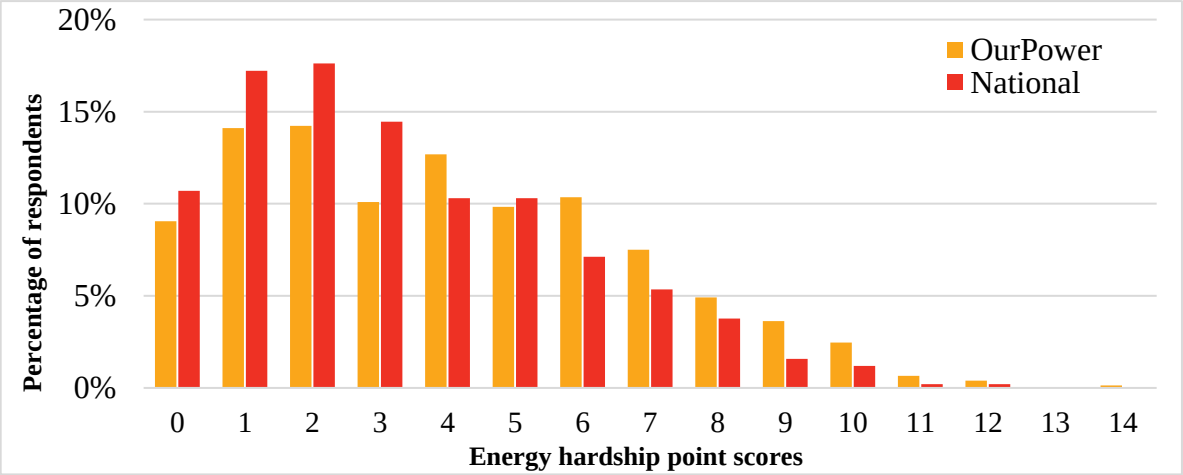

Figure 10: Distribution of energy hardship point scores across OurPower and national survey respondents.

Describing households

Location

The OurPower survey asked respondents for their postcode, being transformed into their equivalent cities/towns. One-way ANOVA test using Welch's F-test showed a statistically significant relationship between each city/town and the EHPS of respondents (P-value <0.00001), but the effect size is small (Cohen's f=0.232). As most of these locations had small sample sizes, results at this level are unlikely to be representative.

Respondents of the national survey provided their region. However, one-way ANOVA test using Welch's F-test showed a P-value=0.303 and a Cohen's f=0.187, meaning there is not a statistically significant relationship between the region of respondents and EHPS.

Household composition

Survey respondents provided the number of people living in their household in each of the age groups below. Even though the data was not ordinal, the distribution was not normal, so Spearman's ρ ranked correlation was the chosen analysis to relate the composition with the EHPS (Table 8 below).

Table 8: Relationship between number of people per age group and energy hardship point score (Spearman's ranked correlation).

Age group	Survey	Median number	Average number	CI of average number	SD	P-value	Effect size	CI of effect size
Below 5 years old	OurPower	0.0	0.4	0.36 to 0.47	0.7	0.000187	0.134	0.0641 to 0.203
	National	0.0	0.2	0.15 to 0.27	0.7	0.343	0.0423	-0.0451 to 0.129
5 to 14 years old	OurPower	0.0	0.8	0.72 to 0.90	1.3	0.0000567	0.144	0.0745 to 0.213
	National	0.0	0.3	0.24 to 0.35	0.7	0.0406	0.0912	0.00394 to 0.177

15 to 64 years old	OurPower	2.0	2.3	1.98 to 2.56	4.1	0.000309	0.129	0.0595 to 0.198
	National	2.00	1.8	1.66 to 1.97	1.7	0.000373	0.158	0.0715 to 0.242
65+ years old	OurPower	0.00	0.2	0.17 to 0.32	1.0	<0.00001	-0.162	-0.230 to -0.0924
	National	0.0	0.4	0.31 to 0.43	0.7	<0.00001	-0.217	-0.298 to -0.132

All the relationships are statistically significant, except for the *Below 5 years old* group in the national survey. All the effect sizes are small. The most significant effect sizes in both surveys were for the *65+ years old* group (ρ of -0.162 for OurPower and of -0.217 for national).

Ethnicity

Survey respondents could select more than one ethnicity to describe all members of their households. Two-tailed Welch's t-tests were used to find the relationships between ethnicity and the EHPS (Table 9 below). Due to small sample sizes in some groups, not all analyses could be performed.

Table 9: Relationship between ethnicity and energy hardship point score (two-tailed Welch's t-test, with * being ranked t-test).

Ethnicity	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS	Average EHPS difference (unselected - selected)	CI of EHPS difference (unselected - selected)	P-value	Effect size
New Zealand European	OurPower	496	64.17%	3.00	3.30	3.08 to 3.53	1.88	1.48 to 2.28	<0.00001	0.711
	National	377	74.65%	3.00	3.14	2.90 to 3.39	0.599	0.0860 to 1.11	0.0223	0.243
Māori	OurPower	291	37.65%	5.00	5.17	4.84 to 5.51	-1.920	-2.32 to -1.52	<0.00001	0.727
	National	51	10.10%	4.00	4.25	3.47 to 5.04	-1.07	-1.88 to -0.251	0.0113	0.435
Pasifika	OurPower	73	9.44%	5.00	4.88	4.33 to 5.42	-0.994	-1.58 to -0.411	0.00104	0.357
	National	21	4.16%	4.00	4.14	3.05 to 5.23	-0.885	-1.99 to 0.224	0.112	0.358
Asian	OurPower	67	8.67%	3.00	3.39	2.80 to 3.98	0.645	0.0200 to 1.27	0.0432	0.231
	National	84	16.63%	3.00	3.19	2.68 to 3.70	0.125	-0.439 to 0.690	0.661	0.0507
Other	OurPower	61	7.89%	4.00	4.49	3.73 to 5.26	-0.56	-1.35 to 0.231	0.163	0.200
	National	49	9.70%	3.00	3.61	2.86 to 4.36	-0.351	-1.14 to 0.433	0.374	0.142
African	OurPower	11	1.42%	4.00	4.36	2.79 to 5.93	-0.393	-1.97 to 1.18	0.452*	0.197*
	National	3	0.59%	2.00	2.33	-	-	-	-	-
Latin American	OurPower	5	0.65%	4.00	4.00	3.12 to 4.88	-0.0235	-0.884 to 0.837	0.356*	0.133*
	National	0	0.00%	-	-	-	-	-	-	-
Middle Eastern	OurPower	2	0.26%	4.50	4.50	-1.85 to 10.85	-	-	-	-
	National	4	0.79%	4.00	3.75	2.95 to 4.55	-0.459	-1.20 to 0.280	0.0211*	0.425*
Do not know or prefer not to answer	National	1	0.20%	4.00	4.00	4.00 to 4.00	-	-	-	-

In both surveys, selecting Māori (as the ethnicity of at least one household member) had the highest effect sizes (Cohen's d of 0.727 for OurPower and 0.435 for the national survey). Not all ethnicities were statistically relevant when relating to EHPS.

Education level

Survey respondents informed the highest level of education obtained by a household member, and an one-way ANOVA test using Welch's F-test measured the relationship between this variable and the EHPS. For OurPower respondents, the relationship was statistically significant (P-value<0.00001), with a moderate effect size (Cohen's f=0.320). However, the relationship was insignificant for respondents to the national survey (P-value=0.287 and Cohen's f=0.109).

General health

Survey respondents selected the option that best described the overall health of their household. Other than *Do not know or prefer not to answer,* the option *Good* was only available in the national survey. One-way ANOVA test using Welch's F-test was used to connect health and EHPS. Results showed P-values<0.00001 for both surveys, with a strong effect size for OurPower (Cohen's f=0.455) and a moderate one for the national survey (Cohen's f=0.338).

Mental wellbeing

Survey respondents reported the how often they woken up feeling fresh and rested, and felt cheerful, in good spirits, calm, relaxed, active and vigorous, and that their daily lives have been filled with things that interest them (in the last two weeks). One-way ANOVA test on ranks linked their answers to their EHPS. OurPower and national survey responses presented statistically relevant relationships (P-values<0.00001) with large effect sizes (Cohen's f of 0.425 and 0.407, respectively).

Disability/chronic illness

Survey respondents indicated if they were or had a disabled/chronically ill household member, being able to select more than one option according to the condition type. Two-tailed Welch's t-tests were run to establish the relationship between this variable and EHPS. The strongest relationship was found for those selecting *Intellectual* in the national survey (P-value=0.0463 and Cohen's d=0.760), but the sample size was small (n=10). Not all conditions were considered statistically significant.

Staying at home full-time

Survey respondents provided the number of household members staying at home full-time per age group. Pearson's r correlations and Spearman's ρ ranked correlations were performed to determine the strength of its relationships to the EHPS. For both surveys, the group *15 to 64 years old* presented the highest effect sizes (even though they are weak), with the OurPower ρ of 0.288 and the national one being 0.201. All the other groups from both surveys (except for *5 to 14 years old* in the OurPower survey) were not statistically relevant.

Income

Survey respondents provided their household's annual income after tax, either by entering the number or selecting the brackets that best represented it. Then, all responses were compiled as income brackets for an one-way ANOVA test using Welch's F-test relating to the EHPS. Both surveys presented P-values<0.00001. The OurPower survey's effect size was large (Cohen's f=0.476), whereas the national survey's was moderate (Cohen's f=0.274).

Affording necessities

Survey respondents of both surveys indicated whether the level their household's income was enough to afford everyday necessities (Table 9 below). Results linking them to

the EHPS showed P-values<0.00001 and strong effect sizes, with Cohen's f=0.697 for OurPower (one-way ANOVA test on ranks) and Cohen's f=0.573 for the national survey (one-way ANOVA test using Welch's F-test).

Table 10: Relationship between household income being sufficient for affording necessities and energy hardship point score.

Income sufficiency for necessities	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS
More than enough money	OurPower	107	13.84%	1.00	1.68	1.33 to 2.03
	National	47	9.31%	1.00	1.43	0.99 to 1.86
Enough money	OurPower	207	26.78%	2.00	2.63	2.33 to 2.93
	National	160	31.68%	2.00	2.18	1.91 to 2.45
Just enough money	OurPower	277	35.83%	4.00	4.42	4.12 to 4.72
	National	204	40.40%	3.00	3.74	3.41 to 4.07
Not enough money	OurPower	181	23.42%	6.00	6.18	5.83 to 6.54
	National	88	17.43%	5.00	5.32	4.78 to 5.86
Do not know or prefer not to answer	National	6	1.19%	3.00	2.83	0.14 to 5.52

Economising

Survey respondents were able to choose the action(s) their household performed to economise money. Two-tailed Welch's t-tests analysed the relationship between the options and the EHPS (Table 11 below).

Table 11: Relationship between actions performed to economise money and energy hardship point score (two-tailed Welch's t-test, with * being ranked t-test).

Action performed to economise money	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS	Average EHPS difference (unselected - selected)	CI of EHPS difference (unselected - selected)	P-value	Effect size
Spent less on hobbies or other special interests	OurPower	522	67.53%	4.00	4.48	4.24 to 4.71	-1.54	-1.94 to -1.14	<0.00001	0.568
	National	299	59.21%	3.00	3.77	3.49 to 4.05	-1.17	-1.60 to -0.744	<0.00001	0.486
Done without, or cut back on, trips to the shops or other local places	OurPower	476	61.58%	4.00	4.6	4.35 to 4.85	-1.62	-2.00 to -1.23	<0.00001*	0.624*
	National	259	51.29%	4.00	4.00	3.69 to 4.31	-1.45	-1.86 to -1.03	<0.00001	0.611
Delayed replacing, or repairing, broken or damaged appliances	OurPower	355	45.92%	5.00	5.06	4.77 to 5.35	-2.00	-2.37 to -1.62	<0.00001*	0.781*
	National	165	32.67%	4.00	4.55	4.17 to 4.92	-1.86	-2.30 to -1.41	<0.00001	0.801
Put up with feeling cold often	OurPower	295	38.16%	6.00	6.27	6.02 to 6.53	-3.71	-4.03 to -3.40	<0.00001	1.74
	National	153	30.30%	5.00	5.60	5.25 to 5.95	-3.31	-3.71 to -2.91	<0.00001	1.69
Gone without fresh fruit or vegetables	OurPower	272	35.19%	6.00	5.68	5.37 to 5.99	-2.63	-3.01 to -2.25	<0.00001	1.05
	National	150	29.70%	5.00	4.97	4.55 to 5.38	-2.38	-2.84 to -1.91	<0.00001	1.07
Postponed or put off visits to the doctor	OurPower	314	40.62%	5.50	5.46	5.16 to 5.76	-2.49	-2.86 to -2.12	<0.00001	0.991
	National	141	27.92%	4.00	4.65	4.27 to 5.03	-1.88	-2.33 to -1.43	<0.00001	0.809
None of those	OurPower	121	15.65%	1.00	1.65	1.36 to 1.94	2.76	2.40 to 3.12	<0.00001*	1.14*
	National	124	24.55%	1.00	1.60	1.33 to 1.88	2.24	1.87 to 2.61	<0.00001*	1.08*
Do not know or prefer not to answer	National	3	0.59%	4.00	3.67	-0.13 to 7.46	-	-	-	-

All options were statistically relevant, except for, *Do not know or prefer not to answer* and *Put up with feeling cold often* presented the highest effect sizes in both surveys (Cohen's d being 1.74 for OurPower and 1.69 for the national survey). and selecting *Put up with feeling cold often* increased the EHPS by one point.

Housing situation

The OurPower survey asked the respondents about their housing situation (relating to homeownership/tenancy), being able to select more than one response, and two-tailed Welch's t-tests were used to connect them to the EHPS For the national survey, respondents were only able to select one answer that best represented their housing situation. Except for the *Other* group in the OurPower survey, all groups were statistically relevant with moderate effect sizes. The highest Cohen's d for OurPower was 0.788 for respondents who selected *Public housing*. One-way ANOVA test on ranks was used for the national survey's EHPS relationship analysis, resulting in a P-value<0.00001 and a medium effect size (Cohen's f=0.379).

Dwelling age

Respondents selected the decade which best represented when their dwelling was built. The relationships between them and the EHPS were performed using one-way ANOVA test using Welch's F-test. The P-values for the OurPower and national surveys were 0.0000607 and 0.0000297, respectively. The former's Cohen's f was 0.275, while the latter's was 0.363, meaning that the effect sizes were moderate.

Dwelling amenities

Survey respondents selected which amenities were present in their dwelling, and two-tailed Welch's t-tests were used to measure the strength of the link between them and the EHPS (Table 12 below).

Table 12: Relationship between dwelling amenities or upgrades and energy hardship point score (two-tailed Welch's t-test, with * being ranked t-test).

Dwelling amenities	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS	Average EHPS difference (unselected - selected)	CI of EHPS difference (unselected - selected)	P-value	Effect size
Electricity grid connection	OurPower	675	87.32%	3.00	3.75	3.54 to 3.96	1.8	1.24 to 2.36	<0.00001	0.657
	National	432	85.54%	3.00	3.12	2.89 to 3.35	1.19	0.563 to 1.82	0.000289	0.489
Gas grid connection	OurPower	225	29.11%	3.00	3.15	2.82 to 3.47	1.17	0.766 to 1.57	<0.00001	0.424
	National	84	16.63%	2.00	2.87	2.38 to 3.36	0.511	-0.0367 to 1.06	0.0672	0.207
Drinkable tap water	OurPower	693	89.65%	3.00	3.65	3.45 to 3.84	3.19	2.55 to 3.83	<0.00001	1.21
	National	454	89.90%	3.00	3.11	2.88 to 3.33	1.85	1.18 to 2.53	<0.00001	0.768
Cooking facility with kitchen sink	OurPower	731	94.57%	4.00	3.82	3.62 to 4.02	2.91	1.98 to 3.85	<0.00001	1.07
	National	474	93.86%	3.00	3.15	2.93 to 3.37	2.40	1.60 to 3.20	<0.00001	0.997
Bathroom with toilet and shower/bath	OurPower	735	95.08%	4.00	3.81	3.61 to 4.00	3.46	2.56 to 4.36	<0.00001	1.28
	National	476	94.26%	3.00	3.14	2.92 to 3.36	2.72	1.88 to 3.57	<0.00001	1.140
Device with internet access	OurPower	673	87.06%	3.00	3.54	3.35 to 3.74	3.36	2.80 to 3.91	<0.00001	1.310
	National	471	93.27%	3.00	3.10	2.88 to 3.32	2.90	2.28 to 3.53	<0.00001	1.23
None of those	OurPower	11	1.42%	9.00	8.18	5.98 to 10.39	-4.27	-6.48 to -2.06	0.000103*	1.19*
	National	3	0.59%	5.00	5.33	-0.92 to 11.58	-	-	-	-
Do not know or prefer not to answer	National	8	1.58%	5.00	5.38	4.29 to 6.46	-2.11	-3.21 to -1.02	0.0000438*	0.983*

In the national survey, *Gas grid connection* was statistically insignificant. *Device with internet access* presented the highest effect sizes (Cohen's d of 1.310 for OurPower and 1.23 for the national survey). Selecting *None of those* counted as a point towards the EHPS. Otherwise, not selecting *Drinkable tap water*, *Cooking facility with kitchen sink*, *Bathroom with toilet and shower/bath*, or *Device with internet access* added one point each.

Describing energy usage

Winter fuel

Respondents of both surveys selected the type of fuel(s) used during winter months. Two-tailed Welch's t-tests were used to measure the relationship between the options and the EHPS Most answers were statistically insignificant. However, *Firewood, charcoal, or pellet* in the OurPower survey presented the highest effect size of those with a P-value<0.05, with a small Cohen's d of 0.290.

Additionally, survey respondents typed their monthly winter fuel expenses per fuel type, and Pearson's r correlation and Spearman's ρ ranked correlation tests were performed to associate them with the EHPS. *Firewood, charcoal, or pellet* for OurPower respondents had the highest effect size (ρ=0.294), being considered moderate. Many groups were statistically insignificant.

Non-winter fuel

Survey respondents selected the type of fuel(s) used during non-winter months. The relationship between the options and the EHPS was analysed using two-tailed Welch's t-tests. Many options could not be analysed due to their sample sizes. Of those that were statistically significant, after *Do not know or prefer not to answer*, the option *Electricity* in the national survey presented the strongest effect size (a medium Cohen's d of 0.643).

Respondents of both surveys also reported their monthly fuel expenses per fuel type (non-winter), and Pearson's r correlation was used to determine the strength of the relationship with the EHPS. Some options had small sample sizes and no analysis could be performed. *Electricity* for the national survey respondents had the only P-value<0.05, however, its effect size was negligible.

Summer thermal comfort

Respondents were asked how often they felt their dwelling was too hot during the summer of 2021/2022. One-way ANOVA test using Welch's F-test was performed, and both surveys presented statistically significant relationship between the answers and the EHPS (OurPower's P-value<0.00001 and national's P-value=0.00259). However, both had small and nearly identical effect sizes (OurPower's Cohen's f 0.177 and national's Cohen's f=0.176).

Winter thermal comfort

Respondents answered if they felt their home was always adequately warm during winter, as well as the reason(s) why if they selected no. Two-tailed Welch's t-tests analysed the relationships between the answers and the EHPS (Table 13 below).

Table 13: Relationship between winter thermal comfort and energy hardship point score (two-tailed Welch's t-tests , with * being ranked t-test).

Home adequately warm during winter	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS	Average EHPS difference (unselected - selected)	CI of EHPS difference (unselected - selected)	P-value	Effect size
Yes	OurPower	348	45.02%	2.00	1.89	1.72 to 2.05	3.81	3.53 to 4.09	<0.00001	1.84
	National	296	58.61%	2.00	1.92	1.73 to 2.11	3.33	2.98 to 3.67	<0.00001	1.79
No, due to financial reasons	OurPower	267	34.54%	6.00	6.23	5.96 to 6.50	-3.45	-3.79 to -3.11	<0.00001	1.52
	National	126	24.95%	6.00	5.79	5.42 to 6.15	-3.32	-3.73 to -2.90	<0.00001*	1.60*
No, due to energy inefficiency	OurPower	193	24.97%	6.00	5.91	5.55 to 6.26	-2.58	-2.99 to -2.17	<0.00001	1.00
	National	105	20.79%	5.00	5.19	4.75 to 5.63	-2.39	-2.89 to -1.90	<0.00001	1.05
No, due to another reason	OurPower	60	7.76%	5.00	5.03	4.28 to 5.79	-1.15	-1.93 to -0.371	0.0044	0.412
	National	17	3.37%	5.00	4.94	3.91 to 5.98	-1.70	-2.76 to -0.649	0.00326	0.693
Do not know or prefer not to answer	National	5	0.99%	4.00	4.20	2.36 to 6.04	-0.914	-2.74 to 0.914	0.125*	0.542*

Selecting *No (financial reasons)* counted as one point towards the EHPS. Selecting either *No (energy inefficiency)* or *No (another reason)* also added one point to the EHPS. In both surveys, selecting , selecting *Yes* had the largest effect sizes, with OurPower's Cohen's d being 1.84 and 1.79 for the national one.

Heater type

Survey respondents selected the heater type(s) they own. Two-tailed Welch's t-tests were used to link the options with the EHPS (Table 14 below).

Table 14: Relationship between heater types and energy hardship point score (two-tailed Welch's t-test, with * being ranked t-test).

Heater type owned	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS	Average EHPS difference (unselected - selected)	CI of EHPS difference (unselected - selected)	P-value	Effect size
Heat pump	OurPower	620	80.21%	3.00	3.71	3.50 to 3.92	1.35	0.809 to 1.89	<0.00001	0.491
	National	338	66.93%	2.00	2.87	2.63 to 3.12	1.28	0.810 to 1.74	<0.00001	0.532
Electric heater	OurPower	384	49.68%	4.00	4.15	3.87 to 4.43	-0.347	-0.743 to 0.0486	0.0855	0.124
	National	258	51.09%	3.00	3.36	3.07 to 3.66	-0.142	-0.576 to 0.292	0.522	0.0572
Fixed gas heater	OurPower	69	8.93%	3.00	3.45	2.83 to 4.07	0.576	-0.0729 to 1.23	0.0812	0.206
	National	33	6.53%	3.00	3.36	2.50 to 4.23	-0.0734	-0.967 to 0.821	0.869	0.0296
Portable gas heater	OurPower	43	5.56%	7.00	6.79	5.92 to 7.66	-2.98	-3.87 to -2.10	<0.00001	1.100
	National	28	5.54%	4.00	4.36	3.44 to 5.27	-1.12	-2.06 to -0.185	0.0205	0.457
Wood burner	OurPower	118	15.27%	3.00	3.26	2.73 to 3.80	0.84	0.264 to 1.42	0.00453	0.301
	National	110	21.78%	3.00	3.49	2.97 to 4.01	-0.250	-0.823 to 0.323	0.389	0.101
Pellet fire	OurPower	1	0.13%	6.00	6.00	-	-	-	-	-
	National	4	0.79%	2.00	2.75	-0.78 to 6.28	0.549	-2.96 to 4.06	0.705*	0.203*
Coal burner	OurPower	4	0.52%	6.00	5.75	1.57 to 9.93	-1.79	-5.95 to 2.38	0.217*	0.673*
	National	2	0.40%	6.50	6.50	0.15 to 12.85	-	-	-	-
Other	OurPower	48	6.21%	3.00	3.06	2.33 to 3.79	0.972	0.216 to 1.73	0.0127	0.348
	National	21	4.16%	2.00	2.95	1.71 to 4.19	0.358	-0.901 to 1.62	0.561	0.144
None	OurPower	9	1.16%	7.00	6.89	4.91 to 8.87	-2.95	-4.93 to -0.969	0.00293*	0.987*
	National	14	2.77%	5.00	6.14	4.83 to 7.46	-2.93	-4.26 to -1.60	<0.00001*	1.11*
Do not know or prefer not to answer	National	2	0.40%	3.50	3.50	-2.85 to 9.85	-	-	-	-

Some options were not statistically relevant. Due to their small sizes, not all groups were analysed. *None* presented very strong effect sizes for the OurPower and national surveys (Cohen's d of 0.987 and 1.11, respectively). *Portable gas* had a high effect size for OurPower and a small one for the national survey (Cohen's d of 1.10 and 0.457, respectively). Selecting *Portable gas* option increased the EHPS by one point for being an indicator. If *None* was selected, that also increased their EHPS by one.

Heated rooms

Survey respondents first selected which rooms they have in their dwellings, followed by selecting which rooms are heated during winter. The relationship between owned rooms that are heated and the EHPS was determined by two-tailed Welch's t-tests (Table 15 below).

Table 15: Relationship between owned rooms that are heated and energy hardship point score (two-tailed Welch's t-test, with * being ranked t-test).

Owned rooms that are heated	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS	Average EHPS difference (unselected - selected)	CI of EHPS difference (unselected - selected)	P-value	Effect size
Living room	OurPower	720	93.14%	3.00	3.78	3.58 to 3.97	2.94	2.12 to 3.76	<0.00001	1.09
	National	439	86.93%	2.00	2.98	2.77 to 3.20	2.24	1.43 to 3.05	<0.00001	0.954
Main bedroom	OurPower	385	49.81%	2.00	2.69	2.45 to 2.93	2.52	2.16 to 2.87	<0.00001	1.01
	National	251	49.70%	2.00	2.37	2.12 to 2.63	1.71	1.31 to 2.12	<0.00001	0.753
Children's bedroom	OurPower	334	43.21%	3.00	3.43	3.14 to 3.71	0.91	0.514 to 1.30	<0.00001	0.329
	National	126	24.95%	2.00	2.78	2.37 to 3.19	0.690	0.194 to 1.19	0.00657	0.284
Kitchen	OurPower	334	43.21%	2.00	2.93	2.66 to 3.21	1.790	1.41 to 2.16	<0.00001	0.675
	National	184	36.44%	2.00	2.40	2.08 to 2.72	1.31	0.887 to 1.73	<0.00001*	0.596*
Other bedroom	OurPower	123	15.91%	2.00	2.72	2.26 to 3.19	1.45	0.935 to 1.96	<0.00001	0.528
	National	73	14.46%	1.00	1.95	1.40 to 2.49	1.47	0.875 to 2.06	<0.00001	0.623
Bathroom	OurPower	108	13.97%	1.00	2.21	1.78 to 2.65	2.01	1.53 to 2.49	<0.00001*	0.798*
	National	82	16.24%	1.00	1.88	1.48 to 2.28	1.60	1.13 to 2.06	<0.00001	0.677
Office	OurPower	71	9.18%	1.00	1.96	1.45 to 2.46	2.18	1.64 to 2.73	<0.00001	0.803
	National	40	7.92%	1.00	1.83	1.23 to 2.42	1.50	0.854 to 2.14	0.0000206	0.628
Other room	OurPower	48	6.21%	2.00	2.29	1.58 to 3.00	1.76	1.02 to 2.49	<0.00001*	0.695*
	National	31	6.14%	1.00	1.68	0.85 to 2.51	1.68	0.819 to 2.54	0.000343	0.695
None	OurPower	18	2.33%	8.00	8.17	6.99 to 9.34	-4.33	-5.52 to -3.15	<0.00001	1.60
	National	17	3.37%	7.00	6.88	5.46 to 8.30	-3.80	-5.23 to -2.37	0.0000325	1.63
Do not know or prefer not to answer	National	5	0.99%	5.00	5.20	3.58 to 6.82	-2.01	-3.61 to -0.402	0.00394*	0.962*

None had the highest effect sizes for the OurPower and national surveys (Cohen's d of 1.60 and 1.63, respectively). Selecting *None* for heated rooms counted as a point towards the EHPS if the respondent did not answer *None* previously in the question about owning a heater. If the participant did not select heating *Living room*, *Main bedroom*, or *Children's bedroom* while having them, each of those unheated rooms added one point to the EHPS.

Support equipment requiring energy use

Respondents were asked about the frequency their household made use of medical, assistance, or mobility equipment at home which required energy consumption in the previous twelve months. The relationship between their answers and the EHPS was done via one-way ANOVA test using Welch's F-test. The national survey presented a high P-value of 0.0865 with a Cohen's f of 0.15, not being statistically significant. Yet, the OurPower survey had a P-value of 0.0000468 with a Cohen's f of 0.223, meaning the effect size was weak.

