Cold homes and tight budgets: measuring energy poverty and the coping strategies used by households in the Town of Bridgewater, Nova Scotia

Laurianne Debanné (260805964)

Department of Geography
McGill University
November 2023

A thesis submitted to McGill University
in partial fulfillment of the requirements of the degree of
Master of Arts in Geography

ABSTRACT

Objective. Energy poverty occurs when households are unable to afford or access the energy services they need to meet their material and social needs. In 2019, the Town of Bridgewater, Nova Scotia, estimated that around 40% of their households were facing energy poverty. Embedded in a larger research project assessing the extent of energy poverty in Bridgewater and its well-being implications, my thesis aims to answer the research questions: *Who experiences energy poverty in the Town of Bridgewater? How do they cope?* To do so, the objectives of the thesis were to measure the prevalence of energy poverty using different indicators, identify the socioeconomic and housing characteristics associated with energy poverty, and describe the coping strategies used by households with a focus on the 'heat or eat' trade-off, which occurs when households are forced to decrease their energy consumption or their grocery spending to balance their finances.

Methods. Data were collected using a community-based survey on energy needs and well-being conducted in the spring of 2022 in the Town of Bridgewater. Energy poverty was assessed using eight expenditure-based and self-reported measured. Survey respondents reported on their socioeconomic and housing characteristics, as well as answered questions about their use of coping strategies to increase thermal comfort and manage finances. Overall, 516 residents of Bridgewater completed the survey. Cross-tabulations and logistic regressions were used to analyse the data. Answers to open-ended questions on coping strategies were also analysed included in the results.

Results. Within the sample, 17% of households were spending more than 10% of their income (before housing costs) on energy expenditures, and 46% had a share of energy expenditures to household income (after housing costs) over twice the national median share. Twenty-one percent reported being unable to maintain an adequate temperature in their dwelling. The prevalence of energy poverty was higher among women, households with children, lower-income households, renters, and those in dwellings in need of major repairs. The use of coping strategies was higher among women compared to men, young adults compared to other age groups, and in households with children. Accounting for socioeconomic and housing characteristics, participants facing energy poverty based on the self-reported inability to afford energy needs were 10.33 times more likely to resort to the 'heat or eat' trade-off than participants not facing energy poverty.

Conclusion. According to all measures considered in this study, at least 30% of households in the sample from the Town of Bridgewater are facing energy poverty. Several participants reported a reliance on strategies to cope with energy poverty, namely to increase thermal comfort in their home and decrease financial strain. These findings reveal the burden energy poverty represents for certain households. Better understanding the experience of households facing energy poverty will help guide effective pathways for interventions for other small towns such as Bridgewater across Canada.

RÉSUMÉ

Objectif. La précarité énergétique réfère aux situations où les ménages ne sont pas capable de subvenir ou d'accéder à suffisamment de services énergétiques pour répondre à leurs besoins matériels et sociaux. En 2019, la ville de Bridgewater, en Nouvelle-Écosse, estimait qu'environ 40 % de leurs ménages étaient en situation de précarité énergétique. Inscrit dans un projet de recherche plus vaste visant à évaluer l'ampleur de la précarité énergétique à Bridgewater et ses impacts sur le bien-être, ce mémoire de maîtrise a pour but de répondre aux questions : *Qui est confronté à la précarité énergétique dans la ville de Bridgewater ? Comment y font-ils face ?* Pour ce faire, les objectifs de ce mémoire étaient de mesurer la prévalence de la précarité énergétique à l'aide de différents indicateurs, d'identifier les caractéristiques socio-économiques et de logement associées à la précarité énergétique et de décrire les stratégies d'adaptation utilisées par les ménages en mettant l'accent sur le compromis du « heat or eat » qui se produit lorsque les ménages sont contraints de réduire leur consommation d'énergie ou leurs dépenses d'épicerie pour équilibrer leurs finances.

Méthodes. Les données ont été collectées à l'aide d'une enquête communautaire sur les besoins énergétiques et le bien-être menée au printemps de 2022 à Bridgewater. Huit indicateurs monétaires et subjectifs ont été utilisées pour mesurer la prévalence de la précarité énergétique. Les répondants à l'enquête ont rapporté leurs caractéristiques socio-économiques et de logement et ont répondu à des questions sur l'utilisation de stratégies d'adaptation pour améliorer le confort thermique et pour gérer les finances. Au total, 516 habitants de Bridgewater ont répondu à l'enquête. Des tableaux croisés et des régressions logistiques ont été utilisés pour analyser les données. Les réponses aux questions ouvertes sur les stratégies d'adaptation ont aussi été analysées et inclues dans les résultats.

Résultats. Au sein de l'échantillon, 17 % des ménages consacraient plus de 10% de leur revenu (avant coûts de logement) aux dépenses énergétiques, et 46 % avaient une part des dépenses énergétiques par rapport au revenu du ménage (après coûts de logement) plus de deux fois supérieure à la part médiane nationale. Vingt-et-un pour cent ont déclaré ne pas pouvoir maintenir une température adéquate dans leur logement. La prévalence de la précarité énergétique était plus élevée chez les femmes, chez les ménages avec enfants, chez les ménages à faible revenu, chez les locataires et chez les personnes vivant dans des logements nécessitant des réparations majeures. L'utilisation de stratégies d'adaptation était supérieure chez les femmes que

chez les hommes, chez les jeunes adultes que chez les autres groupes d'âge, et chez les ménages avec enfants que chez les ménages sans enfants. En tenant compte des caractéristiques socio-économiques et des caractéristiques du logement, les participants confrontés à la précarité énergétique basée sur leur incapacité de maintenir une température adéquate dans leur logement, étaient 10,33 fois plus susceptibles de recourir au compromis du « heat or eat » que les participants qui ne sont pas en situation de précarité énergétique.

Conclusion. Selon toutes les mesures utilisées au sein de cette étude, plus de 30 % des ménages de l'échantillon de la ville de Bridgewater sont en situation de précarité énergétique. Plusieurs participants font recours à des stratégies pour faire face à la précarité énergétique, notamment pour améliorer le confort thermique de leur logement et réduire les contraintes financières. Ces résultats révèlent le fardeau que représente la pauvreté énergétique pour certains ménages. Une meilleure compréhension de l'expérience des ménages en situation de précarité énergétique permettra d'orienter les interventions de manière efficace pour d’autres villes comme Bridgewater à travers le Canada.

ACKNOWLEDGEMENTS

The writing of this thesis would not have been possible without the help, support, and guidance of my supervisor, Prof. Mylène Riva. Thank you for introducing me to the topic of energy poverty three years ago, inviting me to be a part of the BridgES study, and encouraging me to pursue research at the graduate level. A further thanks Prof. Runa Das and Prof. Kim O'Sullivan for being a part of the BridgES study, and to Prof. Graham MacDonald for offering your insights along the way.

Thank you to the Town of Bridgewater, Nova Scotia, for funding part of this research; the staff at *Energize Bridgewater* for providing such a meaningful project to work on; the community organisations that supported our work; and the residents that took the time to complete the survey. My thesis would not have been possible without your help.

To the Social Sciences and Humanities Research Council, the Fonds de recherche du Québec-Société et Culture, the Rathlyn Geography Fieldwork Award, the John Bradbury Award, the McGill Sustainability Systems Initiative (MSSI), Infrastructure Canada, and the CRC in Housing, Community and Health, thank you for your financial support over the past two years.

Stefan, Morgan, and Saman, my fieldwork buddies, thank you for coming to Bridgewater with me to collect this data. I have fond memories of May of 2022 because of you. A special mention to Morgen for being there through it all: from my fieldwork to yours, grad school would not be the same without you.

Finally, thank you to my friends and family. To Nana and Grandpapa, thank you for being the most supportive grandparents. Thank you to friends and cousins, Paul, Christa, Jolian, Juliette, Zoë, Raphaëlle, Milina, Héloïse, Éliane, and many more, for filling my days with deep talks and deeper belly laughs. To my best friend and sister, Jess, your love for words and stories, your willingness to reread my work, and our frequent calls have and will always be cherished. To Maman and Papa, thank you for encouraging me to ask questions, to be saddened by injustice, and to value opportunities to learn. I am forever grateful to be your daughter.

CONTRIBUTION OF AUTHORS

The research question and objectives of this thesis were formulated by myself, Laurianne Debanné, and Prof. Mylène Riva. I conducted the literature review, data analysis, writing and editing of the thesis. Prof. Graham MacDonald offered advice on the conceptual frameworks, research methods, and data analysis. Prof. Mylène Riva provided guidance on the research methods and data analysis, offered feedback on chapters, and assisted with editing.

List of tables

List of figures

List of abbreviations

2M:	Double median measure
Stata/BE:	Stata Basic Edition
BridgES:	Bridgewater Energy Security
CBC:	Canada Broadcasting Corporation
CI:	Confidence interval
CMHC:	Canada Mortgage and Housing Corporation
CUSP:	Canadian Urban Sustainability Practioners
IPCC:	Intergovernmental Panel on Climate Change
iKT:	Integrated knowledge translation
LIM:	Low-Income measure
OR:	Odds ratio
REB:	Research Ethics Board
WHO:	World Health Organisation

Table of Contents

1. INTRODUCTION

Energy poverty refers to a household's inability to afford or access sufficient amounts of energy services to meet their material and social needs and maintain a healthy indoor living environment (Bouzarovski & Petrova, 2015; Thomson, Snell, et al., 2017). A household's vulnerability to energy poverty is influenced by the energy efficiency of their dwelling, their household income, their needs and behaviours, climate and extreme weather events, and the cost of energy (Charlier & Legendre, 2021). Living in energy poverty is associated with various negative health outcomes, compromising social, physical, and mental well-being (Jessel et al., 2019; Longhurst & Hargreaves, 2019; Riva et al., 2023).

In Canada, depending on the measure used, between 6% and 19% of households are living in energy poverty, (Das, Martiskainen, & Li, 2022; Riva et al., 2021). The prevalence of energy poverty in Canada is comparable to countries where the matter is addressed in research and policy, such as the United Kingdom and Ireland (Healy & Clinch, 2002b; Roberts et al., 2015; Robinson et al., 2018), other countries in the European Union (Bouzarovski et al., 2021; Thomson et al., 2019; Thomson, Snell, et al., 2017; Thomson & Snell, 2013), the United States (Bednar & Reames, 2020; Graff et al., 2021; Wang et al., 2021), Australia (Awaworyi Churchill & Smyth, 2020, 2021; Liu & Judd, 2019), and New Zealand (Howden-Chapman et al., 2012; McKague et al., 2016; K. C. O'Sullivan et al., 2015). However, little research has focused on energy poverty in Canada or policy have been developed to address it , limiting our understanding of the issue and suitable pathways for intervention (CUSP, 2019; Das et al., 2022; Kantamneni, 2021; Riva et al., 2021).

The Town of Bridgewater, Nova Scotia, became aware of the burden energy poverty represented for their community. Indeed, the prevalence of energy poverty is over 30% in Atlantic Canada (Riva et al., 2021), and a study conducted by the municipality found that 37% of residents of Bridgewater reported struggling to afford their energy needs (Town of Bridgewater, 2019). The Town of Bridgewater proposed a project to the Smart Cities Challenge that aimed to tackle energy poverty within their community. The Smart City Challenge, lead by Instructure Canada, hopes to enable and support communities around the country as they implemented programs that "improve the lives of their residents through innovation, data and connected technology" (Infrastructure Canada, 2020). By winning the $5M prize received of the Smart Cities Challenge, the Town of Bridgewater aims to implement of a bold community-wide

program, called *Energize Bridgewater* (Town of Bridgewater, 2019). The program has the ambitious goal to reduce the rate of energy poverty in the community by 20% by 2026 with components of the program touching many scales of action, at the individual, household, and community-level (Energize Bridgewater, 2023).

An extensive research project called 'Bridgewater Energy Security' (or 'BridgES') has been documenting the extent of energy poverty in the Town of Bridgewater prior, during, and after the implementation of *Energize Bridgewater*. Additionally, BridgES will assess the health and well-being impacts of *Energize Bridgewater*. My master's thesis is embedded within the BridgES study. My research contributes to BridgES by trying to answer the research question: *Who faces energy poverty in the Town of Bridgewater, Nova Scotia? How do they cope?* The specific objectives of my thesis are to (1) measure and compare the prevalence of energy poverty in Bridgewater using various expenditure-based and self-reported indicators; (2) describe the housing and socioeconomic characteristics of households facing energy poverty and identify variables associated with higher levels of energy poverty; and (3) identify the strategies implemented by households to cope with energy poverty, with a focus on the 'heat or eat' trade-off. The 'heat or eat' trade-off occurs when households are forced to decrease their energy consumption or their grocery spending to balance their finances (Bhattacharya et al., 2003; Snell et al., 2018).

To answer my research questions and objectives, I analysed data collected through a community-wide survey that was distributed to a sample of households in Bridgewater in May and June of 2022. To evaluate the prevalence of energy poverty in Bridgewater, my thesis used a range of indicators of energy poverty given the breadth of data collected. To identify the socioeconomic characteristics associated with energy poverty and the coping strategies of households facing energy poverty, my thesis was guided by the vulnerability (Bouzarovski & Petrova, 2015) and capabilities (Day et al., 2016; Middlemiss et al., 2019) conceptual frameworks as applied to energy poverty research. By doing so, my work illustrates how certain household characteristics and experiences of energy poverty are tied to different coping strategies.

As very little research has explored energy poverty in Canada, important gaps remain. My thesis provides an in-depth characterization of energy poverty in one community in Canada. These findings will directly serve to inform the Town of Bridgewater as they pursue mitigation

strategies through *Energize Bridgewater*, as well as have the potential to benefit other Canadian communities burdened with energy poverty. Furthermore, my thesis is among the first Canadian scholarly analyses identifying the coping strategies of households facing energy poverty.

In this thesis, I begin by reviewing the literature on energy poverty, followed by presenting the two conceptual frameworks that have guided my master's research, namely the vulnerability framework and the capabilities framework. Next, I describe the context of the study by summarizing research on energy poverty in Canada, exploring the specific context of the province of Nova Scotia, and describing the efforts implemented by the Town of Bridgewater to tackle energy poverty in their community through *Energize Bridgewater*. I then offer a description of the larger project in which my research is taking place, BridgES, and how my thesis contributes to this project. The subsequent sections present my methods to collect and analyse data as well as the results I obtained to answer my research questions. Finally, I discuss my findings and how they relate to the literature on energy poverty and the *Energize Bridgewater* program implemented by the Town of Bridgewater.

2. LITERATURE REVIEW

The body of literature devoted to energy poverty has been growing in the past few decades. This literature review will explore the study of energy poverty, research on the socioeconomic and spatial distribution of energy poverty, its implications for well-being, and the coping strategies deployed by households facing energy poverty.

2.1. Geography, housing, and energy services

To begin this literature review, I locate my thesis within the field of geography. As described by Tuan, geography is the study of 'home' at many scales, from the systems guiding the earth on which we live, to our dwellings (Tuan, 1991). My research focuses on the home as the dwelling, i.e., the physical structures and spaces that house us. The dwelling should meet the basic needs of its residents; providing safety, comfort, and ontological security (Bonnefoy, 2007; Tuan, 1991). Housing research in geography helps us better understand the spaces we inhabit, housing inequalities, and the impact of housing on health and well-being (Bonnefoy, 2007; Krieger & Higgins, 2002; Swope & Hernández, 2019; World Health Organization, 2018). Indeed, health geographers have described housing as a key determinant of health, affecting our physical, social, and mental well-being (Bonnefoy, 2007; Dunn et al., 2006; Gatrell & Elliott, 2014). As will be further explored in the following paragraphs, being unable to access or afford sufficient energy services to meet one's needs is relevant and central when studying the 'home' through the lens of geography.

Beyond my thesis being an investigation of the 'home,' my work also studies the socio-spatial factors that influence access to energy services, as done in the field of energy geographies. Over the past decades, scholars have argued that *energy geography* is better understood as *energy geographies* given the expanding theories and methods used within the field (Baka & Vaishnava, 2020; Calvert, 2016). Energy geographies encompass research on the relationship between energy and society, energy trading, energy transitions, and energy technology infrastructures considering spatial, social, political, and economic factors (Calvert, 2016). According to Huber, geographers are "uniquely positioned to theorize the explicit role of energy in the social production of space" (Huber, 2015, p.1). As my thesis analyses a household's ability to access sufficient energy services to meet their needs and their subsequent coping strategies in the Town of Bridgewater, I have aimed to anchor my research in the geographical context in which it takes place, including the climate, energy infrastructure, and socioeconomic landscape of Bridgewater.

Hence, energy geographies offer a conceptual link to bridge my thesis within geographical studies.

Energy justice offers a tool and lens through which to think about energy poverty as a justice issue (Jenkins et al., 2016; Sovacool & Dworkin, 2015; Walker & Day, 2012). Energy poverty is a form of energy injustice, affecting households of energy within the larger energy system (Bouzarovski & Simcock, 2017; Walker & Day, 2012). Energy justice advocates argue that governments need to ensure that people have access to safe, reliable, affordable, environmentally friendly, and modern energy services (Graff et al., 2022). The energy justice framework has broad implication for the ways policy, programs, and innovation can be inclusive and just (Jenkins et al., 2020; Sovacool & Dworkin, 2015).

Jenkins and colleagues describe three dimensions of justice encompassed by energy justices: distributional justice, recognition justice, and procedural justice (Jenkins et al., 2016). Distributional justice assesses *where* injustices are occurring and the imbalance of risks and benefits based on the uneven access to energy resources and energy services, and the subsequent unaffordability of energy tariffs. Regional considerations, climate change, development inequalities, and other physical and spatial factors can help us understand and explain the distribution of injustices (Bouzarovski & Simcock, 2017; Jenkins et al., 2016). Recognition injustice aims to identify, understand, and consider *who* experiences injustice (Jenkins et al., 2016). In some cases, issues of ignorance are to blame, where some levels of injustice re intentional not addressed. Additionally, misrecognition and cycles of vulnerability can also lead to individuals and communities experiencing energy poverty to fall between the cracks (Bouzarovski & Simcock, 2017). Procedural justice aims to assess *how* energy injustices are created, maintained, or addressed through governmental and non-governmental processes (Bouzarovski & Simcock, 2017; Jenkins et al., 2016). In their literature review, Bouzarovski and Simcock argue that both social and spatial factors lead to energy injustices through all three dimensions (Bouzarovski & Simcock, 2017). Ideally, all three dimensions of energy justice would be considered together in research and in policy to tackle energy poverty and injustice holistically and effectively (Graff et al., 2022; Jenkins et al., 2016; Sovacool & Dworkin, 2015; Walker & Day, 2012). While I did not directly use the energy justice framework in the conceptualisation of my thesis, it did influence the direction of my thesis and also enables me to

locate my thesis within geographical research given the spatiality of energy injustice proposed by scholars (Bouzarovski & Simcock, 2017; Jenkins et al., 2016).

2.2. Energy poverty: the evolution of a concept

The first publications on energy poverty came out in the late 1970s and 1980s in the United Kingdom (Bradshaw & Hutton, 1983; Isherwood & Hancock, 1979; Osbaldeston, 1984). At first, the issue was named 'fuel poverty' due to the use of fuel as the main source of energy in the country. Isherwood and Hancock were the first to describe people facing fuel poverty as those spending more than twice the median share of their household income on fuel and power (Isherwood & Hancock, 1979), as noted by Osbaldeston (Osbaldeston, 1984). A couple years later, Bradshaw and Hutton defined fuel poverty as the "inability to afford adequate warmth at home" (Bradshaw & Hutton, 1983, p.249). In their work, they propose social policies that could alleviate fuel poverty in the United Kingdom, notably aimed at increasing incomes and decreasing fuel expenditures. Nevertheless, until that point, the definition of fuel poverty remained unspecific. In 1991, Boardman published her book *Fuel Poverty: From Cold Homes to Affordable Warmth,* in which she offers a formal definition and measurement of fuel poverty (Boardman, 1991). Based on her work in the United Kingdom, Boardman determined that a household was facing fuel poverty if they were spending more than 10% of their income on energy services. From her book, the study of fuel poverty gained prominence and has evolved as a concept and area of research.

Over the past decades, a variety of terms have been used in the literature to refer to energy poverty, such as 'fuel poverty,' 'energy precarity,' 'energy insecurity,' and 'energy burden' to name a few. These terms might differ slightly in their definition, but their main distinction is geographic: research in the United Kingdom refers to 'fuel poverty' (Longhurst & Hargreaves, 2019; Robinson et al., 2018), scholarship produced in the United States tends to refer to 'energy burden' or 'energy insecurity' (Graff et al., 2021; Hernández, 2016), and 'energy precarity' (or 'précarié énergétique') is most used in francophone contexts (Charlier et al., 2015; Charlier & Legendre, 2021). My thesis prioritizes the use of 'energy poverty' as it has been more widely used in the Canadian context in both research (Das, Martiskainen, & Li, 2022; Rezaei, 2017; Riva et al., 2021) and advocacy work (CUSP, 2019; Das & Martiskainen, 2022; Green et al., 2016; Kantamneni, 2021).