Energy financial assistance

Respondents answered if they received any type of financial assistance towards energy in the past twelve months and their sources. Two-tailed Welch's t-tests were used to link the options and the EHPS (Table 16 below).

Table 16: Relationship between receiving financial assistance and energy hardship point score (two-tailed Welch's t-test, with * being ranked t-test).

Source of financial energy assistance	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS	Average EHPS difference (unselected - selected)	CI of EHPS difference (unselected - selected)	P-value	Effect size
Government	OurPower	228	29.50%	5.00	4.88	4.51 to 5.25	-1.28	-1.71 to -0.848	<0.00001	0.468
	National	148	29.31%	3.00	3.20	2.79 to 3.62	0.131	-0.354 to 0.615	0.596	0.0528
Family/friends gave or lent money	OurPower	65	8.41%	7.00	6.40	5.81 to 6.99	-2.65	-3.27 to -2.03	<0.00001	0.98
	National	16	3.17%	6.50	6.00	4.97 to 7.03	-2.79	-3.84 to -1.75	0.0000322	1.15
Took out a loan	OurPower	19	2.46%	6.00	6.16	4.96 to 7.35	-2.24	-3.45 to -1.03	0.001	0.805
	National	2	0.40%	6.50	6.50	-25.27 to 38.27	-	-	-	-
Energy provider	OurPower	42	5.43%	5.00	4.31	3.36 to 5.26	-0.355	-1.32 to 0.615	0.465	0.127
	National	2	0.40%	4.00	4.00	-8.71 to 16.71	-	-	-	-
Other	OurPower	28	3.62%	3.00	4.07	3.09 to 5.05	-0.101	-1.10 to 0.896	0.837	0.036
	National	1	0.20%	7.00	7.00	7.00 to 7.00	-	-	-	-
No assistance received	OurPower	478	61.84%	3.00	3.45	3.21 to 3.69	1.37	0.970 to 1.78	<0.00001	0.505
	National	339	67.13%	3.00	3.21	2.95 to 3.47	0.251	-0.223 to 0.726	0.298	0.102
Do not know or prefer not to answer	National	5	0.99%	4.00	3.60	2.18 to 5.02	-0.308	-1.71 to 1.09	0.243*	0.320*

Some sample sizes were too small, so analyses were performed for them. Not all options in both surveys presented P-values low enough to be statistically relevant. The highest effect sizes in the OurPower and national surveys were for the OurPower and national surveys were for *Family/friends gave or lent money* (Cohen's d of 0.98 and 1.15, respectively).

Choosing between energy or other expenses

Survey respondents answered if they had to choose between paying energy bills or other expenses. Two-tailed Welch's t-tests were run to compare the relationship between each expense listed and the EHPS (Table 17 below).

Table 17: Relationship between paying energy bills or other expenses and energy hardship point score (two-tailed Welch's t-test, with * being ranked t-test).

Expense	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS	Average EHPS difference (unselected - selected)	CI of EHPS difference (unselected - selected)	P-value	Effect size
Hobbies/leisure	OurPower	208	26.91%	5.00	4.89	4.54 to 5.24	-1.22	-1.64 to -0.790	<0.00001	0.441
	National	95	18.81%	5.00	4.80	4.34 to 5.26	-1.85	-2.37 to -1.34	<0.00001	0.783
Clothing	OurPower	239	30.92%	6.00	5.56	5.22 to 5.89	-2.27	-2.67 to -1.86	<0.00001	0.871
	National	84	16.63%	6.00	5.36	4.85 to 5.86	-2.47	-3.02 to -1.93	<0.00001	1.08
Food	OurPower	230	29.75%	6.00	6.25	5.92 to 6.58	-3.23	-3.61 to -2.85	<0.00001	1.36
	National	81	16.04%	6.00	5.95	5.40 to 6.50	-3.16	-3.74 to -2.58	<0.00001	1.45
Transportation expenses	OurPower	230	29.75%	6.00	5.73	5.38 to 6.07	-2.47	-2.88 to -2.07	<0.00001	0.963
	National	62	12.28%	6.00	5.94	5.36 to 6.51	-3.01	-3.62 to -2.40	<0.00001	1.33
Medical expenses	OurPower	186	24.06%	6.00	6.19	5.82 to 6.56	-2.89	-3.32 to -2.47	<0.00001	1.15
	National	61	12.08%	6.00	5.72	5.13 to 6.31	-2.76	-3.39 to -2.13	<0.00001	1.20
Home repairs	OurPower	132	17.08%	5.00	5.42	4.92 to 5.92	-1.71	-2.25 to -1.16	<0.00001	0.62
	National	56	11.09%	5.00	5.20	4.52 to 5.87	-2.14	-2.84 to -1.43	<0.00001	0.897
Rent or mortgage	OurPower	97	12.55%	6.00	6.18	5.68 to 6.67	-2.49	-3.02 to -1.95	<0.00001	0.927
	National	38	7.52%	5.50	5.66	4.85 to 6.47	-2.56	-3.39 to -1.72	<0.00001	1.07
Cleaning products	OurPower	124	16.04%	6.00	5.92	5.48 to 6.36	-2.29	-2.77 to -1.80	<0.00001	0.854
	National	31	6.14%	4.00	4.87	4.19 to 5.55	-1.68	-2.39 to -0.965	0.0000287	0.687
Personal hygiene items	OurPower	96	12.42%	6.00	6.25	5.78 to 6.72	-2.57	-3.08 to -2.05	<0.00001	0.96
	National	26	5.15%	6.00	6.27	5.30 to 7.24	-3.14	-4.13 to -2.14	<0.00001	1.32
Water or other utility bills	OurPower	54	6.99%	6.00	6.04	5.37 to 6.70	-2.18	-2.88 to -1.49	<0.00001	0.794
	National	25	4.95%	6.00	5.76	4.63 to 6.89	-2.59	-3.74 to -1.44	0.0000883	1.08
Education expenses	OurPower	100	12.94%	5.50	5.81	5.28 to 6.34	-2.08	-2.64 to -1.51	<0.00001	0.764
	National	18	3.56%	6.00	6.06	5.05 to 7.06	-2.86	-3.88 to -1.84	0.000012	1.18
Menstrual products	OurPower	78	10.09%	6.00	5.95	5.40 to 6.50	-2.16	-2.75 to -1.57	<0.00001	0.792
	National	17	3.37%	7.00	6.00	4.96 to 7.04	-2.80	-3.86 to -1.74	0.0000311	1.15
Nappies or wipes	OurPower	54	6.99%	6.00	6.30	5.56 to 7.03	-2.46	-3.23 to -1.70	<0.00001	0.9
	National	13	2.57%	7.00	6.46	4.89 to 8.03	-3.25	-4.83 to -1.67	0.0000753*	1.13*
Other essential products or services	OurPower	82	10.61%	6.00	5.93	5.38 to 6.48	-2.15	-2.74 to -1.56	<0.00001	0.789
	National	32	6.34%	7.00	6.34	5.60 to 7.09	-3.25	-4.02 to -2.49	<0.00001	1.39
None of the above	OurPower	357	46.18%	2.00	2.46	2.24 to 2.69	2.95	2.61 to 3.29	<0.00001	1.23
	National	297	58.81%	2.00	2.19	1.98 to 2.40	2.69	2.29 to 3.08	<0.00001	1.28
Do not know or prefer not to answer	National	30	5.94%	4.00	4.17	3.44 to 4.89	-0.927	-1.69 to -0.168	0.0181	0.376

Both OurPower and national surveys presented the largest effect sizes for *Food*, with strong Cohen's d of 1.36 and 1.45, respectively.

Disconnection

Both surveys asked respondents if they had been disconnected for lack of payment of gas or electricity bills in the previous twelve months. The relationship between disconnection and the EHPS was analysed via two-tailed Welch's t-tests (Table 18 below).

Table 18: Relationship between disconnection and energy hardship point score (two-tailed Welch's t-test, with * being ranked t-test).

Disconnections in the last 12 months	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS	Average EHPS difference (unselected - selected)	CI of EHPS difference (unselected - selected)	P-value	Effect size
Yes (self-disconnection)	OurPower	6	0.78%	6.50	6.17	4.02 to 8.31	-2.22	-4.36 to -0.0839	0.0218*	0.860*
	National	3	0.59%	8.00	7.67	3.87 to 11.46	-	-	-	-
Yes (by the provider)	OurPower	53	6.86%	6.00	6.74	6.04 to 7.43	-2.98	-3.70 to -2.26	<0.00001*	1.26*
	National	12	2.38%	6.50	6.75	5.26 to 8.24	-3.54	-5.04 to -2.04	0.000261	1.46
No	OurPower	711	91.98%	3.00	3.75	3.55 to 3.95	2.89	2.19 to 3.60	<0.00001	1.07
	National	486	96.24%	3.00	3.17	2.95 to 3.38	3.41	2.34 to 4.49	<0.00001	1.43
Do not know or prefer not to answer	National	4	0.79%	4.50	5.25	2.24 to 8.26	-1.97	-4.96 to 1.02	0.0342*	0.890*

The sample size for selecting *Yes (self-disconnection)* in the national survey was too small, so no analyses were performed. Selecting *Yes (self-disconnection)* added a point towards the EHPS. For both surveys, selecting *Yes (by the provider)* had the strongest effect sizes (Cohen's d for OurPower being 1.26 and 1.46 for the national survey).

Energy-saving behaviour

Respondents answered if they regularly perform energy-saving behaviours. One-way ANOVA test using Welch's F-test determined the strength of the relationship between this variable and the EHPS. Both surveys presented high P-values (0.983 for OurPower and 0.160 for the national), and low effect sizes (Cohen's f of 0.00205 for OurPower and 0.0869 for the national survey). This means that the relationship was statistically insignificant.

Energy efficiency

Both surveys asked respondents about the presence of energy efficient items and upgrades in their dwellings, including thermal insulation. Two-tailed Welch's t-tests linked the options with the EHPS Some options were not statistically significant. For both surveys, the highest effect sizes were strong (Cohen's d of 0.815 for OurPower and 0.822 for the national one), corresponding to selecting *Windows*.

Dampness

Respondents selected the frequency their home was perceived as damp. One-way ANOVA test using Welch's F-test was performed to analyse the strength between this variable and the EHPS. Both surveys presented P-values<0.00001 and strong effect sizes (Cohen's f of 0.788 for OurPower and 0.776 for the national survey). Selecting *Always* counted as a point towards the EHPS.

Mould

Survey respondents answered if they home had mould. The relationship between mould presence and the EHPS was done via one-way ANOVA test using Welch's F-test. P-values<0.00001 were found for both surveys, in addition to high effect sizes. The Cohen's f for OurPower was 0.596, whereas the national survey's was 0.633. *Always (mould area larger than an A4 sheet)* added a point to the EHPS.

Different statements

Respondents were asked a series of statements about their home and household in the past twelve months, and they selected which ones applied to them. Two-tailed Welch's t-tests were performed to analyse the relationship between each statement and the EHPS (Table 19 below).

Table 19: Relationship between different statements and energy hardship point score (two-tailed Welch's t-test, with * meaning ranked t-test).

Statements	Survey	Total (n)	Total (%)	Median EHPS	Average EHPS	CI of average EHPS	Average EHPS difference (unselected - selected)	CI of EHPS difference (unselected - selected)	P-value	Effect size
In winter, my home gets cold enough that I can see breath indoors	OurPower	204	26.39%	7.00	6.62	6.32 to 6.93	-3.6	-3.96 to -3.24	<0.00001*	1.52*
	National	84	16.63%	7.00	6.45	5.94 to 6.96	-3.79	-4.33 to -3.25	<0.00001	1.86
My household accrued debt on electricity/gas account	OurPower	47	6.08%	7.00	6.68	5.92 to 7.44	-2.88	-3.67 to -2.10	<0.00001	1.06
	National	22	4.36%	7.00	6.68	5.65 to 7.72	-3.54	-4.60 to -2.49	<0.00001	1.49
My household has been unable to pay the electricity/gas bill by the due date >1x	OurPower	104	13.45%	7.00	6.63	6.115 to 7.12	-3.07	-3.60 to -2.55	<0.00001	1.18
	National	35	6.93%	6.00	5.71	4.78 to 6.65	-2.60	-3.56 to -1.64	<0.00001	1.09
In winter, my home gets cold enough that I shiver	OurPower	265	34.28%	6.00	5.76	5.45 to 6.07	-2.72	-3.10 to -2.34	<0.00001	1.09
	National	121	23.96%	5.00	5.44	5.02 to 5.86	-2.82	-3.29 to -2.35	<0.00001	1.30
My household had to make a payment plan or switch to prepay	OurPower	52	6.73%	7.00	7.02	6.30 to 7.73	-3.26	-4.01 to -2.52	<0.00001	1.22
	National	27	5.35%	5.00	4.96	3.95 to 5.97	-1.76	-2.79 to -0.733	0.00153	0.721
My household's primary language is English	OurPower	538	69.60%	3.00	3.66	3.43 to 3.90	1.02	0.597 to 1.45	<0.00001	0.37
	National	413	81.78%	3.00	3.11	2.87 to 3.35	1.02	0.467 to 1.58	0.000384	0.418
My home is in a good shape and does not need any major repairs	OurPower	416	53.82%	2.00	2.36	2.17 to 2.54	3.5	3.19 to 3.82	<0.00001	1.60
	National	277	54.85%	2.00	1.90	1.71 to 2.10	3.08	2.73 to 3.44	<0.00001	1.59
My household has been able to afford a 500 NZD expense without borrowing money	OurPower	276	35.71%	2.00	2.11	1.86 to 2.36	2.90	2.56 to 3.24	<0.00001	1.190
	National	258	51.09%	2.00	2.00	1.79 to 2.22	2.64	2.27 to 3.01	<0.00001	1.26
My household has an electric vehicle that is charged at home	National	11	2.18%	3.00	2.91	1.22 to 4.59	0.395	-1.30 to 2.09	0.637*	0.159*
None of those	National	10	1.98%	4.50	4.60	3.12 to 6.08	-1.33	-2.82 to 0.155	0.0159*	0.632*

Selecting *In winter, my home gets cold enough that I can see breath indoors* and *My household has been unable to pay the energy bill on time >1x* counted as one point towards the EHPS each, as well as not selecting *My home is in a good shape and does not need any major repairs* and *My household has been able to afford a 500 NZD expense without borrowing*.

In winter, my home gets cold enough that I can see breath indoors had the highest effect size for the national survey (Cohen's d=1.86). For the OurPower survey, *My home is in a good shape and does not need any major repairs* had the highest effect size (Cohen's d=1.60).

Discussion

Most relevant indicators

Using Qualtrics, we selected all the indicators and related the scores of both surveys. The results were sorted from most to least relevant indicator. For OurPower, the top indicator was household feeling cold often (Table 20 and Figure 11 below). As for the national survey, it was major housing repairs needed (Table 21 and Figure 12 below).

Table 20: Strong relationships between indicators and energy hardship point score (OurPower survey).

P3: Feeling cold often	P-value	<0.00001
	Effect size (Pearson's r)	0.645
	CI of effect size	0.602 to 0.685
	Test used	Correlation
P22: Housing repairs needed - major	P-value	<0.00001
	Effect size (Pearson's r)	0.624
	CI of effect size	0.579 to 0.665
	Test used	Correlation
P13: Cannot afford warmth	P-value	<0.00001
	Effect size (Pearson's r)	0.585
	CI of effect size	0.536 to 0.629
	Test used	Correlation
P25: Can see breath indoors in winter	P-value	<0.00001
	Effect size (Pearson's r)	0.566
	CI of effect size	0.516 to 0.612
	Test used	Correlation
P9: Unable to afford unexpected expense	P-value	<0.00001
	Effect size (Pearson's r)	0.496
	CI of effect size	0.441 to 0.548
	Test used	Correlation
P16: No main bedroom heating	P-value	<0.00001
	Effect size (Pearson's r)	0.441
	CI of effect size	0.382 to 0.496
	Test used	Correlation
P24: Damp always	P-value	<0.00001
	Effect size (ρ)	0.424
	CI of effect size	0.364 to 0.480
	Test used	Ranked correlation
P19: Trouble heating accommodation	P-value	<0.00001
	Effect size (Pearson's r)	0.396
	CI of effect size	0.335 to 0.454
	Test used	Correlation

P6: No home access to computer or internet	P-value	<0.00001
	Effect size (ρ)	0.365
	CI of effect size	0.302 to 0.425
	Test used	Ranked correlation
P8: Could not pay bills on time >1x	P-value	<0.00001
	Effect size (ρ)	0.356
	CI of effect size	0.293 to 0.416
	Test used	Ranked correlation
P21: Lacking one or more basic amenity	P-value	<0.00001
	Effect size (ρ)	0.332
	CI of effect size	0.268 to 0.393
	Test used	Ranked correlation
P17: No children's bedroom heating	P-value	<0.00001
	Effect size (Pearson's r)	0.324
	CI of effect size	0.260 to 0.386
	Test used	Correlation
P23: Mould larger than an A4 - Always	P-value	<0.00001
	Effect size (ρ)	0.315
	CI of effect size	0.250 to 0.377
	Test used	Ranked correlation
P14: Using prepayment metering	P-value	<0.00001
	Effect size (ρ)	0.273
	CI of effect size	0.206 to 0.337
	Test used	Ranked correlation
P18: No living room heating	P-value	<0.00001
	Effect size (ρ)	0.229
	CI of effect size	0.161 to 0.295
	Test used	Ranked correlation
P15: No heating	P-value	<0.00001
	Effect size (ρ)	0.224
	CI of effect size	0.156 to 0.290
	Test used	Ranked correlation
P20: Unsafe heating	P-value	<0.00001
	Effect size (ρ)	0.222
	CI of effect size	0.154 to 0.288
	Test used	Ranked correlation

Table 21: Strong relationships between indicators and energy hardship point score (national survey).

P22: Housing repairs needed - major	P-value	<0.00001
	Effect size (Pearson's r)	0.620
	CI of effect size	0.563 to 0.671
	Test used	Correlation
P3: Feeling cold often	P-value	<0.00001
	Effect size (Pearson's r)	0.614
	CI of effect size	0.557 to 0.666
	Test used	Correlation
P13: Cannot afford warmth	P-value	<0.00001
	Effect size (ρ)	0.569
	CI of effect size	0.507 to 0.626
	Test used	Ranked correlation
P9: Unable to afford unexpected expense	P-value	<0.00001
	Effect size (Pearson's r)	0.533
	CI of effect size	0.467 to 0.593
	Test used	Correlation
P25: Can see breath indoors in winter	P-value	<0.00001
	Effect size (ρ)	0.497
	CI of effect size	0.429 to 0.560
	Test used	Ranked correlation
P19: Trouble heating accommodation	P-value	<0.00001
	Effect size (ρ)	0.418
	CI of effect size	0.343 to 0.487
	Test used	Ranked correlation
P16: No main bedroom heating	P-value	<0.00001
	Effect size (Pearson's r)	0.356
	CI of effect size	0.277 to 0.430
	Test used	Correlation
P24: Damp always	P-value	<0.00001
	Effect size (ρ)	0.351
	CI of effect size	0.272 to 0.426
	Test used	Ranked correlation

P23: Mould larger than an A4 - Always	P-value	<0.00001
	Effect size (ρ)	0.328
	CI of effect size	0.248 to 0.404
	Test used	Ranked correlation
P21: Lacking one or more basic amenity	P-value	<0.00001
	Effect size (ρ)	0.312
	CI of effect size	0.231 to 0.389
	Test used	Ranked correlation
P18: No living room heating	P-value	<0.00001
	Effect size ρ)	0.297
	CI of effect size	0.215 to 0.375
	Test used	Ranked correlation
P6: No home access to computer or internet	P-value	<0.00001
	Effect size (ρ)	0.294
	CI of effect size	0.212 to 0.372
	Test used	Ranked correlation
P15: No heating	P-value	<0.00001
	Effect size (ρ)	0.285
	CI of effect size	0.203 to 0.363
	Test used	Ranked correlation
P17: No children's bedroom heating	P-value	<0.00001
	Effect size (ρ)	0.256
	CI of effect size	0.173 to 0.336
	Test used	Ranked correlation
P8: Could not pay bills on time >1x	P-value	<0.00001
	Effect size (ρ)	0.235
	CI of effect size	0.150 to 0.315
	Test used	Ranked correlation
P14: Using prepayment metering	P-value	0.0000822
	Effect size (ρ)	0.174
	CI of effect size	0.0884 to 0.258
	Test used	Ranked correlation
P20: Unsafe heating	P-value	0.0113
	Effect size (ρ)	0.113
	CI of effect size	0.0256 to 0.198
	Test used	Ranked correlation

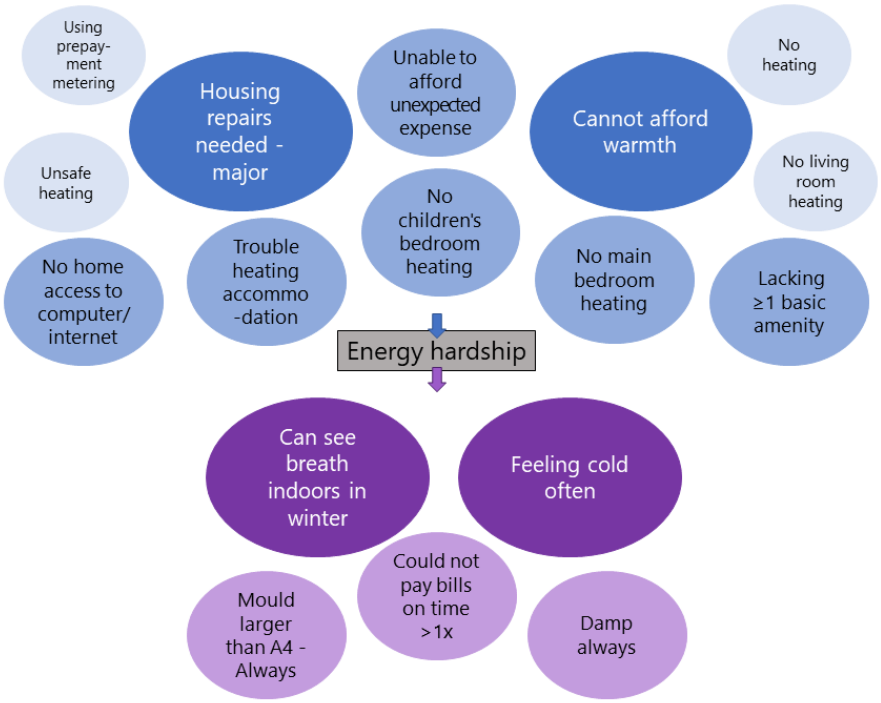

Figure 11: Indicators separated as causes (blue) and consequences (purple) of energy hardship in the OurPower survey (larger sizes with darker shades meaning most relevant ones).

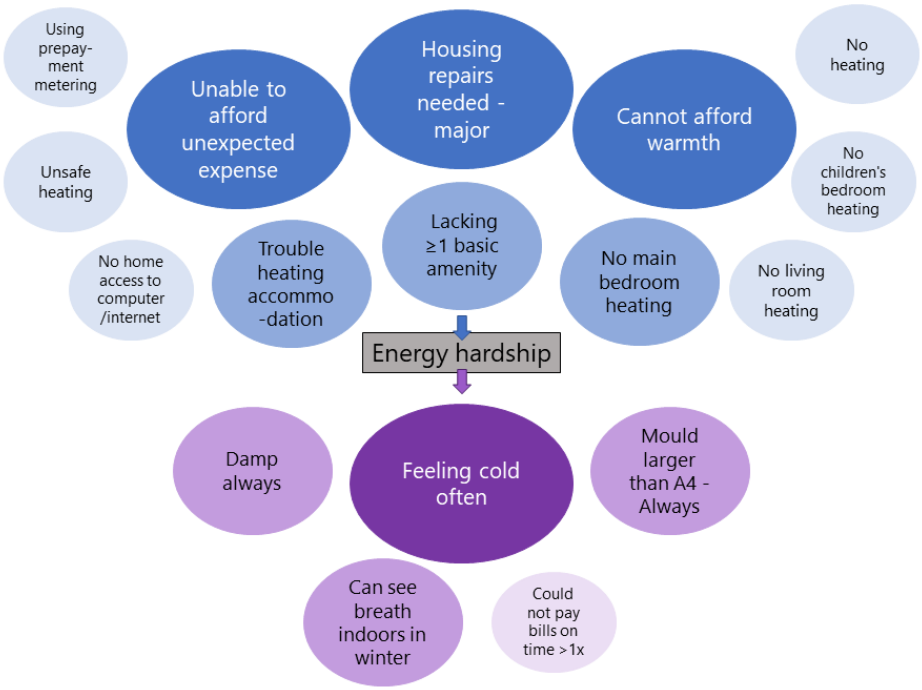

Figure 12: Indicators separated as causes (blue) and consequences (purple) of energy hardship in the national survey (larger sizes with darker shades meaning most relevant ones).

According to both surveys, using the cause indicators of major housing repairs needed and household's inability to afford warmth, in addition to the consequence indicator of household feeling cold often to save money, can be a simpler way of measuring energy hardship in Kiwi homes. Those three are the most critical indicators that have other implications about the household conditions and can be self-reported – making it easy to get large sample sizes and compare results with other studies. Furthermore, they can guide policies and interventions to focus on reducing the main causes of energy hardship: housing quality and energy unaffordability.

Most relevant non-indicator variables

Using Qualtrics, we selected all the non-indicator variables and related to the EHPS of both surveys. The results were sorted from most to least relevant issues - only those that presented strong effect sizes (Tables 22-23 below). For OurPower, the most relevant variable was choosing food expenses over energy bills or vice-versa, and for the national survey it was accumulating debt on the electricity/gas account.

Table 22: Most relevant non-indicator variables associated with the energy hardship point score of the OurPower survey.

Variable	P-value	Effect size
Choosing food expenses over energy bills or vice-versa	<0.00001	Cohen's d=1.36
Choosing medical expenses over energy bills or vice-versa	<0.00001	Cohen's d=1.15
Being disconnected by the energy provider	<0.00001	Cohen's d=1.11
Shivering at home during winter due to cold	<0.00001	Cohen's d=1.09
Accumulating debt on electricity/gas account	<0.00001	Cohen's d=1.06
Going without fresh fruit or vegetables to save money	<0.00001	Cohen's d=1.05
Postponing or putting off visits to the doctor to save money	<0.00001	Cohen's d=0.991
Receiving or borrowing money from family or friends to pay for energy bills	<0.00001	Cohen's d=0.980
Choosing transportation expenses over energy bills or vice-versa	<0.00001	Cohen's d=0.963
Choosing other personal hygiene expenses over energy bills or vice-versa	<0.00001	Cohen's d=0.960
Not earning enough income to match daily necessities	<0.00001	Cohen's f=0.697
Choosing rent or mortgage over energy bills or vice-versa	<0.00001	Cohen's d=0.927
Choosing nappy or wipe expenses over energy bills or vice-versa	<0.00001	Cohen's d=0.900
Choosing clothing expenses over energy bills or vice-versa	<0.00001	Cohen's d=0.871
Choosing cleaning product expenses over energy bills or vice-versa	<0.00001	Cohen's d=0.854
Not having insulated windows	<0.00001	Cohen's d=0.815
Not having energy-efficient lightbulbs	<0.00001	Cohen's d=0.810
Taking out a loan to pay for energy bills	0.001	Cohen's d=0.805
Not heating the home office during winter	<0.00001	Cohen's d=0.803

Table 23: Most relevant non-indicator variables associated with the energy hardship point score of the national survey.

Variable	P-value	Effect size
Accumulating debt on the electricity/gas account	<0.00001	Cohen's d=1.49
Choosing food expenses over energy bills or vice-versa	<0.00001	Cohen's d=1.45
Choosing other essential product or service expenses over energy bills or vice-versa	<0.00001	Cohen's d=1.39
Choosing transportation expenses over energy bills or vice-versa	<0.00001	Cohen's d=1.33
Choosing other personal hygiene expenses over energy bills or vice-versa	<0.00001	Cohen's d=1.32
Shivering at home during winter due to cold	<0.00001	Cohen's d=1.30
Being disconnected by the energy provider	<0.00001	Cohen's d=1.26
Choosing medical expenses over energy bills or vice-versa	<0.00001	Cohen's d=1.20
Choosing educational expenses over energy bills or vice-versa	0.000012	Cohen's d=1.18
Choosing menstrual expenses over energy bills or vice-versa	0.0000311	Cohen's d=1.15
Receiving or borrowing money from family or friends to pay for energy bills	0.0000322	Cohen's d=1.15
Choosing nappy or wipe expenses over energy bills or vice-versa	0.0000753	Cohen's d=1.13
Choosing clothing expenses over energy bills or vice-versa	<0.00001	Cohen's d=1.08
Choosing water or other utility bills over energy bills or vice-versa	0.0000883	Cohen's d=1.08
Choosing rent or mortgage over energy bills or vice-versa	<0.00001	Cohen's d=1.07
Going without fresh fruit or vegetables to save money	<0.00001	Cohen's d=1.07
Choosing home repair expenses over energy bills or vice-versa	<0.00001	Cohen's d=0.897
Not having insulated windows	<0.00001	Cohen's d=0.822
Postponing or putting off visits to the doctor to save money	<0.00001	Cohen's d=0.809
Delaying the replacement or repair of broken or damaged appliances to save money	<0.00001	Cohen's d=0.801

If a household decides to self-ration to reduce their energy expenses, it can lead to thermal discomfort (such as shivering) and having health conditions in the long term (Liddell & Morris, 2010) – and those conditions will be translated into higher health expenses. Energy expenses can also be reduced by having insulated windows and energy-efficient lightbulbs, as well as repairing or retrofitting appliances to consume less energy (Lloyd et al., 2008). However, energy efficient upgrades need an initial expense that many households cannot afford or are unable to perform due to their tenancy status (Ambrose & McCarthy, 2019;

Barton, 2014). Tenants are also more likely to be low-income, creating more financial pressure for them to decide between paying for rent or energy bills.

While having unutilised broken appliances reduces energy consumption, it can increase domestic labour (traditionally mainly performed by women) to substitute their function (Petrova & Simcock, 2019) and also decrease housing quality, potentially leading to health conditions (Ingham et al., 2019; World Health Organization, 2018). Although we were able to get a reasonable sample size to represent a country with a small population (about 5.1 million people (Stats NZ, 2022)), we are aware that household surveys tend to obscure power relations and other intra-household dynamics, often related to gender and age.

Having broken appliances can also lead to food being spoilt and having to purchase ready-made meals, which are likely to be unhealthy options and to increase food costs for households (Sushil et al., 2017). The health is also compromised if the household opts for consuming the spoilt food. Decreasing food expenses (especially when it comes to fruits and vegetables) due to financial restraints can cause health conditions and food insecurity (Cook et al., 2008; O'Neill et al., 2006).

While transportation fuel consumption is not considered as part of the definition of energy hardship in Aotearoa (Ministry of Business Innovation & Employment, 2021, 2022b), transportation expenses can also limit the money available to pay for energy bills, which affects energy hardship and increase existing inequalities relating to right to the city (Berry et al., 2016; Mattioli et al., 2017). Due to the pandemic, more people started working from home on a temporary or permanent basis (Green et al., 2020). Though it reduces commute expenses, using a home office requires appropriate temperature regulation and ventilation to avoid health conditions (Justo Alonso et al., 2022). Other than working from home, online learning rather than going to campus has also become more frequent (Cameron et al., 2022).

Educational expenses also limit the money available for energy needs However, being educated can improve the chances of earning higher income in the future.

If purchasing menstrual products, nappies, or wipes are not prioritised, more domestic labour will be needed to improvise solutions, and health conditions can be developed from their inappropriate maintenance (Boyers et al., 2022; Randles, 2020). Limiting the use of personal hygiene products, cleaning products, utilities (e.g. water), and other vital expenses also lead to health conditions. While saving on clothing can help during times of limited finances, having proper clothes to regulate body temperature is essential for good health, especially with limited heating (Chard & Walker, 2016).

Limiting doctor visits for financial reasons can result in worsening health conditions. Those can also increase the household energy needs, such as increased need for heating and cooling or electricity-powered equipment for dependent users (Snell et al., 2014, 2015a, 2015b). Low funds leading can make households accumulate debt in their energy bills and eventually get disconnected by their providers. Both situations result in extra fees, making it even more difficult for poor households (O'Sullivan et al., 2011). Having family and friends that can give or lend money to pay for energy bills reduces the pressure of that expense and reduces the chances of having debt or being disconnected. Some households may take out a loan to pay for their energy bills during times of financial stress, but eventually they will have to pay off that expense plus interest.

Not having enough money is connected to all issues, making households choose between multiple necessities. The main consequence of the deprivations is the development of health conditions, and those result in health expenses and possible increase in energy needs. More energy needs mean more energy expenses, and without enough income or loved ones helping pay for those expenses, households are vulnerable to accumulating debt in their

energy accounts, being disconnected by their providers, or obtaining loans - all leading to less money over time.

While suggesting more available income for households is not a specific nor a realistic energy policy for the moment, energy hardship will not be eradicated while households are still struggling to make ends meet. Reducing energy expenses by continuing to develop efforts to improve energy efficiency can be helpful, especially by insulating windows and providing LED lightbulbs. We encourage the expansions of programmes such as Warmer Kiwi Homes (Energy Efficiency and Conservation Authority, 2023), but beyond assistance for homeowners only, as tenants are often the most affected by energy hardship.

Providing energy tariff discounts or other financial help for vulnerable households is encouraged, as well as any combination of assistance combining energy and other issues (e.g. targeting food insecure households for energy benefits). Furthermore, subsidies for appliance repairs and retrofits are useful for minimising energy hardship while also prolonging the lifespan of equipment, reducing waste, and decreasing the need for more raw material extraction (Dijst et al., 2018). Less energy consumption not only leads to lower energy bills, but also lower greenhouse gas emissions.

Energy hardship is a complex condition that is connected to climate change, health issues, food insecurity, gender issues, and many more. Investing resources on the major causes of energy hardship can greatly increase the wellbeing of New Zealanders and result in savings for the households and the government. Our findings suggest that the seventeen MBIE indicators used on the two surveys we conducted could be simplified as three to easily identifiable energy hardship indicators that are reinforcing: living in a poor quality (housing repairs needed – major) and paying high energy prices causes bills to be too high, so one

cannot afford heating it (cannot afford warmth), and they end up self-rationing energy and being cold (feeling cold often).

Additionally, we suggest adding one indicator associated with food insecurity, such as the one we used - *choosing food expenses over energy bills or vice-versa* (cause – but can also be a consequence), and another relating to energy debt - *accumulating debt on the electricity/gas account* (consequence). All of those variables have been thoroughly discussed in international literature and even in New Zealand (McKague et al., 2016; O'Neill et al., 2006; O'Sullivan et al., 2011, 2012), and this study highlights that the *heat or eat dilemma* and energy debt issue need to have specific policies and should be considered as additional indicators.

While ethnicity, disability, tenancy status, and education level were related to energy hardship to some extent, those were not major factors. Interestingly, living in the South Island was not even statistically significant in our study, which could be due to the fact we did not use indicators such as ratio of energy expenses over income, which has been traditionally used in New Zealand research (Lawson et al., 2015; Lloyd, 2006). However, we are interested in seeing future analyses of all twenty-six MBIE indicators in the whole country for better comparison of those specific variables.

Our findings also show that, overall, OurPower customers that responded to the survey are in more energy hardship and general deprivation than respondents of the nationally representative survey (even if compared to those in the Waikato region only). This is most likely because OurPower is a social retailer, catering to low-income households by offering simple electricity plans with low prices, and they do not refuse new customers that have poor credit (New Zealand Government, 2023; OurPower, 2023). At the time this manuscript was being written, the New Zealand government was encouraging the expansion

of social retailers to minimise energy hardship, and seeking out public feedback on the strategies regarding how that should be carried out (Ministry of Business Innovation & Employment, 2023; New Zealand Government, 2023).

We hope our study can be translated into efforts being put into the most critical needs of Aotearoa while also inspiring people in other countries to do the same. We encourage researchers worldwide to associate specific critical material needs to fuel and energy poverty to find potential causes and consequences of the issues, as shown by our study.

Furthermore, respondents of both surveys were asked to respond to a follow-up survey in late 2022 to give updates on their condition and feedback on the survey rewards and other energy hardship interventions. Their responses will be used to evaluate those actions and analyse the best practices and propose supplementary interventions for energy hardship eradication in New Zealand.

Conclusion

We identified that the main causes of energy hardship in Aotearoa New Zealand in 2022 were the household's inability to afford sufficient warmth (indicator), major housing repairs needed (indicator), and the household having to choose between paying for food or energy bills. The household feeling cold often due to self-rationing (indicator) and accumulating energy debt were major consequences. We suggest for energy hardship policies to be aimed at increasing energy affordability for vulnerable households, improving housing quality and energy efficiency, as well as integrating efforts with other social programmes in the country. Reducing energy hardship will ameliorate the health and wellbeing of Kiwi households and minimise their financial stress.

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Chapter Six – Empowering: Aiming for Energy Wellbeing and Democracy

Abstract

Energy hardship is a condition that arises out of the lack of energy access and affordability. In this study, perceptions of employees of organisations and households regarding best practices to minimise energy hardship are explored through three surveys carried out in New Zealand. The research addresses the lack of radical interventions relating to the root causes of energy hardship. Additionally, we propose actions based on the survey findings and the concept of energy democracy. Energy wellbeing, which is at the opposite side of the energy hardship spectrum, can be achieved as a consequence of fully renewable and decentralised energy production and democratic decision-making.

Introduction

In 2021, 28.4% of total final energy consumption in Aotearoa was renewable, with 82.1% of all generated electricity in the country being renewable (Ministry of Business Innovation & Employment, 2022b). Still, Aotearoa has a long way to go regarding energy sustainability. Neoliberal ideology caused the privatisation of the generation, distribution, and retail companies in New Zealand during the 1980s and 1990s, and an increase in costs to residential customers followed (Bertram, 2014; Ministry of Business Innovation & Employment, 2014).

The discussions of energy unaffordability and its consequences became more frequent in the country after the 2017 document, *Investigating different measures of energy hardship in New Zealand*, which stated that approximately 6% of the households in that year were spending more than 10% of their income on energy services (Stats NZ, 2017). The threshold was based on the English concept created by Brenda Boardman, who established that a household that needs to spend over 10% of its income to meet its required heating needs is in

fuel poverty (Boardman, 1991, 2013). The concept of fuel poverty evolved, and, even though there is no uniform definition worldwide, it can be understood as the inability to afford sufficient energy services (Boardman, 2012; Brabo-Catala et al., 2022; Li et al., 2014).

At the end of 2021, the New Zealand Ministry of Business, Innovation and Employment (MBIE) produced a thorough discussion document to propose a definition, measures, and a framework for *energy hardship* (Ministry of Business Innovation & Employment, 2021). After receiving feedback, MBIE stated that *energy wellbeing* is on the opposite side of the energy hardship spectrum, being described as "[w]hen individuals, households and whānau [family, extended family, or community living together] are able to obtain and afford adequate energy services to support their wellbeing in their home or kāinga [Māori settlement]" (Ministry of Business Innovation & Employment, 2022a).

In 2023, there are many programmes in the country from different types of organisations focused on reducing energy hardship (New Zealand Government, 2023). However, many of the existing actions are directed at the household level, not systemic changes (Brabo-Catala, Collins, et al., 2023). Since the principal causes of energy hardship are financial hardship (especially the combination of low incomes and high energy prices) and poor dwelling insulation (Ministry of Business Innovation & Employment, 2022a; O'Sullivan & Viggers, 2021), more radical interventions are needed to fully eliminate the condition (Brabo-Catala, Cernic, et al., 2023).

Māori, the original inhabitants of Aotearoa, are overrepresented in households struggling with energy hardship (Ministry of Business Innovation & Employment, 2021; New Zealand Government, 2023; Stats NZ, 2018), even though a significant portion of energy infrastructure is built on Māori land (Casinader, 2021). Almost 200 years after the two distinct versions of Te Tiriti o (the Treaty of) Waitangi were signed by representatives of the

British Crown and Māori leaders (Te Papa Tongarewa, 2020) regarding the governorship of their lands, this indigenous population is still not close to achieving rangatiratanga (sovereignty) over their own resources and decision-making (Ministry of Business Innovation & Employment, n.d.).

The concept of energy democracy, deriving from social justice theory, relies on three ambitious objectives relating to the energy sector: *resist the status quo* (which currently relies on fossil fuels and corporate control), *reclaim the democratic control* (that has been taken away by privatisation) and *restructure the system* by completely shifting to renewables and guaranteeing social justice (through job creation, ubiquitous access to energy and beyond) (Angel, 2016; Burke & Stephens, 2017; Sweeney, 2012). The energy democracy perspective is sceptical that social and environmental issues relating to the energy sector will be solved solely with technical and technological developments, and it is concerned about indigenous issues, such as appropriation of land for renewable energy development.

We are unaware of any studies in Aotearoa linking energy democracy and energy wellbeing. To determine the best practices and propose new solutions based on energy democracy aimed at eradicating energy hardship in New Zealand, we asked organisations and households for feedback on energy wellbeing interventions. We surveyed two groups of households: a nationally representative one, and customers of a social electricity retailer that is powered by a community-owned distributor. The purpose of those surveys was to answer two research questions: *What were the best practices that can be applied for future interventions to minimise energy hardship?* and *What else can be done for different types of organisations to achieve energy democracy and wellbeing?* We believe that the synergy explored in this paper makes our proposals for the energy sector more sustainable and comprehensive.

Methods

This study is divided in two parts: a feedback survey from organisations and follow-up surveys from households (Table 24 below). Ethics approval for the feedback survey and both follow-up surveys was granted in November 2022. All survey questions from this study can be found in Appendix E.

Table 24: Summary of methods used in previous studies and their connection to the current study.

Study	Method	Sample	Period
Previous	Interview	Organisations (n=16)	2021
Previous	Survey	OurPower customers (n=773)	June/July 2022
Previous	Survey	Nationally representative sample (n=505)	September 2022
Current	Survey	Organisations (n=16) [not the same 16]	November/December 2022
Current	Survey (follow-up)	OurPower customers (n=105)	December 2022
Current	Survey (follow-up)	Nationally representative sample (n=69)	December 2022

In 2021, sixteen people working for sixteen organisations in Aotearoa that perform actions to minimise energy hardship were interviewed regarding their operations and views (Brabo-Catala, Collins, et al., 2023). These organisations were invited to respond to the feedback survey explored in this study.

In 2022, we surveyed Kiwi households about their lives and energy usage, and some of them had the opportunity to receive survey rewards from partnering organisations, such as a free month of electricity, energy advice, and energy-related items (Brabo-Catala, Cernic, et al., 2023). In June-July, 983 customers of the social electricity retailer OurPower responded to our survey. In September, we had 559 respondents of a nationally representative sample. Both of the groups were invited to respond to the follow-up surveys of this study, if they agreed to it in the previous survey. Additionally, respondents of the first OurPower and

national surveys could obtain energy-related survey rewards if they agreed to respond to the follow-up surveys.

Feedback from organisations

The survey was available online through Qualtrics XM from November to December 2022. The same sixteen organisations interviewed in 2021 were sent an email invitation to respond to this survey. Organisations that provided energy-related rewards for respondents of the household surveys were also invited to respond. Additionally, this survey was promoted by Energy Wellbeing Evaluation Consortium and during the 16th Otago Energy Research Centre Symposium. This feedback survey had sixteen respondents working at social businesses, government, non-governmental organisations, and energy companies. Despite the limited number of complete feedback responses from organisation employees, all were considered, given the small sample size. The sixteen respondents were not the same as the sixteen interviewees from 2021, even though there is an overlap (the exact number is unknown, as the majority of survey respondents were anonymous).

Follow-ups from households

In addition to feedback data from organisations, follow-up data from households was also sought, with the intention of understanding the intervention perceptions from the ones actually affected by energy hardship, as well as getting them to suggest solutions.

OurPower survey

OurPower is a low-cost electricity retailer operating in the Waikato region of New Zealand. Each OurPower residential customer saved an average of 399 NZD annually according to the company's 2022 data (WEL Networks, 2023). OurPower is the retail brand of the community-owned distribution company WEL Networks, having WEL Energy Trust as the sole shareholder (OurPower, 2023). The Trust provides community and energy

efficiency grants to existing projects from non-governmental organisations (NGOs) in the Waikato region, and its trustees are elected every three years (OurPower, 2023; WEL Networks, 2023). The New Zealand Government is recommending the expansion of social retailers (even using OurPower as an example) as a way towards energy wellbeing (New Zealand Government, 2023).

The first OurPower survey had 983 responses, with 773 considered valid. A total of 358 respondents agreed to participate in the follow-up survey and enter a draw to receive one month of free electricity (given to five). In December 2022, 134 respondents of those 358 answered the online Qualtrics XM follow-up survey, which was sent via email. Of all the responses received, 105 were deemed valid after reviewing the completeness of their answers in the first section. Out of these, 49 completed the survey until the end.

National survey

We hired Dynata, a sample provider, to source a nationally representative sample of Aotearoa for first national survey. We obtained 559 responses, with 505 considered valid. Dynata contacted all respondents to participate in the follow-up survey. In December 2022, 527 respondents answered the online Qualtrics XM follow-up survey, with only 69 being fully completed and considered valid.

Results

Rewards

We decided to offer rewards in the previous household surveys as a way to minimise energy hardship, and to be able to compare the reward effectiveness on respondents who received them *versus* those who did not receive them.

The OurPower respondents were eligible to enter a draw to win one month of free electricity, with five winners selected. When they were invited to respond to the survey, they were already informed about the possibility of the survey rewards.

Respondents of the national survey who resided in the Northland, Auckland, or Canterbury region and had five or more energy hardship indicators (Ministry of Business Innovation & Employment, 2021) were informed of the rewards they could potentially receive by contacting one of three partnering local organisations. Respondents only learnt about the possibility of earning survey rewards at the end of the survey. The rewards included: heaters, hygrometers, insulating curtains, condensation squeegees, blankets, hot water bottles, draught stoppers, education booklets, energy advice, and information on energy efficiency services and eligibility for subsidies.

In the follow-up surveys, we queried respondents about their willingness to accept the offered rewards.

OurPower survey

Only one OurPower respondent claimed to have received the free electricity reward. (Table 25 below). That respondent also stated that the reward was helpful for their household.

Table 25: OurPower follow-up respondents' participation in the draw for a free month of electricity and outcome (n=105).

Did you agree to enter the draw?	Total (n)	Total (%)
Yes, and I did not win	93	88.57%
Do not know or prefer not to answer	8	7.62%
No, I did not enter	3	2.86%
Yes, and I won	1	0.95%

We sought to understand the reasoning behind the decision of the three OurPower respondents who declined to participate in the draw. Their justifications were recorded via a textbox, with two indicating that they could not recall their reasoning and one stating that they felt others needed the reward more.

National survey

In the national survey, we asked respondents if they had the option to receive the rewards and if they agreed. Results showed that 44.93% of respondents agreed to potentially receive the rewards. (Table 26 below).

Table 26: Willingness of national follow-up respondents to receive rewards if available (N=49).

Were rewards available, and did you agree?	Total (n)	Total (%)
Yes, and I agreed	31	44.93%
No, not available	6	8.70%
Do not know or prefer not to answer	4	5.80%
Yes, and I did not agree	2	2.90%

Of the 31 national survey respondents who agreed to receive rewards, we asked if they contacted the organisation who offered the award. Surprisingly, 80.65% reported that they did not reach out. (Table 27 below). Unfortunately, the only two national survey respondents who had contacted the organisation said they could not receive the rewards.

Table 27: National follow-up respondents' contact with organisations to receive rewards (N=31).

Did you reach out to the organisation?	Total (n)	Total (%)
No	25	80.65%
Do not know or prefer not to answer	4	12.90%
Yes	2	6.45%

The 29 respondents who did not select that they reached out to the organisation could justify their reasoning in a textbox (Table 28 below). The most common justification was forgetfulness (27.59%).

Table 28: Themes among national follow-up respondents for not reaching out to organisations (N=29).

Why did you not reach out?	Total (n)	Total (%)
Did not remember	8	27.59%
Lack of information on how to proceed	6	20.69%
Lack of interest	4	13.79%
Do not know	3	10.34%
No reward information was provided	2	6.90%
Felt suspicious	1	3.45%
Did not think the organisation could help	1	3.45%
Lack of time	1	3.45%

Energy actions

The follow-up survey of both household surveys asked respondents if they had taken or received any of the listed energy actions listed since the previous survey (June-July 2022 for OurPower and September 2022 for the national survey). The most frequent action by OurPower follow-up respondents was receiving the Winter Energy Payment, a benefit to minimise energy costs (Table 29 below). Meanwhile, national survey follow-up respondents' most commonly reported action was adopting more energy-efficient habits (15.94%).

Table 29: Household energy actions since the last survey, OurPower respondents (N=69) and national respondents (N=49).

Any energy action since the last survey?	Survey	Total (n)	Total (%)
Received Winter Energy Payment	OurPower	18	36.73%
	National	10	14.49%
No relevant energy-related actions	OurPower	17	34.69%
	National	5	7.25%
Adopted more energy-efficient habits	OurPower	5	10.20%
	National	11	15.94%
Received energy rebate	OurPower	5	10.20%
	National	4	5.80%
Obtained energy-efficient lightbulbs or appliances	OurPower	3	6.12%
	National	5	7.25%
Switched to a cheaper retailer	OurPower	1	2.04%
	National	4	5.80%
Had insulation improvements in the dwelling	OurPower	2	4.08%
	National	2	2.90%
Obtained a better heater	OurPower	3	6.12%
	National	0	0.00%
Other	OurPower	2	4.08%
	National	1	1.45%
Obtained insulating curtains	OurPower	2	4.08%
	National	0	0.00%
Obtained gas access	OurPower	1	2.04%
	National	0	0.00%
Received financial mentoring	OurPower	1	2.04%
	National	0	0.00%

We then queried the respondents on the consequences of the energy actions they reported in the previous question. The most frequently reported outcome in both surveys was that no noticeable consequences had arisen yet (Table 30 below).

Table 30: Noticeable consequences of household energy actions since the last survey, OurPower respondents (N=69) and national respondents (N=49).

Were there noticeable consequences?	Survey	Total (n)	Total (%)
No consequences so far	OurPower	20	40.82%
	National	36	52.17%
Positive consequences only	OurPower	15	30.61%
	National	27	39.13%
Don't know or prefer not to answer	OurPower	14	28.57%
	National	3	4.35%
Negative consequences only	OurPower	0	0.00%
	National	2	2.90%
Both positive and negative consequences	OurPower	0	0.00%
	National	1	1.45%

Respondents were asked to describe the positive and/or negative consequences in a textbox. Only national follow-up respondents reported negative consequences (n=3), and all described the outcomes as higher energy expenses. As for positive consequences, respondents of both follow-ups reported financial savings as the main one (Table 31 below).

Table 31: Themes regarding the consequences of household energy actions, OurPower respondents (N=15) and national respondents (N=28).

Positive consequences?	Survey	Total (n)	Total (%)
Financial savings	OurPower	12	80.00%
	National	22	78.57%
Thermal improvements	OurPower	3	20.00%
	National	7	25.00%
Noise reduction	OurPower	0	0.00%
	National	2	7.14%

Role of organisations

Respondents of all surveys were asked to rank different organisations based on their perceived ability to impact households' access to and affordability of adequate energy. The lowest average score for OurPower and national follow-up respondents was the energy sector, while for the organisation feedback survey, it was the New Zealand (NZ) national government. (Table 32 below).

Table 32: Ranking of organisation type relating to their energy hardship impact, OurPower respondents (N=49), national respondents (N=69), and organisation respondents (N=14).

Importance of organisation?	Survey	Mode	Median	Average	CI of average	Standard deviation	Minimum	Maximum
Energy sector	OurPower	1.00	2.00	1.98	1.67 to 2.29	1.10	1.00	5.00
	National	1.00	2.00	2.00	1.74 to 2.26	1.09	1.00	5.00
	Organisation	3.00	3.00	2.78	2.06 to 3.50	1.47	1.00	6.00
NZ National government	OurPower	2.00	2.00	2.02	1.72 to 3.32	1.06	1.00	6.00
	National	1.00	2.00	2.16	1.88 to 2.43	1.18	1.00	5.00
	Organisation	1.00	2.00	2.67	1.90 to 3.43	1.56	1.00	5.00
Local government	OurPower	3.00	3.00	2.94	2.62 to 3.26	1.13	1.00	5.00
	National	3.00	3.00	3.25	2.95 to 3.55	1.27	1.00	6.00
	Organisation	6.00	5.00	4.78	4.18 to 5.38	1.23	3.00	6.00
NGOs	OurPower	4.00	4.00	3.96	3.63 to 4.28	1.16	1.00	5.00
	National	4.00	4.00	3.86	3.60 to 4.12	1.10	1.00	6.00
	Organisation	5.00	3.00	3.33	2.50 to 4.17	1.70	1.00	6.00
Construction/ housing sector	OurPower	5.00	4.00	4.20	3.92 to 4.49	1.03	1.00	6.00
	National	5.00	4.00	3.77	3.46 to 4.07	1.28	1.00	5.00
	Organisation	2.00	4.00	3.67	2.83 to 4.50	1.70	1.00	6.00
Other	OurPower	6.00	6.00	5.90	5.77 to 6.03	0.46	3.00	6.00
	National	6.00	6.00	5.97	5.93 to 6.01	0.17	5.00	6.00
	Organisation	7.00	7.00	7.00	7.00 to 7.00	0.00	7.00	7.00
Own organisation	Organisation	5.00	4.00	3.78	2.99 to 4.57	1.62	1.00	6.00

We also asked questions to the respondents of the three surveys on how the different organisations could better help households to be able to obtain and afford adequate energy services according to their categories, and the themes were summarised (Tables 33-41 below). Lowering prices was a common theme among different organisation types in all surveys. As these questions were open-ended, another observation is that not all respondents were aware of the responsibility of each type of organisation is (e.g. Table 33 below with 10 respondents total wanting the local government to lower energy prices). Other common potential actions for the local government included lowering taxes and/or other domestic costs and promoting energy information.

Table 33: Potential local government action against energy hardship by theme, OurPower respondents (N=49), national respondents (N=69), and organisation respondents (N=14).

Potential local government action	Survey	Total (n)	Total (%)
Lower energy prices	OurPower	2	1.90%
	National	8	11.59%
Lower taxes/other domestic costs	OurPower	2	1.90%
	National	6	8.70%
Promote energy information	OurPower	2	1.90%
	National	5	7.25%
	Organisation	2	14.29%
Provide insulation help	OurPower	1	0.95%
	National	5	7.25%
	Organisation	1	7.14%
Provide subsidies	OurPower	2	1.90%
	National	4	5.80%
Provide grants	OurPower	1	0.95%
	National	4	5.80%
	Organisation	2	14.29%
Provide energy rebates	OurPower	1	0.95%
	National	3	4.35%
Decentralise the energy sector	National	5	7.25%

	Organisation	1	7.14%
Ensure proper building standards	OurPower	5	4.76%
	Organisation	2	14.29%
Invest in energy research	National	1	1.45%
	Organisation	1	7.14%
Collaborate with the energy sector	OurPower	3	2.86%
Regulate energy pricing	National	2	2.90%
Collaborate with local programmes	Organisation	2	14.29%
Make NZ national government accountable	OurPower	1	0.95%
Provide financial advice	National	1	1.45%
Increase pensions	National	1	1.45%

Considering the total number of respondents of all surveys, the regulation the energy sector and its pricing, in addition to providing grants, were common themes suggested for potential NZ national government action (Table 34 below).

Table 34: Potential NZ national government action against energy hardship by theme, OurPower respondents (N=49), national respondents (N=69), and organisation respondents (N=14).

Potential NZ national government action	Survey	Total (n)	Total (%)
Provide grants	OurPower	4	3.81%
	National	11	15.94%
	Organisation	1	7.14%
Regulate the energy sector and pricing	OurPower	11	10.48%
	National	7	10.14%
	Organisation	1	7.14%
Limit energy profits	OurPower	2	1.90%
	National	6	8.70%
Provide subsidies	OurPower	2	1.90%
	National	4	5.80%
	Organisation	1	7.14%
Provide energy rebates	OurPower	1	0.95%

	National	2	2.90%
Lower energy prices	OurPower	4	3.81%
	National	2	2.90%
Lower taxes	OurPower	1	0.95%
	National	1	1.45%
Produce energy	OurPower	2	1.90%
	National	1	1.45%
Have more accountability	National	4	5.80%
	Organisation	1	7.14%
Ensure proper building standards	OurPower	3	2.86%
	Organisation	1	7.14%
Invest in energy research	National	3	4.35%
	Organisation	1	7.14%
Provide efficiency help	National	3	4.35%
	Organisation	1	7.14%
Increase funding for programmes	Organisation	3	21.43%
Improve the grid	OurPower	1	0.95%
Provide financial advice	National	1	1.45%
Assist local governments	OurPower	1	0.95%

Providing diverse household assistance and promoting energy information were the most popular suggestions for potential NGO actions from all surveys (Table 35 below).