The definition of energy poverty guiding my research refers to a household's inability to afford or access sufficient amounts of energy services to maintain a healthy indoor living environment and meet their social and material needs (Bouzarovski & Petrova, 2015; Thomson et al., 2017). Energy services are the uses of energy within the home (Fell, 2017). At first, energy poverty mostly accounted for the heating requirements of a household. A greater range of energy services and needs have been considered in the context of different studies, such as the energy required to operate domestic appliances, cool a dwelling, maintain telecommunication, and afford transportation (Bouzarovski et al., 2014; Sovacool, 2011; Thomson et al., 2019).

Initially, a household's vulnerability to energy poverty was understood to be influenced by the energy efficiency of their dwelling, their household income, and the cost of energy (Charlier & Legendre, 2021; Grossmann et al., 2021). Over the past decade, a more integrated approach has evolved, where energy poverty is understood to be influenced by a more complex set of factors, such as climate, built environment cultural norms, and household needs and behaviours (Bouzarovski & Petrova, 2015; Bouzarovski & Simcock, 2017; Jessel et al., 2019). Furthermore, energy poverty can, and should, be framed within the context of a household, considering the type of energy that is available to them, its accessibility, reliability, and affordability (Bouzarovski & Petrova, 2015; Bouzarovski & Simcock, 2017; Jenkins et al., 2016).

While there is an association between poverty and energy poverty, it is important to recognize that the two are not the same and can be experienced independently (Boardman, 2009). In a study conducted in the United Kingdom in 2007, researchers estimated that of the 3 million individuals in energy poverty and 3.5 million individuals in income poverty, the overlap of both groups encompassed 1.9 million individuals (Palmer et al., 2008). Such findings highlight that while income poverty can lead a household to struggle to afford their energy expenditures, it is not always the case as more than just income and the cost of energy can lead to energy poverty (Charlier & Legendre, 2021; Legendre & Ricci, 2015). For example, regardless of their financial situation, households living in dwelling in poor conditions can be unable to access enough energy to maintain healthy and comfortable indoor temperatures; and middle-income households might experience constrained finances that hinder their quality of life and well-being given their specific needs and behaviours.

The literature on energy poverty is mostly distinct across the Global North and South. In low-income countries, energy poverty is associated with a household or community's access to

energy, often being a question of economic and social development (Bouzarovski & Petrova, 2015; Sagar, 2005; Ürge-Vorsatz & Tirado Herrero, 2012). In high-income countries, energy poverty is more often associated with the affordability of energy where relative poverty highlights important income and well-being disparities. (Bouzarovski & Petrova, 2015; Charlier & Legendre, 2021). Though this geographic distinction persists, some scholars hope to overcome this gap, arguing that all forms of energy deprivation "are underpinned by a common condition: the inability to attain a socially and materially necessitated level of domestic energy services" (Bouzarovski & Petrova, 2015, p.1). Despite there being a compelling argument for research on energy poverty to be more integrated, few papers have tried to bridge the gap between these two geographies and little research has been done to find ways to apply research from one context to the other.

The concept of 'energy vulnerability' is gaining prominence in the scholarly literature, with scholars distinguish it from 'energy poverty'. Energy vulnerability is defined as a household's situation of energy precarity *at a given point in time*; it refers to the characteristics that make a household susceptible to energy poverty through time (Grossmann et al., 2021). Whereas households might experience energy poverty during one season, they might 'escape' energy poverty at other times during the year, for example, as energy needs decrease or incomes are temporarily higher, such as during the colder and hotter months. Households that fall in and out of energy poverty over longer periods of time, or even throughout their lifetime, would be considered as facing energy vulnerability. Studies conducted in the United Kingdom have highlighted the ways households experience energy poverty given their circumstances and the periods of life that have pushed them in or out of energy poverty (Butler & Sherriff, 2017; Middlemiss & Gillard, 2015). While, because of available data, my thesis cannot explore these vulnerability 'pathways' per se, there is nonetheless a focus on vulnerability in the conceptual frameworks guiding my thesis (Bouzarovski & Petrova, 2015; Oppenheimer et al., 2014).

2.3. Measuring energy poverty

Different indicators have been developed to measure and identify energy poverty, each depicting various sides of the issue. Four main categories of indicators exist to measure energy poverty: expenditure-based indicators, direct measurements, self-reported indicators, and

composite measures, which I will describe below (Charlier & Legendre, 2021; Tirado Herrero, 2017).

2.3.1. Expenditure-based indicators

Expenditure-based indicators of energy poverty identify a household as facing energy poverty if it spends, or needs to spend, more than an established threshold of its income on energy expenditures (Charlier & Legendre, 2021; Robinson et al., 2018; Siksnelyte-Butkiene et al., 2021; Thomson, Bouzarovski, et al., 2017; Tirado Herrero, 2017). Many such indicators are based on energy burdens, i.e., the proportion of a household's income dedicated to domestic energy expenditures. Boardman proposed one of the first expenditure-based indicators in 1991, called the 'Fuel Poverty Ratio' (Boardman, 1991). Household were characterized as experiencing energy poverty if they needed to spend more than 10% of their household income on domestic energy expenditures (the '10% threshold') (Boardman, 1991). To come up with this threshold, Boardman measured the mean share of fuel spending to household income for the 30% lowest income households based on data from the United Kingdom's Family Expenditure Survey (Boardman, 1991; Liddell et al., 2012). At the time, the 10% threshold represented twice the national median share of what households needed to spend to meet their energy needs, which corresponds to the method first proposed by Isherwood & Hancock (Isherwood & Hancock, 1979). While the amount of energy needed for a household to meet its needs is measured in the United Kingdom, this is not the case everywhere. Hence, the indicator is not necessarily suitable or ideal in other contexts, such as Canada, where this data is not available (Riva et al., 2021; Tirado Herrero, 2017). Nonetheless, the 10% threshold is still commonly used internationally to measure the prevalence of energy poverty, looking at the required energy spending of a household when this data is available, or looking at the actual energy spending of a household based on census or reported data (Charlier & Legendre, 2021). The use of the 10% indicator in studies offers notable advantages: being a set threshold, it allows for the prevalence of energy poverty across contexts to be compared, as well as making it simple to set numerical goals when aiming to decrease the prevalence of energy poverty in a locale. Yet, this measure does not take into consideration the ways context affects the energy burden of a household (Charlier & Legendre, 2021). For example, if the energy prices are higher in a region while being alleviated due to other expenses being generally lower (e.g., housing, groceries, etc.), the prevalence of energy poverty might be overestimated.

Another indicator used to measure energy poverty based on energy burdens is the double median measure (or '2M measure'). Using this indicator, households are considered to be in energy poverty if their energy burden share is more than twice the national median share (Charlier & Legendre, 2021; Tirado Herrero, 2017). As noted above, the 2M measure corresponds to the earliest methods offered to measure energy poverty, both by Isherwood & Hancock (1979) and Boardman (1991). This threshold will be different from one country to the other. The advantage of the 2M indicator is that it reflects the burden of energy expenditures for households within a specific geographical context. Given the variations in energy costs and incomes over time, the 2M measure is likely changing from one year to the next, meaning the threshold needs to be computed regularly for an accurate measurement.

The Low-Income High-Cost and After Fuel-Cost Poverty measures are other expenditure-based indicators of energy poverty that considers whether a household's equivalized income falls below a threshold of income poverty after considering housing costs and/or and energy expenditures (Charlier & Legendre, 2021; Tirado Herrero, 2017). In their review, Tirado Herrero (2017) criticizes the use of the Low-Income High Cost measure, which is commonly used in England, as the measure highlights energy inefficiency and income poverty, but overlooks energy unaffordability and questions of energy justice.

Overall, expenditure-based indicators of energy poverty offer the advantage of being relatively objective, making them widely used in academia and policy (Tirado Herrero, 2017). However, expenditure-based measures do not always capture the households facing 'hidden' energy poverty (Charlier & Legendre, 2021; Meyer et al., 2018). 'Hidden' energy poverty occurs when households intentionally limit their energy use to decrease energy costs. Consequently, their energy burden might not be very high, leading to an underestimation of the actual proportion of households experiencing energy poverty.

As described above, most expenditure-based indicators of energy poverty use the income of a household in their computation. However, there is debate on how household income should be measured (Charlier & Legendre, 2021; Thomson et al., 2017; Tirado Herrero, 2017). Some scholars argue that using equivalized income should be prioritized when measuring energy poverty (Hills, 2012; Moore, 2012; Tirado Herrero, 2017), while others consider that a household's disposable income is the ideal selection (Thomson & Snell, 2013). Equivalized income adjusts income based on the size of a household, reflecting that larger households might

require more resources to meet their needs (Hills, 2012; Moore, 2012). In Canada, the equivalized disposable income of households is calculated by Statistics Canada (Statistics Canada, 2022). Additionally, equivalized household income can be calculated using the disposable income of a household, which is then divided or multiplied by a factor based on their household composition and size (Hills, 2012). Disposable income is the income a household has access to after having paid taxes and social contributions, and, in some contexts, housing (Charlier & Legendre, 2021). After-tax income is generally considered more representative of the finances households can access to meet their needs than before-tax income (Charlier & Legendre, 2021). However, this data is not always available or as easily reported by individual. Being unable to access the after-tax income of household, a study conducted in Japan considered that their findings might have underestimated the prevalence of energy poverty given the higher incomes households seemed to have access to (Okushima, 2016). Researchers must also decide whether to use household income before or after housing costs (Thomson, Bouzarovski, et al., 2017). Housing costs encompass rent or mortgage, property taxes, and housing services like water and waste removal. Since housing costs are generally non-negotiable and paid at the beginning of the month, households are more likely to manage their finances based on what is left after ensuring they can keep a roof over their head (Anderson et al., 2012; Butler & Sherriff, 2017). Using a household's income after considering housing costs illustrates an even more integrated portrait of disposable income.

2.3.2. Direct measurements

Direct measurements of energy poverty assess the energy services within a home to identify whether a household is facing energy poverty (Sareen et al., 2020; Thomson, Bouzarovski, et al., 2017). To do so, researchers will monitor the indoor temperatures and/or humidity levels of a dwelling and compare them to established thresholds to determine whether a household is accessing (or attaining) enough energy to meet their needs, as stated in definitions of energy poverty (Bouzarovski & Petrova, 2015; Thomson et al., 2017). Thresholds used include those proposed by the World Health Organisation and the Mayo Clinic, where indoor temperatures should be maintained between 18 and 22°C (World Health Organization, 2018) and humidity levels should be between 30 and 50% (Mayo Clinic Staff, 2021) to ensure the health and well-being of household members. Direct measurements offer important information and quantitative data that facilitates assessments of the health implications of experiencing energy

poverty and thermal discomfort (K. C. O'Sullivan, 2019; Thomson, Bouzarovski, et al., 2017). However, these indicators have their own technical and ethical limitations. Indeed, the assessment of energy services and indoor housing conditions requires that research teams enter dwellings and that living spaces are constantly monitored, which raises ethical concerns (Thomson et al., 2017). Furthermore, when based on 'adequate' temperature thresholds, such as those suggested by the World Health Organisation, one overlooks the climatic variations, cultural norms, and personal preferences of households (Sareen et al., 2020). To account for some of these difficulties, some studies have also asked households to report the usual humidity levels or indoor temperature in their home and their overall satisfaction with thermal comfort, which would consider 'perceived' energy poverty (Meyer et al., 2018; Petrova et al., 2013).

2.3.3. Self-reported indicators

Third, self-reported indicators of energy poverty are based on subjective assessments of a household's experience with energy poverty (Charlier & Legendre, 2021; Thomson, Bouzarovski, et al., 2017; Tirado Herrero, 2017). To collect this data, household members are asked questions about their thermal comfort, energy needs, and the financial strain caused by energy expenditures. Self-reported indicators describe households as experiencing energy poverty if they report struggling to pay their energy bills; being unable to keep their dwelling adequately warm; living in a damp or mouldy dwelling; or limiting their energy use to decrease energy bills (Charlier & Legendre, 2021; Meyer et al., 2018; Thomson & Snell, 2013; Tirado Herrero, 2017). Self-reported indicators of energy poverty are beneficial as they account for some of the households not identified through expenditure-based indicators, notably those intentionally limiting their energy spending to manage their budget (Meyer et al., 2018). Furthermore, they highlight some of the facets of energy poverty that cannot be illustrated using indicators based on quantitative data, including thermal discomfort and financial trade-offs made by households. As energy needs vary from one household to the next depending on its composition and behaviours, self-reported indicators of energy poverty will consider energy poverty beyond overarching recommendations and thresholds, such as those used with expenditure-based and direct measures of energy poverty. Instead, self-reported indicators highlight and identify the priorities of households (Charlier & Legendre, 2021; Meyer et al., 2018). However, as they are solely based on self-reported data, they can be considered prone to bias, making their use more limited in policy and research (Tirado Herrero, 2017).

2.3.4. Using multiple indicators

Beyond being critical of specific metrics given their limitations, scholars have criticized the use of a single metric to measure energy poverty (Charlier & Legendre, 2021; Tirado Herrero, 2017). The focus has shifted from trying to find the 'best' indicator, but rather to encourage researchers to use multiple metrics separately or in combination to create multidimensional indicators of energy poverty (Castaño-Rosa et al., 2019; Charlier & Legendre, 2021; Siksnelyte-Butkiene et al., 2021; Thomson et al., 2017). As described above, different indicators highlight different facets of household's experience of energy poverty, while also revealing the extent and intensity of the experience. While some indicators highlight the financial strain energy expenditure represent for households, others touch on the thermal discomfort in dwellings. In some cases, households dealing with financial hardships will not experience thermal discomfort, and vice-versa (Meyer et al., 2018). By integrating multiple indicators in a study, the portrait of energy poverty will be more representative of the multiple ways energy poverty is present within a population.

Recent studies on energy poverty have developed multidimensional indicators of energy poverty (Okushima, 2017; Tait, 2017) or used a mix of indicators to measure energy poverty (Meyer et al., 2018; Papada & Kaliampakos, 2016; Sokołowski et al., 2020). Among these studies, I've selected two to illustrate how indicators can be used in parallel or in combination to measure energy poverty within a given context. In their study conducted in Belgium, Meyer and colleagues aimed to consider 'measured,' 'hidden,' and 'perceived' energy poverty based on the energy barometer implemented by the country (2018). Measured energy poverty, which considers the financial burden of households, was assessed using expenditure-based measures. Hidden energy poverty, which occurs when households purposefully limit their energy use to save money, was measured based on low-income levels (based on income deciles), low energy expenditures, and housing conditions (i.e., dwelling not well insulated). Perceived energy poverty was measured based on households reporting being unable to adequately warm their dwelling (Meyer et al., 2018). Each of these facets and indicators were used in an additive way to draw a more complete picture of the issue in the country. The method used by Meyer and colleagues (2018), which measured energy poverty based on the tool proposed by the national government, has the advantage of recognising the different experiences of energy poverty through national survey data. In their research, Sokolowski and colleagues created a multidimensional index of

energy poverty for their study in Poland (2020). This index was a combination of two expenditure-based indicators and three self-reported indicators of energy poverty. To be identified as facing energy poverty, households had to experience at least two forms of 'deprivation' (Sokołowski, Lewandowski, et al., 2020). With such a method, energy poverty is shown as a multidimensional issue, affecting the financial security, housing conditions, and thermal comfort of a household. Sokolowski and colleagues (2020) suggest that their method has the advantage of considering energy poverty as multifaceted and of identifying more severe cases of energy poverty.

2.4. Social and spatial distribution of energy poverty

Research focused on the social and spatial distribution of energy poverty has revealed disparities between who is more likely to experience energy poverty. These disparities include an association with energy poverty and household compositions and socioeconomic inequalities, housing conditions, and regional differences, each of which will be explored below.

2.4.1. Social distributions of energy poverty

Previous research has established that different age groups are more vulnerable to energy poverty (Jessel et al., 2019). First, older adults are be more likely to experience energy poverty while also being more vulnerable to its health consequences. Research suggest decreased incomes after retirement; an increased amount of time spent at home; and higher incidences of pre-existing health conditions and lower thermoregulation capability in older age explain the correlation (Burholt & Windle, 2006; Chard & Walker, 2016; Kwon & Jang, 2017; K. C. O'Sullivan, 2019). Second, the prevalence of energy poverty is higher among young adult households due to the living insecurity they are subject to; the lower incomes available to younger adults; and the normalization of poor housing conditions during this period of life (Butler & Sherriff, 2017; Clark et al., 2022; Middlemiss, 2022; O'Sullivan et al., 2017; Petrova, 2018).

Women have been observed to be more vulnerable to energy poverty than men (Jessel et al., 2019; Middlemiss, 2022; Riva et al., 2021; Robinson, 2019; Sánchez-Guevara Sánchez et al., 2020). Robinson (2019) identifies five dimensions to explain the association: economic exclusion; arduous and unpaid labour; heightened awareness and exposure to the health and well-

being impacts; a lack of social protection; and the social responsibility to care for others. In addition, households with children are more likely to be burdened by energy poverty (Middlemiss, 2022). Children are more vulnerable to the negative health consequences of energy poverty, such as asthma and other respiratory illnesses, as their thermoregulatory systems are not fully developed. (Jessel et al., 2019; K. C. O'Sullivan & Chisholm, 2020; Tod et al., 2016). Parents and guardians must therefore have increased energy needs and limited financial flexibility when it comes to spending priorities as they try to ensure a safe living environment for children (Brunner et al., 2012; Dogan et al., 2021). Lone-parent households have been observed to be further vulnerable to energy poverty, often having a single income to balance all the needs and expenditures of the family (Middlemiss, 2022; Riva et al., 2021; Robinson, 2019; Sánchez-Guevara Sánchez et al., 2020).

People that live alone are also more likely to be facing energy poverty due to the higher cost of living for those who cannot share expenses with others (Middlemiss, 2022; Middlemiss et al., 2019; Riva et al., 2021). Social isolation, which can be a consequence of living alone for some (Klinenberg, 2016), can limit the access to resources and support (Bartiaux et al., 2021; Grossmann et al., 2021; Middlemiss et al., 2019).

Studies have identified that individuals with disabilities are more likely to experience energy poverty than able-bodied individuals (Cronin de Chavez, 2017; Ivanova & Middlemiss, 2021; Middlemiss, 2022; Snell et al., 2015). Cronin de Chavez (2017) describes the triple-hit effect of energy poverty and disabilities, where experiencing energy poverty can exacerbate negative health and well-being outcomes, disabilities increase the risk of energy poverty because of unequal access to the labour market and lower incomes, and disabilities require individuals to consume more energy services to keep their dwelling warm enough and power medical equipment. In their study, Snell and colleagues (2015) found that households with individuals with a disability were more likely to use a pre-payment meter in order to limit their energy usage. Ivanova & Middlemiss (2021) explain that while households with individuals with disabilities were more likely to experience energy poverty, their energy consumption was significantly lower than in households without disabilities, highlighting income and energy access inequalities.

The prevalence of energy poverty is higher among low-income households (Brown et al., 2020; Graff et al., 2021; Middlemiss, 2022; Palmer et al., 2008; Riva et al., 2021). As described previously, there is a strong link between financial poverty and energy poverty, where limited

household finances can lead to the inability to afford energy needs. Indeed, for low-income households, energy bills are often perceived as an important burden in an already strenuous financial situation (Hernández, 2016). Studies in Canada also noted that households whose main income came from government aid were more likely to experience energy poverty (Das, Martiskainen, & Li, 2022). As will be further explored below, housing in poor physical condition, which is often more affordable and accessible to low-income households, is often less energy efficient (Hernández, 2016; Petrova et al., 2013; Reames, 2016; Swope & Hernández, 2019). Levels of education are also tied to varying proportions of energy poverty: households with lower levels of education might have a harder time navigating the bureaucracy of dealing energy accessibility issues, making them more vulnerable to energy poverty (Das, Martiskainen, & Li, 2022; Jessel et al., 2019)

Minority groups and racialized communities experience higher levels of energy poverty given the many layers of socioeconomic inequalities that they face (Graff et al., 2021; Jessel et al., 2019; Middlemiss, 2022; Wang et al., 2021). In the United States, it was found that residential energy efficiency was lower in neighbourhoods with more ethnic diversity (Reames, 2016). In Canada, studies have investigated the higher prevalence of energy poverty in Indigenous communities, notably in British-Colombia (Rezaei, 2017; Rezaei & Dowlatabadi, 2016).

2.4.2. Energy poverty and housing conditions

The place where someone is housed has important implications for their well-being, notably in relation to their ability to afford their energy needs (Swope & Hernández, 2019). To think about housing more holistically, different conceptual frameworks for healthy housing help us consider a dwelling as more than just a set of conditions, but also as a place and a home within a context (Mallett, 2004; Sharpe et al., 2018; Swope & Hernández, 2019). The conceptual framework proposed by Swope and Hernández (2019) describes four pillars of healthy housing: cost, conditions, consistency, and context, which I will explore below.

First, housing costs, which considers the expenditures required to maintain a dwelling and the potential financial strain they can represent for a household. In Canada, housing will be considered unaffordable when households are spending more than 30% of their gross income on housing costs (Statistics Canada, 2013). In 2021, 15% of Canadians were living in unaffordable dwellings (Statistics Canada, 2022b). Unaffordable housing can lead individuals and families to

make trade-offs between basic needs, such as having to choose between paying rent, heating, or food (Anderson et al., 2012). Second, housing conditions relate to the physical state of a dwelling for its residents. In Canada, the suitability and the adequacy of a dwelling are the measures used to assess housing conditions (Statistics Canada, 2013). Housing suitability refers to the size of the dwelling in relation to the size and composition of the household. A dwelling is characterized as unsuitable, or (over)crowded, if the ratio of residents to bedrooms is more than two to one (CMHC, 2022). Inadequate housing can be housing in need of major repairs, showing signs of decay, and representing a health hazard for residents (Sharpe et al., 2018). Often, older homes are in poorer conditions when households are unable to keep up with maintenance and the infrastructure decays over time. Studies have found that living in housing that is inadequate is associated with less efficient energy infrastructure and insulation, as well as being more susceptible to mould and poor air quality (Healy & Clinch, 2004; Kwon & Jang, 2017; Petrova et al., 2013; Sharpe et al., 2018). Moreover, families and individuals that inhabit poor-quality housing generally have lower household incomes, meaning that they are already navigating the challenges of strained financial resources (Reames, 2016). As expressed by Sharpe and colleagues, "typically, people do not choose unhealthy housing for themselves and their family when healthy alternatives are available" (Sharpe et al., 2018, p.5). Third, the consistency of a dwelling refers to "residents' capacity to willingly remain in their homes free from harassment or dispossession" (Swope & Hernández, 2019, p.6). Different methods exist to measure the consistency of housing, including the number of moves within a timeframe, and experiencing homelessness, evictions, or overcrowding (e.g., suitability). Finally, the context of a dwelling refers to the characteristics of the neighbourhood in which it is located and the resources accessible to a household within that context (Swope & Hernández, 2019).

The second conceptual framework is a 'whole system' approach to healthy housing (Sharpe et al., 2018). In this work, Sharpe and colleagues touch on many of the same pillars as Swope and Hernández, describing the ways housing standards, affordability, tenure, and overcrowding can be barriers to achieving healthy housing, while also elaborating on the ways context influences the ability to access healthy housing (Sharpe et al., 2018). A last pillar that is not included in either of these frameworks but has a clear association with healthy housing is ontological security (Dupuis & Thorns, 1998; Mallett, 2004; Padgett, 2007). Ontological security refers to the sense of 'home' one can experience in their dwelling; which includes feeling safe, unthreatened, and not feeling surveyed within the dwelling (Mallett, 2004).

Energy poverty is a factor that can compromise each of the pillars described above. First, in some cases, energy expenditures can be included in calculations to measure the affordability of a dwelling, notably when operational costs are being assessed (Swope & Hernández, 2019). This is indeed the case in Canada, where shelter costs include the cost of electricity and heating (Statistics Canada, 2022b). Second, the conditions of a dwelling can lead to or exacerbate a households experience of energy poverty, while energy poverty can worsen housing conditions (Petrova et al., 2013; Sharpe et al., 2018; Swope & Hernández, 2019). Indeed, inefficient housing, which includes those with little to no insulation, leaky windows and doors, drafts, and non-functioning energy infrastructure will force households to spend more on heating or cooling to try to maintain thermal comfort (Bartiaux et al., 2021; Bouzarovski, 2014; Middlemiss, 2022). Such conditions can be heightened in older dwellings, notably when the infrastructure becomes increasingly energy inefficient over time. Indeed, research has found people living in older dwellings are more likely to experience energy poverty (Healy, 2017; Rezaei, 2017). In addition, being unable to afford energy services, especially heating and ventilation, will worsen the incidences of mould, condensation, and poor air quality within the dwelling (Bartiaux et al., 2021; Castaño-Rosa et al., 2019; Middlemiss, 2022). Third, housing consistency can be threatened by households experiencing energy poverty, especially in the case of renters. High energy bills can push residents to move from one dwelling to the next to find a more cost-effective option, sometimes at the expense of overall housing conditions (Hernández, 2016). Fourth, the context of a dwelling influences a household's vulnerability to energy poverty. On a larger scale, context will impact the cost of energy, while the more local context can affect the circle of trust and resources available to households when they are facing issues relating to energy poverty (Grossmann et al., 2021). Furthermore, efforts to increase the energy efficiency of dwelling within neighbourhoods have led to spikes in the cost of housing, as described by the term 'low-carbon gentrification' (Bouzarovski et al., 2018; Rice et al., 2020). Consequently, long-term residents are forced to move away from their neighborhoods to find affordable housing, which is often older, in poorer condition and less energy efficient. Finally, the ontological security residents experience in their dwelling will be affected if they do not feel safe, healthy, and warm (Mallett, 2004).

People experiencing energy poverty may purposefully spend time away from their dwelling when they are unable to achieve thermal comfort (Harrison & Popke, 2011; Longhurst & Hargreaves, 2019; Stojilovska et al., 2021). In their work with young adults in the United

Kingdom, Butler and Sherriff found that participants tried overcoming energy poverty by increasing the ‘sense of home’ in their dwelling by making it warmer and cozier, notably by adding warm blankets to couches (Butler & Sherriff, 2017). Likewise, in their realist review on the health impacts of intervention programs offered to increase the energy efficiency of dwellings, Willand and colleagues found when housing conditions were improved, households had a stronger ‘sense of home’ (Willand et al., 2015).

The prevalence of energy poverty has also been observed to be higher among renters compared to homeowners (Das, Martiskainen, & Li, 2022; Riva et al., 2021). Some scholars suggest that this is due to the limited agency renters have in changing the energy efficiency of their dwelling. On the contrary, landlords generally are those with decisional power in regard to housing upgrades. As described by Bird and Hernández, the split incentive occurs when rental housing is not likely to be retrofitted by landlords; and when they are, rents increase (Bird & Hernández, 2012). Consequently, these housing options become inaccessible to lower income tenants, leading to the process of ‘low-carbon gentrification’ described above.

2.4.3. Spatial distribution of energy poverty

Studies on the spatial distribution of energy poverty in high-income countries have revealed the ways in which energy justice and the prevalence of energy poverty varies based on geographical differences (Bouzarovski & Simcock, 2017; Bouzarovski & Tirado Herrero, 2017; Garvey et al., 2022; Reames, 2016; Riva et al., 2021; Robinson, 2019; Robinson et al., 2018). On one hand, rural regions and smaller towns tend to have higher proportions of energy poverty in comparison to urban settings (Bouzarovski & Tirado Herrero, 2017; Riva et al., 2021; Roberts et al., 2015). In Canada, the proportion of households facing energy poverty in rural and urban areas is respectively 32.5% and 14.8% (Riva et al., 2021). This disparity is associated with many factors, such as increased energy needs due to different livelihood activities; as well as less-extensive energy infrastructures, forcing some rural communities to rely on more expensive forms of fuel (Bouzarovski & Simcock, 2017; Roberts et al., 2015).

On the other hand, within cities, variations can be detected as the proportion of households facing energy poverty is often higher in low-income neighborhoods (Bouzarovski et al., 2018; Reames, 2016). The factors associated with this disparity include tenure and a mainly rental market, lower incomes, and other socioeconomic considerations that have been described previously. The prevalence of energy poverty might also be underestimated in urban areas given

the proportion of renters for whom utilities are included in rent payments, meaning they are excluded from most expenditure-based indicator of energy poverty (Riva et al., forthcoming).

Looking at the intersection between energy justice and spatial justice, Bouzavorski and Simcock (2017), encourage researchers to pay more attention to the spatial inequalities around energy poverty rather than solely focusing on social inequalities. They argue that material deprivation (e.g., climate, built environment, and rurality), geographic underpinnings of energy affordability (i.e., the factors that increase energy costs between regions), vicious cycles of vulnerability (e.g., geographical health inequalities), and spaces of misrecognition (i.e., the lack of recognition granted to certain groups and regions) lead to a spatial and social marginalization associated with energy poverty (Bouzarovski & Simcock, 2017).

In their work in the United Kingdom, Golubchikov and O'Sullivan (2020) develop the concept of energy peripheries. They describe energy peripheries as "places that are systematically disadvantaged through the whole energy system due to their inferior position within the asymmetrical spatial distribution of economic, political and symbolic resources and capabilities" (Golubchikov & O'Sullivan, 2020). While being a spatial consideration, the socioeconomic makeup of the region and housing stock available contribute to the existence of energy peripheries. Much of the research touching on energy peripheralization has focused on an uneven energy transition, with some regions being less likely to benefit from such efforts (Garvey et al., 2022; Golubchikov & O'Sullivan, 2020; K. O'Sullivan et al., 2020). One study identified that non-urban areas are often disadvantaged in energy transition plans, exacerbating the peripheralization of rural areas (K. O'Sullivan et al., 2020). Ultimately, this furthers the already unequal distribution of energy poverty between urban and rural regions.

2.5. Coping with energy poverty

Ways of coping is a topic of research within the field of psychology (Frydenberg, 2014; Skinner et al., 2003). Different terminology and definitions are presented in the literature to refer to the actions undertaken by individuals to cope. I wanted to explore the distinction between a coping strategy and a defense mechanism. Overall, both defense mechanisms and coping strategies aim to "protect individuals from the emotional consequences of adversity" (Cramer, 1998, p.920). Defense mechanisms are strategies employed without conscious intentionality, whereas coping mechanisms are strategies implemented with the conscious purpose of mitigating

the problem. Overall, the terms ‘defense’ and ‘coping’ are distinguishable, while the terms ‘mechanisms’ and ‘strategies’ are used interchangeably (Cramer, 1998). For the purpose of my thesis, I will be using the term ‘coping’ rather than ‘defense’ strategies (or mechanisms) to refer to the ways of coping deployed by households, highlighting that the strategies have been adopted in a conscious manner to alleviate the burden of energy poverty.

To further distinguish ways of coping, Holahan & Moos (1987) describe both active and avoidant strategies. Active coping encompasses strategies that are intentional in nature, with the objective of addressing the problem. Avoidant ways of coping include strategies that aim to eliminate stress by avoiding the issue at hand (Holahan & Moos, 1987). However, some psychologists argue that dichotomous categorizations are not ideal as many strategies address the issue in more complex ways, such as Skinner and colleagues (2003) who suggest that coping strategies be categorized in more detail according to action type. In their work, coping strategies are described to be aimed at: problem-solving (e.g., implementing solution strategies), information seeking (e.g., learning more about the issue), helplessness (e.g., cognitive exhaustion), escape (e.g., avoiding the issue), self-reliance (e.g., protecting personal resources), support seeking (e.g., asking for help), delegation (e.g., complaining), isolation (i.e.., avoiding others), accommodation (e.g., minimizing and accepting), negotiation (e.g., setting priorities and bargaining), submission (e.g., giving up), and opposition (e.g., blaming others). One of the advantages of their classification is that different strategies can touch on multiple action types at once (Skinner et al., 2003).

Relying on both quantitative and qualitative data and analysis, studies have identified the ingenious, yet sometimes problematic, ways households cope with energy poverty (Ambrose et al., 2021; Anderson et al., 2012; Brunner et al., 2012; Chard & Walker, 2016; Grossmann et al., 2021; McKague et al., 2016; Middlemiss, 2022). Overall, this body of research has found that households resort to coping strategies to: (1) improve their living conditions and thermal comfort by using supplemental sources of heating and increasing the energy efficiency of their dwelling, or (2) alleviate the financial strain associated with energy poverty by keeping to a tight budget and making financial sacrifices. Studies have also identified that the adoption of coping strategies varies depending on the socioeconomic characteristics of a household, such as their household composition and their social connectedness. In the words of Stojilovska, Yoon & Robert, “coping

skills fluctuate from person to person, and depend on the family situation" (Stojilovska et al., 2021, p.7).

To cope with energy poverty, households have reported adapting and renovating their homes to increase energy efficiency, such as replacing window frames and patching holes in sealing (Balaskas et al., 2021; Brunner et al., 2012); covering windows with thick curtains or blankets (Brunner et al., 2012; Chard & Walker, 2016; Harrison & Popke, 2011); and hanging blankets on door frames to isolate rooms (Harrison & Popke, 2011). Individuals have also reported wearing excessive amounts of clothing in the house to keep warm (Anderson et al., 2012; Brunner et al., 2012; Chard & Walker, 2016; Stojilovska et al., 2021); sitting close to sources of heat (Ambrose et al., 2021; Brunner et al., 2012); and using alternative methods of heating, such as space heaters and leaving the oven door open while functioning, which can create additional health risks (Harrison & Popke, 2011).

Studies describe individuals trying to spend significant amounts of time away from their home to escape cold or hot homes (Harrison & Popke, 2011; Stojilovska et al., 2021). Some households spent time with family or friends that could afford to keep their dwelling thermally comfortable (Ambrose et al., 2021; Longhurst & Hargreaves, 2019; Tod et al., 2016), and others stayed longer hours at work or school. In their study, Ambrose and colleagues highlight the importance of 'third places' as a means of respite for households facing energy poverty (Ambrose et al., 2021). Third places refer to places outside of the home (first places) or their workplace (second places), such as libraries, community centers, malls, and restaurants (Oldenburg & Brissett, 1982). Such places are available to individuals for free or for a small fee, giving them a thermally comfortable environment that feels safe, often with Internet connection, and without the stresses present in their homes.

When faced with energy poverty, some households intentionally fell into debt or borrowed money from people in their social networks to cover all of their expenditures (Anderson et al., 2012; Grossmann et al., 2021; Harrison & Popke, 2011; Tod et al., 2016). Conversely, other households describing experiencing a fear of debt (Anderson et al., 2012; Longhurst & Hargreaves, 2019; Tod et al., 2016), especially among older households and those that had been struggling with energy poverty for a long time (Chard & Walker, 2016). Some households in energy poverty have to juggle their expenditures and figure out which bills and needs they can afford to pay for on a monthly basis (Anderson et al., 2012; Brunner et al., 2012;

Harrison & Popke, 2011; McKague et al., 2016). To decrease their energy costs, some households may limit their use of heating, either by turning it off or down. Households have also described restricting the use of heating to one or two rooms and limiting their living to those spaces (Anderson et al., 2012; Chard & Walker, 2016; Harrison & Popke, 2011; Stojilovska et al., 2021; Tod et al., 2016).

There are socioeconomic considerations worth noting when it comes to the use of coping strategies. Indeed, some households are limited in the coping strategies they can implement because on their specific circumstances, such as households with children (Brunner et al., 2012; McKague et al., 2016; Tod et al., 2016) and socially isolated households (Grossmann et al., 2021; Harrison & Popke, 2011; Longhurst & Hargreaves, 2019). Certain households with children reported not being able to limit their use of heating as they had to keep the dwelling adequately warm for the children (Brunner et al., 2012), while others reported only heating their dwelling when children were at home (Tod et al., 2016). One study conducted among households with children in Australia found that parents facing energy poverty described a prevalent need for control (Tod et al., 2016). Being unable to change their living conditions due to low incomes, parents described the use of pre-payment meters to control their energy use even though this option is more expensive. Furthermore, some parents and guardians made supplemental sacrifices to their comfort by sleeping in the same bed as their kids to make sure they were warm enough (McKague et al., 2016). Socially isolated households are sometimes unable to visit friends or family when their dwelling is uncomfortable or cannot ask for loans within their limited social networks (Longhurst & Hargreaves, 2019). One study found that without a strong social network, households facing energy poverty were left without insights from others on effective coping strategies and support services (Grossmann et al., 2021).

2.5.1. The 'heat or eat' trade-off

When dealing with limited financial resources, households facing energy poverty might be forced to choose between paying for either their utility bills or groceries (Ambrose et al., 2021; Anderson et al., 2012; Balaskas et al., 2021; Bartiaux et al., 2021; Brunner et al., 2012; Butler & Sherriff, 2017; Harrison & Popke, 2011; Hernández & Laird, 2021; Longhurst & Hargreaves, 2019). This coping strategy is called the 'heat or eat' trade-off, or dilemma (Bhattacharya et al., 2003; Burlinson et al., 2022; Pannell & Yeakey, 2013; Snell et al., 2018). In the 'heat or eat' trade-off, both groceries and utilities are considered elastic expenditures. Early

work on the ‘heat or eat’ trade-off in the United States found that poorer households reduced their spending on groceries and their consequent caloric intake by 10% when utility bills increased in the winter because of colder weather (Bhattacharya et al., 2003). In higher income households, no changes in grocery spending or caloric intake during the colder months were observed. A study conducted in the United Kingdom found that individuals in households using pre-payment meters consumed almost three fewer portions of fruits and vegetables than those in households using post-payment methods (Burlinson et al., 2022). Their findings suggest that the use pre-payment meters, common amongst households facing energy poverty (Butler & Sherriff, 2017; Longhurst & Hargreaves, 2019; O’Sullivan et al., 2015; Tod et al., 2016), is associated with sacrifices in the quality and the quantity of food consumed. In Canada, research conducted on food insecurity between 1997 and 2001 found that the spike in energy prices could explain up to 61% of the rise in food insecurity during this time period (Emery et al., 2012). The findings also show that levels of food insecurity increased among homeowners during this timeframe, while they stayed stable for renters. This distinction could be attributed to utilities often being included in rent payments, meaning sudden energy cost increases did not affect renters directly. However, outside of these rapid energy shocks, both food insecurity and energy poverty are often a greater burden for renters in the country (McIntyre et al., 2016; Riva et al., 2021), meaning the ‘heat or eat’ trade-off can be a serious issue across tenure types. Another study conducted in the Canadian context found that households facing food insecurity generally spent less on other needs overall, including utilities, compared to food secure homes (Fafard St-Germain & Tarasuk, 2018).

Consequently, scholars suggest that the ‘heat or eat’ trade-off should not be overly simplified. Indeed, while the terminology of ‘heat or eat’ insinuates a dichotomous choice between heating a home and buying groceries, the trade-off is often more complex than that. A study conducted in the United Kingdom posits that households create spending priorities even within the need to heat and eat (Snell et al., 2018). When it comes to energy services, households will decide to power kitchen appliances while limiting heating and lighting; or opt to pay for quantity of food rather than quality (Burlinson et al., 2022; Snell et al., 2018). Furthermore, the ‘heat or eat’ trade-off can consider the other basic needs households have to pay for but might be sacrificing because of high energy costs, such as housing payments, social activities, clothing, healthcare, and education (Balaskas et al., 2021; Bartiaux et al., 2021; Hernández & Laird, 2021; McKague et al., 2016; Pannell & Yeakey, 2013; Snell et al., 2018). I have decided to examine the ‘heat or eat’ trade-off in my thesis because of the lack of research that has assessed it in the

Canadian context, as well as the notable implications it can have on the health and well-being of those with a limited ability to afford to pay for their basic needs.

2.6. Health and well-being implications of energy poverty

Several international studies have identified a negative association between experiencing energy poverty and poorer physical, mental, and social health and well-being outcomes (Howden-Chapman et al., 2012; Liddell & Guiney, 2015; Liddell & Morris, 2010; Riva et al., 2023; Thomson, Snell, et al., 2017). While health and well-being are not topics I explore directly in my thesis, I decided to include this section to my literature review to highlight the burden energy poverty can represent for households.

Experiencing energy poverty can have a negative influence on the physical health of individuals. Indeed, due to energy poverty, housing can become a hazard for inhabitants through different pathways (Sokołowski, Frankowski, et al., 2020). First, living in a dwelling where adequate temperatures cannot be maintained can aggravate or provoke respiratory, cardiovascular and musculoskeletal illnesses (Jessel et al., 2019; Liddell & Morris, 2010; K. C. O'Sullivan, 2019; K. C. O'Sullivan & Chisholm, 2020; Sokołowski, Frankowski, et al., 2020; Tod et al., 2016), both in the winter with extreme cold temperatures and in the summer with heat. In more extreme cases, experiencing energy poverty during the colder months can lead to mortality, measured as excess winter deaths (Fowler et al., 2015). Extreme heat experienced in the home, especially when respite is not achieved at night, can increase the risk of heat exhaustion and morbidity (K. C. O'Sullivan & Chisholm, 2020; Sanchez-Guevara et al., 2019; Thomson et al., 2019). Second, for some households in energy poverty, the formation of mould can occur when suitable ventilation is not achieved (Castaño-Rosa et al., 2019). Living in a dwelling with mould can increase the risk of experiencing asthma and other respiratory difficulties, especially among children (Marmot & Team, 2011; Mohan, 2021; Tod et al., 2016). Third, households facing energy poverty can be subject to physical hazards in their home when they limit their use of energy services. Studies have noted an increased risk of falls in households where the lights are not kept on, food poisoning when food is not refrigerated, burns from alternative modes of heating, and poorer hygiene if the use of hot water is constrained (Jessel et al., 2019; Kimemia et al., 2014; K. C. O'Sullivan, 2019).