Table 35: Potential NGO action against energy hardship by theme, OurPower respondents (N=49), national respondents (N=69), and organisation respondents (N=14).

Potential NGO action	**Survey**	**Total (n)**	**Total (%)**
Provide diverse household assistance	OurPower	5	4.76%
	National	10	14.49%
	Organisation	1	7.14%
Promote energy information	OurPower	4	3.81%
	National	10	14.49%
	Organisation	2	14.29%

Connect to the energy sector	OurPower	1	0.95%
	National	2	2.90%
Provide efficiency help	OurPower	1	0.95%
	National	12	17.39%
	Organisation	1	7.14%
Connect to government	OurPower	4	3.81%
	National	1	1.45%
	Organisation	1	7.14%
Provide grants	National	7	10.14%
Limit or stop profiteering	National	2	2.90%
Lower energy prices	National	2	2.90%
Produce energy	National	2	2.90%
Provide subsidies	National	2	2.90%
Have more accountability	National	1	1.45%
Refuse tax benefit	National	1	1.45%
Obtain more funding	Organisation	1	7.14%
Develop stronger regional networks	Organisation	1	7.14%

Undoubtedly, respondents of the three surveys prioritised lower energy rates and changing pricing structure as the top potential energy sector action (Table 36 below).

Table 36: Potential energy sector action against energy hardship by theme, OurPower respondents (N=49), national respondents (N=69), and organisation respondents (N=14).

Potential energy sector action	Survey	Total (n)	Total (%)
Lower energy rates/change pricing structure	OurPower	18	17.14%
	National	32	46.38%
	Organisation	3	21.43%
Increase sustainability	OurPower	4	3.81%
	National	7	10.14%
Provide discounts	OurPower	1	0.95%
	National	6	8.70%
	Organisation	1	7.14%

Invest in solar power	OurPower	3	2.86%
	National	1	1.45%
Promote energy information	National	5	7.25%
	Organisation	3	21.43%
Increase customer assistance	National	1	1.45%
	Organisation	5	35.71%
Invest in energy research	National	1	1.45%
	Organisation	1	7.14%
Provide more payment options	National	4	5.80%
Find cheaper energy sources	National	3	4.35%
Become nationalised again	OurPower	2	2.90%
Provide grants	National	1	1.45%
Provide energy rebates	National	1	1.45%
Increase competition	National	1	1.45%
Provide consistent/easy to read bills	Organisation	1	1.45%
Build trust with the community	Organisation	1	1.45%

The most frequent theme for the potential action from the construction and housing sector was increasing efficiency and insulation, according to all surveys (Table 37 below).

Table 37: Potential construction and housing sector action against energy hardship by theme, OurPower respondents (N=49), national respondents (N=69), and organisation respondents (N=14).

Potential construction/housing sector action	**Survey**	**Total (n)**	**Total (%)**
Increase efficiency/insulation	OurPower	16	23.19%
	National	25	36.23%
	Organisation	5	35.71%
Lower housing-related costs	OurPower	1	1.45%
	National	10	14.49%
Improve overall housing quality	OurPower	3	4.35%
	National	7	10.14%
	Organisation	2	14.29%

Increase sustainability	OurPower	1	1.45%
	National	6	8.70%
	Organisation	1	7.14%
Promote energy information	OurPower	2	2.90%
	National	1	1.45%
Have more accountability	National	1	1.45%
	Organisation	3	21.43%
Build energy generators	National	3	4.35%
Build more homes	National	2	2.90%

Regarding potential actions from other sectors, the most common responses from all surveys related to increasing sustainability and promoting energy information (Table 38 below).

Table 38: Potential action against energy hardship from other sectors separated by theme, OurPower respondents (N=49), national respondents (N=69), and organisation respondents (N=14).

Potential action from other sectors	Survey	Total (n)	Total (%)
Promote energy information	OurPower	2	2.90%
	National	4	5.80%
Increase sustainability	OurPower	3	4.35%
	National	4	5.80%
Lower overall costs	National	6	8.70%
Increase customer assistance	National	2	2.90%
Have more accountability	National	1	1.45%
Make the construction sector accountable	OurPower	1	1.45%
Highlight the importance of Powerswitch	Organisation	1	7.14%

For OurPower respondents, the number one potential action from the retailer is to keep their rates as cheap as possible (Table 39 below).

Table 39: Potential OurPower action against energy hardship separated by theme, OurPower respondents (N=105).

Potential action from OurPower	Total (n)	Total (%)
Keep rates as cheap as possible	16	15.24%
Already satisfied with current actions	12	11.43%
Provide more payment options	8	7.62%
Advertise more	7	6.67%
Offer specific household hardship assistance	7	6.67%
Track hourly and daily usage	5	4.76%
Expand service to more households	5	4.76%
Supply gas	4	3.81%
Educate clients about energy	3	2.86%
Supply business clients	1	0.95%

Respondents of the national survey mentioned providing and promoting cheaper energy rates as the most popular theme for potential action from survey reward providers (Table 40 below).

Table 40: Potential action against energy hardship from survey reward providers separated by theme, according to national respondents (N=31).

Potential action from reward providers	Total (n)	Total (%)
Provide and promote cheaper energy rates	6	19.35%
Provide energy rebates	5	16.13%
Facilitate information sharing	4	12.90%
Act on energy efficiency/conservation	3	9.68%
Provide more rewards	3	9.68%
Be involved in more research	2	6.45%
Provide financial advice	2	6.45%
Protect vulnerable households	2	6.45%
Improve their own services	1	3.23%
Decentralise the energy production/distribution	1	3.23%

Respondents from the organisation survey entered their response relating to potential action from their own organisation in the textbox (Table 41 below).

Table 41: Potential action against energy hardship from own organisation, according to respondents of the organisation follow-up survey (N=14).

Potential action from own organisation
Keep providing advice to our customers as a community-owned organisation. Keep giving back to our customers through our yearly lines discount, and use our trusted reputation for good
People above profits
Hold energy sector accountability and feed into policy changes. Support whānau to make behaviour changes.
More funding
Assisting with resolving disputes and sharing systemic issues and trends with the sector
Support all of the above [actions from other organisation types] *to happen*
Ability to access families that might be difficult for others to reach, providing support via programmes like we are currently doing

Learning from practice

OurPower follow-up respondents explained why they chose OurPower as their electricity retailer. The vast majority of them stated the company's lower prices (n=97) as the reason (Table 42 below).

Table 42: Reasoning for choosing OurPower as an electricity retailer, OurPower respondents (N=105).

Why OurPower?	**Total (n)**	**Total (%)**
Cheaper bills	97	92.38%
Simple pricing system with a single rate	53	50.48%
Weekly payment	47	44.76%
Community electricity sharing	16	15.24%
Do not know or prefer not to answer	2	1.90%
Other (please specify)	6	5.71%

Local company	1	16.67%
Bad credit not relevant	1	16.67%
Only option available	1	16.67%
No daily charge	1	16.67%
Recommended by local district health board	1	16.67%
Easy transfer of retailer	1	16.67%

We asked the organisations during their feedback survey about their current programme actions and if they planned on continuing them. Most respondents (n=8) stated that they would continue with the actions they are currently providing, while two were unsure/did not want to respond, and four did not fill in this specific answer (Table 43 below).

Table 43: Current energy wellbeing actions and their future status, organisation respondents (N=14).

Does your programme offer any of the following for households?	Other (please specify) – Text	Any of the actions mentioned in the previous question will be continued or discontinued?	Continued (please specify) - Text
Home energy assessments, efficient light bulbs or appliances, promotion of energy-efficient habits, other (please specify)	*Low flow shower heads (to reduce hot water consumption)*	Continued (please specify)	*We have received more funding from MBIE to continue our programme. Also, the advice we give households are actions they can continue long term to keep costs down.*
Home energy assessments, efficient light bulbs or appliances, insulating curtains, cheaper electricity plans, promotion of energy-efficient habits, financial mentoring		Continued (please specify)	*Will keep actioning our HH* [Healthy Homes] *program*
Home energy assessments, efficient heaters, efficient light bulbs or appliances, insulating curtains, promotion of energy-efficient habits		Continued (please specify)	*We will continue to provide the heaters as we know the health implications of living and sleeping in a cold room. We hope that we can provide solutions to reducing energy use to put towards heating through our behaviour change education.*
Home energy assessments, insulation improvements in the fabric of the dwellings, efficient heaters, efficient light bulbs or appliances, insulating curtains, promotion of energy-efficient habits		Continued (please specify)	*All*
Energy rebates		Do not know or prefer not to answer	
Promotion of energy-efficient habits, other (please specify)	*Dispute resolution between energy providers and their customers*	Continued (please specify)	*Ongoing assistance to energy customers*
Do not know or prefer not to answer		Do not know or prefer not to answer	
Home energy assessments, promotion of energy-efficient habits, other (please specify)	*Help accessing WKH* [Warmer Kiwi Homes], *HHI* [Healthy Homes Initiative] *etc and referring to other programmes*	Continued (please specify)	*This is an ongoing program with no end date. We hope more councils can join in.*
Home energy assessments, insulation improvements in the fabric of the dwellings, efficient heaters, insulating curtains, promotion of energy-efficient habits, other (please specify)	*Deep retrofits, community energy*	Continued (please specify)	*All so far although would like to do more re deeper retrofits and education*
Insulation improvements in the fabric of the dwellings, efficient heaters, efficient light bulbs or appliances, insulating curtains, promotion of energy-efficient habits, other (please specify)	*Home assessments - physical state of the home not energy assessments as per above*	Continued (please specify)	*Yes if families move from this current home, they can still use new behaviours, and for new families into this home will also receive the benefit of minor and significant repairs.*
Cheaper electricity plans, promotion of energy-efficient habits			

Respondents of the organisation feedback survey reported the main findings of their programmes (Table 44 below), with positive energy education outcomes being a theme in over a third of them (n=5).

Table 44: Main programme findings, organisation respondents (N=14).

Main programme finding
A few simple changes to people's behaviour or to their homes can help them make good savings on their power bills.
people lack knowledge about how to live in a house. People don't understand how to use electric equipment correctly that are in their houses. ie Heat pumps
78% strongly agreed that their home is warmer and drier. *95% learned something new from the information and education.* *46% cannot afford to pay their power bill* *(Plus the other data in previous entries)*
Education is one of the most impactful things to creating long lasting change, this needs to be coupled with providing those in need with targeted support for repairs, heating, insulation, curtains, appliances
Energy retailers hold most of the keys to access the people in hardship, so a 3rd party organisation like ours will be key in connecting all of them
Electricity providers are doing much better with their vulnerable customers and are valuing all their customers more than say 10 years ago
That those with power and $$ do not understand what is happening on the ground. Or if they do, cannot fit their worldview into a truly successful programme
Some interesting findings from our most recent survey were: *95% of families said they had learned something new from the information and education and nearly 93% said they did things differently now* *63% agreed or strongly agreed that, since receiving support from Habitat* [for Humanity] *they can use the heater efficiently (having less impact on electricity bill) whenever it is needed.*

We also asked the respondents of the feedback survey on organisations to share any additional thoughts on energy wellbeing and the interventions towards it. Three respondents

explicitly brought up the concern of vulnerable consumers being left behind due to lack of financial resources (Table 45 below).

Table 45: Additional thoughts on energy wellbeing interventions, organisation respondents (N=14).

Additional thoughts on energy wellbeing interventions
Energy affordability is only going to get harder, especially for the poor as new technologies that could help them reduce costs over time (EVs, heat pumps) are out of their range with a large upfront cost.
There is a big gap in affordability, creating inequities in access to energy. This needs to be addressed and rising energy prices needs to be the focus for government subsidies, not just in winter, but all seasons. The rising cost of living pushes vulnerable whānau further into energy poverty, increasing the gaps in health, education and wellbeing. While asking whānau to reduce energy in some areas to put towards other areas is valid in some households, in many of the whare we are working in whānau struggle to afford the baseline (minimum) energy costs and when your bill is $160 [NZD] *and you only have $100* [NZD] *left every month, reducing the shower time isn't going to make a dent in affordability! The reality is incomes are not matching the cost of living.*
Those most vulnerable have no access to the most efficient technologies because of the cost, all social housing should have the most efficient technologies by default
It's complex, and will require many, many programs all working together. Hopefully not duplicating each other, but complimenting and collaborating to work towards the same goal
The new consumer advocacy council and MBIE hardship panel is filling a much needed consumer gap specifically for the sector
Needs well resourced and strong collaboration across government, research and on the ground. Kaupapa Maori [the Māori framework] *is a long way behind and that regional approach needs to bring that through big time.*

Discussion

This research sought to answer the question: What were the best practices that can be applied for future interventions to minimise energy hardship? According to the findings of three surveys and the energy democracy framework, what else can be done for different types of organisations to achieve energy democracy and wellbeing? To fully answer our questions, we will separate our discussion into subtopics.

Best practices for energy hardship minimisation

Low electricity rates

The lower rates charged by OurPower are the main reason the respondents chose the company as their electricity retailer. OurPower customers are in more material and energy hardship than the national average, even the Waikato average (Brabo-Catala, Cernic, et al., 2023). Keeping energy costs as low as possible is a central theme discussed in the three surveys as a suggestion for reducing energy hardship. High energy expenses are a major cause of the condition (Boardman, 2013).

This finding was confirmed by the 2019 Electricity Price Review and the 2021 Defining Energy Hardship documents, which highlighted the importance of augmenting energy affordability in Aotearoa, especially for vulnerable households with medical conditions present (Ministry of Business Innovation & Employment, 2021; New Zealand Government, 2019).

Simple plans and bills

About half of the OurPower respondents also stated OurPower's simple single-rate billing as a reason for choosing them. OurPower does not have a daily fixed charge, which one respondent described as another reason. Electricity plans and bills in New Zealand are heterogeneous, unclear, and can even be deceptive to customers (New Zealand Government, 2019). Often, low-income households without proper energy literacy or knowledge of plan comparison websites such as Powerswitch end up paying more for energy services (especially if using prepayment), deepening their financial and energy hardship (Ministry of Business Innovation & Employment, 2021; O'Sullivan et al., 2011, 2015).

Winter Energy Payment

More than a third of OurPower and 14.49% of national follow-up respondents affirmed receiving the Winter Energy Payment between the first and follow-up surveys. In 2022, the government financial assistance was paid automatically from 1 May to 1 October to Kiwi households receiving benefits such as the NZ superannuation, veteran's pension, and sole parent support (Work and Income NZ, 2023). Households of single people without dependent children received 20.46 NZD weekly, whereas those with couples or dependent children received 31.82 NZD weekly (Work and Income NZ, 2023). Furthermore, many respondents mentioned that the Winter Energy Payment was the reason for their financial savings, which they saw as a positive result of the energy-related action received since the previous survey.

Energy awareness interventions

The 2021 Defining Energy Hardship discussion document describes energy awareness as, "[t]he understanding of how much energy your household uses, for what purpose, and the most efficient way to use it. Changing some energy use habits can save households money on their energy bill" (Ministry of Business Innovation & Employment, 2021, p. 21). Most respondents of the organisation survey stated to promote energy-efficient habits, and their main programme findings were positive outcomes from energy awareness actions. OurPower and national survey follow-up respondents also stated positive consequences of adopting more energy-efficient habits, even though those positive consequences were less frequent and intense than receiving the Winter Energy Payment. Some respondents emphasised that learning the efficient use of their heater increased their thermal comfort while reducing costs.

Strategising for energy hardship eradication

While actions aiming for energy wellbeing in Aotearoa discussed in this study thus far have been extremely important and relate to different facets of the energy hardship framework proposed by MBIE (Ministry of Business Innovation & Employment, 2021), they are not sufficient to solve the leading causes of energy hardship: poor housing quality, low incomes, and high energy prices (Boardman, 1991; O'Sullivan & Viggers, 2021). The existing programmes are also strongly associated with energy citizenship: household-centred practices focused on energy literacy and awareness (Wahlund & Palm, 2022). On the other hand, energy democracy relates to the democratic decision-making, production, distribution, and use of renewable energy (van Veelen & van der Horst, 2018). While prosumerism (increasing involvement of consumers in production processes) is key in both energy citizenship and democracy, the main difference is that the latter uses workers and community activism to achieve it rather than *personal choice* (Wahlund & Palm, 2022).

In the national follow-up, it was expected that the households with a relevant number of energy hardship indicators would obtain the survey rewards, however, that did not materialise. The respondents' reasoning for not engaging can demonstrate a significant presence of hard-to-reach energy users in Aotearoa, as "typically either hard-to-reach physically, underserved, or hard to engage or motivate in behavior change, energy efficiency and demand response interventions that are intended to serve our mutual needs" (Rotmann, 2019). This needs to be considered for interventions aimed at eradicating energy hardship in Aotearoa, especially those requiring democratic participation.

Potential ways to engage hard-to-reach energy users include modification of communication (e.g. using various channels and languages), programme customisation (e.g. creating incentives and building trust), and local community partnerships (e.g. hiring and

training locals) (Ashby et al., 2020). Engaging with local Māori and Pasifika organisations can optimise the efficiency of programmes by using adequate language and cultural tools (including Kaupapa Māori, as mentioned by an organisation survey respondent), especially as those ethnic groups are the most affected by energy hardship in New Zealand (O'Sullivan et al., 2017; Teariki et al., 2020).

Linking this study's survey findings with the energy democracy framework (Angel, 2016; Burke & Stephens, 2017; Chilvers & Longhurst, 2016; Chilvers & Pallett, 2018; Fairchild & Weinrub, 2017), we propose the development of the following for achieving energy wellbeing in Aotearoa:

Locally consumer-owned renewable energy companies

Respondents of the three surveys emphasised the need for cheaper energy services, with OurPower respondents stating that the company's low tariff is the main reason for choosing it. Making all distributors and retailers locally consumer-owned and democratic takes away the influence of shareholders that are solely focused on profitability.

Decentralising generation, distribution, retailing, and their associated decision-making makes the energy system more focused on the specific needs of the community.

The smaller scale also makes it easier to decarbonise the grid, aligned with the household follow-up survey respondents priorities regarding sustainability. This can be facilitated by the Māori and Public Housing Renewable Energy Fund (Ministry of Business Innovation & Employment, 2023). During the process of decentralisation, non-renewable plants can be phased out while transitioning employees to get unionised work in the new renewable development.

Expanded energy programmes for households

The Winter Energy Payment was stated to be a cause of financial savings for respondents of the OurPower and national follow-ups. We suggest that the programme is expanded and increased according to household vulnerability, to include households such as those with respiratory health conditions and multiple young children that have not been receiving the benefit thus far. Other programmes that should be expanded and increased to all regions and tenure status according to household vulnerability are the Warmer Kiwi Homes (insulation and heater grants) and Healthy Homes Initiative (insulation assessment and diverse thorough energy assistance) (Energy Efficiency and Conservation Authority, 2023; Ministry of Health, n.d.). These two programmes were mentioned by an organisation survey respondent, and NGOs serve an important role by connecting households to government. Furthermore, OurPower and national follow-ups respondents frequently stated that energy grants and insulation and building improvements were priorities for them.

Equal opportunities

While not explicitly discussed by respondents of the three surveys, the multiple levels of inequality in Aotearoa are a root cause of energy hardship. Ensuring Te Tiriti o Waitangi obligations are followed at all levels is essential to start achieving rangatiratanga. Making energy infrastructure built on Māori land consumer-owned and democratic by local Māori communities would greatly increase their energy wellbeing and democracy.

The proposed actions above mostly relate to the *Resist the dominant energy agenda* and *Reclaim the energy sector* goals of energy democracy (Burke & Stephens, 2017). The first goal mainly focuses on stopping further fossil fuel development, whereas the second goal predominantly concerns localising and publicly owning the energy sector. The third

goal, *Restructure the energy sector*, is a consequence of treating energy as a common good, with the sector emphasising on wellbeing, sufficiency, and environmental quality.

While our suggestions alone will not solve the low income issue or the fact that landlords and tenants have antagonist interests (Barton, 2014; Brabo-Catala et al., 2022), they have the potential to be non-reformist reforms. Those are defined as reforms that contest the power structures status quo and build a strong and necessary foundation for future struggles (Bond, 2008), which can greatly impact the lives of households in Aotearoa. Still, unionised job opportunities and potential financial savings from cheaper energy expenses can alleviate income restraints for many households, while ensuring strict building codes can significantly improve housing quality and energy efficiency for all.

We emphasise that a decentralised and democratic control of the energy sector can reduce costs and should be focused on the diverse local needs as it moves away from the corporate profit motive (Angel, 2016; Stephens, 2019). The operation strategy can be through co-operative, elected trustees, community ownership, or others, depending on what is most appropriate and chosen by the locals (Chilvers & Longhurst, 2016; Rountree & Baldwin, 2018; Szulecki, 2017; Van Veelen, 2018). Additionally, strong campaigns on energy education (including, but not limited to, awareness and literacy) are extremely valuable in assisting the communities with the quality of the informed decision-making process (Cervas & Giancatarino, 2017).

Though we do not expect our suggestions to be adopted by the organisations that benefit from the *status quo*, we hope that some proposals can be embraced by those that both have the material means and desire to eradicate energy hardship, since they can lead to greater change. As for the more audacious suggestions, they can be used as a horizon to achieve energy wellbeing and democracy.

Conclusion

To guide future actions against energy hardship, we carried out follow-up surveys with New Zealand households and a feedback survey with organisations working to minimise energy hardship in the country. The best practices here related to the retailer OurPower's low electricity rates and simple bills, in addition to the government's Winter Energy Payment, and various energy awareness interventions from various organisations. Furthermore, we used the survey findings and the energy democracy framework to propose non-reformist reforms focused on local, renewable, and democratic control of energy systems. While this research is focused on Aotearoa, our research strategies and proposals can be modified to be applied worldwide.

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Chapter Seven – Conclusion

The main reason I decided to research energy hardship was seeing how much the social side of energy is neglected, even by academics. In times of climate crisis, a lot of attention has been focused on technical and technological solutions towards mitigation and adaptation. Meanwhile, many people in New Zealand – considered a developed nation – are deeply struggling with poor health and wellbeing because they are unable to get a grant for insulation, their heater is too old and inefficient, or they did not choose the best electricity plan for their household needs. While I am not as charismatic or optimistic as a tech startup CEO (and I am not providing a silver bullet), I wanted to envision ways of potentially making those Kiwis' lives better regarding their difficulty to obtain and afford energy services. I started by thinking *What are the best interventions to eradicate energy hardship in Aotearoa?* However, multiple steps were needed to answer this main research question, which required qualitative and quantitative methods.

I used a transition management framework to guide me through the whole research process, with Loorbach (2010) being the main guide. The idea of this framework is mainly "learning-by-doing," meaning that small-scale experiments are used to obtain best practices for the larger scale, adjusting for improvements according to feedback. This thesis was composed of five manuscripts, which in total, answer my main and my sub research questions.

In Chapter Two - *Key Fuel Poverty Indicators and Variables: A Systematic Literature Review*, I compared indicators and variables of fuel poverty, energy poverty, and energy hardship from eighty-four publications. I found, subjective indicators were the most utilised in the extant literature, and variables relating to the household composition and structure were the most frequent. Additionally, of the selected themes, I learnt health was the most

commonly found in the selected publications. These findings strongly support the claim that fuel poverty, energy poverty, and energy hardship are social issues. This manuscript is currently in press by the journal *Economics of Energy and Environmental Policy*.

In Chapter Three - *Fuel Poverty or Energy Hardship? Analysing the literature, the proposed official definition, and the views of experts in Aotearoa New Zealand*, the goal was answering: *How does the MBIE concept of energy hardship compare to its international counterparts?* To learn about fuel poverty definitions, indicators, and issues, I first analysed the major international publications, especially, Bouzarovski and Petrova (2015), Healy and Clinch (2004), Hills (2011), Moore (2012), and Thomson et al. (2016). After analysing the literature, I interviewed five Kiwi energy experts to learn about their views on the differences between fuel poverty and energy hardship based on the MBIE proposal. While the MBIE definition of energy hardship relates to both energy unaffordability and lack of access, fuel poverty is only associated with the financial facet. Still, I learnt both terms are used as synonyms in Aotearoa, mainly due to affordability being the main concern in the country. I also concluded that the MBIE definition and measures (indicators) of energy hardship were comprehensive and aligned with the literature and the views of the five interviewees. This manuscript was published by *Policy Quarterly* in November 2022 (Volume 18, Issue 4, Pages 46-53).

In Chapter Four - Trends in Current Energy Wellbeing Interventions in Aotearoa New Zealand and the Energy Hardship Conceptual Framework, I interviewed sixteen Kiwi organisations with energy hardship minimisation interventions to answer the question: *What types of interventions exist to minimise energy hardship?* I used the MBIE energy hardship framework to understand what has been done and what has been missing from their actions. I learnt that while there is still room for improvement regarding the environmental facet and

actions beyond the household-level, the interventions are extremely synergetic. This manuscript is ready for submission.

In Chapter Five - The heat goes on: Simplifying the identification of energy hardship, I conducted one survey with 773 customers of the electricity retailer, OurPower, and another survey with 505 respondents of a nationally representative sample of New Zealand. Two sub questions were answered: *What is the demographic of households in energy hardship?* and; *What socioeconomic issues relate to energy hardship?* Using the MBIE indicators as points, I related energy hardship scores to survey responses regarding household and dwelling characteristics through t-test, correlation, and ANOVA. I found that the five main variables relating to more severe energy hardship were the household's inability to afford sufficient warmth (MBIE indicator), major housing repairs needed (MBIE indicator), the household having to choose between paying for food or energy bills, feeling cold often due to self-rationing (MBIE indicator), and accumulating energy debt. This manuscript was published by Heliyon in August 2023 (Volume 9, Issue 8, E19087).

Lastly, in Chapter Six - Aiming for Energy Wellbeing and Democracy, I carried out follow-up surveys with OurPower and national survey respondents to answer my main research question. Additionally, I conducted a feedback survey with sixteen organisations that do energy hardship minimisation – but not the same as the sixteen interviewees from Chapter Four. I learnt that the respondents found the best practices to be OurPower's cheap rates and simple bills, the Winter Energy Payment, and multiple energy awareness interventions from various organisations. To provide further suggestions to eradicate energy hardship in Aotearoa, I used the energy democracy framework linked with survey findings. They can be summarised as locally consumer-owned renewable energy companies, expanded energy programmes for households (e.g. Warmer Kiwi Homes), and creating equal opportunities for Māori households. This manuscript is ready for submission.

The chapters of this thesis and their corresponding journal articles contain some differences in text, meaning they may not be exactly the same. In the next subsection, I answer the research sub questions and main question in detail. Then, I discuss the contribution of my research. Ultimately, I provide future research possibilities.

How does the MBIE concept of energy hardship compare to its international counterparts?

While the initial intention of this part of the research was to introduce a definition and indicators of fuel poverty that would fit the Aotearoa context, that was comprehensively done by MBIE – and using the term energy hardship. Therefore, the goal became doing an analysis of the existing definitions and indicators through a literature review and interviews to understand their strengths and weaknesses.

Chapters Two and Three relate to the "strategic step" within the transition management framework. The focus of this step is on developing the culture of the transition, being the perspectives on the energy hardship issue and pathways towards common goals for eradication (Köhler et al., 2019; Loorbach, 2010). A comprehensive comparison of the terms *fuel poverty* and *energy hardship* (in addition to *energy poverty* in the case of Chapter Two) was completed by examining international and national academic publications, reading past and current government reports on energy hardship in Aotearoa, and interviewing five experts (from government, energy sector, NGO, academia, and independent consultancy).

The definition of energy hardship in Aotearoa is at the opposite end of the spectrum of energy wellbeing, with the two being on a continuum instead of binary (Ministry of Business Innovation & Employment, 2021). Energy wellbeing is "defined as when individuals, households and whānau are able to obtain and afford adequate energy services to

support their wellbeing in their home or kāinga" (Ministry of Business Innovation & Employment, 2022a).

The official definition of energy hardship was established after MBIE received feedback on their proposed definition that had affordability implied but not explicit, which occurred while this research was being carried out (Ministry of Business Innovation & Employment, 2021, 2022a, 2022b). The affordability aspect is the main concern in the country (and of more interest to this research rather than the access aspect) – which is possibly why *fuel poverty* is still frequently used as a synonym. What is clear is that the often-used threshold of more than 10% of a household's income being spent on energy services as the determination of energy hardship should not be used (as the initial definition of fuel poverty), since this threshold was based on 1988 data from England (Liddell et al., 2012).

The MBIE proposal document did not include the 10% as an indicator of energy hardship, and instead had twenty-six objective and subjective indicators of energy hardship (Ministry of Business Innovation & Employment, 2021). Even though two primary measures (indicators) consider the *actual* energy expenditure instead of the *required*, those are interim, as MBIE stated that calculating the latter is not feasible at the moment (Ministry of Business Innovation & Employment, 2021).

Using the actual energy expenditure is considered a weakness, since it can downplay the effects of self-rationing (Boardman, 2012, 2013). However, the MBIE document included other ways to acknowledge those effects, such as the indicators *Absolute domestic energy expenditure half the national median or less (moving line)* and *Put up with feeling cold to keep costs down a lot*. Chapter Two searched for publications using median/2, known as the

hidden fuel poverty indicator, and subjective variables, being manners to recognise the issue of households under-consuming energy.

Still, MBIE uses multiple variables that have been thoroughly explored in the fuel and energy poverty research and policies (such as dampness, inability to afford warmth, and two times the median ratio of income being spent on energy services), being a well-rounded way to measure energy affordability and access (Ministry of Business Innovation & Employment, 2021). The five interviewees in Chapter Three (from academia, government, an energy company, an independent consultancy, and a nongovernmental organisation) also expressed the need to have a combination of subjective and objective indicators, and their opinions were overall well aligned with the MBIE definition and indicators.

What types of interventions exist to minimise energy hardship?

Once the culture of energy hardship and wellbeing was identified, the next step in the transition management framework is the "tactical" one. The tactical step identifies actors who have energy hardship minimisation programmes to learn more about their interventions to support partnerships between them (Köhler et al., 2019; Loorbach, 2010). In Chapter Four, semi-structured interviews are detailed with sixteen employees of organisations classified as government, social businesses, and non-profits.

Using the MBIE energy hardship framework (Ministry of Business Innovation & Employment, 2021), it was found that the interviewed organisations are mainly focused on household interventions relating to service literacy (such as promoting energy literacy and awareness). Other interventions were energy assessments, home repairs or retrofits, cheaper energy services, budget advice, consumers support, and energy generation.

A positive finding was that the interviewed organisations were well connected in multiple ways, including delivering programmes together, obtaining funding from one

another, and being part of the Energy Wellbeing Evaluation Consortium (EWEC). EWEC is a collaboration between the government, NGOs, the energy sector, social businesses, and academia, having working groups on frameworks, indicators, diversity, and data sharing. The synergy found shows that resources, efforts, and data regarding energy wellbeing from the interviewed members of organisations are being spent and shared efficiently.

Overall, the interviewed members of organisations covered the different facets of the MBIE energy hardship framework. However, an identified gap from the findings is consideration of the environment, which includes climate, taiao (natural resources) and location. Energy rights actions should be integrated with environmental justice, as the climate crisis cannot be ignored, especially considering the energy hardship context. Other minor gaps identified in the interventions were already addressed as recommendations in the 2019 document Electricity Price Review (New Zealand Government, 2019), showing they need to be implemented.

What is the demographic of the households in energy hardship?

With a clear definition of energy hardship and an understanding of the tactical actors and the interventions used, the next focus of the transitional management framework is the operational step. The research analysed operational activities and experiments by focusing on *learning by doing* by partnering with four organisations to provide energy-related rewards and organise two surveys (Köhler et al., 2019; Loorbach, 2010), as explored in Chapter Five. One survey was conducted with 773 customers of the social electricity retailer OurPower in the Waikato region, powered by a community-owned distributor. The questions were designed to understand the energy hardship demographics and were about household and dwelling characteristics, as well as energy use. All OurPower survey respondents could enter a draw to win a month of free electricity, with five respondents being selected.

Another survey, almost identical, was carried out with 505 respondents from a nationally representative sample. Respondents who had five or more energy hardship indicators (aligned with the MBIE indicators) and lived in Northland, Auckland, or Canterbury regions were able to obtain survey rewards. Habitat for Humanity (NGO) offered thermal curtains and winter warmer packs in Northland and Auckland. In Northland, Northpower (a community-owned electricity distributor) offered personalised power-saving tips. In Canterbury, Orion (community-owned electricity distributor) offered information on energy efficiency services, independent energy advice, and eligibility for subsidies in mid-Canterbury.

It was found that the OurPower respondents presented more energy hardship indicators compared to respondents of the national survey. It is most likely because OurPower is a social retailer catering to that specific public. In both surveys, having at least one person in the household being Māori were related to having more energy hardship indicators (moderate effect size). In both surveys, the income was inversely proportional to the number of energy hardship indicators (moderate effect size for the national survey), being more severe for OurPower respondents (strong effect size). An inversely proportional relationship was also the case for the highest education level obtained by a household member and the number of energy hardship indicators for the OurPower respondents (moderate effect size).

Those findings aligned with the literature (Butler et al., 2003; Davie et al., 2007; Howden-Chapman et al., 2021; Lloyd, 2006; McKague et al., 2016; O'Sullivan et al., 2016; Stats NZ, 2018). However, what was unexpected is that this study did not show location of households as a statistically significant variable relating to energy hardship in either of the surveys, contradicting a major study (Lloyd, 2006). The number of people per age group, presence of disability, and tenancy status were statistically significant, but did not present

strong effect sizes to be considered critical variables. Those variables are considered to be major determinants for identifying households in fuel poverty or energy hardship vulnerability (Boardman, 2012; Fahmy et al., 2011; Healy & Clinch, 2004; New Zealand Government, 2023; O'Sullivan & Viggers, 2021; Snell et al., 2014, 2015; Stats NZ, 2017; Taltavull de La Paz et al., 2016; Thomson & Snell, 2013). A potential reason for this is due to the nature of the indicators used, as the income-related ones had to be excluded in this study, those are often used in research and policies.

What socioeconomic issues relate to energy hardship?

Still on Chapter Five and the operational step, other survey responses were related to the number of energy hardship indicators to further understand the socioeconomic issues associated with the condition. The energy hardship indicators that were the most associated with selecting other indicators, and thus having a higher number of them, were the inability to afford sufficient warmth, major housing repairs needed, and feeling cold often due to self-rationing.

The inability to afford sufficient warmth and major housing repairs needed represent causes of energy hardship, with the former being high energy expenses and/or low income, and the latter being poor housing quality, especially associated with insufficient insulation. Feeling cold often due to self-rationing represents a consequence, as feeling cold by self-rationing is a way to cut down on energy expenses, which can cause or exacerbate health conditions and even death (Hernandez, 2016; Hernandez & Siegel, 2019; Mould & Baker, 2017; O'Sullivan et al., 2017). These findings summarise that energy hardship in Aotearoa is represented by the poor quality of its dwellings, households being low income, energy services costing too much, and households having to find dangerous coping mechanisms to afford energy bills.

Other variables that are not MBIE indicators were also related to the number of energy hardship indicators. The statistically significant ones with the highest effect sizes were food insecurity and energy debt. The former can be both a cause and consequence of energy hardship, as households with limited income find themselves in the *heat or eat dilemma* (Cook et al., 2008; O'Neill et al., 2006). As for the latter, it is a consequence of the inability to afford sufficient energy services.

Since these three indicators were strongly connected to a higher number of indicators, those three can be used to simplify the identification of energy hardship, especially by organisations that work directly with households on energy hardship minimisation programmes. Additionally, considering food insecurity (choosing between paying for food or energy expenses) and energy debt can be useful not only for those types of organisations, but also as potential MBIE secondary indicators.

What are the best interventions needed to eradicate energy hardship in Aotearoa?

The final step of the transition management framework involved assessing and evaluating activities and experiments aimed at minimising energy hardship in Aotearoa, in order to identify best practices and potential interventions for achieving energy wellbeing (Köhler et al., 2019; Loorbach, 2010). This step answered the main research question and built upon activities and programs from the operational and tactical steps. The other steps were not only necessary to get to this stage, but the sub research questions also brought depth to ultimately responding this question.

Chapter Six details, three surveys that were conducted: 1) a follow-up with OurPower respondents (N=105); 2) a follow-up with respondents of the nationally representative survey (N=69); and 3) a feedback survey with employees of organisations that have programmes to minimise energy hardship (N=16). For the last survey (3), interviewees of Chapter 4 were

invited to respond, in addition to other existing organisations. The goal of the three surveys was to understand the perceptions of energy hardship minimisation interventions from organisations and households, as well as their suggestions for future interventions.

Regarding the survey rewards, the only winner of the free month of electricity who responded to the OurPower follow-up stated that the reward was helpful for their household. Of the OurPower follow-up respondents, 88.57% said they chose to enter the draw, but they did not win. As for the national follow-up, none of the follow-up respondents indicated to have received the rewards. Interestingly, 80.65% of those follow-up respondents who were able to receive them did not reach out to the partnering organisation, with the most frequent justifications being forgetfulness, followed by the lack of information on how to proceed, and disinterest.

In the case of the national survey, even though it was expected that respondents with five or more energy hardship indicators would be interested in receiving energy-related rewards, that did not materialise. This possibly indicates the significant presence of hard-to-reach energy users in the country (Rotmann, 2019), meaning that the strategies used to engage with them need to be modified to increase trust, especially through culturally-sensitive partnerships with local organisations (Ashby et al., 2020). For example, having Māori and Pasifika health providers trained as home performance advisors explaining to households the risks of mould and how they can identify, eliminate, and prevent the issue.

Best practices

High energy expenses are a leading cause of energy hardship (Boardman, 2013), and this issue was a main finding from the three surveys. OurPower follow-up respondents stated that the retailer's low rates are the main reason for choosing the company, and thus making low electricity rates a best practice found to minimise energy hardship. This is also aligned

with the New Zealand government's goal of increasing energy affordability (Ministry of Business Innovation & Employment, 2021; New Zealand Government, 2019).

Half of OurPower's follow-up respondents also identified the company's simple plans and bills as a reason for choosing it as their retailer, being another best practice found. It is known that comparing plans and understanding electricity bills in Aotearoa is not a simple task due to their heterogeneity and obscure language (New Zealand Government, 2019). Unfortunately, the most affected group are low-income households who end up choosing for suboptimal and more expensive plans, worsening their energy and material hardship (Ministry of Business Innovation & Employment, 2021; O'Sullivan et al., 2011, 2015).

More than a third of OurPower and a seventh of national follow-up respondents affirmed to have received the Winter Energy Payment. Those respondents often stated that this help from the government resulted in financial savings. The Winter Energy Payment, an automatic financial payment sent to Kiwi households that receive government assistance, was considered a best practice. In 2022, the payments were performed from 1 May to 1 October, 20.46 NZD to households of single people without dependent children per week or 31.82 NZD to those with couples or dependent children.

Respondents of the three surveys highlighted the importance of adopting energy-efficient habits, with OurPower and national survey follow-up respondents reporting financial savings and thermal comfort as consequences. As for the organisation feedback survey, promoting energy-efficient habits was the most common intervention they reported, and their main programme findings were positive outcomes from energy awareness actions – making this another best practice.

Further interventions

The findings of the three surveys were linked with the energy democracy framework to develop further solutions to eradicate energy hardship for each type of organisation. Energy democracy is a concept that is concerned with social and environmental aspects of the energy sector and the power dynamics within, such as the sources of energy used, the land use for energy development, the ownership of the means of production, the fair distribution of energy and its benefits, and the working conditions (Angel, 2016; Sweeney, 2012). While the absolute eradication of energy hardship is an aspirational intention, it should remain the goal instead of striving to achieve less.

Decentralising the energy sector by making generation, distribution, and retailing companies community-owned can decrease household energy expenses by eliminating the profits of shareholders. This change will also allow them to use their localised decision-making to support needed community initiatives, such as building solar infrastructure focused on the needs of vulnerable households. Completely switching to local and sustainable renewable sources must be prioritised, being more achievable with decentralisation. These suggestions are aligned with the respondents' desire for lower energy expenses and higher sustainability. Simultaneously, energy democracy focuses on the community's energy needs and taking action against the climate crisis through citizens being in charge of the decentralised decision-making in energy, not the interests of shareholders (Sweeney, 2012).

Government programmes such as the Warmer Kiwi Homes, Healthy Homes Initiative, and Winter Energy Payment should be enlarged to include more vulnerable people that have not been covered. The first two currently do not include tenants, who have no power regarding their decisions to improve their dwelling and appliances quality. The three programmes have been mentioned by survey respondents, who highlighted the importance of

the Winter Energy Payment. Warmer Kiwi Homes and Healthy Homes Initiative provide energy assistance and grants towards dwelling improvements, being strongly aligned with the respondents' suggestions. Expanding and improving these three programmes will reduce the energy hardship risk of more vulnerable households by reducing the root causes of the issue. Additionally, the concept of energy democracy is concerned about the fulfilling the diverse energy needs of people, promoting equity (Angel, 2016).

The energy sovereignty of indigenous peoples is also a major goal of energy democracy (Fairchild & Weinrub, 2017), with the term representing a "clearer rejection of imperialism and colonialism" relating to their decentralised decision-making (Angel, 2016, p. 12). Even though it was not explicit in the survey responses, it is crucial to ensure that Te Tiriti o Waitangi obligations are followed, and that Māori people actually benefit from having their land historically used for energy infrastructure. This study and other publications show that Māori are overrepresented in homes struggling with energy hardship (New Zealand Government, 2023; O'Sullivan et al., 2017; Teariki et al., 2020). The Māori and Public Housing Renewable Energy Fund should be expanded to guarantee energy sovereignty, especially in more isolated areas where grid access can be an issue (Ministry of Business Innovation & Employment, 2023). This fund allows "low-income communities or communities with insecure access to energy" to have their own renewable generation and storage (Ministry of Business Innovation & Employment, 2023), which could significantly improve the lives of many Māori households.

NGOs can create partnerships with other organisations for specific purposes, connecting them and the households, especially when culture and language may be a barrier (e.g. Māori and Pasifika communities). The lack of success of the national survey (2) rewards shows the need for better engagement with hard-to-reach energy users. Providing households with the needed resources and tools, especially the hard-to-reach ones, and being an ally for

the decision-making processes are vital for the maintenance of this energy democracy scenario (Ashby et al., 2020; Fairchild & Weinrub, 2017; Rotmann, 2019). The NGO partnerships can facilitate the households' access to government programmes mentioned previously. Moreover, they can promote energy awareness and literacy according to the needs of the community, aligning with the responses of all follow-up surveys.

Proposing to have the energy sector be community-owned, decentralised, all renewable, and moving away from the profit motive may sound unrealistic and it is far from a small thing, but eradicating energy hardship is also not a simple task. However, there are good examples: the Bristol Energy Cooperative in the UK, which funded over 17 sustainable energy initiatives since 2011 (Perrett, 2023). It powers over 3,000 homes using solar, wind and battery storage systems, with members paying less for energy during these difficult times than local non-members (Perrett, 2023). This coop also teaches people about energy systems and reaches out to the homes in need (Perrett, 2023).

In March 2023, the New Zealand Government released the document *Te Kore, Te Pō, Te Ao Marama - Energy Hardship: The challenges and a way forward*. One of the proposed strategies was to "[e]xplore ways to promote and facilitate social retailing as an option to increase access and choice," and the government sought out the public opinion on how it should be carried out, providing four possible scenarios (New Zealand Government, 2023, pp. 58-60). The option that was most aligned to energy democracy was the one which "[t]he Government could establish a scheme to support small-scale distributed generation located in communities through a contestable funding pool" with those generator-retailers being "community-based not-for-profit organisations" (New Zealand Government, 2023, pp. 59-60). While the results have not been made public yet, the fact that the government considered this option shows that the country is willing to fund more empowering solutions towards energy wellbeing.

Improving and expanding existing government programmes such as the Winter Energy Payment, Warmer Kiwi Homes, Healthy Homes, and Māori and Public Housing Renewable Energy Fund can reduce the energy hardship of many households struggling with multiple levels of vulnerability on the short to medium term. Additionally, the development of partnerships with NGOs aiming to educate and empower the households in a culturally sensitive manner is crucial to guarantee their participation in the energy wellbeing future.

Without significant changes in the energy sector structure in Aotearoa, little can be achieved in terms of energy wellbeing, only remediated. The same is true for the housing and renting conditions. The low salaries and increased cost of living will only make energy hardship more prevalent, even worse for already marginalised groups. There is no silver bullet – and this study showed it will require comprehensive cooperation and solidarity to build a future based on energy democracy and wellbeing.

Research contribution

In this section, the contributions that this research make into the existing literature and body of knowledge will be separated into theoretical (to researchers and academics) and practical (to practitioners and policymakers), as shown below.

Theoretical contributions

In Chapter Two, I performed a systematic literature review on fuel poverty, energy poverty, and energy hardship to compare their indicators and variables - and the frequency of both. The trends on important associated conditions were also assessed: home tenure, presence of household members who are children or elderly, associated health conditions, and food issues. No other systematic literature review with those analyses had been done previously. The findings, using critical theory, highlight that the choice of indicators and variables can prioritise or overlook certain household or dwelling characteristics. It was also

found that more than 94% of selected publications discussed health issues, being a major concern and consequence of fuel poverty, energy poverty, and energy hardship.

In Chapter Four, I used the MBIE energy hardship framework, which aligned to the transition management framework, to analyse the effectiveness of existing interventions in Aotearoa. This new framework with eight contributing facets of energy hardship is comprehensive (e.g. environment, household resources, and service literacy facets) and not solely focused on efficiency of the dwelling or appliances. It should be considered by international researchers, with only minor adaptions being necessary.

In Chapter Five, the sociodemographic data of Kiwi households relating to their energy hardship indicators was obtained and socioeconomic factors related to the condition in Aotearoa were analysed, also based on critical theory. It was important to do a data comparison (my data *versus* government and other research data), and, in case of a mismatch, hypothesise the reasoning. Since my survey was the first study to use the proposed MBIE indicators, that was possibly a reason why there was some differences regarding the sociodemographic data.

Practical contributions

Throughout the whole study, I engaged with multiple organisations working with energy hardship minimisation in New Zealand to share data and insights, particularly through the Energy Wellbeing Evaluation Consortium. I also provided feedback on the 2021 *Defining Energy Hardship* discussion document regarding the MBIE energy hardship definition, measures, and framework. My feedback was made available in the MBIE website by my choice, and one of my opinions was discussed and quoted in the Summary of Submissions report (Ministry of Business Innovation & Employment, 2022b). In 2023, the discussion paper *Te Kore, Te Pō, Te Ao Marama - Energy Hardship: The challenges and a way forward*

was released, and I provided brief feedback on it and emphasised the need to choose the option “Government support for a number of community/regional integrated social generator-retailers” (New Zealand Government, 2023, p. 59).

In Chapter Four, I obtained data about sixteen Kiwi organisations working to minimise energy hardship. The main achieved goals were seeing how they operated, what were the focus of their interventions according to the MBIE energy hardship framework, and what were their gaps. I found that the organisations were very connected to one another, diversified in their foci, but the environmental facet was the most overlooked one.

In Chapter Five, through my partnership with the retailer OurPower, we were able to provide one month of free electricity to five survey respondents selected via draw. OurPower is a social retailer powered by the community-owned distributor WEL Networks working with customers experiencing energy hardship. In the following chapter, one of the winners (the only one responding to the OurPower follow-up) stated that this reward was helpful for their household.

During Chapter Five and Six, the OurPower and national surveys and follow-ups have allowed me to share information about energy hardship directly with the general public, with over 1.2 thousand households from the first surveys. The data I obtained about the households and their dwellings also allowed me to simplify how to measure energy hardship and suggest two more indicators related to the condition. The simplification can optimise the time and resources of organisations to identify energy hardship, while the addition of two indicators can make the identification more robust and intersectional.

Finally, in Chapter Six, I found some of the best practices in Aotearoa according to the findings of the OurPower and national follow-up surveys and the organisation feedback survey. They included low electricity charges, the Winter Energy Payment, and simple bills

and plans. Linking survey findings with the energy democracy concept, I suggested further interventions to achieve energy wellbeing in the country. Some of the proposed actions are to decentralise the energy sector by making them locally community-owned, improve and expand existing programmes (e.g. Winter Energy Payment and Warmer Kiwi Homes), and strengthen education and support partnerships to empower people.

Future research possibilities

Energy hardship is an interdisciplinary condition, with multiple aspects to be explored that are beyond the scope of this study. In this section, I propose some future research possibilities related to my research.

One suggestion that would be fascinating is comparing the findings of Chapter Five with future data that uses different measures of energy hardship - all twenty-six MBIE indicators and others, especially a comparison between income and non-income indicators. Comparing data from Aotearoa and other countries using those indicators would also be beneficial.

Studies on larger energy interventions (e.g. significant retrofits and more efficient heaters) and their effects on the health, wellbeing, and finances of households in Aotearoa are currently being conducted (including by EECA and Motu), and it would be interesting to see studies on long-term effects of more minor interventions, like energy awareness and literacy programmes and switching to a cheaper electricity plan.

Ethnographic studies on Kiwi households struggling with energy hardship and their experiences are incredibly relevant, especially those that explore people engaged in activism and other actions to ameliorate the condition.

Finally, studies relating to Māori energy sovereignty would be fantastic. There are great projects happening, such as the social electricity retailer Nau Mai Rā and the already

mentioned Māori and Public Housing Renewable Energy Fund. Positive examples exist, and achieving rangatiratanga is possible.

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Appendix A

Table 46: Publications used in the systematic literature review (Chapter Two)

Author	Paper	Type
Ali et al (2015)	Responding to consumers' financial hardship: An evaluation of the legal frameworks and company policies	Journal article
Awaworyi Churchill et al (2020)	Fuel poverty and subjective wellbeing	Journal article
Azpitarte et al (2015)	Fuel poverty, household income and energy spending: an empirical analysis for Australia using HILDA data	Report
Barnes et al (2011)	Energy poverty in rural Bangladesh	Journal article
Bednar & Reames (2020)	Recognition of and response to energy poverty in the United States	Journal article
Berry et al (2016)	Investigating fuel poverty in the transport sector: Toward a composite indicator of vulnerability	Journal article
Betto et al (2020)	A new measure of Italian hidden energy poverty	Journal article
Bilodeau et al (2017)	Household material hardship in families of children post-chemotherapy	Journal article
Bona et al (2015)	Trajectory of Material Hardship and income Poverty in Families of Children Undergoing Chemotherapy: A Prospective Cohort Study	Journal article
Bona et al (2015)	Prevalence and Impact of Financial Hardship among New England Pediatric Stem Cell Transplantation Families	Journal article
Bourova et al (2017)	Reporting on Hardship Practice in the Consumer Credit and Energy Sectors: An Analysis	Journal article
Bouzarovski & Tirado Herrero (2017)	Geographies of injustice: the socio-spatial determinants of energy poverty in Poland, the Czech Republic and Hungary	Journal article
Bouzarovski (2013)	Energy poverty in the European Union: landscapes of vulnerability	Journal article
Bouzarovski et al (2012)	Energy poverty policies in the EU: A critical perspective	Journal article
Brabo-Catala et al (2022)	Fuel Poverty or Energy Hardship? Analysing the literature, the proposed official definition, and the views of experts in Aotearoa New Zealand	Journal article
Burke et al (2015)	Household energy use: Consumption and expenditure patterns 1993-2012	Report
Burlinson et al (2018)	The elephant in the energy room: Establishing the nexus between housing poverty and fuel poverty	Journal article
Burlinson et al (2021)	Fuel poverty and financial distress	Journal article
Castaño-Rosa & Okushima (2021)	Prevalence of energy poverty in Japan: A comprehensive analysis of energy poverty vulnerabilities	Journal article
Castaño-Rosa et al (2019)	Towards a multiple-indicator approach to energy poverty in the European Union: A review	Journal article
Chan (2015)	Rethinking water and energy affordability in Australia: an analysis of the efficiency, effectiveness and equity of current policy	PhD thesis
Charlier & Legendre (2019)	A Multidimensional Approach to Measuring Fuel Poverty	Journal article
Charlier & Legendre (2021)	Fuel poverty in industrialized countries: Definition, measures and policy implications a review	Journal article
Che et al (2021)	Assessing global energy poverty: An integrated approach	Journal article

Cong et al (2022)	Unveiling hidden energy poverty using the energy equity gap	Journal article
Day et al (2016)	Conceptualising energy use and energy poverty using a capabilities framework	Journal article
Deller et al (2021)	Energy poverty indicators: Inconsistencies, implications and where next?	Journal article
Dodd & Nelson (2022)	Australian household adoption of solar photovoltaics: A comparative study of hardship and non-hardship customers	Journal article
Fabbri (2015)	Building and fuel poverty, an index to measure fuel poverty: An Italian case study	Journal article
Fahmy (2011)	The definition and measurement of fuel poverty	Briefing paper
Fahmy et al (2011)	Predicting fuel poverty at a small-area level in England	Journal article
Faiella & Lavecchia (2021)	Energy poverty. How can you fight it, if you can't measure it?	Journal article
Fernandez et al (2018)	Dual Food and Energy Hardship and Associated Child Behavior Problems	Journal article
Fizaine & Kahouli (2018)	On the power of indicators: how the choice of fuel poverty indicator affects the identification of the target population	Journal article
Frank et al (2010)	Cumulative hardship and wellness of low-income, young children: multisite surveillance study	Journal article
Halkos & Gkampoura (2021)	Evaluating the effect of economic crisis on energy poverty in Europe	Journal article
Heindl (2015)	Measuring Fuel Poverty: General Considerations and Application to German Household Data	Journal article
Hernandez & Siegel (2019)	Energy insecurity and its ill health effects: A community perspective on the energy-health nexus in New York City	Journal article
Hernandez (2016)	Understanding 'energy insecurity' and why it matters to health	Journal article
Hernandez et al (2016)	Housing hardship and energy insecurity among native-born and immigrant low-income families with children in the United States	Journal article
Hills (2011)	Fuel poverty: the problem and its measurement	Report
Hills (2012)	Getting the measure of fuel poverty: Final Report of the Fuel Poverty Review	Report
Imbert et al (2016)	Same but different: On the applicability of fuel poverty indicators across countries—Insights from France	Journal article
Judson & Zirakbash (2022)	Investigating the potential of solar energy for low-income communities in Australia to reduce hardship, debt and inequality	Journal article
Kahouli (2020)	An economic approach to the study of the relationship between housing hazards and health: The case of residential fuel poverty in France	Journal article
Kose (2019)	Energy poverty and health: the Turkish case	Journal article
Legendre & Ricci (2015)	Measuring fuel poverty in France: Which households are the most fuel vulnerable?	Journal article
Lewis et al (2020)	Energy efficiency as energy justice: addressing racial inequities through investments in people and places	Journal article
Liddell et al (2011)	Defining fuel poverty in Northern Ireland: A preliminary review	Report
Liddell et al (2012)	Measuring and monitoring fuel poverty in the UK: National and regional perspectives	Journal article
Lloyd (2006)	Fuel poverty in New Zealand	Journal article
März (2018)	Assessing the fuel poverty vulnerability of urban neighbourhoods using aspatial multi-criteria decision analysis for the German city of Oberhausen	Journal article
Maxim et al (2016)	Implications and Measurement of Energy Poverty across the European Union	Journal article
Meyer et al (2018)	Capturing the multifaceted nature of energy poverty: Lessons from Belgium	Journal article

Middlemiss (2017)	A critical analysis of the new politics of fuel poverty in England	Journal article
Moore (2012)	Definitions of fuel poverty: Implications for policy	Journal article
Morrison et al (2008)	Fuel poverty in Scotland: Refining spatial resolution in the Scottish Fuel Poverty Indicator using a GIS-based multiple risk index	Journal article
Mould & Baker (2017)	Documenting fuel poverty from the householders' perspective	Journal article
Nelson et al (2019)	The drivers of energy-related financial hardship in Australia–understanding the role of income, consumption and housing	Journal article
O'Sullivan & Viggers (2021)	Six ways to help fix energy hardship in New Zealand	Journal article
O'Sullivan et al (2014)	The influence of electricity prepayment meter use on household energy behaviour	Journal article
Oliveras et al (2020)	The association of energy poverty with health, health care utilisation and medication use in southern Europe	Journal article
Papada & Kaliampakos (2016)	Measuring energy poverty in Greece	Journal article
Phimister et al (2015)	The Dynamics of Energy Poverty: Evidence from Spain	Journal article
Rademaekers et al (2016)	Selecting Indicators to Measure Energy Poverty	Report
Roberts et al (2015)	Fuel poverty in the UK: Is there a difference between rural and urban areas?	Journal article
Robinson et al (2018)	'Getting the measure of fuel poverty': The geography of fuel poverty indicators in England	Journal article
Romero et al (2018)	The policy implications of energy poverty indicators	Journal article
Schuessler (2014)	Energy Poverty Indicators: Conceptual Issues - Part I: The Ten-Percent-Rule and Double Median/Mean Indicators	Discussion paper
Siksnelyte-Butkiene et al (2021)	Energy poverty indicators: A systematic literature review and comprehensive analysis of integrity	Journal article
Simcock et al (2016)	Fuel poverty in the UK: Beyond heating	Journal article
Simhauser & Nelson (2012)	The energy market death spiral-rethinking customer hardship	Working paper
Simhauser & Nelson (2014)	The Consequences of Retail Electricity Price Rises: Rethinking Customer Hardship	Journal article
Simoes et al (2016)	Mapping Fuel Poverty in Portugal	Journal article
Sokolowski et al (2020)	A multidimensional index to measure energy poverty: the Polish case	Journal article
Thomson & Bouzarovksi (2019)	Addressing Energy Poverty in the European Union: State of Play and Action	Report
Thomson & Snell (2013)	Quantifying the prevalence of fuel poverty across the European Union	Journal article
Thomson et al (2016)	Fuel poverty in the European Union: a concept in need of definition?	Journal article
Thomson et al (2017)	Rethinking the measurement of energy poverty in Europe: A critical analysis of indicators and data	Journal article
Tirado Herrero (2017)	Energy poverty indicators: A critical review of methods	Journal article
Tonn et al (2021)	Income, housing and health: Poverty in the United States through the prism of residential energy efficiency programs	Journal article
Waddams Price et al (2012)	Objective and subjective measures of fuel poverty	Journal article
Walker et al (2014)	Estimating fuel poverty at household level: An integrated approach	Journal article
Willand et al (2019)	Integrating energy efficiency & hardship improvements into the Care at Home system	Report

Appendix B

Questions asked to all interviewees from Chapter Four included:

- Can you briefly describe the energy hardship project, service, or product your organisation is engaged in?
- Is there a specific definition and measure of energy hardship adopted by your organisation?
- What are the main goals of the project?
- What are the main issues you have been encountering in this project, and how do you think they can be improved?
- Who is the target of your project?
- How do you reach out to your target audience?
- What is the source of funding for this project?
- How much does this service cost to your consumers?
- What are the next steps of this project?
- Are there any other groups or organisations that collaborate on this project?
- Which other New Zealand organisations do you see as major actors working towards energy hardship minimisation and eradication?
- Which types of large-scale interventions (beyond the capacity of this project) do you believe to be necessary to eradicate energy hardship?
- What is the purpose of eradicating energy hardship, in your opinion?
- What would a future without energy hardship look like, in your opinion?
- If you were to design your programme knowing what you now know, would you do it differently?