People facing energy poverty are also subject to negative mental health and well-being outcomes. The financial strain associated with energy poverty and the inability to create a safe living environment burdens individuals and can lead to high levels of stress and anxiety (Brunner et al., 2012; Liddell & Guiney, 2015; Robinson, 2019). A systematic review of the literature addressing the mental health impacts of energy poverty found that worry and fear were a common experience for those in energy poverty (Liddell & Guiney, 2015). In other cases, members in households facing energy poverty avoided opening their energy bills as a defense mechanism (Anderson et al., 2012; Brunner et al., 2012; Tod et al., 2016). Individual facing energy poverty have also been found to try to normalize their sub-standard living conditions as a way of not addressing the problem, namely when solutions seemed limited (Anderson et al., 2012; Butler & Sherriff, 2017; Chard & Walker, 2016; Hernández & Laird, 2021). The normalization of living conditions was observed among young adults, who viewed their experience of energy poverty as a rite of passage (Butler & Sherriff, 2017; Petrova, 2018). Individuals and households experiencing energy poverty often feel embarrassed and ashamed about their living conditions (Longhurst & Hargreaves, 2019; McKague et al., 2016), which can lead to social isolation (Liddell & Guiney, 2015), as further explored below.

Social well-being has been found to have a considerable impact of the ways households experience energy poverty. Stigma has been identified as an important obstacle for households facing energy poverty (Day & Hitchings, 2011; Liddell & Guiney, 2015; Longhurst & Hargreaves, 2019), limiting people's willingness to reach out for help and support from government programs, community organisations, and social networks. Many households facing energy poverty experience shame and embarrassment linked to their living condition and experience of energy poverty. As noted above, when households in energy poverty consider that their dwelling is too cold, damp, or unsuitable, they might avoid inviting guests due to embarrassment (Harrison & Popke, 2011; McKague et al., 2016). While being a hurdle in of itself, stigma and shame can also lead households dealing with energy poverty to social isolation. Studies have identified that social isolation can push households further into energy poverty or be a barrier to escaping it (Grossmann et al., 2021; Longhurst & Hargreaves, 2019; Stojilovska et al., 2021). Indeed, when lacking a trusted social network, households facing energy poverty might receive fewer insights on efficient strategies to alleviate the burden of energy poverty; struggle more when negotiating with energy provision companies; and be less likely to seek help from community organisations or government programs (Grossmann et al., 2021; Stojilovska et

al., 2021). Households in energy poverty can further experience social isolation when they are not eligible for government support programs and are not offered other resources to help (Middlemiss et al., 2019). Inversely, studies have identified that households in energy poverty with strong social network could access support programs more easily as their peers could relay the information and their experiences (Grossmann et al., 2021; Stojilovska et al., 2021). Households also felt empowered when they participated in community activism to advocate for better programs to support other households facing energy poverty (Grossmann et al., 2021; Stojilovska et al., 2021).

2.7. Energy poverty and Covid-19

Over the past few years, the COVID-19 pandemic further heightened the experience of energy poverty for many households (Ambrose et al., 2021; Cuerdo-Vilches et al., 2021; Fell et al., 2020). In Canada, like in many other places around the world, most households were confined to their dwellings for weeks and months at a time, drastically altering the needs, behaviours, and routines of households (Ambrose et al., 2021; Cuerdo-Vilches et al., 2021; Fell et al., 2020). As households spent more time at home (if not all their time), their energy use and subsequent costs increased (Cuerdo-Vilches et al., 2021). While most households normally used very little energy during the day when residents went to work or school, many saw an increase in their consumption of energy services to ensure thermal comfort, telecommunication for remote work and schooling, and use of appliances while confined. Moreover, during the confinement period, few professional home improvement projects could be undertaken, meaning housing quality and the energy efficiency of homes decreased over time (Cuerdo-Vilches et al., 2021). As the global economy was altered over the course of several months, sources of income were lost or reduced, leaving some households with limited financial resources (Cuerdo-Vilches et al., 2021). These factors simultaneously increased a household energy use and energy expenditures while negatively affecting their financial situation.

During the pandemic, we saw the closure of most, if not all, of the secondary and third places, namely places of work, school, community centers, libraries, restaurants and cafés, and open public places. These closures have limited the places households could visit to escape their dwelling, especially throughout the winter when COVID-19 transmission was high and outdoor spaces were not viable options (Ambrose et al., 2021).

3. CONCEPTUAL FRAMEWORKS GUIDING THE THESIS

In the previous section, I reviewed the literature on the evolution of energy poverty as a concept, the social and spatial distribution of energy poverty, the coping strategies of households facing energy poverty, and the health and well-being implications of energy poverty. Through this process, different relationships have emerged, indicating that energy poverty does not occur in a vacuum but as a consequence of different social, spatial, political, and economic factors.

Scholars have proposed different conceptual frameworks to illustrate the way energy poverty relates to a range of factors. Depending on the lens through which one looks at energy poverty, interactions between these factors can differ, with energy poverty influencing or being influenced by them. Considering my research objectives, two conceptual frameworks have guided my work: the vulnerability and the capabilities approaches, as have been adapted for research on energy poverty. The two conceptual frameworks, which I view as platforms to organize knowledge, influenced my understanding of the literature and directed the data analysis and interpretation.

First created and used for research on climate change and risk assessment (Adger, 2006; Füssel, 2007; Turner et al., 2003), the vulnerability conceptual framework was adapted for use in energy poverty research by both Bouzarovski & Petrova (2015) and Middlemiss & Gillard (2015). Vulnerability is defined as "the propensity or predisposition to be adversely affected […] [and a] sensitivity or susceptibility to harm and lack of capacity to cope and adapt" by the IPCC (Oppenheimer et al., 2014, p.1048). The vulnerability framework adapted to energy poverty research proposes that we shift our focus away from the efficiency and affordability of energy, and rather investigate the broader context through which household are unable to secure sufficient energy services (Bouzarovski & Petrova, 2015). A bottom-up approach to the vulnerability framework suggests that an individual or household's vulnerability is based on their lived experience and ability to adapt (Middlemiss & Gillard, 2015). Thus, certain household characteristics and sociopolitical factors would lead a household to experience energy poverty at different points in time (Grossmann et al., 2021). Within the context of my thesis, I aim to have an integrated perspective that considers the broader context through which households are more likely to experience energy poverty in Bridgewater.

The theory of capabilities was developed by Sen and Nussbaum and informed research on poverty and welfare (Sen, 1993, Nussbaum, 2003). The theory was subsequently adapted to

research on energy poverty (Day et al., 2016; Middlemiss et al., 2019). The capability approach suggests that individuals have both functionings and capabilities (Nussbaum, 2003; Sen, 1993). Functioning are an individual's ability to accomplish tasks, and capabilities are their opportunities to exercise these functionings. The capabilities approach argues that poverty (and, by extension, energy poverty) is not just a question of the material limitations experienced by a household, but more importantly, the social and economic connections that households have (Middlemiss et al., 2019). Hence, when thinking about energy poverty, a household's experience of energy poverty limits and is impacted by their functionings and capabilities. The capabilities framework proposed by Day and colleagues (2016) is a linear diagram that describes the relationship between energy sources, energy services, and outcomes. The energy source and the power supply impact the domestic energy services available to a household (e.g., heating, cooling, fueling appliances, etc.). Energy services then influence the secondary capabilities of a household (e.g., preparing food, telecommunicating, etc.), finally affecting the basic capabilities of households, such as maintaining good health, accessing education, and living in dignity (Day et al., 2016). Building off of Day and colleagues work, Middlemiss and collaborators proposed an adapted framework which includes feedback loops and non-linear interactions between capabilities, functioning's, and energy poverty (Middlemiss et al., 2019). In this framework, capabilities are understood as both causes and consequences for a household's vulnerability to energy poverty over time. There is a greater emphasis on social connections in their iteration of the capabilities framework (Middlemiss et al., 2019).

Both the vulnerability and capabilities frameworks have been valuable to my research and my analysis of coping strategies as they describe a household's sometimes limited ability to change their living conditions and access the energy services they need given their context. Using the figures that illustrate and describe these two conceptual frameworks, as presented in all four articles (Bouzarovski & Petrova, 2015; Day et al., 2016; Middlemiss et al., 2019; Middlemiss & Gillard, 2015), I created my own visual representation of energy poverty (see Figure 1). I was first inspired by Middlemiss et al.'s (2019) conceptualisation by illustrating the relationships between energy poverty and the context and capabilities of a household. I used arrows pointing in two directions to show that energy poverty is affected and affects both context and capabilities. I decided to place energy poverty in the middle of the framework to illustrate it as the central concept rather than solely an outcome. I supplemented the list of capabilities in the figure with those described by Day and colleagues (2016). I based the categories and examples used for

'context' on the frameworks of Bouzarovski & Petrova (2015) and Middlemiss & Gillard (2015). This framework design has helped me picture how different contextual factors within Bridgewater (and beyond) and household capabilities inform vulnerability to energy poverty.

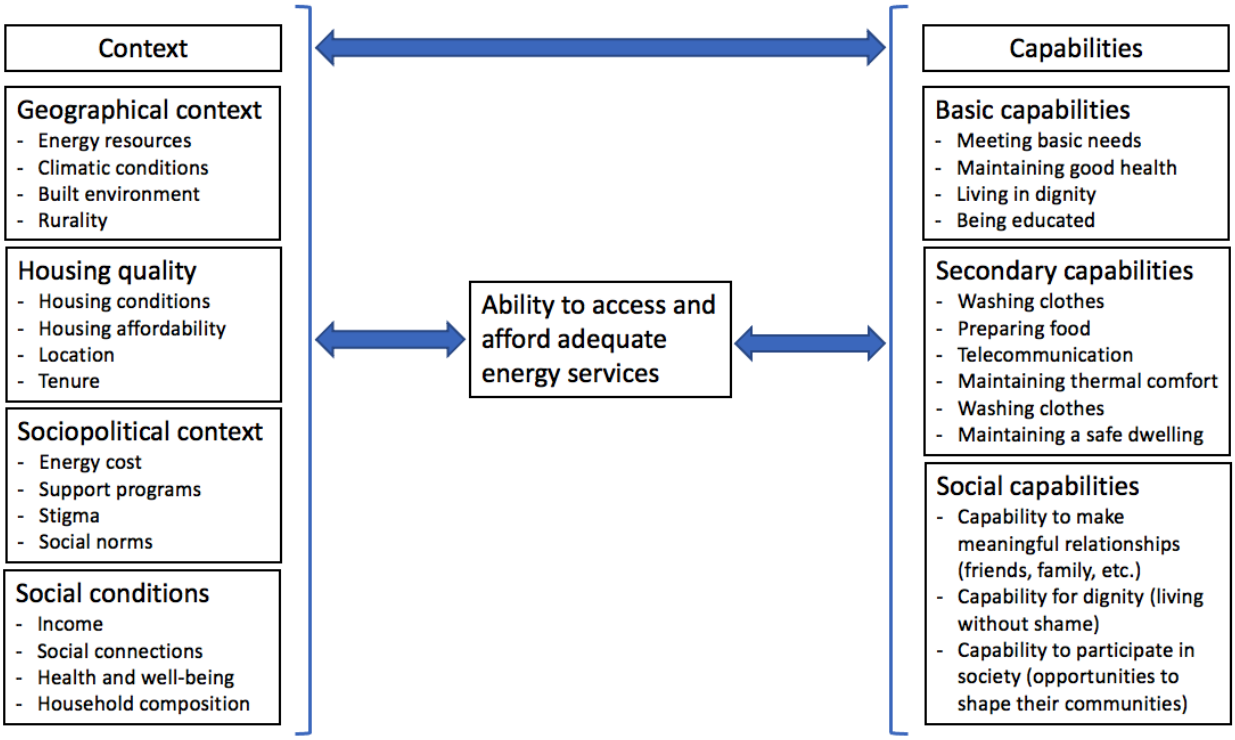

Figure 1. Positioning energy poverty within the context and capabilities of a household (author's illustration, adapted from Bouzarovski & Petrova, 2015; Day et al., 2016; Middlemiss et al., 2019; Middlemiss & Gillard, 2015).

4. CONTEXT OF THE STUDY

4.1. Energy poverty in Canada

Canada is one of the most important energy producers in the world, with some of the country's provinces having important energy resources, infrastructure, and technologies (Natural Resources Canada, 2021; Sinclair, 2010). Consequently, energy costs in some regions remain relatively low while being much higher in others (Green et al., 2016). These differences are associated with the prevalence of energy poverty varying across the country (see Figure 2). In Canada, 19% of households are facing energy poverty (using the 2M indicator, after housing costs) (Riva et al., 2021). Using the 2M indicator, the prevalence of energy poverty is above 30% in all Atlantic provinces (Newfoundland and Labrador, Prince Edward Island, New Brunswick, and Nova Scotia) (see Figure 2). Around 32% of households in rural areas are facing energy poverty, compared to 22% in small to medium size towns in the country (Riva et al., 2021). The prevalence of energy poverty in Canada is worth noting as it is similar to what is observed in countries like England (Department for Energy Security & Net Zero, 2023), yet energy poverty has been researched and addressed in policy across the United Kingdom. Conversely, scholars agree that there is a lack of research on energy poverty in Canada (Das, Martiskainen, Bertrand, et al., 2022; Das, Martiskainen, & Li, 2022; Riva et al., 2021, 2023).

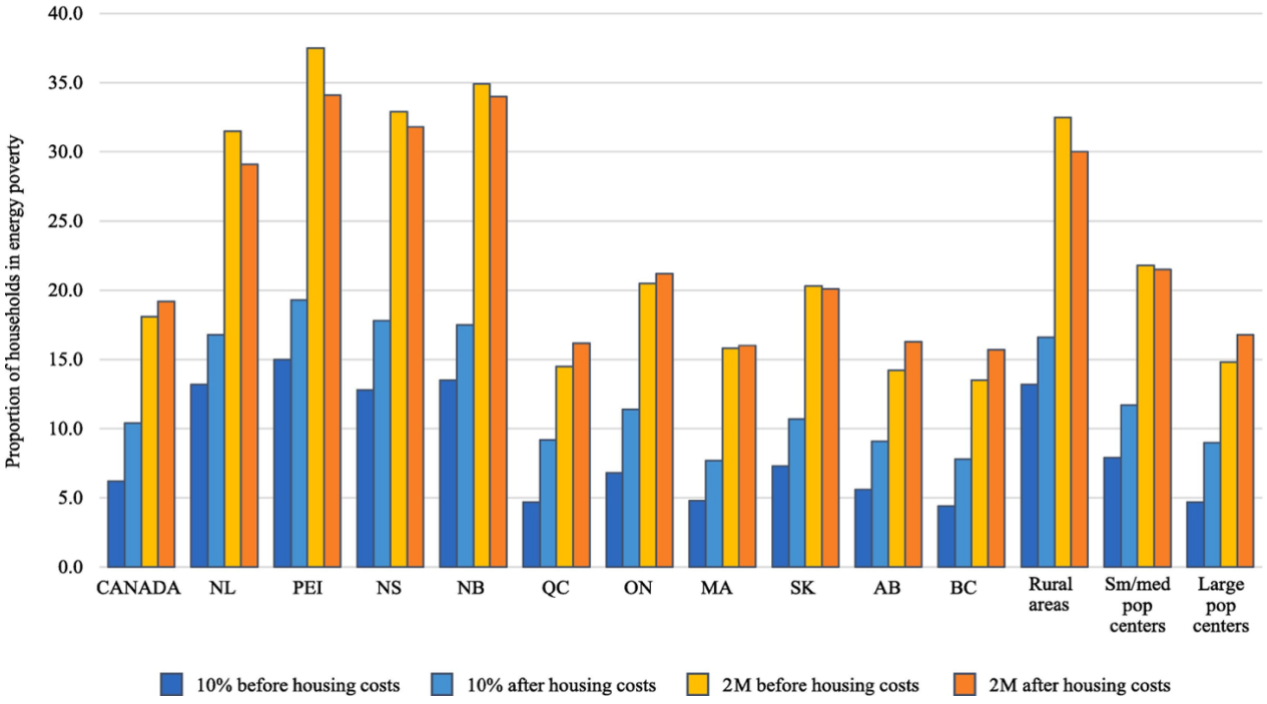

Figure 2. Proportion of households in energy poverty, by different indicators and by province and region of Canada, 2017 Survey of Household Spending (from Riva et al., 2021).

Over the past decade, few peer-reviewed articles and graduate theses on energy poverty in Canada were published. Firstly, research has tried to draw a portrait of energy poverty across the nation. Two recent studies quantified the prevalence of energy poverty in Canada and examined the social and spatial disparities, as referred to in my literature review (Das, Martiskainen, & Li, 2022; Riva et al., 2021). Research articles have also investigated the association between energy poverty and health outcomes, notably poor self-rated general and mental health (Riva et al., 2023) and the risk of hospitalisation for cardiovascular and respiratory outcomes (Kingunza Makasi, 2023; Kutuka et al., forthcoming). In their doctoral thesis, Rezaei explored the ways energy poverty manifests itself in the settler-colonial context of Canada (Rezaei, 2017).

Some Canadian research has also focused on energy poverty, the programs aimed at supporting households facing energy poverty, the link between Canada's energy transition and energy poverty, and different solution options. Initial work was done by the Fraser Institute (a conservative think-tank), who published a report in 2016 on household energy and electricity spending across Canadian urban centers (Green et al., 2016). Efficiency Canada, an advocacy organization, has made a call for Canada to implement a national energy poverty strategy that is inspired by initiatives adopted by other governments (Kantamneni, 2021). Furthermore, much of their work focuses on the importance of targeting the energy efficiency of low-income households to tackle both energy poverty and the carbon emission targets of the country (Kantamneni & Haley, 2022). The network for Canadian Urban Sustainability Practitioners (or 'CUSP') has conducted some work on energy poverty in Canada and published a report on the equity implication of energy poverty in the country (CUSP, 2019). The report recommends that further research and policy efforts tackle energy poverty in Canada to address these disparities. One study analysed initiatives addressing energy poverty in the province of Ontario, where financial aid, energy saving, and consumer protection programs were identified as the three main types of policies available (Das, Martiskainen, Bertrand, et al., 2022). Tardy and Lee researched the the ways retrofitting, behaviour changes, and renewable energy production are pathways to improving the housing stock and lessening energy poverty among low-income households in Canada (Tardy & Lee, 2019). In a recent report, the David Suzuki Foundation calls for a clean and just energy transition in the country with recommendations for a national energy poverty strategy, the decarbonization and energy efficiency of residential homes, energy affordability and universal access to clean energy services (Das & Martiskainen, 2022). Moreover, MacArthur and

colleagues's article (2020) identifies that Canada's Green New Deal has mostly failed to acknowledge energy poverty in its initial iteration (MacArthur et al., 2020).

4.2. Nova Scotia as an energy periphery

Being the province in which my research takes place, it is important to understand the specific context of this province. The prevalence of energy poverty in Nova Scotia is among the highest in the country. Indeed, after accounting for housing costs, around 33% of households are in energy poverty based on the 2M indicator (after housing costs) (Riva et al., 2021). Nova Scotia could be described as an energy periphery, a region that struggles to provide sufficient amounts of clean, reliable, and affordable energy services to its population (Golubchikov & O'Sullivan, 2020). Different factors are associated with the high prevalence of energy poverty and the energy peripheralization of the province.

First, energy prices in Nova Scotia are higher than in many other Canadian regions. Nova Scotia's contribution to Canada's energy production is small, representing less than 0.1% for crude oil, 0.4% for natural gas, and 1% of electricity (Canada Energy Regulator, 2021). Consequently, the province imports a large portion of its energy, making it more expensive (Bligh & Ismet Ugursal, 2012; Hughes, 2010). Nova Scotia is reliant on oil for residential heating. Indeed, oil makes up 32% of heating energy in the province (Nova Scotia Department of Finance, 2023), while also the most expensive heating method in Canada (Campbell, 2023). With the spikes in oil costs following the pandemic, many households' energy burdens were exacerbated (Cnockaert, 2022). Moreover, a study conducted by the Fraser Institute measured household energy and electricity costs in major Canadian cities in 2016 and found that electricity costs were 7.89 ¢/kWh in Montréal, but were more than double in Halifax, at 16.22 ¢/kWh (Green et al., 2016). In 2021, the cost of electricity in Québec was still below 8.0 ¢/kWh, and over 17.0 ¢/kWh in Nova Scotia (Urban, 2021). Higher costs might be leading Nova Scotians to limit their energy use: the province's electricity consumption is 24% lower than the Canadian average (Canada Energy Regulator, 2021).