Appendix C

Questions asked to survey respondents from Chapter Five are shown below. Specific questions relating to terms of agreement and rewards were not included. Possible answers were shown in the results section.

OurPower survey questions

- What is the postcode of your residence?
- In which region does your household live in? [if previous was empty]
- How many people reside in your household, including yourself? Write the number of people per age group ("0" if none).
- What are the ethnicities of the people who live in your household? Select all that apply.
- What is the highest education level achieved by a household member?
- How would you describe the general health of people in your household (including yourself)?
- In the last two weeks, how often have you:
  - felt cheerful and in good spirits?
  - felt calm and relaxed?
  - felt active and vigorous?
  - woken up feeling fresh and rested?
  - felt that your daily life has been filled with things that interest you?
- Are there any household members with a disability or an impairing chronic illness? Select all that apply.

- How many household members stay at home full-time (e.g. working from home, retired, unemployed, not going to school)? Write the number of people staying at home full-time per age group ("0" if none).
- What is the total annual gross income of your household in NZD? Write the number (e.g. 34500.92). Click here to use an income calculator, if needed.
- Which group best represents the total annual gross income of your household? Click here to use an income calculator, if needed. [if previous was empty]
- How well does your household's total income meet your everyday needs, for such things as accommodation, food, clothing, and other necessities?
- In the last 12 months, have you done any of the following things to keep costs down? Select all that apply.
- What is your household's accommodation situation? Select all that apply.
- Select the fuels used by your household during winter months (June, July, and August only). Consider fuels used to run appliances, indoor heating/cooling, water heating, and cooking. Disregard transportation fuel.
- How much does your household spend on energy during winter months (June, July, and August only)? Consider fuels used to run appliances, indoor heating/cooling, water heating, and cooking. Disregard transportation fuel. Add the average monthly expense per selected group.
- Select the fuels used by your household during non-winter months (all months except for June, July, and August). Consider fuels used to run appliances, indoor heating/cooling, water heating, and cooking. Disregard transportation fuel.
- How much does your household spend on energy during non-winter months (all months except for June, July, and August)? Consider fuels used to run appliances, indoor

heating/cooling, water heating, and cooking. Disregard transportation fuel. Add the average monthly expense per selected group.

- Which of the following types of heating, if any, do you have in your home? Select all that apply.
- Is your home always adequately warm during winter? Select all that apply.
- Select all types of rooms you have in your home.
- Select all the rooms you heat in your home during winter.
- Did you feel your dwelling was too hot during last summer (2021/2022)?
- In the last 12 months, has your household ever had to choose between paying energy bills or any of the following? Select all that apply.
- Does your household regularly perform energy-saving behaviours such as drying clothes naturally, taking shorter showers, and turning off the lights?
- In the last 12 months, has your household been disconnected (or self-disconnected if you prepay) for late or non-payment of electricity or gas bill? Select all that apply.
- During the last 12 months, has your household received any financial assistance to help pay for energy services? Select all that apply.
- During the past 12 months, how often have any of your household members used medical, assistance, or mobility equipment at home which required energy consumption (e.g. oxygen concentrators and motorised wheelchairs)?
- Does your home have any thermal insulation/energy efficiency upgrades in any of the following? Select all that apply.
- Approximately, in what decade was your home built?
- Does your home have any of the following amenities? Select all that apply.
- Would you say your home is always damp, sometimes damp, or not damp at all (e.g. damp floors, foundation, walls, or leaking roof)?

- Does any part of your home have mould growing on it (e.g. walls, ceiling, window frames, curtains, or blinds)?
- Which of the following statements apply to your household from the last 12 months until now? Select all that apply.

National survey questions

- In which region do you live in?
- How many people reside in your household, including yourself, in each of the groups below? Please type in a number in each text box ("0" if none).
- What are the ethnicities of the people who live in your household (including yourself)? Select all that apply.
- What is the highest education level achieved by a member of your household?
- How would you describe the general health of people in your household (including yourself)?
- In the last two weeks, how often have you:
  - felt cheerful and in good spirits?
  - felt calm and relaxed?
  - felt active and vigorous?
  - woken up feeling fresh and rested?
  - felt that your daily life has been filled with things that interest you?
- Are there any household members with a disability or an impairing chronic illness? Select all that apply.

- How many household members stay at home full-time (e.g. working from home, retired, unemployed, not going to school)? Write the number of people staying at home full-time for each group. If no members stay at home full time please type in "0".
- What is the total annual gross income (before tax and other deductions) of your household in NZD? Write the number of NZD below (e.g. 34500.92). Click here to use an income calculator, if needed.
- Which group best represents the total annual gross income (before tax and other deductions) of your household? Click here to use an income calculator, if needed. [if previous was empty]
- How well does your household's total income meet your everyday needs, for such things as accommodation, food, clothing, and other necessities?
- In the last 12 months, have you done any of the following things to keep costs down? Select all that apply.
- What is your household's accommodation situation?
- Select the fuels used by your household during winter months (June, July, and August only). Include fuels used to run appliances, indoor heating/cooling, water heating, and cooking. Exclude transportation fuel.
- How much does your household spend on energy during winter months (June, July, and August only)? Include fuels used to run appliances, indoor heating/cooling, water heating, and cooking. Exclude transportation fuel. Add the average monthly expense for each group shown below.
- Select the fuels used by your household during non-winter months (all months except for June, July, and August). Include fuels used to run appliances, indoor heating/cooling, water heating, and cooking. Exclude transportation fuel.

- How much does your household spend on energy during non-winter months (all months except for June, July, and August)? Include fuels used to run appliances, indoor heating/cooling, water heating, and cooking. Exclude transportation fuel. Add the average monthly expense for each group shown below.
- Which of the following types of heating, if any, do you have in your home? Select all that apply.
- Is your home always adequately warm during winter? Select all that apply.
- Select all types of rooms you have in your home.
- Select all the rooms you heat in your home during winter.
- Did you feel your dwelling was too hot during last summer (2021/2022)?
- In the last 12 months, has your household ever had to choose between paying energy bills or any of the following? Select all that apply.
- Does your household regularly perform energy-saving behaviours such as drying clothes naturally, taking shorter showers, and turning off the lights?
- In the last 12 months, has your household been disconnected from electricity or gas (or self-disconnected if you prepay) for late or non-payment of bill? Select all that apply.
- During the last 12 months, has your household received any financial assistance to help pay for energy services? Select all that apply.
- During the past 12 months, how often have any of your household members used medical, assistance, or mobility equipment at home which required energy consumption (e.g. oxygen concentrators and motorised wheelchairs)?
- Does your home have any thermal insulation/energy efficiency upgrades in any of the following? Select all that apply.
- Thinking of the home you live in, approximately in what decade was it built?
- Does your home have any of the following amenities? Select all that apply.

- Would you say your home is always damp, sometimes damp, or not damp at all (e.g. damp floors, foundation, walls, or leaking roof)?
- Does any part of your home have mould growing on it (e.g. walls, ceiling, window frames, curtains, or blinds)?
- Which of the following statements apply to your household considering the last 12 months until now? Select all that apply.

Appendix D

Table 47: MBIE indicators of energy hardship used in Chapter Five

Indicator	Survey	Total (n)	Total (%)
Unable to afford unexpected expense without borrowing*	OurPower	497	64.29%
	National	247	48.91%
Housing repairs needed - major	OurPower	357	46.18%
	National	282	55.84%
Not heating own bedroom in winter	OurPower	370	47.87%
	National	230	45.54%
Put up with feeling cold to keep costs down a lot	OurPower	295	38.16%
	National	153	30.30%
Cannot afford to keep the dwelling adequately warm	OurPower	267	34.54%
	National	126	24.95%
Trouble heating accommodation and/or keeping it warm in winter	OurPower	240	31.05%
	National	116	22.97%
Not heating children's bedroom in winter	OurPower	225	29.11%
	National	120	23.76%
Can see breath indoors in winter	OurPower	204	26.39%
	National	84	16.63%
Lacking one or more basic amenity	OurPower	99	12.81%
	National	70	13.86%

Indicator	Survey	Total (n)	Total (%)
Could not pay electricity, gas, rates, or water bills on time (more than once)**	OurPower	104	13.45%
	National	35	6.93%
No home access to computer or internet	OurPower	100	12.94%
	National	34	6.73%
Damp always	OurPower	81	10.48%
	National	29	5.74%
Mould larger than an A4 - Always	OurPower	64	8.28%
	National	38	7.52%
Not heating main living room in winter	OurPower	44	5.69%
	National	42	8.32%
Using (or having used) prepayment metering***	OurPower	55	7.12%
	National	29	5.74%
Use of unsafe substitute heating methods (portable gas heater)	OurPower	43	5.56%
	National	33	6.53%
No heating type used	OurPower	27	3.49%
	National	17	3.37%

*500 NZD expense.

**We specifically asked for energy bills (electricity and gas).

***Prepayment or energy plan.

Appendix E

Questions asked to survey respondents from Chapter Six are shown below. Specific questions relating to terms of agreement were not included. Possible answers were shown in the results section.

Organisation feedback survey questions

- Does your programme offer any of the following for households?
- Regarding your programme, please share what was done that was positive and/or negative in terms of alleviating energy hardship.
- Any of the actions mentioned in the previous question will be continued or discontinued?
- Rank the following organisation groups based on how much impact they can have on households obtaining/affording adequate energy. Drag and drop each organisation group: 1 meaning the most impactful and 5 being the least impactful.
- Thinking of policies, how do you think the below can better help the households in the community to be able to obtain and afford adequate energy services to support their wellbeing in their home or kāinga?
- What was the main finding of your programme so far?
- Please share any additional thoughts on energy wellbeing and its interventions.

OurPower follow-up survey questions

- Did you enter the draw to win a month of free electricity?
- Can you please share why you did not enter the draw?
- Did you find the free month of electricity to be useful for your household?
- Which were your reasons for choosing OurPower as your electricity provider? Select all that apply.

- Are there ways in which you think OurPower can better help the households in the community to be able to obtain and afford adequate energy services to support their wellbeing in their home or kāinga?
- Did your household do any of the following energy-related actions since June/July 2022?
- Did your household notice any consequences of the energy-related actions mentioned in the question above?
- Rank the following organisation groups based on how much impact they can have on households obtaining/affording adequate energy. Drag and drop each organisation group: 1 meaning the most impactful and 5 being the least impactful.
- How do you think the below can better help the households in the community to be able to obtain and afford adequate energy services to support their wellbeing in their home or kāinga?

National follow-up survey questions

- Were you offered the option to potentially receive survey rewards at the end of the previous survey?
- Did you or someone else in your household reach out to the organisation to potentially obtain survey rewards?
- After contacting the organisation, was your household able to receive survey rewards?
- Did you find the survey reward to be useful for your household?
- How do you think the organisations that provided the survey rewards can better help the households in the community to be able to obtain and afford adequate energy services to support their wellbeing in their home or kāinga?
- Can you please share why you did not reach out to the organisation to potentially obtain survey rewards?

- Did your household do any of the following energy-related actions since September 2022?
- Did your household notice any consequences of the energy-related actions mentioned in the question above?
- Rank the following organisation groups based on how much impact they can have on households obtaining/affording adequate energy. Drag and drop each organisation group: 1 meaning the most impactful and 5 being the least impactful.
- How do you think the below can better help the households in the community to be able to obtain and afford adequate energy services to support their wellbeing in their home or kāinga?

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Postgraduate Studies Office
Student and Academic Services Division
Wahanga Ratonga Matauranga Akonga
The University of Waikato
Private Bag 3105
Hamilton 3240, New Zealand
Phone +64 7 838 4439
Website: http://www.waikato.ac.nz/sasd/postgraduate/

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Please indicate the chapter/section/pages of this thesis that are extracted from a co-authored work and give the title and publication details or details of submission of the co-authored work.
Chapter 2 - Key Fuel Poverty Indicators and Variables: A Systematic Literature Review

Nature of contribution by PhD candidate	Determined search criteria, analysed literature, created tables and figures, wrote and reviewed the manuscript.
Extent of contribution by PhD candidate (%)	80%

CO-AUTHORS

Name	Nature of Contribution
Professor Eva Collins	Provided feedback on methods, reviewed the manuscript. Contributed 10%.
Professor Barry Barton	Reviewed the manuscript. Contributed 10%.

Certification by Co-Authors

The undersigned hereby certify that:

- the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and

Name	Signature	Date
Luiza Fernandes Brabo	Luiza Brabo-Catão	30/04/2023
Professor Eva Collins	Eva Collins Sign here	7 May 2023
Professor Barry Barton	Barry Barton	8 May 2023

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Postgraduate Studies Office
Student and Academic Services Division
Wahanga Ratonga Matauranga Akonga
The University of Waikato
Private Bag 3105
Hamilton 3240, New Zealand
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Chapter 3 - Fuel Poverty or Energy Hardship? Analysing the literature, the proposed official definition, and the views of experts in Aotearoa New Zealand.

Nature of contribution by PhD candidate	Analysed the literature, contacted potential interviewees, wrote questions, conducted interviews, analysed answers, wrote and reviewed the manuscript.
Extent of contribution by PhD candidate (%)	80%

CO-AUTHORS

Name	Nature of Contribution
Professor Eva Collins	Provided feedback on methods and interview questions, reviewed the manuscript. Contributed 10%.
Professor Barry Barton	Reviewed the manuscript. Contributed 10%.

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The undersigned hereby certify that:

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Chapter 4 - Trends in Current Energy Wellbeing Interventions in Aotearoa New Zealand and the Energy Hardship Conceptual Framework

Nature of contribution by PhD candidate	Contacted potential interviewees, wrote questions, conducted interviews, analysed answers, wrote and reviewed the manuscript.
Extent of contribution by PhD candidate (%)	80%

CO-AUTHORS

Name	Nature of Contribution
Professor Eva Collins	Provided feedback on methods and interview questions, reviewed the manuscript. Contributed 10%.
Professor Barry Barton	Reviewed the manuscript. Contributed 10%.

Certification by Co-Authors

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Name	Signature	Date
Luiza Fernandes Brabo	Luiza Brabo-Catalá	30/04/2023
Professor Eva Collins	Eva Collins	7 May 2023
Professor Barry Barton	Barry Barton	8 May 2023

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Student and Academic Services Division
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Chapter 5 - The heat goes on: Simplifying the identification of energy hardship

Nature of contribution by PhD candidate	Created survey questions, reached out to sample providers, organised reward distribution with partners, analysed data, wrote and reviewed manuscript.
Extent of contribution by PhD candidate (%)	70%

CO-AUTHORS

Name	Nature of Contribution
Professor Eva Collins	Provided feedback on methods and survey questions, reviewed the manuscript. Contributed 10%.
Professor Barry Barton	Reviewed the manuscript. Contributed 10%.
Doctor Anca Cernic	Provided feedback on survey questions, analysed data, reviewed the manuscript. Contributed 10%.

Certification by Co-Authors

The undersigned hereby certify that:

- the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and

Name	Signature	Date
Luiza Fernandes Brabo	Luiza Brabo-Catalá	30/04/2023
Professor Eva Collins	Eva Collins	7 May 2023
Professor Barry Barton	Barry Barton	8 May 2023
Doctor Anca Cernic	Anca Cernic	05/05/2023

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Please indicate the chapter/section/pages of this thesis that are extracted from a co-authored work and give the title and publication details or details of submission of the co-authored work.	Chapter 6 - Aiming For Energy Wellbeing and Democracy
Nature of contribution by PhD candidate	Created survey questions, reached out to sample providers, analysed data, wrote and reviewed manuscript.
Extent of contribution by PhD candidate (%)	70%

CO-AUTHORS

Name	Nature of Contribution
Professor Eva Collins	Provided feedback on methods, reviewed the manuscript. Contributed 10%.
Professor Barry Barton	Reviewed the manuscript. Contributed 10%.
Doctor Anca Cernic	Reviewed the manuscript. Contributed 10%.

Certification by Co-Authors

The undersigned hereby certify that:

- the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and

Name	Signature	Date
Luiza Fernandes Brabo	Luiza Brabo-Cotas	30/04/2023
Professor Eva Collins	Eva Collins	7 May 2023
Professor Barry Barton	Barry Barton	8 May 2023
Doctor Anca Cernic	Anca Cernic	05/05/2023

Ethics documentation

The ethics application forms, information sheets for participants, consent forms, and ethics approvals for this study are shown below. The original ideas for this study presented in the application forms was not materialised exactly as described. However, all the changes that occurred were thoroughly informed to the supervisors and were reported to the head of the Waikato Management School and the postgraduate representative in the candidate progress evaluations.

Chapters Three and Four

Application for Ethical Approval

Waikato Management School
Te Raupapa

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Template:

Use clear and simple language. Avoid technical terms wherever possible.

*Please allow **at least two weeks** for your application to be reviewed by the WMS Ethics Committee*

You must gain ethics approval prior to the commencement of data collection for your research project

See How to fill out the form for guidance.

1. Identify the project.

1.1 Title of Project

Critically assessing fuel poverty in New Zealand for strategising its eradication

1.2 Researcher(s) name and contact information

Luiza Brabo-Catala
+1 510 660 9577
lb170@students.waikato.ac.nz

1.3 Supervisor's name and contact information (if relevant)

Eva Collins (chief supervisor)
+64 7 838 4083
eva.collins@waikato.ac.nz

1.4 Anticipated date to begin data collection

Once given approval, most likely around 01/04/2021.

2. Describe the research.

2.1 Briefly outline what the project is about including your research goals and anticipated benefits. Include links with a research programme, if relevant.

Fuel poverty (or energy hardship) is usually defined by spending more than 10% of income on energy services. It is a complex issue relating to economic poverty, food insecurity, health issues, and poor housing quality (Baker, Mould, & Restrick, 2018). Many studies on the topic conducted in New Zealand have focused on quantitative data regarding economic factors and technical solutions, such as suggesting measures regarding insulation and energy efficiency (Lloyd, Callau, Bishop, & Smith, 2008; McKague, Scott, Wooliscroft, & Lawson, 2016; Phillips & Scarpa, 2010). More recent studies on the topic have been led by public health scholars and have social vulnerability as a central issue, as fuel poverty relates to an increase in morbidity and mortality (Howden-Chapman et al., 2012; O'Sullivan, Howden-Chapman, & Fougere, 2012, 2015).

There is a gap in studies on the less explicit causes of fuel poverty, such as the power structures which oppress the most marginalised populations, including an analysis of the dynamic of relationships that are disproportionally favouring the dominant stakeholders, such as tenant/landlord and low income domestic consumer/retailer. This study proposes to acknowledge the existence of structures that support the failed energy situation in Aotearoa, which currently counts with hundreds of thousands of people struggling with paying for sufficient energy services (New Zealand Government, 2019). It also intends on thoroughly understanding those structures through a critical analysis of the systems involved in order to challenge them towards a future in which access to energy is universal. Without the perspective of power relations, the proposed solutions are still within the structure which created the problem in the first place – and that can result in either sub-optimal solutions or simply creating initiatives that will be temporary, with the issue eventually emerging back to its normalcy, as the root causes were not addressed (Marcuse, 2012).

The theoretical framework used for this study will be the transition management for sustainable transitions, as it involves the interconnection of multiple social and technical aspects of systems (in this case, energy) in order to steer long-term transformative change towards sustainability (Markard, Raven, & Truffer, 2012). This model was chosen due to the active engagement with the actors (parties involved in fuel poverty issues and its minimisation, such as government and consumer rights association) throughout the process, its flexibility, which allows the ability to re-direct future actions by collectively reflecting on the outcome of previous activities, as well as its normative aspect such as the opportunity of working with actors who are involved in ongoing initiatives and developing policies to eliminate fuel poverty in the country, in addition to creating boundaries to protect the affected population and avoid the re-creation of the causal circumstances (Wittmayer, Schäpke, van Steenbergen, & Omann, 2014). Critical and systems theories will shape the methods and forms of analysis throughout the study for understanding the power dynamics behind the interaction of relationships which cause and/or are connected to fuel poverty in New Zealand (Jackson, 2019). Thoroughly understanding the involved systems is essential for defining the problem and developing activities using transition management (Loorbach, 2010), and a critical perspective on power relations is needed to highlight the social facet of the sustainability transition and avoid business-as-usual approaches (Shove & Walker, 2007).

Based on those theories, the mixed-method approach chosen for this study includes thorough literature reviews, stakeholder mapping, semi-structured interviews, surveys, systems modelling and active and direct involvement with actors during the planning and execution of projects relating to fuel poverty in New Zealand. These methods were chosen to prioritise the voice of the marginalised populations and see the interconnectedness of issues (by analysing previous initiatives, identifying major social, political, economic, and environmental events in the recent past which connect to the ability to afford energy services, and finding patterns of the oppression in the affected population), which can provide insightful inputs to those initiatives aiming for fuel poverty eradication.

As the core of the sustainability transition management framework is governance through normative means, an energy democracy perspective will be used to suggest a set of strategies and goals in the discussions with those engaged actors (Angel, 2016; Burke & Stephens, 2017). The actions taken and the reflections on them will be based on the participation and inputs of multiple actors, including the affected households (such as interviews, surveys, mapping, engagement through activities proposed by the actors) (Chilvers & Pallett, 2018). Energy democracy can be summarised as a social movement towards the full energy transition to renewables, focusing on social topics (including public and social ownership of the means of production and democratic decision-making) as much as environmental ones (Stephens, 2019). Energy democracy criticises neoliberalism in the energy sector, and it has the access to energy services to all people as one of its objectives (Burke & Stephens, 2018).

Summarising, this study intends on interpreting fuel poverty in the context of Aotearoa, as well as developing material means to eradicate it, having the affected people as protagonists of this process of emancipatory change, challenging the current power structures towards a sustainable and truly democratic future. This study proposes to collectively contribute towards the emancipation of people from the condition of fuel poverty in New Zealand through the critical analysis of the systems associated with the issue, practical activities based on the findings and suggestion of interventions after reflecting on their outcomes.

Research question is: How can fuel poverty be defined and interpreted in order to develop interventions to eradicate it?
Sub-questions are: A) How is fuel poverty defined?; B) What is the demographic of the households in fuel poverty?; C) What socio-economic issues relate to fuel poverty?; and D) What are the most effective measures for eradicating fuel poverty?

2.2 Briefly outline your method.

Step 1: strategies – Doing a thorough literature review on fuel poverty and preliminary semi-structured interviews with experts (scholars and other professionals relating to the field) in order to adopt or create a definition of fuel poverty to be used in this study, as there is no consensus in New Zealand yet. Those interviews will be done online and the names/organisations will not be shared in any publication, as the intention is solely to listen to their perspectives (in addition to the literature review) for elaborating the definition and measurement of the term, as well as for their suggestion of potential actors to be contacted.

Then, identifying who the actors will be for this study based on the literature findings and interviews, selecting those who are connected to the issue (e.g. government, energy companies, charitable organisations, tenant associations, consumer protection organisations) and using a stakeholder map to select the best allies to become frontrunners. Those actors will be interviewed via online videocall platforms for the purpose of defining the themes (topics to be developed relating to fuel poverty and their scope of action). Their names of the people interviewed or/and their associated organisations will be shared, as transparency and communication between actors are crucial components for successfully and efficiently integrating information and action.

Step 2: tactics – Performing semi-structured interviews with the potential actors and frontrunners identified previously in order to understand their visions for the future without fuel poverty, as well as sharing their experiences and challenges relating to the topic. Same idea as mentioned earlier about their identities.

Then, developing online surveys (using Qualtrics) with the assistance of the actors to collect data about the frequency of fuel poverty in New Zealand (first survey, general pubic) as well as the demographics, socio-economic details and personal experiences and suggestions from those in such condition (follow-up survey with those who fall under the definition of fuel poverty). Potential survey questions can be seen starting on page 7 of this document. The surveys will be anonymous, and the participants will be asked during the first survey if they

consent to participate of follow-up surveys. If they do so, they will be provided with a code at the end of the survey which will also be used to claim the rewards for their participation, if they wish to receive them and participate in the next ones (completely voluntary).

Providing survey participants with rewards which can minimise fuel poverty, such as energy-saving kits with LED bulbs (general public) and free energy audits (those in fuel poverty). They will email the researcher with the code and address, and the researcher will be the only person with access to such information, which will be used to ship the kits. As for the free audits, the participants will receive information on how to get access to them – so they can share their addresses and arrange the appointment without my interference, and without the actors knowing those people are in fuel poverty.

The results will be used to create systems models which link fuel poverty to other larger social and economic issues (also by seeing patterns associated with major events which affected the country, found through literature review), and they will be analysed from a critical perspective.

Step 3: operations – Immersing in the current projects relating to fuel poverty mitigation by providing data obtained by this study, connecting actors, providing insights and suggestions, collecting data obtained by the actors, engaging in activities as needed (e.g. participating in energy audits, teaching about energy literacy).