Second, poverty and lower incomes heighten energy insecurity in the province. Indeed, in most Atlantic provinces, poverty rates are higher than the Canadian average, with Nova Scotia having the highest poverty rate (Saulnier & Plante, 2021). The cost of poverty, defined as "all costs that could potentially be reallocated, and benefits that could potentially be realized if all

poverty were eliminated" (Saulnier & Plante, 2021, p.4), in Nova Scotia was estimated at 2 billion dollars annually. To calculate the cost of poverty, Saulnier & Plante (2021) looked at opportunity costs (i.e., potential revenue and productivity if individuals were brought out of poverty), remedial costs (i.e., to account for the damages caused by poverty), and intergenerational costs (i.e., the long-term opportunity and remedial costs of children trapped in poverty cycles). Nova Scotia has experienced declining economic sectors, which are based on fisheries, coal, and forestry (Beaton, 2004; Gibson et al., 2015). Job opportunities are few and wages are low, driving young professionals to leave the province toward the country's larger urban centers.

Third, Nova Scotia has among the highest proportions of its population residing in rural communities (Gibson et al., 2015). As in many other parts of the country, there is a rural to urban migration as young professionals are leaving for urban settings, decreasing the economic potential in rural regions and leading to an aging the population. These factors not only limit the provision of public services in rural Nova Scotia (Gibson et al., 2015), but are also associated with higher proportions of energy poverty in rural communities, as described earlier (Roberts et al., 2015).

Fourth, an older housing stock and current housing crisis is exacerbating the experience of energy poverty for many households in the province. Housing unaffordability is an important concern for Nova Scotians (Arsenault, 2021; Rankin, 2023). With higher poverty rates and limited employment options, households are left spending larger portions of their incomes on housing costs (Beaton, 2004; Kawar, 2019). Housing prices have risen at much faster rates since the beginning of the COVID-19 pandemic as city-dwellers have decided to purchase properties in appealing natural regions, such as the Nova Scotia landscape (Arsenault, 2021). Renters' rights are limited in the province, meaning evictions are common and landlords rarely face penalties, increasing housing insecurity for tenants (Tutton, 2021). Furthermore, the housing stock mostly dates back to the 1970s and 1980s, increasing the needs and costs of maintenance (Beaton, 2004). Older dwellings are generally less energy efficient, increasing the energy needed to maintain a healthy indoor living environment. This concern was recognized by Housing Nova Scotia, the most important residential landlord in Nova Scotia that provided healthy and affordable housing options for low-income households in the province (Housing Nova Scotia, 2022; Kawar, 2019). From 2014 to 2016, they committed to build three pilot housing projects with better energy-

efficiency through the use of passive cooling and heating strategies (Kawar, 2019). These projects were deemed a success given the important housing needs throughout the province. However, their impact remains limited as few of them have been built in the province thus far.

Finally, Nova Scotia is also a leading province in Canada's energy transition (Gaede et al., 2022). Indeed, the province has made important commitments to promote renewable energies, both through import and the construction of wind farms (Canada Energy Regulator, 2021; Gaede et al., 2022). Despite the important role that energy transition plans play in bringing communities forward in our efforts to address climate change, such programs also pose the risk of increasing the unequal access to clean energy services and sustainable living conditions. As highlighted in the work by O'Sullivan and colleagues, it is important to have a holistic approach to the transition to ensure that no one is left behind; unable to afford clean energy services (K. O'Sullivan et al., 2020). Indeed, equity and justice are rarely the initial goal of energy transition plans (Jenkins et al., 2018; Sovacool et al., 2016), making it difficult for everyone to benefit from energy transition programs, especially those already facing energy poverty. If not considered adequately, the energy transition can exacerbate the burden of energy poverty. Hence, work undertaken by communities like the Town of Bridgewater are necessary to ensure that the energy transition is just and inclusive, notably by tackling energy poverty directly (Town of Bridgewater, 2019).

4.3. The Town of Bridgewater, Nova Scotia

The Town of Bridgewater, the community in which my master's research took place, is located in the Lunenburg county of Nova Scotia, Canada. In 2021, according to the Canadian Census, Bridgewater had a population of 8,790, with 4,260 permanently occupied private dwellings (Statistics Canada, 2022a). The age structure of the population is older with 12% aged 0-14 years, 58% aged 15 to 64 years, and 30% aged 65 years and older.

Single-attached houses represented the largest proportion of these dwellings (48%), followed by apartments in buildings with fewer than five storeys (29%), and movable dwellings (12%). Other dwelling types present in the town are semi-detached homes, duplexes, row houses, apartments in buildings with five or more storeys, and other single-attached houses. Of the private dwellings permanently occupied, more than half (58%) were owned by the occupants, and the rest (42%) were rented. Concerning the age of dwellings, 27% of dwellings were built prior to

1960. Looking at the median monthly shelter costs for owned and rented dwellings, they were $800/month and $920/month respectively. A little less than one quarter of households were spending more than 30% of their income on housing costs. This includes 9% of household owners and 43% of tenants.

Considering the composition of households in private dwellings, 20% were occupied by persons living alone, and census families occupied 74% of households (Statistics Canada, 2022). Statistics Canada defines a census family as "a married couple (with or without children of either and/or both spouses), a common-law couple (with or without children of either and/or both partners) or a lone parent of any marital status, with at least one child living in the same dwelling" (Statistics Canada, 2022a). Couple families made up the majority of this number, representing 80% of census families in private households; 53% of these were without children and 28% had at least one child. Lone-parent households represented 20% of the families living in private dwellings.

The median after-tax total household annual income in Bridgewater in 2020 was $51,600, which is around $10,000 lower than the provincial median and close to $20,000 lower than the national median (Statistics Canada, 2022). This value falls to $28,600 for one-person private households and $67,500 for two-or-more-person households. The median after-tax annual income was $62,800 for couple economic families without children; $97,000 for couple economic families with children; and $50,400 for lone-parent economic families. According to the low-income measure, after tax (or 'LIM-AT'), 19% of the population of Bridgewater would be categorized as low-income. Within the population, 19% had received no academic certificate or degree. The unemployment rate in Bridgewater was 12%, which is slightly lower than the provincial rate.

Looking at the population in private households, 7% were immigrants; 4% were not Canadian citizens; and less than 2% were non-permanent residents. Most residents of the town had a Canadian official language (English or French) as their mother tongue (94%).

4.4. Energize Bridgewater

The Town of Bridgewater has been aware of the burden energy poverty represents for their community for over a decade (Town of Bridgewater, 2019). To help fund *Energize*

Bridgewater, a program aiming to tackle energy poverty, Bridgewater applied to Canada's Smart Cities Challenge. After being announced a finalist in the Challenge, the Town of Bridgewater conducted a mixed-method community-led study to strengthen their application by providing a clearer picture of energy poverty in the community (Town of Bridgewater, 2019). The results from this study indicated that the prevalence of energy poverty was higher among lower-income, lone- parent and visible minority households, as well as for those in rented dwellings and dwellings in poorer conditions. Overall, Bridgewater found that 37% of responding households reported having a hard time affording their energy expenditures. Findings from this study were published in a summary report in July 2019 (Town of Bridgewater, 2019). Bridgewater was one of the winners of the Smart Cities Challenge that year.

The goal of *Energize Bridgewater* is to reduce the rate of energy poverty by 20% by 2026 (Energize Bridgewater, 2023). In other words, from the 37% of respondents reporting having a hard time affording their energy expenditures, the aim is to bring this number down to 31%. The full implementation of *Energize Bridgewater* started in the Fall of 2022. *Energize Bridgewater* takes a 'whole system' approach to tackle energy poverty at multiple angles and scales, including housing energy efficiency improvements; coordinated access services and support programs for households living in energy poverty; improvement in the offer of public transportation to offset the costs of private transportation; and community outreach on energy-related issues. *Energize Bridgewater* has the potential to reduce energy poverty and improve health for the community as a whole and for individuals enrolled in specific components of *Energize Bridgewater*.

4.5. Bridgewater Energy Security (BridgES) Study

The BridgES research project (for Bridgewater Energy Security), led by Prof. Riva in collaboration with the Town of Bridgewater, explores the impacts of the *Energize Bridgewater* program. The research aims to document the changes in the prevalence of energy poverty in Bridgewater and health and well-being impacts of the *Energize Bridgewater*, both at the community and individual level. A central value and approach to this research project is integrated knowledge translation (or 'iKT'), through which knowledge translation is prioritized at every step of the research (Canada, 2018; Kothari & Wathen, 2017). Such an approach was prioritized to strengthen the collaboration between the team of *Energize Bridgewater*, our knowledge users, and the researchers from McGill. By working together closely to establish

research questions, create the survey, and interpret results, iKT ensured accessibility and effective contribution of the research for the community (Riva et al., 2022).

A baseline study was the first step for the BridgES study. The objectives of the baseline study were to assess the extent of energy poverty in Bridgewater, as well as the extent of other housing and well-being indicators, prior to the implementation of the *Energize Bridgewater*. To do so, a cross-sectional community-wide survey assessing the extent of energy poverty and its association with health and well-being was conducted in the spring of 2022. I used data from this survey for my master's thesis. Results from this study were first published in a report that was written in close collaboration with the Town of Bridgewater (Riva et al., 2022).

Since the fall of 2021, I have been involved in the BridgES research project, first as a research assistant and a research coordinator since 2022. Through this role, I have participated in every step of the research project, from helping to create the data collection material and coordinating the data collection fieldwork. I co-wrote the summary report that presents the descriptive statistics of the study to the municipality (Riva et al., 2022). Additionally, I am the second author on the first article based on this study, which is currently under review (Riva et al., forthcoming). The article is complimentary to the work I undertook in my thesis and further expands on the research presented.

5. METHODS

With my overarching questions in mind (*Who experiences energy poverty in the Town of Bridgewater, Nova Scotia? How do they cope?*) the objectives of my thesis were to: (1) measure and compare the prevalence of energy poverty in Bridgewater using expenditure-based and self-reported indicators; (2) describe the housing and socioeconomic characteristics of households facing energy poverty and identify variables associated with higher levels of energy poverty; and (3) identify the strategies implemented by households to cope with energy poverty, with a focus on the 'heat or eat' trade-off. To ensure the validity and rigour of my research methods and design, I followed insights and concepts described for energy social science research (Sovacool et al., 2018). The following sections will first describe the methods that were used to collect data for BridgES, followed by the methods I used to conduct the data analysis for my thesis.

5.1. Data collection

5.1.1. Recruitment

I led a team of research assistants from McGill University for the data collection in the Town of Bridgewater throughout the month of May 2022. The team received training on interviews administration and research ethics. By being in the field, our goal was to build trust in the community, encourage residents of Bridgewater to participate in the survey, and facilitate data collection. The survey received ethical approval from the McGill University Research Ethics Board (REB # 21-12-003).

During our time in the field, with the help of the municipality, community organizations, and local businesses, we implemented different recruitment techniques to encourage individuals to complete the survey. We were hoping for the largest number of individuals to participate in the study to increase our sample size. Information on the survey was distributed through media platforms: an official statement about the survey was posted on the town's official website and social media pages, and posts were made on various relevant Facebook pages. Posters with information about the survey were displayed at the library, community centers, clinics, local businesses, and churches. The research team went door-to-door to distribute postcards with information about the survey and to speak with residents about the research project. About three-quarters of private dwellings in the town were reached through this effort. The research team also

took part in several community events to get to know residents and encourage participation. Overall, we probably reached more than half of Bridgewater's adult population living in private dwellings and invited them to complete the survey.

We recruited participants through convenience sampling. This sample was not projected to be representative of the population of Bridgewater but to provide the necessary information to understand the extent of energy poverty and the experience of vulnerable households. While in the field, we targeted our recruitment to promote the participation of various demographic groups more likely to be vulnerable to energy poverty, notably low-income households, renters, lone-parent households, older households, and visible minorities (Jessel et al., 2019; Middlemiss, 2022). We started our door-to-door recruitment in lower income neighbourhoods, went to the family resource center, and talked to people in passing to increase diversity in our sample.

One person per household was invited to complete the survey. To be eligible to participate in the survey, individuals had to be: (1) aged 19 years or older; (2) living at their current dwelling at least since January 2022; (3) residing within the city limits (confirmed using the 6-digit postal code); and (4) being either a homeowner or a renter. Overall, 516 individuals completed the survey, which represents around 13% of households in Bridgewater.

5.1.2. Survey questionnaire

The questionnaire used in this data collection was composed of seven sections: eligibility criteria; housing conditions; energy use and thermal comfort; dwelling and community satisfaction; health and well-being; mobility and transportation; and socio-demographic circumstances. The questionnaire was developed by Prof. Riva and myself, drawing on surveys conducted elsewhere, as well as with the input of energy poverty scholars from Canada and New Zealand. Bridgewater provided input on the questionnaire throughout its development to confirm the relevance and accessibility of the content. Further feedback was received from Nova Scotia Public Health Western Zone and the South Shore Open Doors Association, a local organisation providing housing support services.

The questionnaire was administered through the Lime Survey software. Participants were able to complete the survey online, over the phone, or in-person. Research assistants (including myself) administered the questionnaire with individuals who preferred to complete the survey over the phone or in-person. An audio recording of each question was be available on the online survey platform to increase the accessibility of the data collection process. The questionnaire

took approximately 30 minutes to complete. Overall, 82.4% of the surveys were completed online, 9.5% over the phone, and 8.1% in-person.

A majority of the questions in the survey were 'mandatory,' meaning participants could not choose to omit answering, limiting the presence of missing data in the dataset. The only exception was the question on household income: we considered that some individuals might be uncomfortable answering this question, and so they had the option to only give us their income category. However, this option has implications for the calculations of the prevalence of energy poverty, as will be described in the data analysis section. Only completed surveys were kept in the dataset.

5.2. Variables and measures

5.2.1. Energy poverty

To measure energy poverty in Bridgewater, I used two expenditure-based measures and six self-reported measures. The use of each of these is described and justified in Table 1.

The most common indicator used to assess the prevalence of energy poverty is the 10% threshold (Charlier & Legendre, 2021). Using this measure, households are considered in energy poverty if more than 10% of their household income is spent on domestic energy expenditures. The 2M measure, or double the national median share, is an adaptation of the 10% threshold that is anchored in the context of a study. The Canadian national median share of household income (after tax and after housing costs) to energy expenditures equaled 2.72% in 2021. Hence, a household would be characterised as experiencing energy poverty if its share of household income to energy expenditures is above 5.44% in Canada. This proportion was calculated using data from the 2021 Canadian census, which is accessible to the Canada Research Chair in Housing, Community, and Health. I decided to use both of these indicators to highlight both the extent and depth of energy poverty. The 10% threshold presents a more severe prevalence of energy poverty, where those identified as in energy poverty are dedicating a higher share of their household income to energy expenditures. The 2M measure has a broader reach, including households that could still be struggling to navigate their energy needs and expenditures at a lesser degree.

To utilize expenditure-based indicators in this study, I used survey data on household income, housing costs, and energy expenditures. Participants reported their total annual household income, before taxes and deductions, which was considered to be less prone to error than self-reported after-tax income. Housing costs corresponded to annual rent or mortgage payments. Due to uncertainties about the validity of the data on other housing expenses such as water bills and property taxes, they were not included in total housing costs. Participants reported their electricity and/or heating bills. Participants had the option to report their monthly or bi-monthly expenditures depending on their payment plan. Their responses were multiplied and summed to calculate their total annual energy expenditures. The ratio of household income to energy expenditures was measured both using total and disposable household income, which refers to annual household income after removing housing costs. For respondents who did not want to disclose their household income and instead reported their income bracket, the mid-point value of the bracket was used as their household income. This calculation could not be executed for participants whose utilities are included in rent payments. These respondents would correspond to 'missing' data, which was still included in the calculation of the proportion.

I also measured the prevalence of energy poverty based on the self-reported indicators relating to a household's perceived experience of thermal comfort and ability to afford energy. Each of these variables related to a single question in the survey and served as an independent indicator of energy poverty. This method is based on Healy and Clinch's consensual approach for self-assessed energy poverty (Healy & Clinch, 2002a; Thomson, Bouzarovski, et al., 2017). Petrova and colleagues used a similar approach in their study on perceived thermal comfort in a town in Ukraine (Petrova et al., 2013). In our survey, some questions were set in a time frame referring to the past 'cold season' (approximately October to March). Not all variables are considered within a time frame, as described below. All participants had to answer these questions, meaning there is no missing data to consider with these proportions.

To assess the prevalence of energy poverty based on the self-reported ability to maintain thermal comfort in the dwelling, participants were asked if they were able to keep their dwelling adequately warm over the past cold season based on a five scale of 'always,' 'often,' 'sometimes,' 'rarely,' or 'never.' This was recoded to a dichotomous yes/no variable (never, rarely, or sometime = no; often or always = yes), with no corresponding to the 'inability to keep dwelling adequately warm.'

Table 1. Descriptions, and justifications of energy poverty indicators used in this study.

Measure	Description	Justification
Expenditure-based measures		
10% threshold	The 10% threshold is an absolute value; households are considered in energy poverty if more than 10% of their household income is spend on energy expenditures.	The 10% threshold is widely used in energy poverty research, making the findings from this study easily comparable to other studies.
2M indicator	Households are characterised as experiencing energy poverty if their share of household income to energy expenditures is more than twice the national median share (≥5.4%).	The 2M measure has been more frequently used in studies on energy poverty in Canada and offers a relative threshold to energy poverty.
Self-reported measures		
Inability to keep dwelling adequately warm	Participants reported on their ability to keep their dwelling adequately warm in the past 'cold season.'	Looking at the definition of energy poverty that is widely used, this measure touches on a households ability to 'afford' and to 'access' enough energy.
Inability to *afford* to keep dwelling adequately warm	Participants reported on their ability to afford to keep their dwelling adequately warm in the past 'cold season.'	This measure reports on the affordability of energy for households, which is an important component of energy poverty.
Indoor temperature below WHO guidelines (≤18°C)	Participants reported on the usual indoor temperature inside their home. The threshold for energy poverty corresponds to that recommended by the WHO.	This measure was chosen to illustrate the inability to maintain healthy indoor living environments.
Dwelling so cold that participant shivered inside	Participants reported on whether they had ever shivered inside their dwelling because of the cold.	This is a clear indicator of dwellings being below a socially acceptable level of warmth.
Dwelling so cold that participant could see their breath inside	Participants reported on whether they had ever seen their breath inside their dwelling because of the cold.	This is a clear indicator of dwellings being below a socially acceptable level of warmth.
Dwelling so cold that participant had a hard time sleeping	Participants reported on whether they had ever had a hard time sleeping because of the cold.	This is a clear indicator of dwellings being below a socially acceptable level of warmth.

The ability to afford thermal comfort in the dwelling over the past cold season was posed as a dichotomous question, with 'yes/no' being the offered responses in the survey. Experiencing energy poverty corresponded to the 'inability to *afford* to keep dwelling adequately warm.'

Participants were asked to report on the usual indoor temperature in the main living area. This question was in the section of the survey on 'energy use during the cold season,' indicating that we were looking for the usual temperature in the winter. If the reported temperature was below the threshold recommended by the WHO (≤18°C), they were considered to be experiencing energy poverty. This threshold and measure relates back to an important reference point for research on housing and health and highlights a households inability to maintain healthy indoor living conditions. This variable allowed us to illustrate a more physical facet of living in energy poverty, being an alternative to direct measures of energy poverty that does not raise to the same ethical concerns (Sareen et al., 2020).

Participants were also asked whether or not they had ever shivered, seen their breath, or had a hard time sleeping in their dwelling because of the cold. These variables highlight some of the more extreme manifestations of thermal discomfort and consider what is below social norms. Participants answered either 'yes' or 'no' to each of these questions, and those reporting 'yes' to any of the questions were considered to be experiencing energy poverty.

5.2.2. Socioeconomic and housing characteristics

Through the survey, we also collected information on the socioeconomic and housing characteristics of respondents. For the purpose of my thesis, socioeconomic characteristics included income category and demographic characteristics (i.e., gender, age, marital status, education level, activity limitation) as described in Table 2. The selected socioeconomic characteristics are those that have been found to be associated with energy poverty in the literature, as explored in my literature review. This data was used to contrast the socioeconomic characteristics of households facing energy poverty to the general population, as well as to compare the profile of households characterised as experiencing energy poverty using the different measures of energy poverty.

Table 2. Questions from the survey to identify socioeconomic characteristic variables.

Variable	Question and answer options
Socioeconomic characteristics	
Gender	Which gender do you identify with? ☐ Women

	☐ Men ☐ Non-binary ☐ Gender-fluid ☐ Two spirited ☐ Agender ☐ Prefer not to say ☐ Other, please specify
Age category	How old are you? (numerical answer) OR What is your age group? (five-year intervals from 19 years and up)
Marital status	What is your marital status? ☐ Single ☐ Married/Common law relationship ☐ Separated ☐ Divorced ☐ Widowed
Household composition	Including yourself, how many people are living in this dwelling? (numerical answer) AND Including yourself, how many people are aged between? ☐ 0-4 years (numerical answer) ☐ 5-17 years (numerical answer) ☐ 18-64 years (numerical answer) ☐ ≥65 years (numerical answer) AND What is your marital status? (see 'Marital status' variable)
Activity limitation	Do you have a physical condition or mental condition or health problem that limits the amount or the kind of activity you can do? ☐ Yes ☐ No
Education level	What is the highest certificate, diploma or degree you have completed? ☐ Less than high school ☐ High school diploma or a high school equivalency certificate ☐ Trade certificate ☐ College or other non-university post-secondary certificate or diploma ☐ University certificate or diploma
Income	What is your best estimate of the total annual income for your household, so income received by all household members, from all sources, before taxes and deductions in the past 12 months? (numerical answer) OR Please indicate the income category which applies to your household. ($5000 intervals from 'no income' to 'more than $100,000')

To describe the housing characteristics of households in Bridgewater, I considered housing characteristics such as tenure, dwelling type, heating equipment, age of dwelling, and housing conditions (see Table 3). Housing adequacy was used as the indicator for housing

conditions, participants being asked whether their dwelling requires only regular maintenance, minor repairs, or major repairs. Additionally, participants were also asked whether or not their dwelling was damp or humid, or if it had large patches of mould.

Table 3. Questions from the survey to identify housing characteristic variables.

Variable	Question and answer options
Housing characteristics	
Tenure	What is your current living situation or arrangement? ☐ Rent/share unit ☐ Own with or without a mortgage or line of credit
Dwelling type	What type of dwelling do you live in? ☐ Single-detached house ☐ Semi-detached house ☐ Mobile home ☐ Apartment - in older, converted building ☐ Apartment - in a purpose-built building ☐ Other, please specify
Year dwelling was built	When was your dwelling built? ☐ Before 1961 ☐ Between 1961 to 1995 ☐ After 1995
Repairs needed	Is your dwelling in need of any repairs? ☐ No - Only regular maintenance is needed ☐ Yes - Minor repairs are needed ☐ Yes - Major repairs are needed
Damp or humid dwelling	A damp dwelling may feel or smell damp or have damp patches on the walls, ceiling, floor or window frames. How often is the inside of your dwelling damp or humid? ☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always
Patches of mould	In the past 12 months, inside your dwelling have you seen patches of mould larger than a letter size sheet of paper (8 ½ x 11 inch) on walls or ceiling? ☐ Yes ☐ No

5.2.3. Household coping strategies

I aimed to analyse the coping strategies employed by households to cope with energy poverty within the third and final objective of my master's thesis. In the survey, I was able to integrate six questions that allowed participants to report their coping strategies (Table 4).

Participants were asked about their strategies to keep warm in their dwelling, improve the energy efficiency of their dwelling, leave their dwelling in the summer and winter, limit energy use, and make financial trade-offs. These questions were in a multiple-choice format, meaning participants could select multiple answers, which was made clear in the survey with every question being followed with '(check all that apply).' Each question also had a multiple-choice option as 'other, please specify', allowing participants to list any other strategies employed if not already identified on the survey or to elaborate on their answers. The 'heat or eat' trade-off variable was created by combining the variables 'had to cut back on paying utilities (power and/or heating) to pay for food' and 'had to cut back on groceries to pay for utilities' using the AND/OR; if participants resorted to either or both of these strategies, I considered that they engaged in the 'heat or eat' trade-off.

There are two broad categories of coping strategies: those used to increase the thermal comfort of the dwelling and those used to alleviate the financial strain associated with energy bills and energy poverty (Anderson et al., 2012). Furthermore, some strategies can be considered as 'avoidant' (i.e., to avoid energy poverty) and those that are 'active' (i.e., to deal with energy poverty) (Holahan & Moos, 1987). Using both of these distinctions, I classified the different coping strategies as means of 'keeping warm,' which are avoidant strategies aimed at increasing thermal comfort; 'increasing energy efficiency,' which are active strategies to increase thermal comfort; 'leaving the dwelling,' as avoidant means to increase thermal comfort; 'limiting energy use,' which are active strategies to alleviate the financial strain; and 'financial trade-offs,' which are passive strategies to alleviate the financial strain.

Table 4. Questions from the survey to identify household coping strategies.

Coping strategy classification	**Question**	**Multiple choice options**
Keeping warm (avoidant, thermal comfort)	Some people use various strategies to keep warm. Which strategies you used during this past cold season?	□ Space heater □ Oven/stove □ Candles □ Electric blankets □ Hot-water bottles □ Put on more layers of clothing

		□ Take multiple hot showers □ Had more hot drinks than usual
Increasing energy efficiency (active, thermal comfort)	Do you do any of the following to improve warmth in your dwelling?	□ Put plastic on windows □ Use tape to cover holes in windows/doors □ Hang several curtains or blankets on windows □ Hang blankets on door frames to insulate rooms □ Lay blankets or extra carpets on the floor
Leaving the dwelling (avoidant, thermal comfort)	During this past cold season, did you ever leave your dwelling, or stay away from it, to escape the cold? If so, where did you go?	□ Go to a friend or relative's house □ Go to public places, ex: mall, library, etc. □ Stay longer at work/school
	Last summer, did you ever leave your home or stay away from it to escape the heat? If so, where did you go?	□ Go to a friend or relative's house □ Go to public places, ex: mall, library… □ Stay longer at work/school □ Go to a park □ Go to a municipal pool or beach
Limit energy use (active, financial strain)	Do you do any of the following to limit energy use in your dwelling?	□ Turn off the lights, even if you would prefer them on □ Turn heating down, even if you would prefer it higher □ Heat some rooms only, even if you would prefer it on □ Turn off the heating, even if you would prefer it on □ Heat more when there are visitors □ Take shorter showers to use less hot water □ Use less (or no) hot water when washing clothes
Financial trade-offs (avoidant, financial strain)	In the last 12 months, has any of the following happened to you or to any member of your household?	□ Had to juggle bills to pay for utilities □ Had to cut back on groceries to pay for utilities □ Had days when the home was not heated because bills could not be paid □ Had difficulty paying utility bills on time □ Skipped or delayed a mortgage or rent payment □ Received a notification from utilities company threatening to shut off utilities for not paying bills □ Utilities (power and/or heating) were disconnected □ Had to cut back on paying utilities for food

5.3. Data analysis

Data management and analysis was conducted in Stata/BE 17.0 (StataCorp., 2021). Descriptive statistics (frequencies) were first be presented to Bridgewater in the summary report (Riva et al., 2022). The following section describes the data analysis I conducted to answer my research objectives. Throughout the results, I used a p-value of 0.10, 0.05 and 0.01 to define

marginal, moderate, and high significance. I decided to use all three p-values due to the small sample size.

To determine the concordance between expenditure-based and self-reported indicators of energy poverty, i.e., whether households characterized as experiencing energy poverty using one indicator are also characterized using another, I conducted cross-tabulations and Pearson chi-square tests.

To describe the housing and socioeconomic characteristics of households experiencing energy poverty, I conducted cross-tabulations and chi-square tests between energy poverty indicators and select housing and socioeconomic characteristics. I used six indicators of energy poverty: the 10% threshold (after housing costs), the 2M measure (after housing costs), the reported inability to keep the dwelling warm, the reported inability to afford to keep the dwelling warm, reporting a usual indoor temperature below WHO guidelines, and reporting shivering inside the dwelling. The small number of participants reporting their dwelling was so cold that they had a hard time sleeping and/or that they could see breath inside prevented analysing the distribution of this variable with housing and socioeconomic indicators.

To identify which housing and socioeconomic characteristics associated with energy poverty in the context of Bridgewater using odds ratios, I performed logistic regression models. The same six indicators of energy poverty as in the previous paragraph were used as the outcome variable. I prioritised expenditure-based indicators of energy poverty using income after housing cost to better represent the disposable income of households. Predictor variables included age, gender, household composition, education, activity limitation, tenure, age of dwelling, and housing adequacy. I chose these variables because of their significant association with energy poverty indicators through the chi-square tests (Table 6 and 7), or because of their potential role as confounders. Income was not added to the regressions as it is linked to the calculation of energy poverty using expenditure-based measures. As marital status and household composition overlap to some extent, I opted for household composition to have a more diverse picture of living situations. I chose to only use a dwelling's needs for repairs as the main measure of housing condition instead of the variables on dampness and mould. Odds ratios, confidence interval, and p-values are reported in the result table.

Next, I identified and described the coping strategies implemented by households to alleviate the burden of energy poverty. I started by ranking the coping strategies based on the

frequency of their use among the whole sample. I then conducted cross-tabulations and Pearson chi-squared tests between household coping strategies and indicators of energy poverty, as well as household coping strategies and socioeconomic characteristics. This process was conducted with housing characteristics, but the results were insignificant, so I excluded them from further analysis. Four indicators of energy poverty were used in this analysis: I excluded the 10% threshold and indoor temperatures below WHO guidelines to consolidate the data and because the results using these variables resembled those using the 2M measure (for the 10% threshold) and the 'shivered inside' variable (for indoor temperatures below WHO guidelines). The same socioeconomic characteristics were used as those described for the previous sections to maximise representation and efficiency.

As seen in Table 4, with all questions relating to household coping strategies, participants had the option to indicate other options that were not already listed. Many participants indicated further information and precisions on the ways they used specific coping strategies as well as coping strategies that were not included in the survey. I conducted descriptive qualitative content analysis to provide additional context to my quantitative results. To do so, I identified the answers to open-ended questions that added new information to the topics addressed; recording the coping strategies we had not considered in the survey and pulling out quotes to illustrate certain experiences or practices.

Finally, to further explore the 'heat or eat' trade-off with this data, I performed logistic regressions to determine if experiencing energy poverty could be seen as a predictor for participants reporting 'cutting back on paying utilities (power and/or heating) to pay for food,' 'cutting back on groceries to pay for utilities,' and resorting to the 'heat or eat' strategy. Each variable was treated independently as the outcome variable as they are binomial (yes/no), then in combination as the 'heat or eat' trade-off variable. As my primary predictor variable, I selected two indicators of energy poverty, repeating the logistic regression models twice with each indicator: the 2M measure (after housing costs) and the reported inability to afford energy needs respectively. As confounding variables to account for, I included gender, age category, household composition, income level (only for the reported inability to afford energy needs), tenure, and a dwelling's need for repairs because of their significant association with either the coping strategies and/or energy poverty. Odds ratios, confidence interval, and p-values are reported.

6. RESULTS

6.1. Description of participants

Overall, 516 individuals in Bridgewater completed the community-survey. The comparison between the socioeconomic and housing characteristics of the sample and the population of the Town of Bridgewater using data from the 2021 Census are presented in Appendix A. The table is also presented in the summary report written by the McGill research for the Town of Bridgewater (Riva et al., 2022) and the article based on this study (Riva et al., forthcoming). As described in both of these publications (Riva et al., 2022; Riva et al., forthcoming), the socioeconomic profile of the sample differs from that of the population of the Town of Bridgewater. The sample has an overrepresentation of women and an underrepresentation of men compared to census data. Lone-parent households, individuals living alone, those with lower education levels, those living in multi-unit apartment buildings, and those renting their dwelling are present in smaller proportion in the sample compared to the census. The lower participation of men and of people with lower education levels is a common issue in population surveys (Galea & Tracy, 2007). Furthermore, through the recruitment process and door-to-door campaign, it was often not possible to enter apartment buildings, meaning this population was harder to reach.

Considering at the comparison between the sample and the actual population in Bridgewater according to Census data, the research team decided that there was a need to weigh the data to account for gender discrepancies, namely the underrepresentation of men. By creating this weight, the sample was adjusted so that it better matched the proportion of men and women in the community. All results presented in this section are weighted. The difference between weighted vs non-weighted results is about 1%.

6.2. Measuring and comparing the prevalence of energy poverty using various indicators

Using expenditure-based indicators, the proportion of households experiencing energy poverty in Bridgewater within the sample varied between 17.2% (10% before housing) and 45.9% (2M after housing). Using self-reported indicators, the proportion of households experiencing energy poverty was around 20.5% using the ‘inability to keep dwelling warm,’ ‘inability to afford to keep the dwelling warm,’ and ‘shivered inside because of the cold.’ Furthermore, 15.2% of participants reported a usual indoor temperature below WHO guidelines;

12.0% had a hard time sleeping in their dwelling because of the cold; and 7.6% could see their breath inside their dwelling. These results are presented Figure 3.

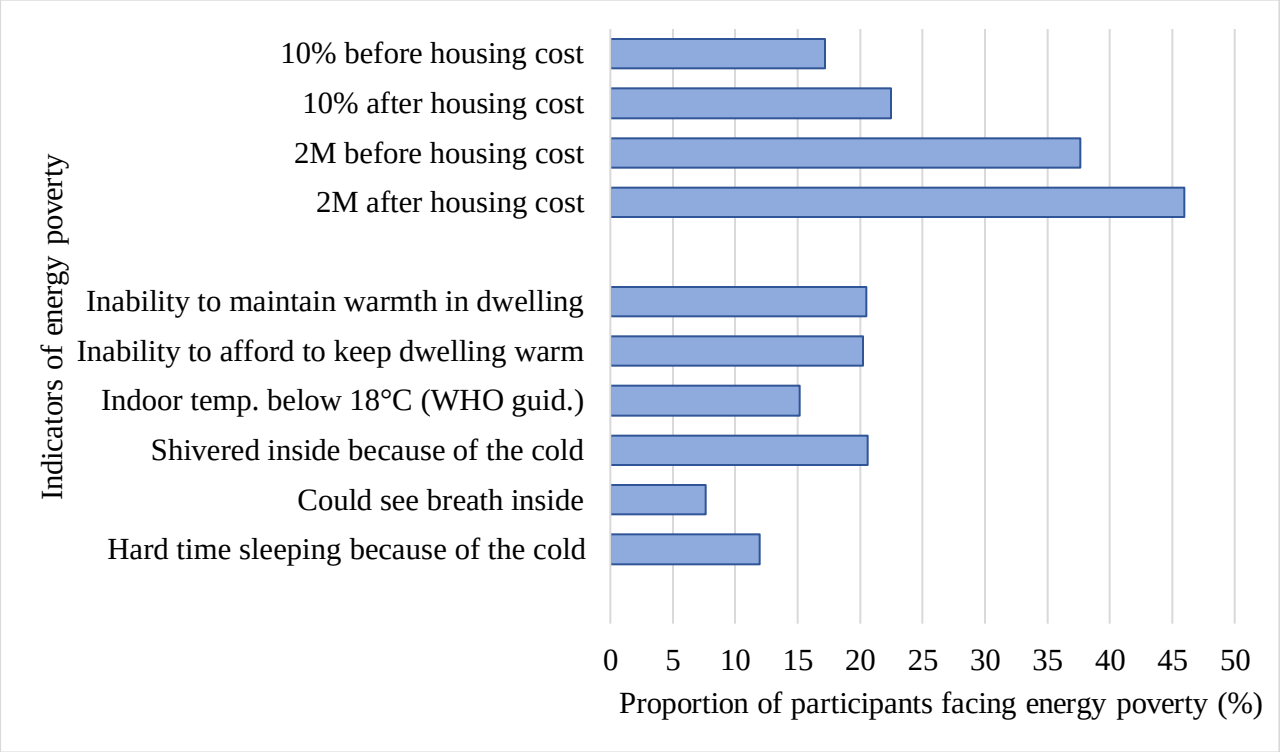

Figure 3. Proportion (%) of households experiencing energy poverty in Bridgewater, Nova Scotia, by different indicators of energy poverty.

Results from the cross-tabulations to measure the concordance between energy poverty measures are presented in Table 5. The rows and columns list the various indicators of energy poverty used in this study. The table can be read per row, with each box indicating what proportion of participants that experience energy poverty according to the row indictor are also identified as facing energy poverty using the column indicator. The significance of these associations is shown in the table. For example, of the participants facing energy poverty based on them having ‘shivered inside’ their dwelling, 43.63% are also identified as facing energy poverty using the ‘10% before housing’ indicator, the concordance being significant at $p < 0.01$. The top left section of the table illustrates the concordance between expenditure-based indicators. The results indicate the gradient between the different thresholds set by the 10% and the 2M indicator.

Table 5. Concordance (%) between indicators of energy poverty.

Indicator of energy poverty	Of sample		**10% (before housing costs)**	**10% (after housing costs)**	**2M (before housing costs)**	**2M (after housing costs)**	**Inability to maintain warmth**	**Inability to afford warmth**	**Usual temp. below 18°C**	**Shivered inside**
	n=	(%)								
Expenditure-based measures										
10% before housing costs	95	17.17		100.00**	100.00**	100.00**	25.13*	40.68**	19.81	27.07*
10% after housing costs	120	22.46	74.10**		95.65**	100.00**	32.37**	41.70**	19.96†	32.79**
2M before housing costs	198	37.64	45.62**	57.90**		100.00**	29.08**	35.09**	18.16	25.91**
2M after housing costs	241	45.94	36.23**	48.90**	80.79**		29.02**	34.25**	19.16**	25.85**
Self-reported indicators										
Inability to maintain warmth	111	20.48	25.96*	44.19**	65.86**	81.01**		65.65**	49.28**	58.56**
Inability to afford warmth	110	20.24	37.89**	51.77**	71.65**	86.95**	66.43**		37.35**	51.47**
Indoor temp. below 18°C	77	15.16	27.53	35.05†	54.02	69.16**	65.20**	49.18**		58.41**
Shivered inside	110	20.58	28.93	43.63**	57.76**	70.33**	58.29**	50.63**	44.25**	
Could see breath inside	39	7.61	32.67**	48.35**	57.58	75.09*	68.01**	57.35**	59.49**	84.95**
Hard time sleeping	64	11.95	23.63	45.14**	54.88†	67.31*	62.67**	53.09**	36.35**	72.87**

Note: p-value below 0.10†, 0.05* and 0.01**

The top-right and bottom-left sections of the table present the concordance between expenditure-based and self-reported measures of energy poverty. Around 15% of participants that considered that they could not afford to keep their dwelling adequately warm and 30% of the participants that shivered inside their households because of the cold were not in energy poverty according to the 2M after housing measure. Similarly, of households in energy poverty using the 2M after housing costs indicator, only 29% considered themselves unable to maintain an adequate temperature in their dwelling, 34% were unable to afford their energy needs, and 19% reported indoor temperatures below WHO guidelines, and 26% had shivered inside their dwelling.

Between self-reported indicators, we observe differences between their concordance. Around 65% of participants that reported having difficulties affording to keep their dwelling warm also reported being unable to keep their dwelling adequately warm, and vice-versa. When results were significant, less than half of the participants reporting experiencing energy poverty based on the other self-reported indicators also had usual indoor temperatures below WHO guidelines. There was a lack of significance when looking at participants reporting having a hard time sleeping because of the cold and seeing their breath inside their dwelling due to a small sample size for these indicators.

6.3. Describing the socioeconomic and housing characteristics of participants in energy poverty

6.3.1. Socioeconomic characteristics

Table 6 presents the results from the cross-tabulations and Pearson chi-square tests conducted between energy poverty indicators and different socioeconomic characteristics. Results represent the proportion of individuals from the row's characteristic identified as facing energy poverty (or not) according to the different indicators. For example, when looking at gender, 26.3% of women consider themselves unable to keep their dwelling adequately warm, compared to 14.2% of men. These results are significant at $p < 0.01$.

We notice that the prevalence of energy poverty is significantly higher among women compared men across most indicators. Indeed, 31.0% of women experience energy poverty based on the 10% indicator compared to 20.0% of men. Around 25% of women were unable to always keep their dwelling warm, are unable to afford to keep their dwelling warm, and have shivered inside their dwelling. These numbers were below 20% for men.

Table 6. Prevalence (%) of energy poverty by socioeconomic characteristic.