Step 4: reflections – Using surveys to get feedback from participants of the interventions done in step 2 and 3 (e.g. energy savings kit, energy audit, energy literacy classes) to see their effects in parameters such as reducing energy bills, keeping appropriate indoor temperatures and reducing health issues. The participants will also be asked to provide feedback on the interventions themselves and even suggest further actions (this will be another online survey, with the same privacy control as the others).

The actors involved will be surveyed and interviewed (online and in person) to discuss the data obtained from those surveys done with the participants in order to analyse which interventions worked and which ones did not, what were the limitations found, how to plan for future strategies, etc. The best practices found during this study will be combined with other successful interventions and policies found in the literature as suggestions for further actions to be performed by the actors.

When done from a distance, semi-structured interviews will be carried using Zoom and other similar online platforms, and the audio will be collected (by saving the meeting), otherwise, they will be done in person and the audio will be collected by using an audio recorder. The content will be transcribed using Rev.com and analysed via NVivo.

2.3 Describe plans to give participants information about the research goals.

Preliminary contact with experts and potential actors: I will briefly describe the research and its goals in the emails when reaching out to them, and I will clarify the details once talking via Zoom, prior to asking the questions.

General public: research goals will be mentioned in the social media posts containing the link access the survey, as well as disclosed in detail in the survey, prior to asking consent to the participants and the survey questions.

2.4 Identify the expected outputs of this research (e.g., reports, publications, presentations), including who is likely to see or hear the reports or presentations on this research

Reports (written documents and presentations) will be done in order to present the findings of the study to the actors involved in the project (e.g. government, energy companies, charities, activist groups), which may include presentations to illustrate those results as well. They will also be made available to the general public through social media (Facebook, Twitter, Medium, Instagram).

Manuscripts will be written and submitted to journals relating to sustainability, management, and energy policy. Presentations will also be carried in events of similar fields. The public of both journals and events are likely to be academics and professionals of the mentioned areas.

PhD thesis and its defence, which is a thesis with publications (containing the articles mentioned above). It will be read and seen by professors, students and other professionals interested on the specific topic of this study, especially those in the fields of management, sustainability, policy, and energy.

Potential manuscripts:

Conceptualising fuel poverty: defining fuel poverty focusing on quality of life through qualitative aspects rather than quantitative economic aspects.

A critical systems analysis of fuel poverty: using systems models and an analysis of oppression and power dynamics for understanding fuel poverty and co-related issues.

Current actions for eradicating fuel poverty: discussing ongoing projects being carried in Aotearoa and comparing them to past efforts and international projects.

Potential interventions for fuel poverty eradication: suggesting interventions (i.e. actions, policies) based on the best practices found in this study as well as in the literature.

Transition management for eradicating fuel poverty: a summary of this whole study, focusing on the transition management framework and its steps used towards eradicating fuel poverty in New Zealand.

2.5 Identify the physical location(s) for the research, the group or community to which your potential participants belong, and any private data or documents you will seek to access. Describe how you have access to the site, participants and data/documents. Identify how you obtain(ed) permission from relevant authorities/gatekeepers if appropriate and any conditions associated with access.

Due to the COVID-19 pandemic and border restrictions, the initial activities will be carried from a distance (literature reviews, interviews, surveys, manuscript writing). Interview participants will be professionals who are connected to fuel poverty through their work (most of them being from New Zealand). The participants of the first survey will be households in New Zealand, following up with a second survey targeting those who fall under the definition of fuel poverty. Those who answered the surveys may receive rewards for their participation, which will require obtaining their names and addresses (only if they reach out to the researcher, who will create an email address for them to reach out to if they wish to receive the survey rewards). Actors will be asked to share any relevant documents they have regarding fuel poverty, and all the necessary agreement documents will be filled. Final surveys will be carried with the participants and actors who were already mentioned to gather feedback on the activities performed.

3. Obtain participants' informed consent, without coercion.

3.1 Describe how you will select participants (e.g., special criteria or characteristics) and how many will be involved.

Interviews with experts: about 5 experts will be pre-selected to provide their perspective on defining and measuring fuel poverty in New Zealand, and they will be scholars and other professionals working with projects relating to fuel poverty, priotising those in the country.

Interviews with actors: the total number of actors (and the people involved in those organisations) chosen for engaging in this research will depend on identifying who are the organisations and projects happening nationally regarding fuel poverty minimisation/eradication.

Initial survey: general public, with a majority learning about the surveys through social media (actors such as Our Power will be posting the link on their Facebook page). For a population of 5,000,000 (to represent the country), a confidence level of 95% and an error margin of 5%, the first survey would require a sample size of 385 participants (SurveyMonkey, 2020). The goal of this survey will be to evaluate how prevalent fuel poverty is in the country and gather basic information to identify households that condition. Those participants who fall under the category of fuel poverty or are at risk (details to be defined) will be invited to answer a follow up survey with specific questions to analyse their socioeconomic conditions, at this point it is hard to determine how many will be. As mentioned, those participants will also answer a further survey to provide feedback in the future.

As the surveys will be done online, households composed of elderly members and those who are struggling with having reliable access to internet may be underrepresented.

3.2 Describe how you will invite them to participate.

I will email the experts and potential actors with an introduction about myself and briefly explaining research and I will be asking them if they agree to have an online meeting to discuss fuel poverty and its definition and ways to measure it, as well as their personal and organisational experiences on the topic, ongoing projects, and visions for the future. I will also make myself available to answer any question or concern they may have.

The survey will be advertised on social media pages from the involved actors (selected after the literature review and preliminary interviews), highlighting the importance of public participation for elaborating actions regarding fuel poverty eradication, in addition to mentioning the rewards for participation and their benefits in terms of reducing energy consumption and saving money. Actors who have direct and in-person contact with people who are in fuel poverty (such as libraries and charitable organisations) may provide them with a link to the survey through flyers and posters.

3.3 Show how you provide prospective participants with all information relevant to their decision to participate. Attach your information sheet, cover letter, or introduction script. See document on informed consent for recommended content. Information should include, but is not limited to:

- **what you will ask them to do;**
- **how to refuse to answer any particular question, or withdraw any information they have provided at any time before completion of data collection;**
- **how and when to ask any further questions about the study or get more information.**
- **the form in which the findings will be disseminated and how participants can access a summary of the findings from the study when it is concluded.**

Done for the first part of the research (interviews with experts). Other forms will follow. This will be sent via email during the preliminary contact with the potential interviewees. As for the surveys (attached as well), the information will be provided during the survey, prior the questions.

3.4 Describe how you get their consent. (Attach a consent form if you use one.)

Consent will be sought verbally for the interviews conducted via digital platforms. Consent forms will be used in the future for other activities. As for the surveys, there will be a brief explanation about the research prior to initiating the questions, and the first question will be asking for consent for participating, and the last one will be regarding using their answers for the study and its associated publications.

3.5 Explain incentives and/or compulsion for participants to be involved in this study, including monetary payment, prizes, goods, services, or favours, either directly or indirectly.

As a reward for their participation and an attempt to ameliorate fuel poverty, participants of the first survey (general public) may be receiving an energy-savings kit (e.g. LED bulbs, caulking for windows, weather stripping for doors) as well as a booklet including information on their rights as tenants and consumers, how to read their energy bills, understanding energy star ratings, how to compare providers and plans, government and charity resources like grants and services regarding energy efficiency, financial and environmental benefits of energy conservation and efficiency, and other relevant information. The kits and the booklets will be developed and produced with the assistance of the actors, and these rewards will be mentioned on the social media posts in order to attract survey participants.

A possible reward for the second survey (targeting people in fuel poverty) is a free energy audit done to their homes, as this service is being performed at no cost in many parts of the country. If a free in-person energy audit is not possible, self-audit kits could be lent to the participants. For example, Auckland Libraries let the public borrow Home Energy Audit Toolkits, which include:

- A hygrometer - to measure air temperatures and moisture levels including tips on how to avoid cold, damp conditions that cause condensation and mould.
- An infrared thermometer - to find thermal leaks due to poor insulation of ineffective seals including tips on how to fix them.

- A stopwatch - to measure your shower flow rate including tips on how to make savings through efficient use of hot water.
- A power meter - to measure the running cost of plug-in appliances including tips on how you can save money on appliances, heating and lighting.
- Instructions on how to use each tool.
- A record booklet for recording your measurements and energy saving actions.
- Infosheets you can take away with more detailed information. (Auckland Council, 2020)

4. Minimise deception.

4.1 If your research involves deception – this includes incomplete information to participants -- explain the rationale. Describe how and when you will provide full information or reveal the complete truth about the research including reasons for the deception.

N/A

5. Respect privacy and confidentiality

5.1 Explain how any publications and/or reports will have the participants' consent.

Before starting the interviews, the participants will be informed that their answers may be made public through publications unless specified. For the actors, their names and/or names of their organisations will be informed in text. The information sheet will be sent to them via email prior to the interviews, and at the beginning of the interview they will be asked if they consent to participant and have their answers used in the study and its publications.

At the beginning of the surveys, participants will select if they agree to share their anonymous answers with the researcher and involved actors for the purpose of collaborating with this doctorate study and for developing potential interventions relating to fuel poverty eradication, which may also be used for reports and publications. If they do not consent, the survey will not proceed.

5.2 Explain how you will protect participants' identities (or why you will not).

Experts and professionals who will be interviewed for their visions on defining fuel poverty will have their identity protected. Potential actors will have their names and affiliation mentioned as needed (they will be informed and will provide consent prior to that). This will serve as a way to show who are the involved parties in New Zealand which are working towards minimising fuel poverty.

The survey questions will not ask for any personal information which can identify them (name, address, phone number, or email). A code will be created for each participant, shown to them at the end of the survey. An email address will be created, and it will be provided to the participants at the completion of the survey so they can ask for the survey rewards by providing me with their code and their address (not mandatory). I will be the only person with access to such information, as I will ask the actors to send all the rewards to myself, and I will be responsible for distributing them.

As there will be a follow-up surveys with those who fall under the category of fuel poverty, an email will be sent to them based on their answers and provided code. As mentioned earlier, participants will be aware that they may be invited to answer another survey – and information about that survey and its rewards (potentially an energy audit) will be informed in that follow-up email. Once they have completed this second survey, I will provide them with information on how to get access to their participation rewards. I will be the only person who will be aware of the participants' personal information and fuel poverty status.

Additionally, all the survey results will only be published in an anonymous and cumulative manner – no personal data will be shared.

5.3 Describe who will have access to the information/data collected from participants. Explain how you will protect or secure confidential information.

Access to confidential data/information (mostly likely to be names, phone numbers and addresses of survey participants who wish to retrieve their participation rewards): researcher, who will be providing the rewards. Such

information will be received and shared directly with them via email. The data will be kept in the researcher's personal laptop a cloud platform such as Google Drive and Dropbox for the exclusive use of the researcher (both the computer and the cloud platform being protected by strong passwords). It will be kept in those platforms for as long as the survey periods last. As for the interviews, even though the opinions of the experts will be anonymous, there will not be any confidential information. The interviews with the actors will not have any confidential information involved. Summarising, the interviews will be considered general data/info, and their content will be shared (with consent) with supervisors and other actors as needed.

Platforms/resources used for general data/information:
Collection: online meeting platforms such as Zoom and Skype, audio recorder, video camera, Qualtrics
Analysis: Rev.com, NVivo, Microsoft Office
Storage: cloud platforms such as Google Drive and Dropbox

6. Minimise risk to participants.

'Risk' includes physical injury, economic injury (i.e. insurability, credibility), social risk (i.e. working relationships), psychological risk, pain, stress, emotional distress, fatigue, embarrassment, and cultural dissonance and exploitation.

6.1 Where participants risk change from participating in this research compared to their daily lives, identify that risk and explain how your procedures minimize the consequences.

N/A

6.2 Describe any way you are associated with participants that might influence the ethical appropriateness of you conducting this research – either favourably (e.g., same language or culture) or unfavourably (e.g., dependent relationships such as employer/employee, supervisor/worker, lecturer/student). As appropriate, describe the steps you will take to protect the participants.

As critical theory (analysis of power dynamics to rupture oppressive conditions towards human emancipation) and energy democracy (just and clean energy for all with democratic control of the energy sector) are perspectives chosen for this research, the study will emphasise the opinions of the people directly affected by fuel poverty in the decision-making, as well as those actors who prioritise human rights and wellbeing. This perspective (which will be made clear to all) can put some actors in a "defensive mode" in which they are unwilling to cooperate (e.g. share data) in order to protect their own interests. In such cases, only data available publicly will be used and partnership with such actors may be reconsidered. There is no perceived influence/risk regarding the survey participants (general public and people in fuel poverty).

6.3 Describe any possible conflicts of interest and explain how you will protect participants' interests and maintain your objectivity.

Energy companies have the profit motive as a major reason for wanting to mitigate fuel poverty, meaning that their interest in the cause relates to having more clients being able to pay for their energy tariffs. Since this study has a strong bias that all humans should have access to energy services regardless of their income, this energy democracy perspective will be made clear with all the actors involved, as there can still be collaboration in terms of selecting tactical and strategical allies for specific purposes, even if the motivations are divergent. As for the survey participants, their main interest is likely to be associated with reducing their energy expenses and staying warm, which does not necessarily create conflicts with this study – since it shares the vision of eradicating fuel poverty in the country. Those in fuel poverty will be sharing their visions and suggestions regarding how to mitigate the issue through the survey, being considered in addition to the actors' as well, however, the opinions from the former group will be shared by them individually and anonymously, meaning that there is a high chance that some people's perspectives and suggestions on the issue will not be implemented for a myriad of reasons, including time and budget restrictions.

7. Exercise social and cultural sensitivity.

7.1 Identify any areas in your research that are potentially sensitive, especially from participants' perspectives. Explain what you do to ensure your research procedures are sensitive (unlikely to be insensitive). Demonstrate familiarity with the culture as appropriate.

Preliminary investigation through literature review suggests that Pacific and Māori are overrepresented amongst households in fuel poverty. The surveys and interviews that will be conducted do not contain any specific content which may be considered culturally inappropriate, as they ask questions which are mostly related to income and energy literacy and consumption. The survey questions which will be used with the general public will be shared with the actors prior to being available to the participants to make sure they agree with their language and content.

7.2 **If the participants as a group differ from the researcher in ways relevant to the research, describe your procedures to ensure the research is culturally safe and non offensive for the participants.**

If engaging in any direct action with the public, it will be organised and conducted by relevant and trustworthy actors, such as the government and poverty relief organisations.

Potential questions

Regarding the semi-structured interviews with the experts and defined actors, potential questions can include:

1. How would you define energy hardship?
2. Which issues do you perceive to be causing energy hardship?
3. Which actors do you think are involved with the issue of hardship?
4. Which types of action do you believe to be necessary to eradicate energy hardship?
5. How would a future without energy hardship would look like in your opinion?
6. What is your vision for a sustainable future?

Observation: the prefer term for this study is *fuel poverty*, however, it is more commonly known as *energy hardship* in New Zealand.

First survey questions developed for the general public during Step 2 may include:

1. What is your current ZIP code? (write in the box)
2. How many people are part of your household? (write in the box)
    - Number of members who are between 0 and 17 years old
    - Number of members who are between 18 and 64 years old
    - Number of members who are over 65 years old
3. During the last 12 months, has your household lived in a rented property? (choose one answer)
    - Yes – exclusively
    - Yes – for more than 6 months
    - Yes – for less than 6 months
    - No
4. Approximately, how old is the dwelling in which your household spent most of the time during the past 12 months? (choose one answer)

- Up to 5 years old
- From 6 to 10 years old
- From 11 to 20 years old
- From 21 to 30 years old
- From 31 to 40 years old
- From 41 to 50 years old
- Over 51 years old
- Don't know or not sure

5. Has your dwelling ever undergone any improvements on the items mentioned below regarding thermal insulation or energy efficiency? (choose one or more answers)
    - Windows
    - Walls
    - Doors
    - Floor

- Ceiling/rooftop
- Heater
- Lighting
- Appliances
- Other (please elaborate in the box)
- Don't know or not sure

6. During the last 12 months, has your dwelling felt damp? (choose one answer)
    - Yes – sometimes
    - Yes – always
    - No (Stats NZ, 2019)
7. During the last 12 months, the indoor temperature of your dwelling usually: (choose one answer)
    - Feels colder than I would like
    - Feels warmer than I would like
    - Feels adequate to me (Stats NZ, 2019)
8. During the last 12 months, has your dwelling had issues with mould? (choose one answer)
    - Yes – and it is still an issue
    - Yes – but it was solved
    - No
9. During the last 12 months, has your household used prepaid energy services? (choose one answer)
    - Yes – exclusively
    - Yes – but no longer
    - Yes – we had regular billing but switched to prepaid
    - No
10. During the last 12 months, how many times has your household encountered financial difficulties paying for energy services, such as electricity and gas? (write in the box)
11. During the last 12 months, has your household made at least one late payment for energy services? (choose one or more answers)
    - Yes – we did not have the money
    - Yes – we forgot to pay
    - Yes – other reasons (please elaborate in the box)
    - No
12. During the last 12 months, has your household been disconnected from access to electricity due to lack of payment? (choose one or more answers)
    - Yes – by the provider
    - Yes – self-disconnection (prepayment user)
    - No
13. During the last 12 months, has your household received any financial assistance to help pay for energy services? (choose one or more answers)
    - Yes – government assistance (such as Winter Energy Payment)
    - Yes – family and friends gave or lent money for such purpose
    - Yes – other (please elaborate in the box)
    - No
14. During the last 12 months, has your household switched to a different electricity provider? (choose one of more answers)
    - Yes – for financial reasons
    - Yes – we moved to a different area
    - Yes – other (please elaborate in the box)
    - No
15. During the last 12 months, which electricity providers were used by your household? (write in the box)
16. During the last 12 months, has your household lived in state housing? (choose one answer)
    - Yes
    - No
17. During the last 12 months, has your household struggled with homelessness or have been at risk of being homeless? (choose one answer)
    - Yes – struggled with homelessness

- Yes – have been at risk of being homeless
- No

18. During the last 12 months, how often has your household reduced energy consumption exclusively due to financial constraints, such as avoiding heating? (choose one answer)
    - Always
    - Frequently
    - Occasionally
    - Rarely
    - Never
19. During the last 12 months, how often did your household make any late rent or mortgage payments? (choose one answer)
    - Always
    - Frequently
    - Occasionally
    - Rarely
    - Never
20. During the last 12 months, how often has your household reduced grocery expenses in order to pay for energy services? (choose one answer)
    - Always
    - Frequently
    - Occasionally
    - Rarely
    - Never
21. During the last 12 months, how often has your household members sleep in the room where the heater was (instead of their own bedroom) when it was too cold? (choose one answer)
    - Always
    - Frequently
    - Occasionally
    - Rarely
    - Never
22. During the last 12 months, how often has your household encountered financial difficulties paying for regular services other than energy, such as water, cable/streaming and telephone? (choose one answer)
    - Always
    - Frequently
    - Occasionally
    - Rarely
    - Never
23. Which group best describes your current annual household disposable income? (choose one answer)
    - Up to $20,000
    - Between $20,001 and $40,000
    - Between $40,001 and $60,000
    - Between $60,001 and $80,000
    - Between $80,001 and $100,000
    - Over $100,001
24. Which group best describes the percentage of your current household disposable income spent on rent? (choose one answer)
    - Not applicable: not renting
    - Less than 15%
    - 15 to 30%
    - 31 to 50%
    - 51 to 75%
    - Over 76%
25. What type of heater does your household currently use? (choose one or more answers)
    - Heat pump
    - Electric heater
    - Wood burner

- Fixed gas heater
- Portable gas heater
- Coal burner
- Pellet fire
- No heater
- Other type (please elaborate in the box) (Stats NZ, 2018)

26. What type of dehumidifier does your household currently use? (choose one or more answers)
    - Fixed
    - Portable
    - No dehumidifier
27. Which rooms of your dwelling have access to heating? (choose one or more answers, including which rooms your dwelling has and which ones have heating)
    - Living room
    - Kitchen
    - Dining room
    - Nursery
    - Bedroom
    - Guest room
    - Bathroom
    - Study room / office / art studio
    - Television / game room (separate from living room)
    - Laundry room
    - Other type of room
28. During the past 12 months, what is the average cost of energy services per month (four weeks)? (write in the box)
    - Electricity
    - Gas
    - Wood/charcoal
    - Coal
    - Other
29. During the past 12 months, how often has your household received financial assistance from the government, other than relating to energy payments? (choose one answer)
    - Consistently
    - A few times
    - One time
    - Never

Potential questions for the follow-up survey targeting those who are in fuel poverty or seem to be at risk for the condition may include:

1. Which groups best describe your household's ethnicity? (choose one or more answers)
    - European
    - Māori
    - Pacific
    - Asian
    - Middle Eastern
    - Latin American
    - African
    - Other (please elaborate in the box)
2. How many of your household members are: (write in the box)
    - Number of female members
    - Number of male members
    - Number of members with other gender identity
3. Which languages are the main ones spoken at your household? (choose one or more answers)

- English
- Te Reo Māori
- New Zealand Sign Language
- Samoan

- Mandarin
- Hindi
- French
- Other (please elaborate in the box)

4. What is the highest qualification level achieved by the members of your household? (choose one answer)
    - No qualification
    - Level 1-4
    - Level 5-6
    - Level 7
    - Level 8-10
5. During the past 12 months, has at least one of your adult household members consistently worked from home? Include homemakers as "Yes – full time working from home". (choose one answer)

- Yes – but only during the lockdown
- Yes – some of the time at home (besides the lockdown)
- Yes – full-time working from home (besides the lockdown)
- No

6. During the past 12 months, has at least one of your adult household members (18-64 years old) been unemployed? By unemployed, we mean either actively searching for employment or unable to work. Disregard students who are not searching for work, homemakers and the retired. (choose one answer)

- Yes – up to a month
- Yes – from 1 to 3 months
- Yes – from 3 to 6 months
- Yes – from 6 to 9 months
- Yes – over 9 months
- No

7. How many your household members have a disability or long-term health condition? (write in the box)

- Number of children/teenagers (0-17 years old) with disability or long-term health condition
- Number of adults (18-64 years old) with disability or long-term health condition
- Number of seniors (65+ years old) with disability or long-term health condition

8. During the past 12 months, has any of your household members had received diagnoses or had diagnosed episodes of any of the conditions mentioned below? (choose one or more answers)
    - Respiratory issues, including allergies
    - Cardiovascular issues, including high blood pressure
    - Major mental health issues, including chronic depression and anxiety
    - Diabetes
    - Other major issue (please elaborate in the box)
9. During the past 12 months, how often has any of your household members had the need for using medical equipment at home which required energy consumption, such as oxygen concentrators? (choose one answer)
    - Consistently
    - A few times
    - One time
    - Never
10. Which products that you currently own have an energy rating of 1 to 3 stars? (choose one or more answers)
    - Clothes washer
    - Clothes dryer
    - Dishwasher
    - Refrigerator
    - Television
    - Air conditioning
    - None of those / not sure
11. How do your household members stay warm in their bedrooms at night when the temperatures are low? (choose one or more answers)

- Fixed heater
- Portable heater
- Extra blankets
- Electric blankets
- Extra layers of clothing
- They sleep in another room with heating
- Other (please elaborate in the box)

12. Which of the following electricity saving behaviours does your household perform? Select if they are done either voluntarily with the purpose of saving electricity (occasionally) or if they are done consistently (Aguirre-Bielschowsky, Lawson, Stephenson, & Todd, 2018). (choose one or more answers)
    - Lights off
    - Televisions off
    - Computers off
    - Heaters off or low
    - Appliances off at the wall
    - Closing curtains
    - Short and medium showers
    - Wearing extra clothing (instead of using heater)
    - Drying clothes naturally
13. Has your household been financially damaged by the COVID-19 pandemic? (choose one answer)
    - Yes – significantly
    - Yes – but it has been manageable
    - No
14. Has your household noticed an increase in cost for energy services during the COVID-19 pandemic? (choose one or more answers)
    - Yes – because we have increased our consumption
    - Yes – because the fuel cost (including electricity rate) has increased
    - Yes – other (please elaborate in the box)
    - No
15. During the past 12 months, what was the maximum number of indoor pets your household owned at a time? (write in the box)
16. If you could point at the causes of difficulty in paying for energy services in your household, what would they be? (write in the box)
17. If you were able to create actions and policies to assist people who are struggling with paying for energy services, what would they be? (write in the box)

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Information Sheet for Participants – Preliminary Interviews

Waikato Management School
Te Raupapa

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Critically assessing fuel poverty in New Zealand for strategising its eradication

Overview

My name is Luiza Brabo-Catala, and as part of the PhD programme in Management and Sustainability, I am required to conduct a comprehensive research project and write a thesis with publications. For my project, I wish to research fuel poverty (also known as energy hardship) in New Zealand.

My first goal is to define the concept of fuel poverty in order to determine the parameters used to identify households in such condition. For that, I will interview professionals relating to fuel poverty to gather preliminary ideas, as well as doing a thorough literature review on the topic. Then, I will be contacting actors who are involved with fuel poverty in the country (e.g. government, energy companies, charitable organisations, activist groups) with the intention of organising collective efforts, having their opinions and suggestions used to guide the following steps of the research. Surveys will be done with the general public and those who fall under the category of fuel poverty for creating systems models which contain socioeconomic issues connecting to fuel poverty, and they will be analysed using a critical systems perspective. After that, I will be actively participating in the ongoing projects for mitigating fuel poverty in New Zealand, using the data I collected as a tool for re-directing actions. Feedback surveys will be done to determine whether the actions taken were perceived to be successful by both participants and actors, which will be used to propose further interventions relating to fuel poverty eradication.

What will you have to do and how long will it take?

I would like to conduct an interview with you regarding your preliminary perspectives on fuel poverty and your personal and organisational experience relating to the issue. It will take about 30 to 60 minutes total.

The interview will be done via an online platform (e.g. Zoom/Google Hangouts/Skype) and it will be recorded.

What will happen to the information collected?

The participants' answers (including yours) will help me understand fuel poverty from the perspectives of other experts in the area, which will also assist with elaborating a definition of the issue which will be used throughout the study – and potentially other projects as well.

Your answers will be used to write an academic article, which will be part of my thesis. Your name and affiliation will not be shared so your identity can be preserved. Only my supervisors, the transcription company and I will have access to the full information you provide me in the interview recording and transcriptions. I will keep a copy of the files on a cloud platform but will treat it with the strictest confidentiality.

The article will be published in a journal relating to energy and/or sustainability. Professionals and students from those fields, as well as the actors eventually involved in this study, will be accessing the article.

Declaration to participants

If you take part in the study, you have the right to:

- Refuse to answer any particular question, and to withdraw from the study by 31/01/2021.
- Ask any further questions about the study that occurs to you during your participation.
- Be given access to a summary of the findings from the study when it is concluded.

If you have any questions about this interview of the overall research project you can e-mail me at LB170@students.waikato.ac.nz or message/call me at +1 510 660 9577. My project is being supervised by Dr Eva Collins and she can be contacted at 021 056 4122, e-mail her at Eva.collins@waikato.ac.nz or contact her at

Dr Eva Collins
Department of
Waikato Management School
PO Box 3105
HAMILTON 3240
NEW ZEALAND

Consent Form for Participants – Preliminary Interviews

Waikato Management School
Te Raupapa

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Critically assessing fuel poverty in New Zealand for strategising its eradication

Consent Form for Participants

I have read the **Information Sheet for Participants** for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I am free to withdraw from the study by 01/04/2021, or to decline to answer any particular questions in the study. I agree to provide information to the researchers under the conditions of confidentiality set out on the **Information Sheet**.

☐ I agree for this interview to be recorded (video and audio)

☐ I agree to participate in this study under the conditions set out in the **Information Sheet** form.

Signed: _____

Name: _____

Date: _____

Researcher's Name and contact information:

Luiza Brabo-Catala
LB170@students.waikato.ac.nz or +1 510 660 9577

Supervisor's Name and contact information:

Dr Eva Collins
eva.collins@waikato.ac.nz or 021 056 4122

Information Sheet for Participants – Interviews about ongoing projects

Waikato Management School
Te Raupapa

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Critically assessing fuel poverty in New Zealand for strategising its eradication

Overview
My name is Luiza Brabo-Catala. I am a PhD candidate in Management and Sustainability. I am conducting acomprehensive research project on fuel poverty (also known as energy hardship) in New Zealand.

My first goal was defining the concept of fuel poverty in order to determine the parameters used to identify households in such condition. I interviewed professionals relating to fuel poverty to gather preliminary ideas, as well as writing a literature review on the topic. Now, I am contacting stakeholders who are involved with fuel poverty projects in the country (e.g. government, energy companies, charitable organisations, activist groups), with the intention of organising collective efforts and having their opinions and suggestions used to guide the following steps of the research.

What will you have to do and how long will it take?
I would like to conduct an interview with you regarding your project(s) relating to fuel poverty alleviation and your organisational experience. It will take about 30-60 minutes total.

The interview will be done via Zoom and it will be recorded, and the audio will be transcribed.

What will happen to the information collected?
The participants' answers (including yours) will help me understand what types of interventions and projects are currently being developed and carried out in order to minimise fuel poverty in New Zealand. This will help me see the perspectives used in the country (such as the objectives and the techniques employed), as well asmaking connections that can result in optimising resources and better integrating efforts.

Your answers will be used for academic articles about the ongoing projects for mitigating and eradicating fuel poverty, which will be part of my thesis. I will also use your answers to communicate your organisation's efforts to other organisations that are working on the issue of fuel poverty. Your name, contact and/or affiliation will be shared as appropriate (e.g. creating synergy with other projects will most likely include sharing your name, organisation and contact information such as phone number or email, whereas the article will focus on the organisation and will not share your contact information) – **in the first case, I will give you details about the organisations and projects beforehand and I will ask you if you consent to having your information shared with them**. Only my supervisors, the transcription company and I will have access to the full information you provide me in the interview recording and transcriptions, but I may share your answers with the appropriate organisations for the purposes mentioned earlier. I will keep a copy of the files (names, organisations, contact information and transcribed interviews) on a cloud platform with password protected access for up to 5 years after my thesis defence (estimated for April 2023).

The articles will be published in journals relating to energy, management and/or sustainability. Professionals and students from those fields, as well as the stakeholders eventually involved in this study, will be accessing the article.

Next steps
Surveys will be conducted with the general public and those who fall under the category of fuel poverty for creating systems models which contain socioeconomic issues connecting to fuel poverty, and they will be analysed using a critical systems perspective. After that, I will be actively participating in some of the ongoing

projects for mitigating fuel poverty in New Zealand, using the data I collected as a tool for re-directing actions. Feedback surveys will be done to determine whether the actions taken were perceived to be successful by both participants and actors, which will be used to propose further interventions relating to fuel poverty eradication.

Declaration to participants

If you take part in the study, you have the right to:

- Refuse to answer any particular question, and to withdraw from the study by 01/07/2021.
- Ask any further questions about the study that occurs to you during your participation.
- Be given access to a summary of the findings from the study.

If you have any questions about this interview or the overall research project, you can e-mail me at LB170@students.waikato.ac.nz or message/call me at +1 510 660 9577. My project is being supervised by Associate Professor Eva Collins and Professor Barry Barton.

Eva can be contacted at 021 056 4122, her e-mail is eva.collins@waikato.ac.nz or you can contact her at

Associate Professor Eva Collins
Department of
Waikato Management School
PO Box 3105
HAMILTON 3240
NEW ZEALAND

Barry can be contacted at 07 838 4187 and his email is barry.barton@waikato.ac.nz

Waikato Management School
Te Raupapa

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Critically assessing fuel poverty in New Zealand for strategising its eradication

Consent Form for Participants

I have read the **Information Sheet for Participants** for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I am free to withdraw from the study by 01/07/2021, or to decline to answer any particular questions in the study. I agree to provide information to the researchers under the conditions of confidentiality set out on the **Information Sheet**. Please check the boxes if you consent to the statements below:

☐ I agree for this interview to be recorded (if applicable)

☐ I agree to participate in this study under the conditions set out in the **Information Sheet** form.

Signed: _____

Name: _____

Date: _____

Researcher's name and contact information:

Luiza Brabo-Catala
LB170@students.waikato.ac.nz or +1 510 660 9577

Supervisors' names and contact information:

Associate Professor Eva Collins
eva.collins@waikato.ac.nz or 021 056 4122

Professor Barry Barton
barry.barton@waikato.ac.nz or 07 838 4187

Luiza Brabo-Catala
By email: lb170@students.waikato.ac.nz

9 February 2021
Dear Luiza

Ethical Application WMS 20/144
Critically assessing fuel poverty in New Zealand for strategising its eradication

The above research project, as outlined in your submitted application, has been granted Ethics Approval for Research by the Waikato Management School Human Research Ethics Committee.

Please note: you will need to submit your survey for additional ethic approval, and should you make any major changes to the project outlined in the approved ethics application, you may need to reapply for ethics approval.

Best wishes for your research.

Kind regards,

Amanda Sircombe

Amanda Sircombe
WMS Research and Postgraduate Manager

Chapters Five and Six

Application for Ethical Approval
Outline of Research Project

Waikato Management School
Te Raupapa

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Template:

Use clear and simple language. Avoid technical terms wherever possible.

*Please allow **at least two weeks** for your application to be reviewed by the WMS Ethics Committee*

You must gain ethics approval prior to the commencement of data collection for your research project

See How to fill out the form for guidance.

1. Identify the project.

1.5 Title of Project Critically assessing fuel poverty in New Zealand for strategising its eradication

1.6 Researcher(s) name and contact information Luiza Brabo-Catala (ID 1553284) lb170@students.waikato.ac.nz

1.7 Supervisor's name and contact information (if relevant) Chief supervisor: Professor Eva Collins eva.collins@waikato.ac.nz

1.8 Anticipated date to begin data collection

No data collection will begin prior to ethics approval. Dates will be postponed if needed.
Pilot test of the first survey: 08/04/2022,
First survey: 14/04/2022,
Pilot tests of the follow-up survey: 08/11/2022, and
Follow-up survey: 14/11/2022.

2. Describe the research.

2.6 Briefly outline what the project is about including your research goals and anticipated benefits. Include links with a research programme, if relevant.

I am planning a nationally representative survey (n=500) to identify households in energy hardship in New Zealand. The participants who fall under the criteria of energy hardship will have the opportunity to receive rewards to ameliorate their condition. Six months later, they will be invited to respond to a follow-up survey about the rewards: any improvements they noticed, suggestions, or critiques.

Goals:

- Find the prevalence of energy hardship in Aotearoa,
- Identify the most affected demographics in energy hardship,
- Compare different types of energy hardship/fuel poverty indicators, and
- Understand patterns that associate energy hardship with other deprivations.

Implications:

- Include the public view on energy hardship actions,
- Minimise energy hardship by providing affected households with relevant rewards, and
- Get feedback from households regarding the effectiveness of the rewards.

Benefits:

- Test the effectiveness of the indicators proposed by MBIE,
- Reexamine the scholarship on energy hardship in New Zealand considering the context of the pandemic and increasing energy costs, and
- Direct current energy hardship interventions to specific issues, since organisations such as MBIE, EECA, Vector, WEL/OurPower, Northpower, and Habitat for Humanity will be engaged in this research.

2.7 Briefly outline your method.

- A draft survey was developed to identify energy hardship according to the literature on fuel poverty, NZ Stats surveys, the MBIE discussion document on definition and indicators, a survey draft provided by the Energy Hardship Evaluation Consortium (EHEC, with members including EECA, MBIE, and the University of Otago), and opinions from experts involved with energy hardship projects.
- The survey was created on Qualtrics (click here to see the questions, answer yes to the first question and skip all of them to see all questions available).
- Professionals from multiple organisations gave feedback the survey (see Table 48 below), including its questions, delivery strategies, and rewards.
- A pilot test will be conducted by OurPower (energy retailer) with up to 100 of their clients once I receive ethics approval.
- Sample provider Dynata will ensure that a nationally representative sample of 500 adults (decisionmakers regarding energy in their homes) answer the finalised survey.
- People who meet defined criteria for energy hardship (total points≥10, see Table 2 below) will be asked to reach out to my email to potentially receive survey rewards relating to the condition - if they agree to answer a follow-up survey in six months.
- Critical systems thinking will be used to link the relationships among the elements analysed (e.g. education level, income, poor housing quality, prepayment plan).
- A manuscript will be written containing the survey findings on the conditions of people affected by energy hardship and suggestions for interventions.
- A follow-up Qualtrics survey will be sent to those who received the rewards to get their feedback (e.g. households' health, energy consumption, approval of the rewards, suggestions). An additional ethics approval application will be submitted prior to that.
- Critical systems thinking will be used again to find patterns and connect issues before and after the rewards.
- Another manuscript will be written regarding the effectiveness of the rewards and plans for the future.

Table 48: Organisations that provided survey feedback.

Organisation	Description of organisation
Community Energy Network	Energy education, assessment, and retrofit provider
Connectics	Energy distributor
Dynata	Sample provider
EECA/EHEC	Crown entity/energy hardship collaboration group
ERANZ	Energy retailers' association
Habitat for Humanity	Housing nonprofit
MBIE/Energy Hardship Working Group	Ministry/energy hardship information sharing group
My2Cents	Energy research panel
Northpower	Energy distributor
Octopus Energy	Energy retailer
Orion	Energy distributor
Vector	Energy distributor
WEL Networks/OurPower	Energy distributor/retailer

Table 49: Energy hardship criteria and points.

MBIE ID	Criteria	Points
P3	Put up with feeling cold to keep costs down a lot	10
P4	Dampness and/or mould problems - major	10
P5	No access to electricity supply	5
P6	No home access to computer or internet	5
P7	No access to financial institution account	5
P8	Could not pay electricity, gas, rates, or water bills on time (>1x)	5
P9	Unable to afford unexpected expense without borrowing	5
P13	Cannot afford to keep the dwelling adequately warm	5
P14	Using prepayment metering	5
P15	No heating type used	5
P16	Not heating own bedroom in winter	5
P17	Not heating children's bedroom in winter	5
P18	Not heating main living room in winter	5
P19	Trouble heating accommodation and/or keeping it warm in winter	5
P20	Use of unsafe substitute heating methods (portable gas heater)	5
P21	Lacking one or more basic amenity	5
P22	Housing repairs needed - major	5
P23	Mould larger than an A4 - Always	5
P24	Damp always	5
P25	Can see breath indoors in winter	5
P26	Indoors always colder than would like in winter	5

2.8 Describe plans to give participants information about the research goals.

Research goals will be explained in the survey prior to the questions (see link to survey above or description of survey introduction below).

2.9 Identify the expected outputs of this research (e.g., reports, publications, presentations), including who is likely to see or hear the reports or presentations on this research

Anonymous data will be shared with the members of the EHEC and other interested organisations, including those who provided feedback, the pilot test, and rewards (no indentifying information will be collected). Those organisations include EECA, MBIE, Vector, WEL/OurPower, Northpower, and Habitat for Humanity.

Future outcomes (conference presentations, journal articles, and a doctoral thesis) will likely be seen by energy professionals, researchers, policymakers, and members of the EHEC.

2.10 Identify the physical location(s) for the research, the group or community to which your potential participants belong, and any private data or documents you will seek to access. Describe how you have access to the site, participants and data/documents. Identify how you obtain(ed) permission from relevant authorities/gatekeepers if appropriate and any conditions associated with access.

For the pilot test, OurPower will send the survey link to its customers (Waikato Region), expecting up to 100 participants.

The sample for the survey itself will be representative of the whole country, conducted by Dynata. The survey will be anonymous, and I will be asking about income, energy consumption and habits, demographic information, dwelling conditions, and health. Participants will have to consent to the terms of the survey to respond to the questions, and they are able to skip any questions.

3. Obtain participants' informed consent, without coercion.

3.3 Describe how you will select participants (e.g., special criteria or characteristics) and how many will be involved.

For the pilot test of the first survey, OurPower will be sharing the survey with their customers (Waikato region). We set a cap of 100 participants. The follow-up survey pilot test will be sent only to those who meet the criteria of energy hardship while agreeing to obtain the reward (one month of free electricity) and answer a follow-up survey.

For the first survey, Dynata will collect a nationally representative sample of 500 adults in Aotearoa who are decision-makers regarding energy choices at their homes. The follow-up survey will be sent only to those classified as in energy hardship and have agreed to receive a reward and follow up.

3.2 Describe how you will invite them to participate.

OurPower will send emails to its customers with the Qualtrics link ($n \leq 100$).

Dynata is responsible for finding suitable participants (500 adults who make decisions in their home about energy). The company will provide the Qualtrics link to them.

3.3 Show how you provide prospective participants with all information relevant to their decision to participate. Attach your information sheet, cover letter, or introduction script. See document on informed consent for recommended content. Information should include, but is not limited to:

- **what you will ask them to do;**
- **how to refuse to answer any particular question, or withdraw any information they have provided at any time before completion of data collection;**
- **how and when to ask any further questions about the study or get more information.**
- **the form in which the findings will be disseminated and how participants can access a summary of the findings from the study when it is concluded.**

Message shown on Qualtrics before survey starts (see survey link above):

According to the Ministry of Business, Innovation and Employment, energy hardship is when individuals, households and whānau are not able to obtain adequate energy services to support their wellbeing in their home or kāinga. It is estimated that hundreds of thousands of Kiwis are currently struggling with energy hardship, resulting in cold and damp homes, health issues, financial difficulties, energy disconnection, and poor quality of life. However, more research is still needed to identify those households and develop actions to reduce energy hardship.

This survey is designed to learn about your household and home, including your health status, household expenditures, energy consumption, and behaviours that may impact those areas. The survey will take about 12 minutes to complete. Your responses are anonymous and confidential. Please skip any question if you do not feel comfortable answering it.

Your answers will help us:
• Understand how common energy hardship is in Aotearoa New Zealand,
• Find the groups which are most impacted by energy hardship,
• Compare different ways of identifying households in energy hardship,
• Connect energy hardship with other types of struggles, and
• Assist with the creation of energy hardship minimisation programmes.

Our findings will be shared in the form of anonymous data, presentations, journal articles, and a doctoral thesis. Additionally, the results will be shared with organisations that work to reduce energy hardship, including the government, universities, non-profits, and social businesses.

If you have any questions about the survey itself or this research, please email Luiza Brabo-Catala at lb170@students.waikato.ac.nz.
Do you agree with the terms mentioned above?

A statement shown on Qualtrics at the end of the survey (only to participants who fall in the energy hardship criteria):

Would you be interested in the possibility of obtaining a survey reward? If you agree, you will be asked to answer a follow-up survey in November to evaluate its effects on your household. Rewards are subject to availability.

Potential rewards may include:
• a home energy assessment,
• a month of electricity,
• a heater,
• queen/single/baby blankets,
• a hot water bottle,
• curtains,
• an education booklet,
• a door/draught snake,
• a scoopy,
• a hygrometer,
• a mould cleaning kit,
• a shower timer,
• efficient lightbulbs,
• pipe lagging,
• a hotwater cylinder wrap, and
• a low-flow shower head.

If they agree:

Thank you for your interest in receiving the survey reward and answering a follow-up survey in November! Your ID number is [generated by Qualtrics]. Make sure to write down this number.

Please send an email to lb170@students.waikato.ac.nz by 05/05/2022 with the subject line "Survey reward" and add your ID number to the email body. No other information needs to be provided in the

message – you do not have to mention your name or address. You will receive details regarding the reward available to you and how you can obtain it.

In November, you will receive a link to answer the follow-up survey regarding the reward you received. Please add lb170@students.waikato.ac.nz to your contacts list.

3.4 Describe how you get their consent. (Attach a consent form if you use one.)

Only participants that agree to the terms of the survey will be able to access the survey.

3.5 Explain incentives and/or compulsion for participants to be involved in this study, including monetary payment, prizes, goods, services, or favours, either directly or indirectly.

The participants classified as in energy hardship will be asked if they are interested in potentially receiving a survey reward – and if so, they will be sent a follow-up survey in six months. Agreeing to that will lead them to a message asking them to email me only saying they want the rewards + the ID number generated by Qualtrics. I will send them the information regarding the available rewards, and they will have to contact the organistion providing the rewards.

OurPower will provide a month of free electricity to participants of the pilot test (who already are their clients).

Habitat for Humanity will provide twenty Winter Warmer Packs in the Auckland and Northland regions. They typically include an education booklet, a heater, queen/single/baby blankets, a hot water bottle, a door/draught snake, a scoopy, a hygrometer, and a mould cleaning kit. In Auckland, participants can also potentially get curtains and energy efficient items (such as a shower timer, lightbulbs, pipe lagging, a hotwater cylinder wrap, and a low-flow shower head).

Northpower will provide home energy assessments to people in the Northland region. They will also provide LED lightbulbs and efficient shower heads to the participants.

Participants interested in rewards may have to provide their names, phone numbers, and addresses to the organisations in order to obtain the rewards. However, none of the organisations will know of their responses. Additionally, they can refuse to follow through the reward process.

4. Minimise deception.

4.2 If your research involves deception – this includes incomplete information to participants -- explain the rationale. Describe how and when you will provide full information or reveal the complete truth about the research including reasons for the deception.

To avoid biased answers or make people feel ashamed of their condition, the survey will not specify that only those in energy hardship will have the opportunity to receive rewards. Additionally, rewards will only be discussed with those who are considered to be in energy hardship, adding that they are subject to availability.

5. Respect privacy and confidentiality

5.4 Explain how any publications and/or reports will have the participants' consent.

Participants will have to agree to the terms of the survey before they start it. The survey is anonymous.

5.5 Explain how you will protect participants' identities (or why you will not).

The surveys will be anonymous. If the participant falls under the selected criteria for identifying energy hardship, they will be asked if they are interested in obtaining rewards. If so, they will have to reach out to me. This means that the participant will have to take the initiative to send me an email and obtain the reward available to them. Since the organisations providing the rewards already do so as part of their regular programmes, they will not know anything specific about the participants' information.

5.6 Describe who will have access to the information/data collected from participants. Explain how you will protect or secure confidential information.

Data collected with the survey will be shared with Vector Limited, Habitat for Humanity, Northpower, and EHEC members (which include the government, nonprofit organisations, and businesses). Since the surveys will be anonymous and the participants who are considered to be in energy hardship will obtain the surveys themselves, no confidential information will be collected.

6. Minimise risk to participants.

'Risk' includes physical injury, economic injury (i.e. insurability, credibility), social risk (i.e. working relationships), psychological risk, pain, stress, emotional distress, fatigue, embarrassment, and cultural dissonance and exploitation.

6.4 Where participants risk change from participating in this research compared to their daily lives, identify that risk and explain how your procedures minimize the consequences.

Embarrassment related to issues such as financial struggle and poor health may occur when responding to the questions and/or obtaining the rewards. However, the survey is anonymous, any question can be skipped, rewards are optional, and the organisations providing the rewards will not know about the participants' specific responses.

6.5 Describe any way you are associated with participants that might influence the ethical appropriateness of you conducting this research – either favourably (e.g., same language or culture) or unfavourably (e.g., dependent relationships such as employer/employee, supervisor/worker, lecturer/student). As appropriate, describe the steps you will take to protect the participants.

Participants of the pilot test are OurPower customers, so they may feel uneasy about providing sensitive information as solicited by their energy retailer. However, the survey is anonymous, and they can skip questions.

As for language and culture, the survey received feedback from multiple organisations.

6.6 Describe any possible conflicts of interest and explain how you will protect participants' interests and maintain your objectivity.

OurPower (WEL Energy Trust) will only survey their customers, so providing a month of free electricity is beneficial to the participants. They will not know about the rewards unless they were selected.

Northpower (Northpower Trust) and Habitat for Humanity will provide energy advice and items related to energy efficiency and thermal comfort. Since one is not a retailer and the other is a nonprofit, there are no conflicts of interest. Like the pilot test, participants will not know about the rewards unless they were selected.

7. Exercise social and cultural sensitivity.

7.3 Identify any areas in your research that are potentially sensitive, especially from participants' perspectives. Explain what you do to ensure your research procedures are sensitive (unlikely to be insensitive). Demonstrate familiarity with the culture as appropriate.

Questions received feedback from multicultural experts, and the fourteen organisations providing the rewards are highly regarded and diverse.

7.4 **If the participants as a group differ from the researcher in ways relevant to the research, describe your procedures to ensure the research is culturally safe and non offensive for the participants.**

Research questions were evaluated by experts from different backgrounds (educational and cultural). As for the survey rewards, participants need to actively pursue them. All the organisations providing rewards are respectable institutions that collaborate with the government in their actions.

COMMENTS ON APPLICATION

Comment 1:
In general, this application relates to a project that can be considered relatively low risk. The following issues need to be resolved, before this application can be reassessed and approved:

- **In Section 1.4, the dates seem infeasible given that data collection will not usually begin until after the six-month confirmation of the PhD. However, there is nothing to prevent you from making a 'PhD Final' ethics application provided you have addressed the other comments here.**

  Sorry, I misunderstood what *final* meant in this case.

- **In Section 2.3, you need to explain how participants will be provided with information about the research. For example, when will participants be given the Participant Information Sheet? If they are being contacted by the third party survey firm, will they be providing the information and if so, how?**

The information is in the survey, prior to the survey questions (front page). This serves as the information sheet.

- **In Section 2.4, you state that "no identifying information will be collected". However, if that is the case, how will you conduct the follow-up survey? Surely you need to know who completed the first survey and who has opted into the follow-up? Or are you not intending to link data between the baseline and follow-up surveys? Also, if OurPower is providing a month of free electricity to participants of the pilot test, the pilot test survey must not be anonymous (otherwise, how would OurPower know who participated?).**

  When participants answer the survey until the end, they will see a random ID number generated by Qualtrics. If they want to receive the rewards, they will need to email the ID number to me. Participants will be informed by me that organisations providing the rewards may ask for their details, but they will not know about their specific survey answers. They can also opt out if they do not feel comfortable.

- **In Section 3.1, you explain how the sample will be selected for the pilot, but you have not provided enough information about the sampling frame for the full survey. Is it based on a survey panel that Dynata already has, or something else? How will Dynata determine who gets invited to participate?**

Dynata will select 500 New Zealand adults who are decision makers regarding energy. The proportion of people in each region and their ethnicities will be proportional to the national numbers. Dynata will contact those people as they are a sample provider.

- **In Section 3.2, you need to be more specific about how Dynata will invite participants to participate in the research. I note that the invitations should provide enough information for participants to make an informed choice. Usually, this means distributing the Participant Information Sheet at the time of the invitation, but given that this information will be on the first page of the online survey, a more limited amount of information may be given in the invitation.**

  Participants will be contacted by Dynata and will receive the link to the survey.

- **In Section 3.3, I note that *all* of the information required on the Participant Information Sheet should appear on the first page of the online survey (see my other comments below).**

I will update that.

- **In Section 3.4, with anonymous online surveys, it is difficult to manage the consent process, because participants cannot withdraw. You have included a consent question at the beginning of the survey, but the final question of the survey should also be asking the participants for their consent. The first question should ask for consent to participate, and the last question should ask for consent to include their responses in the research (which could be in the form of a 'submit my responses' button or similar).**

  I will do that.

- **In the Participant Information Sheet (which will also be the front page of your online survey), you must note the rights of the participants, including that they have the right not to answer any question, and the right to ask any questions about the research, and have their questions answered to their satisfaction. You don't tell the participants what is going to happen to their data, and especially you are not clear about who their data (albeit anonymised) is going to be shared with (in the application, you say that you are going to share this data with the sponsoring organisations, so this must be made known to research participants). You must also make it clear the purpose of the research is for a PhD thesis study, and make the PhD supervisors identities and contact details (phone and email) available, as well as your own phone contact details.**

  I will make sure all the needed information is there.

- **Given that data collection is only via an online survey, the Consent Form is not required.**

  Sounds good.

- **In the survey, for most of the questions (but not all), if a participant chooses not to answer, they are then forced to confirm that they don't want to answer with a popup box. That can falsely give the impression that those questions are required to be answered, which is inconsistent with the rights of participants. You should ensure that option is switched off for all questions in the Qualtrics settings. Also, the final question (about rewards) currently forces an answer, and that should be changed.**

  I will do that.

[For Chapter Six] This is an update on the same study. The same participants of both surveys will be contacted by Dynata and OurPower, and everything should be the same, except for no rewards for this follow-up survey. Their data will be anonymous, they can refuse to respond to any question, and they can contact my supervisors or me if they have any questions. The follow-up survey can be found here. Note that it has not been programmed, meaning that you are able to see all questions possible (keep moving forward to see them all).

Additionally, people interviewed last year regarding their energy hardship intervention projects will be contacted again via email to respond to this follow-up survey.

Since the interviews and the surveys had ethics approval, this is just an update on those regarding the new questions, as the circumstances are virtually the same.

We intend to start the surveys on 01/12/2022 and finish them by 23/12/2022. The documents provided to the participants prior to the surveys will be the same as those before.

In general, this application relates to a project that can be considered relatively low risk. The following issues need to be resolved, before this application can be reassessed and approved:

- **As it currently stands, the questions in the survey force the research participant to provide an answer before they can proceed to the next question. This is a violation of the rights of the participant not to answer any question. The questions must be set up so that research participants can choose not to answer, without needing to select any option (even if there is an option that states "I prefer not to answer").**

- **In Section 2.3, I don't believe it is sufficient that participants are only given information about the research at the start of the survey. You should be providing them with information at the time they make an initial decision to participate, i.e. at the time of invitation. So, if participants are being contacted by the third party survey firm, will the survey firm be providing the information and if so, how?**
- **In Section 3.1, how will Dynata determine who gets invited to participate?**
- **In Section 3.2, you need to be more specific about how Dynata will invite participants to participate in the research. I note that the invitations should provide enough information for participants to make an informed choice. Usually, this means distributing the Participant Information Sheet at the time of the invitation, but given that this information will be on the first page of the online survey, a more limited amount of information may be given in the invitation.**

If these changes are made and points clarified, to the satisfaction of your supervisor, then the application is approved. Good luck with your research!

Sample Information Sheet for Participants

Waikato Management School
Te Raupapa

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Critically assessing fuel poverty in New Zealand for strategising its eradication

Kia ora.
According to the Ministry of Business, Innovation and Employment, energy hardship is when individuals, households and whānau are not able to obtain adequate energy services to support their wellbeing in their home or kāinga. It is estimated that hundreds of thousands of Kiwis are currently struggling with energy hardship, resulting in cold and damp homes, health issues, financial difficulties, energy disconnection, and poor quality of life. However, more research is still needed to identify those households and develop actions to reduce energy hardship.

This survey is designed to learn about your household and home, including your health status, household expenditures, energy consumption, and behaviours that may impact those areas. The survey will take about 12 minutes to complete. Your responses are anonymous and confidential. Please skip any question if you do not feel comfortable answering it.

Your answers will help us:
• Understand how common energy hardship is in Aotearoa New Zealand,
• Find the groups which are most impacted by energy hardship,
• Compare different ways of identifying households in energy hardship,
• Connect energy hardship with other types of struggles, and
• Assist with the creation of energy hardship minimisation programmes.

Our findings will be shared in the form of anonymous data, presentations, journal articles, and a doctoral thesis. Additionally, the results will be shared with organisations that work to reduce energy hardship, including the government, universities, non-profits, and social businesses.

If you have any questions about the survey itself or this research, please email Luiza Brabo-Catala at lb170@students.waikato.ac.nz.
Do you agree with the terms mentioned above?

O Yes
O No

Luiza Brabo-Catala
By email: lb170@students.waikato.ac.nz

2 May 2022

Dear Luiza

Ethical Application WMS 22/19
Critically assessing fuel poverty in New Zealand for strategising its eradication

The above research project, as outlined in your submitted application, has been granted Ethics Approval for Research by the Waikato Management School Human Research Ethics Committee.

Please note: should you make changes to the project outlined in the approved ethics application, you may need to reapply for ethics approval.

Best wishes for your research.

Kind regards,

Amanda Sircombe

Amanda Sircombe
WMS Research and Postgraduate Manager

Luiza Brabo-Catala
By email: lb170@students.waikato.ac.nz

23 November 2022

Dear Luiza

Ethical Application WMS 22/114
Critically assessing fuel poverty in New Zealand for strategising its eradication

The above research project, as outlined in your submitted application, has been granted Ethics Approval for Research by the Waikato Management School Human Research Ethics Committee.

Please note: should you make changes to the project outlined in the approved ethics application, you may need to reapply for ethics approval.

Best wishes for your research.

Kind regards,

Amanda Sircombe

Amanda Sircombe
WMS Research and Postgraduate Manager