Variables	of sample		10% thresh.	2M ind.	Inabl. to maintain warmth	Inabl. to afford warmth	Usual temp. below 18°C	Shiv. inside
	n=	%						
Gender								
Women	272	52.7	31.00*	58.30*	26.27**	25.63**	24.37	16.18*
Men	234	45.4	20.00*	47.27*	14.21**	13.09**	15.79	14.13*
Age category								
19-34 years	82	15.89	22.59	47.54†	31.38**	31.38**	37.85**	33.14**
35-64 years	260	50.35	28.01	50.07†	24.58**	22.39**	22.82**	13.51**
≥65 years	174	33.76	24.65	60.22†	9.25**	11.80**	9.11**	9.18**
Marital status								
Single	113	21.96	33.72**	64.29**	28.33*	30.17**	24.63	16.40
Married/Common-law	290	56.24	18.34**	44.22**	16.58*	14.89**	18.58	13.92
Sep/divorce/widow	112	21.8	41.77**	69.65**	22.65*	24.06**	21.66	17.24
Household composition								
Couples w/out children	165	31.98	14.36**	45.70**	11.04**	9.99**	15.66	11.79
Couples with children	112	21.73	31.54**	45.37**	26.45**	25.02**	26.68	19.64
Lone-parent household	57	11.09	25.75**	58.68**	27.51**	35.90**	21.50	16.75
Living alone	145	28.07	34.43**	67.81**	21.15**	17.75**	19.27	15.03
Other	37	7.13	41.04**	58.96**	31.10**	37.10**	27.75	14.88
Activity limitation								
Yes	226	43.89	35.17**	62.11**	24.07†	25.48**	24.12*	19.39*
No	290	56.11	18.84**	46.22**	17.68†	16.15**	17.81*	11.91*
Education level								
Less than high school	44	8.59	58.70**	83.70**	26.93**	24.16†	20.54	20.11
High school	142	27.56	35.15**	61.53**	26.74**	25.96†	23.80	18.25
Trade certification	45	8.64	26.16**	62.21**	22.92**	19.32†	28.45	16.76
College/post-secondary	142	27.5	20.88**	26.99**	21.06**	21.33†	20.11	13.46
University	143	27.72	14.29**	20.61**	10.93**	12.56†	15.40	11.79
Income ($)								
> 20,000	45	8.77	84.43**	87.94**	30.57**	24.79**	30.57†	11.21*
20,000 to 39,999	126	24.77	49.24**	81.21**	26.72**	31.01**	24.18†	23.66*
40,000 to 59,999	102	20.06	27.91**	71.70**	23.36**	28.67**	24.09†	15.78*
60,000 to 99,999	143	28.15	12.15**	36.35**	17.27**	14.77**	16.23†	14.65*
≥100,000	93	18.25	0.00**	13.75**	8.61**	3.18**	15.24†	6.62*

Note: p-value below 0.10†, 0.05* and 0.01**

Using the 2M indicator of energy poverty, the prevalence of energy poverty is significantly higher among older adults, being at 60.2% compared to 50.1% for those aged between 35 and 64 years and 47.5% for those aged between 19 and 34 years. Using self-reported indicators, the prevalence of energy poverty is significantly higher among younger adults (below 35 years of age) compared to other age categories. Indeed, over 30% of young adults reported experiencing energy poverty based on all four indicators, while the proportion among older adults was around or below 10%. Considering indoor temperatures below WHO guidelines, 33.1% of young adults reported low indoor temperatures compared to 13.5% of adults aged between 35 and 64 years and 9.2% of older adults.

Concerning marital status, the prevalence of energy poverty using self-reported measures was higher among singles. Indeed, around 30% of single participants experienced energy poverty based on the 10% threshold, reported being unable to keep their dwelling adequately warm, and were unable to afford to keep their dwelling warm. The prevalence of energy poverty using expenditure-based measures is higher among participants that were separated, divorced, or widowed. In fact, using the 10% indicator, 41.8% of those in this group were experiencing energy poverty, which is more than double the proportion for their counterparts that were married or in common-law relationships. For household composition, energy poverty is lower among individuals that were married or in a common-law relationship without children. Depending on the measure used, the prevalence of energy poverty was significantly higher in households with children. Indeed, 26.5% of households with children were unable to always keep their dwelling warm, compared to 11.0% for couples without children. A higher prevalence of energy poverty was also observed among individuals living alone and those in ‘other’ household compositions, which would include living with roommates. Considering the 2M indicator, 67.8% of participants living alone are in energy poverty. The sample size for the ‘other’ household compositions is quite small, so little interpretation has been done. The prevalence of energy poverty was significantly higher among respondents with health conditions limiting their activity levels compared to those without activity limitations across most indicators. For example, the proportion of participants in energy poverty for participants with an activity limitation compared to those without activity limitations based on the 10% threshold is almost double at 35.2%. Considering income and education levels, we see a clear gradient with the prevalence of energy poverty: as incomes and education levels decrease, the prevalence of energy poverty increases. This relationship is not as clear using self-reported indicators, with a higher proportion of

participants in lower middle-income households (between $20,000 and $59,000) reporting being unable to keep their dwelling or being unable to afford to keep their dwelling warm.

6.3.2. Housing conditions

Table 7 presents the results from the cross-tabulations and Pearson chi-square tests conducted between energy poverty indicators and housing characteristics. Housing characteristics are presented in the rows and indicators of energy poverty in the columns. The results shown in the table represent the proportion of individuals from the row's characteristic that are identified as facing energy poverty based on the column's indicator. The reading of this table is the same as with Table 6. The prevalence of energy poverty among renters was significantly higher than homeowners using all indicators except the 2M measure. In some cases, the proportion of renters facing energy poverty was more than double the proportion among homeowners. Most notably, the proportion of households reporting indoor temperatures having shivered inside their dwelling because of the cold was 26.0% for renters compared to 9.6% for homeowners. While results are not significant across all indicators, the prevalence of energy poverty was often higher for people living in apartments in converted older buildings. Indeed, for participants living in apartments in converted buildings, 35.8% and 29.1% were, respectively, unable to keep their dwelling warm and reported usual indoor temperatures below WHO guidelines. These proportions of energy poverty are at least 10% higher than for other dwelling types. Considering the age of dwelling, across all indicators, energy poverty was more common for participants living in older homes across all indicators. Indeed, the proportion of participants in energy poverty based on the inability to keep the dwelling warm is 7.5% for those in dwellings built after 1995, yet 23.5% for those in dwellings built between 1961 and 1995 and 26.3% for those in dwellings built before 1961. Looking at the condition of dwellings (i.e., need for repairs, presence of mould, and damp/humid dwellings), we see that inadequate dwelling conditions are associated with a higher prevalence of energy poverty across most indicators (exceptions with the variable 'presence of mould'). Notably, 75.6% participants in dwellings in need of major repairs are in energy poverty based on the 2M indicator; and 64.0% for those in damp or humid dwellings. Over 40.0% of participants in dwellings in need of major repairs reported being unable to keep their dwelling adequately warm, unable to afford to keep their dwelling warm, and shivering inside their dwelling because of the cold.

Table 7. Prevalence (%) of energy poverty by housing characteristic.

Variables	Of sample		10% thres.	2M ind.	Inabl. to maintain warmth	Inabl. to afford warmth	Usual temp. below 18°C	Shiv. inside
	n=	(%)						
Tenure								
Renter	180	34.87	37.44**	59.45†	31.72**	26.12*	28.04**	25.96**
Owner	336	65.13	21.83**	50.92†	14.47**	17.10*	16.59**	9.64**
Dwelling type								
Single-detached house	272	52.63	24.82	53.46*	17.31**	20.16*	19.98	10.73**
Semi-detached house	30	5.75	24.32	52.11*	22.82**	28.62*	22.82	19.92**
Mobile home	68	13.16	25.92	58.21*	19.93**	20.29*	16.48	10.82**
Apartment, converted	72	13.86	39.04	64.96*	35.78**	28.89*	30.45	29.09**
Apartment, purpose built	75	14.6	21.14	34.53*	16.98**	8.99*	16.18	20.82**
Year dwelling was built								
Before 1961	153	29.7	34.31**	64.46**	26.33**	24.00*	21.60*	21.56**
1961-1995	238	46.16	27.23**	55.07**	23.51**	21.91*	24.08*	15.26**
After 1995	125	24.14	13.66**	36.03**	7.51**	12.44*	12.64*	7.07**
Dwelling's need for repairs								
Regular maintenance	247	47.89	18.28**	43.00**	8.37**	11.01**	8.92**	4.65**
Minor repairs	82	39.78	28.75**	58.82**	27.33**	23.98**	27.51**	22.28**
Major repairs	53	12.33	48.03**	75.63**	45.44**	44.07**	43.51**	34.74**
Damp or humid dwelling								
Yes	187	36.22	36.00**	63.98**	41.20**	36.33**	38.78**	28.12**
No	329	63.78	20.80**	47.57**	8.71**	11.11**	10.24**	7.95**
Patches of mould								
Yes	70	13.53	40.17*	58.63	42.84**	38.09**	43.04**	32.26**
No	446	86.47	24.12*	52.48	16.98**	25.46**	17.06**	12.62**

Note: p-value below 0.10†, 0.05* and 0.01**

6.3.3. Identifying the socioeconomic and housing variables associated with energy poverty

Results from the logistic regressions conducted to identify the housing and socioeconomic variables associated with energy poverty are presented in Table 8. Results demonstrate that different socioeconomic and housing characteristics are associated with energy poverty.

Considering gender, women were significantly more likely to experience energy poverty across all indicators, except when considering usual indoor temperatures. Noticeably, women were 2.07 times more likely to report being unable to afford to keep their dwelling adequately warm. Depending on the indicator, young adults were more likely to experience energy poverty compared to adults between 35 and 64 years of age. Young adults were 2.14 times more likely to report being unable to afford to keep their dwelling warm compared to adults between 35 and 64 years of age; and 3.13 times more likely to report usual indoor temperatures below WHO guidelines. While older adults were 1.75 times more likely to experience energy poverty than adults aged between 35 and 64 years based on the 2M indicator, they were less likely to report being unable to keep the dwelling warm or report shivering inside their dwelling. Individuals with lower education levels were more likely to experience energy poverty. Indeed, compared to participants with a university degree, participants having not gone to school past high school were 4.03 more likely to experience energy poverty based on the 10% threshold; and 2.83 times more likely to report being unable to maintain an adequate temperature in their dwelling. Considering household composition, the odds of experience energy poverty using the 10% indicator compared to couples without children were 2.93 times time higher for couples with children and 2.11 times higher for participants living alone.

For housing characteristics, the odds of experiencing energy poverty is over 2 times higher for participants living in a dwelling built before 1961 compared to those in dwellings built after 1995 using the 10% indicator, the 2M indicator, and the inability to keep dwelling adequately warm. Considering housing conditions, participants living in dwellings in need of major repairs were noticeably more likely to experience energy than those in dwellings in need of regular maintenance. The odds ratios of experiencing energy poverty for participants in dwelling in need of major repairs compared to those in dwellings only requiring regular maintenance was 2.25 using the 10% threshold; 2.86 using the 2M indicator; 5.64 for the inability to keep the dwelling warm; 4.06 for the inability to afford to keep their dwelling warm; 9.01 for indoor temperatures below WHO guidelines; and 7.71 for having shivered inside the dwelling.

Table 8. Associations between indicators of energy poverty, and socioeconomic characteristics, and housing variables.

Variables	10% threshold	2M indicator	Inability to maintain warmth	Inability to afford warmth	Usual temp. below 18°C	Shivered inside
	Odds ratios and confidence intervals (OR (95% CI))					
Gender						
Men	1.00	1.00	1.00	1.00	1.00	1.00
Women	1.70* (1.02, 2.81)	1.55† (1.00, 2.40)	1.93* (1.12, 3.34)	2.07** (1.20, 3.55)	0.99 (0.55, 1.77)	1.60† (0.94, 2.72)
Age category						
35 to 64 years	1.00	1.00	1.00	1.00	1.00	1.00
19-34 years	0.60 (0.28, 1.28)	0.97 (0.52, 1.79)	1.57 (0.82, 3.01)	2.14* (1.12, 4.08)	3.13** (1.56, 6.31)	2.52** (1.34, 4.71)
≥65 years	1.20 (0.67, 2.13)	1.75* (1.03, 2.96)	0.40** (0.21, 0.78)	0.60 (0.32, 1.14)	0.85 (0.40, 1.80)	0.41** (0.22, 0.77)
Education level						
University degree	1.00	1.00	1.00	1.00	1.00	1.00
Other post-secondary	1.47 (0.78, 2.77)	2.08** (1.23, 3.48)	1.67 (0.84, 3.29)	1.65 (0.85, 3.18)	0.99 (0.47, 2.09)	1.27 (0.67, 2.41)
High school or less	4.03** (2.13, 7.62)	3.20** (1.86, 5.49)	2.83** (1.41, 5.69)	2.59** (1.30, 5.15)	1.75 (0.86, 3.55)	1.61 (0.85, 3.06)
Household composition						
Couples w/out children	1.00	1.00	1.00	1.00	1.00	1.00
Couples with children	2.93** (1.45, 5.95)	0.99 (0.54, 1.79)	1.41 (0.66, 2.98)	1.80 (0.88, 3.71)	0.87 (0.37, 2.03)	0.84 (0.41, 1.71)
Lone-parent household	1.52 (0.67, 3.48)	1.38 (0.69, 2.79)	2.03 (0.82, 5.02)	3.87** (1.64, 9.12)	1.05 (0.35, 3.17)	0.94 (0.39, 2.26)
Person living alone	2.11* (1.08, 4.12)	1.81* (1.02, 3.18)	1.32 (0.63, 2.76)	1.27 (0.57, 2.86)	0.67 (0.31, 1.46)	0.83 (0.42, 1.67)
Other	3.89** (1.43, 10.53)	1.59 (0.64, 3.91)	1.48 (0.56, 3.94)	2.97* (1.21, 7.27)	0.48 (0.14, 1.61)	0.81 (0.32, 2.08)
Tenure						
Owner	1.00	1.00	1.00	1.00	1.00	1.00
Renter	1.34 (0.77, 2.32)	0.98 (0.60, 1.62)	1.54 (0.91, 2.61)	0.87 (0501, 1.52)	2.28* (1.20, 4.32)	1.20 (0.70, 2.06)
Year dwelling was built						
After 1995	1.00	1.00	1.00	1.00	1.00	1.00
1961 to 1995	1.76 (0.87, 3.59)	2.00* (1.17, 3.42)	2.62* (1.22, 5.65)	1.89† (0.96, 3.71)	1.29 (0.52, 3.17)	1.58 (0.78, 3.20)
Before 1961	2.35* (1.11, 4.99)	2.46** (1.36, 4.46)	2.64* (1.18, 5.92)	1.85 (0.88, 3.87)	1.67 (0.68, 4.08)	1.03 (0.48, 2.22)
Dwelling's need for repairs						
Reg. maintenance	1.00	1.00	1.00	1.00	1.00	1.00
Minor repairs	1.25 (0.72, 2.18)	1.62* (1.00, 2.61)	2..72** (1.50, 4.94)	1.82* (1.01, 3.26)	5.07**(2.35, 10.93)	3.16** (1.74, 5.73)
Major repairs	2.25* (1.08, 4.67)	2.86** (1.37, 5.95)	5.64** (2.66, 11.98)	4.06** (2.00, 8.25)	9.01**(3.57, 22.70)	7.71**(3.65, 16.26)

Note: p-value below 0.10†, 0.05* and 0.01**

6.4. Identifying the strategies implemented by households to cope with energy poverty

This next section presents findings related to the coping strategies of participants in households facing energy poverty. Table 9 presents the different coping strategies included in the survey, organised and ranked within the categories of 'keeping warm,' 'increasing energy efficiency,' 'liming energy use,' 'financial trade-offs,' and 'leaving the dwelling.'

Table 9. Ranking of household coping strategies and trade-offs.

Coping strategies and trade-offs	Proportion (%)
Keeping warm	
Wore extra layers of clothing	70.43
Had more hot drinks	29.86
Space heater	27.27
Electric blanket	18.47
Hot water bottles	13.33
Oven	11.76
Took multiple hot showers	10.59
Increasing energy efficiency	
Towels at bottom of doors	23.76
Extra curtains or blankets on windows	18.56
Plastic on windows	16.43
Extra carpets or blankets on floor	13.79
Taping holes	13.76
Blankets on door frames	9.19
Limit energy use	
Used less hot water when washing clothes	58.15
Turned lights off	57.72
Turned heating down	53.71
Heated some rooms only	52.53
Heated more when visitors are over	35.33
Took shorter showers	33.04
Turned heating off	25.73
Financial trade-offs	
Had to juggle bills to pay for utilities (power and heating)	34.89
Had to cut back on groceries to pay for utilities (power and heating)	31.86
Had to cut back on paying utilities (power and/or heating) to pay for food	18.58
Resorted to the 'heat or eat' trade-off	34.24
Had days when the home was not heated because bills could not be paid	8.95
Skipped or delayed a mortgage or rent payment	8.75
Leaving the dwelling	
Left home to escape the heat (summer)	21.01
Left home to escape the cold (winter)	4.86

The coping strategy used most commonly was wearing extra layers of clothing indoors to stay warm, which was used by 70.4% of participants. To limit their energy use, over half of survey participants turned their heating lower than they considered comfortable, only heated some rooms in their dwelling, and heated more when they had visitors. A quarter of participants turned off their heating to decrease their energy spending or used a space heater to keep warm. While reported less frequently, many more extreme coping strategies were used. Indeed, 11.8% used their oven as an extra source of heating, 9.2% of participants put blankets on their door to increase insulation, 9.0% had days when heating was turned off because their bills could not be paid, 8.8% skipped or delayed a housing payment to pay for utilities, and 4.9% reported purposefully spending more time outside their home to escape the cold in the winter.

The results from the cross-tabulations conducted between coping strategies and indicators of energy poverty are presented in Table 10. The table shows the proportion of participants reporting the use of a coping strategies, comparing participants in energy poverty or not based on different measures of energy poverty. For example, 50.4% of participants in energy poverty according to the 2M indicator reported having to juggle bills to pay for utilities compared to 20.1% of those not facing energy poverty. Overall, almost all coping strategies were used significantly more for households in energy poverty than those not experiencing energy poverty.

The use of coping strategies by households in energy poverty according to the expenditure-based measure was usually lower than for those in energy poverty using self-reported indicators. To illustrate, while 16.2% of participants whose energy burden was more than twice the national median placed extra carpets/blankets on floor, this proportion was 36.4% of those reporting having shivered inside their dwelling. Likewise, the proportion of those reporting having to juggle bills to afford their utility bills was 50.4% of those in energy poverty based on the 2M indicators and 85.0% of those reporting being unable to afford to keep their dwelling warm.

Table 10. Use of coping strategies and trade-offs for households in energy poverty (or not) by indicator (%).

Variables	Of sample		**2M after housing costs**		**Inability to keep dwelling warm**		**Inability to afford to keep dwelling warm**		**Shivered inside**	
	n=	%	yes (%)	no (%)	yes (%)	no (%)	yes (%)	no (%)	yes (%)	no (%)
Keeping warm										
Space heater	141	27.27	28.04	26.41	49.26**	21.61**	45.24**	22.71**	44.38**	22.84**
Oven	61	11.76	11.11	7.80	21.66**	9.21**	18.38*	10.08*	23.53**	8.71**
Electric blanket	95	18.47	19.00	18.73	29.34**	15.66**	31.34**	15.20**	30.37**	15.38**
Hot water bottles	69	13.33	16.35*	9.22*	26.78**	9.87**	27.33**	9.78**	30.84**	8.80**
Extra layers of clothing	363	70.43	76.52**	65.20**	95.93**	63.87**	91.04**	65.20**	96.64**	63.64**
Multiple hot shower	55	10.59	10.54	7.56	24.56**	6.99**	17.20**	8.92**	25.15**	6.82**
More hot drinks	154	29.86	34.83**	23.15**	56.23**	23.07**	53.12**	23.96**	57.36**	22.73**
Increasing energy efficiency										
Plastic on windows	85	16.43	22.43**	9.10**	30.74**	12.75**	28.97**	13.25**	36.05**	11.35**
Taping holes	71	13.76	15.73*	8.04*	35.17**	8.25**	30.16**	9.60**	39.41**	7.12**
Curtains/blankets on windows	96	18.56	22.17**	9.92**	34.22**	14.52**	36.28**	14.06**	40.44**	12.89**
Extra carpets/blankets on floor	71	13.79	16.15**	7.91**	33.76**	8.64**	32.63**	9.00**	36.39**	7.93**
Towels at bottom of doors	123	23.76	29.38**	13.88**	54.13**	15.93**	54.18**	16.03**	56.44**	15.29**
Limiting energy use										
Turning lights off	298	57.72	61.73†	54.04†	81.03**	51.72**	86.22**	50.49**	82.50**	51.30**
Turning heating down	277	53.71	61.83**	47.66**	78.81**	47.25**	84.92**	45.79**	84.58**	45.72**
Heating some rooms only	271	52.53	55.61	51.56	65.89**	49.08**	70.32**	48.01**	71.61**	47.58**
Turning heating off	133	25.73	31.97**	20.19**	53.90**	18.48**	59.71**	17.11**	52.49**	18.80**
Heating more with visitors	182	35.33	39.51	32.37	58.45**	29.37**	55.37**	30.24**	56.56**	29.82**
Taking shorter showers	170	33.04	41.89**	22.09**	51.80**	28.20**	55.70**	27.28**	54.57**	27.46**
Less hot water for laundry	300	58.15	66.03**	53.21**	72.76**	54.39**	78.80**	52.91**	70.10**	55.05**
Financial trade-offs										
Juggled bills to pay for utilities	180	34.89	50.35**	20.13**	66.46**	26.75**	85.04**	22.16**	63.49**	27.48**
Cut back on groceries for utilities	164	31.86	46.04**	15.82**	66.00**	23.06**	79.74**	19.70**	61.40**	24.20**
Cut back on utilities for groceries	96	18.58	15.68**	7.38**	24.69**	12.06**	29.93**	8.82**	22.85**	13.24**

Note: p-value below 0.10†, 0.05* and 0.01**

Generally, the use of coping strategies used to ‘keep warm’ was higher among participants in energy poverty based on their reported inability to keep their dwelling warm and reporting having shivered inside their home. Notably, a quarter of participants in energy poverty based on the two indicators have taken multiple hot showers per day to stay warm; and almost half of those unable to keep their dwelling warm used a space heater

To increase the insulation of their dwelling, participants in households in energy poverty based on self-reported indicators were noticeably higher than for those not facing energy poverty. Across all self-reported indicator, around 30% of those in energy poverty taped holes in doors and windows, which is more than double the proportion for those not in energy poverty. The proportion of those that placed blankets on door frames was 25% for participants reporting having shivered inside their dwelling compared to 5% for those that had not.

Considering efforts to limit energy use, just short of 60% of those reporting being unable to afford to keep their dwelling warm reported having turned their heating off when they would have preferred to have it on. Almost 85% of households having shivered inside their dwelling and reporting being unable to afford to keep their dwelling warm turned their heating down; and about 70% limited heating to specific rooms.

The proportion of participants using coping strategies associated with financial trade-offs was highest for those in energy poverty based on their inability to afford to keep their dwelling warm compared to all other indicators. Indeed, over a quarter of those unable to afford to keep their dwelling warm skipped or delayed a mortgage or rent payment to manage household finances; 79.7% had to cut back on groceries to pay for utilities; and 29.9% cut back on utilities to pay for groceries.

Tables 11 and 12 present the proportion of participants using each coping strategy by socioeconomic characteristic. Overall, where results were significant, women used coping strategies more than men. Namely, the proportion of women resorting to certain financial trade-offs was higher than among men, as well as wearing extra layers of clothing and having extra hot dinks to keep warm.

Table 11. Use of coping strategies to keep warm and increase energy efficiency by socioeconomic characteristics (%).

Variables	Of samples		Keeping warm						Increasing energy efficiency				
	n=	%	Space heater	Oven	Elect. blanket	Extra layers	Hot showers	Hot drinks	Plastic on window	Tap holes	Thick curtains blankets	Extra carpets	Towels for draft
Gender													
Women	272	52.7	23.10†	9.81	17.09	76.27*	9.49	33.54*	16.14	13.61	18.35	13.29	26.58
Men	234	45.4	31.58†	13.68	20.00	63.68*	11.05	24.74*	15.26	13.68	17.89	13.68	21.05
Age category													
19-34 years	82	15.89	27.04**	16.07*	24.63**	82.29*	21.77**	40.69**	24.47*	28.83**	33.49**	22.98**	32.29**
35-64 years	260	50.35	33.07**	14.26*	22.13**	71.99*	11.61**	35.99**	17.72*	14.64**	18.19**	15.25**	26.90**
≥65 years	174	33.76	18.73**	6.01*	10.11**	62.53*	3.82**	15.61**	10.03*	5.26**	12.09**	7.28**	15.05**
Household composition													
Couples w/out kids	165	31.98	25.74	10.60**	16.64*	66.49	4.70*	20.07**	10.07**	4.62**	8.95**	5.22**	12.98**
Couples with kids	112	21.73	29.32	17.57**	27.34*	76.62	17.24*	40.72**	29.75**	19.87**	25.14**	23.61**	30.52**
Lone-parent household	57	11.09	40.65	4.72**	25.61*	75.90	15.05*	38.70**	20.86**	17.85**	17.85**	16.79**	33.12**
Persons living alone	145	28.07	22.44	7.13**	11.73*	65.74	10.79*	25.91**	11.13**	14.02**	22.68**	14.78**	24.04**
Other (e.g., roommates)	37	7.13	26.11	28.45**	15.04*	79.27	9.04*	42.48**	15.04**	28.76**	26.42**	13.72**	35.78**
Income ($)													
< 20,000	45	8.77	22.86	21.22	11.30	72.71	15.43*	30.84	12.67	20.11*	33.60**	18.17*	38.85**
20,000 - 39,999	126	24.77	22.15	12.19	19.51	70.82	14.15*	36.19	19.70	17.95*	26.34**	20.29*	31.79**
40,000 - 59,999	102	20.06	26.87	9.88	21.56	71.69	7.10*	32.52	17.58	16.51*	17.83**	14.94*	25.30**
60,000- 99,999	143	28.15	29.04	8.68	15.29	62.53	4.47*	21.47	11.42	5.58*	12.03**	7.65*	13.40**
≥100,000	93	18.25	35.12	14.31	23.32	77.48	17.49*	32.06	20.15	15.64*	12.06**	12.06*	20.67**
Limited activity													
Yes	226	43.89	28.48	13.15	19.46	70.85	12.44	29.44	19.51	17.39*	26.35**	17.17*	28.04*
No	290	56.11	26.33	10.68	17.69	70.11	9.14	30.13	13.60	10.93*	12.46**	11.14*	20.40*

Note: p-value below 0.10†, 0.05* and 0.01**

Table 12. Use of coping strategies to limit energy use and make financial trade-offs by socioeconomic characteristics (%).

Variables	Of samples		Limiting energy use							Financial trade-offs		
	n=	%	Turn lights off	Turn heat down	Heat fewer rooms	Turn heat off	Heat more w/ visitors	Shorter showers	Less hot water for laundry	Juggle bills	Cut on groceries	Cut on utilities
Gender												
Women	272	52.7	59.49	57.59	53.16	28.16**	36.76	34.49	63.29*	41.46**	39.24**	21.20**
Men	234	45.4	54.74	48.95	51.05	21.05**	34.21	31.05	52.11*	25.79**	22.11**	14.21**
Age category												
19-34 years	82	15.89	75.22**	68.78**	65.77*	42.65**	42.65*	39.04	60.21†	53.30**	49.24**	35.73**
35-64 years	260	50.35	59.49**	56.93**	52.62*	29.64**	39.27*	32.06	61.76†	41.59**	35.46**	23.06**
≥65 years	174	33.76	46.86**	41.84**	46.15*	11.94**	26.00*	31.66	51.80†	15.68**	18.30**	3.82**
Household composition												
Couples w/out kids	165	31.98	50.81*	47.46**	52.01*	15.44**	32.91*	24.41**	55.07**	23.87**	18.20**	10.07**
Couples w/ kids	112	21.73	66.97*	67.94**	60.60*	39.30**	46.56*	41.70**	68.71**	59.60**	41.04**	28.86**
Lone-parent household	57	11.09	69.23*	63.00**	65.81*	34.60**	43.86*	46.16**	77.85**	47.93**	44.28**	30.95**
Persons living alone	145	28.07	53.95*	47.49**	42.05*	19.79**	25.57*	31.27**	48.76**	27.18**	33.22**	14.02**
Other (e.g., roommates)	37	7.13	57.52*	48.48**	50.82*	40.14**	37.10*	33.44**	46.14**	49.49**	40.45**	24.08**
Income ($)												
< 20,000	45	8.77	53.44*	45.72	37.18	30.84	25.06	32.24*	42.40**	61.15**	60.32**	42.98**
20,000 - 39,999	126	24.77	65.07*	59.32	50.04	23.80	34.14	40.68*	59.31**	40.18**	43.50**	23.70**
40,000 - 59,999	102	20.06	62.40*	57.34	53.13	31.31	32.29	39.97*	64.45**	38.55**	37.71**	24.21**
60,000 - 99,999	143	28.15	56.35*	50.60	56.87	24.74	38.32	28.52*	64.77**	31.00**	23.35**	10.39**
≥100,000	93	18.25	45.57*	49.25	54.71	23.18	41.32	22.25*	45.82**	19.59**	10.46**	7.68**
Limited activity												
Yes	226	43.89	61.84	52.44	52.71	29.17†	36.95	39.45**	63.25*	39.44*	39.93**	24.67**
No	290	56.11	54.50	54.71	52.38	23.04†	34.06	28.02**	54.17*	31.33*	25.54**	13.81**

Note: p-value below 0.10†, 0.05* and 0.01**

Considering the age category of participants, the proportion of young adults using coping strategies was higher than for older adults across every coping strategy. Indeed, 21.8% of young adults took multiple hot showers to keep warm compared to 3.8% of older adults. Similar results were found when looking at the use of blankets on doorframes to insulate rooms. Looking at ways young adults limited their energy use, 68.8% and 42.7% turned their heating down or off, respectively, when they would have preferred to have it on at a warmer temperature.

Looking at household composition, households with children, either with two- or lone-parents, reported using coping strategies and trade-offs more than couples without children and individuals living alone. Because of the small sample size of 'other' household compositions, those results are considered with limited weight. Overall, 41.0% of couples with children left their dwelling during the warm season to escape excess heat compared to 16.0% of couples without children. The proportion of lone-parent households putting plastic on their windows is approximately double that of couple households or individuals living alone; and the proportion is tripled among couple households with children. Over 60% of households with children (two- or single-parent) were limiting heating to specific rooms in their dwelling; and over 40% heated their dwelling more if they had visitors over. Three in five couple households with children had to juggle their bills to manage finances.

The use of coping strategies is sometime significantly higher among certain income level groups. Most often, the proportion of households using coping strategies was highest among households in the lower income category. This was the case for the use of hot water bottles, having thick curtains or blankets on windows, having extra carpets on the floor, placing towels to block drafts at the bottom of windows or doors, and certain financial trade-offs. However, middle-income and higher-income also use certain coping strategies as much, if not more, than low-income households. This was the case for taking multiple hot showers to keep warm and limiting hot water use for laundry, though environmental consciousness might also push individuals to decrease the use of hot water.

Results indicate that certain socioeconomic characteristics are not associated with the use of coping strategies. Indeed, the proportion of participants using coping strategies to keep warm, increase warmth, and/or limit energy use was rarely significantly different between participants based on education level. Similarly, the use of coping strategies to keep warm were not used significantly more among participants with activity limitations compared to those without.

6.4.1. Other means of keeping warm and increasing energy efficiency

The following three subsections present the answers to open-ended questions using qualitative descriptive content analysis. Results are described and quotes are presented in italic throughout the text to add nuance and depth to my main quantitative analysis.

Beyond the options presented in the survey, participants were asked to report on other means of keeping warm and increasing warmth in their dwelling not listed in the survey or detail the use of these coping strategies. To keep warm, many participants added that they used extra blankets (non-electric) or comforters, either on their bed, on the couch, or walked around wrapped in a blanket. The use of the fireplace or wood stove was also named by many, which was used when the usual means of heating were not sufficient. A few participants also mentioned going to bed early or spending more time in bed. The following three quotes pulled from the survey responses are representative of the use of these coping strategies:

"Wrap blankets around to sit at desk and work from home. Tried to use fireplace in living room to get some heat when on main level. Got so cold in kitchen pipes froze to kitchen sink several times."

- Survey participant #1250

"Went to bed early, not because there was problem with the heat but because I can't afford to pay the bill."

- Survey participant #1097

"Spend most of the day under sheets in bed, or carry my comforter around the house"

- Survey participant #1087

Furthermore, other participants mentioned going for a run or walk and taking time to exercise as a way of increasing heat. To improve warmth in the home, participants elaborated and detailed the ways that they would further insulate their dwellings, such as adding insulation to walls and ceilings, packing snow around the house, and blocking holes that could lead to drafts such as the mail shoot and the oven hood range. One participant explained some of the compounding impacts of energy poverty and his ways of coping:

"I place comforters on the windows, which I have to wash soon afterwards because mold forms on them."

- Survey participant #1087

Indeed, trying to block the cold air coming from windows and doors was a measure used by many participants. Others mentioned making sure to always close and seal windows, having heated and thick curtains, keeping blinds and curtains closed most of the time, and adding caulking and weather stripping around door and window frames.

6.4.2. Other means of limiting energy use and making financial trade-offs

Beyond the options listed in the survey, participants named a few other ways by which they limited their energy use to reduce costs. Among the action described, many related to limiting the use of appliances. Namely, participants mentioned doing large loads of laundry to limit use of washing machine, drying close on clothesline or on clothing racks, turning heating off at night, only heating or cooling the main living room or spaces used by children, and limiting hours to watch the television. The following quotes illustrate the use of many coping strategies by households:

"I take baths, do laundry and run the dishwasher after eleven because hydro is cheaper. I heat only one room in the house. Sometimes on a sunny day the attic gets warm so I open the hatch to let some heat in the garage."

- Survey #1097

"Rinse items before going in dishwasher so it runs less often, do less laundry and hang dry when possible, cook multiple items when oven on … freeze some, almost all lights converted to [LED] energy bulbs, more frequent cleaning of filters."

- Survey #381

"Not an issue of affording heating but accessing it as it is included in my rent, but they don't provide enough to be comfortable. I pay for my housing first, then medicine, then groceries with what is left."

-Survey participant #864

To not waste energy and save on costs, participants described the use of appliances during non-peak hours and weekends, investing in or participating in governmental programs to purchase energy efficient appliances and lightbulbs, making sure to turn off and unplug appliance when they were not in use, and making spending priorities. One participant reported intentionally charging electronic devices (cellphone and laptop) at work to decrease energy use at home.

6.4.3. Leaving dwelling to escape excess heat or cold

As presented in Table 9, participants reported leaving their dwelling to escape thermal discomfort. Indeed, 4.9% of participants reported leaving their dwelling during the cold season.

Participants that left their dwelling to escape thermal discomfort were asked to report on the locations they visited. During the cold season, participants went to the house of friends or relatives (78.0%); and public places (52.9%).

While most of the study pertains to thermal discomfort in the winter, i.e., experiencing cold temperatures in the dwelling, the experience of thermal discomfort during the warmer months is also worth considering. In fact, 21.0% of participants reported leaving their dwelling during the warm season. Participants most commonly went to the beach (79.6%); public places (e.g., public library, malls, and community centers) (65.8%); the park (46.9%); and the house of friends or relatives (45.3%).

Overall, a higher percentage of participants left their dwelling to escape thermal discomfort during the warm season compared to the cold season. Figure 4 presents the proportion of survey participants leaving their dwelling and visiting the locations listed in the survey. Public places were visited more often to escape excess heat, while the house of friends or relatives and work or school were more often visited to escape excess cold.

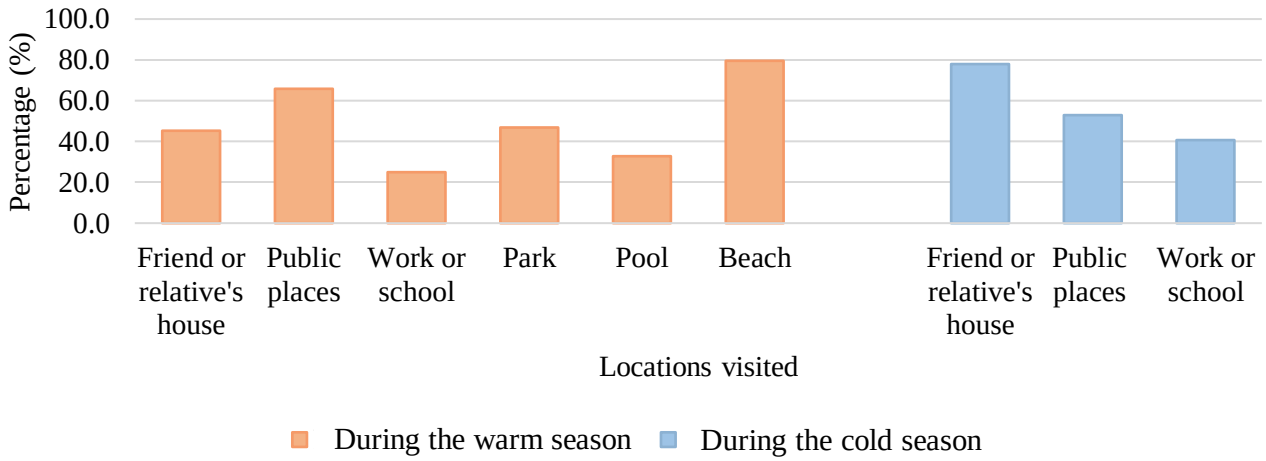

Figure 4. Percentage (%) of participants visiting given locations to escape thermal discomfort of

Beyond the options given in the survey, participants also reported other places that they would go to in order to escape the excess cold or heat they experienced in their dwelling. To escape the heat of their dwelling during the warm season and access air conditioning, participants mentioned going for drives and turning on the air conditioning in their car, intentionally going to the grocery

store, and going to the hospital. To escape the cold, participants spent time in the spaces of community organisations that support low-income households, went for a drive in a heated car, and visited roadside stores.

6.4.5. Analysing the use of the 'heat-or-eat' trade-off by socioeconomic characteristic

Finally, the results from the logistic regressions conducted to compute the associations between the 'heat or eat' trade-off and energy poverty, socioeconomic characteristics, and housing variables are presented in tables Table 13 and Table 14. The first table presents results from the logistic regressions using the 2M indicator (Table 13) and the second using the inability to afford to keep dwelling warm (Table 14).

Overall, using the 2M indicator, the odds ratios are lower than when using the inability to afford to keep dwelling warm. Participants facing energy poverty based on the 2M indicator were between 3.7 and 4.1 times more likely to resort to the coping strategies associated with the 'heat or eat' trade-off. Compared to men, women were 1.8 times more likely to cut back on food to afford utilities. Young adults were around two times more likely to resort to coping strategies related to the 'heat or eat' trade-off than participants between 35 and 64 years, while older adults were significantly less likely to resort to these coping strategies. Compared to participants with a university degree, participants having achieved lower levels of education were generally significantly more likely to resort to the 'heat or eat' trade-off. Participants with non-university post-secondary education were 2.2 times more likely to resort to the 'heat or eat' trade-off. Participants in dwelling in need of major repairs were 2.5 times more likely to cut back on utilities to afford groceries than participants in dwelling not in need of repairs. Household composition and tenure were not associated with the 'heat or eat' trade-off.

Compared to those not in energy poverty, participants unable to afford to keep their dwelling warm were 11.0 times more likely to cut back on food for utilities; 12.8 times more likely to cut back on utilities for food; and 10.3 times more likely to resort to the 'heat or eat' trade-off. Compared to participants aged between 19 and 34 years, young adults were 2.1 times more likely to cut back on food to pay for utilities; whereas older adults were significantly less likely to make trade-offs. Education and income level were also significantly associated with the trade-offs. Indeed, participants without a high school degree were 3.1 times more likely to cut back on groceries for utilities and 9.8 times more likely to cut back on utilities to pay for food.

Participants with an annual household income below $30,000 were 7.3 times more likely to resort to the 'heat or eat' trade-off than participants whose household income was at least $60,000. Tenure, and housing conditions were not or associated with the 'heat or eat' trade-off, or with marginal significance.

Table 13. Associations between the 'heat or eat' trade-off and energy poverty based on the 2M indicator, socioeconomic characteristics, and housing variables.

Variables	**Had to cut food for utilities**	**Had to cut back on utilities for food**	**Heat or eat**
	OR (95% CI)	OR (95% CI)	OR (95% CI)
In energy poverty (2M after housing costs)			
No	1.00	1.00	1.00
Yes	4.96** (2.34, 6.72)	4.14** (1.99, 8.62)	3.67** (2.19, 6.15)
Gender			
Men	1.00	1.00	1.00
Women	1.83* (1.08, 3.09)	1.49 (0.75, 2.92)	1.85* (1.10, 3.09)
Age category			
35 to 64 years	1.00	1.00	1.00
19-34 years	2.63* (1.25, 5.53)	2.72* (1.14, 6.51)	2.43* (1.16, 5.09)
≥65 years	0.37** (0.19, 0.70)	0.12** (0.04, 0.35)	0.31** (0.16, 0.58)
Education level			
University degree	1.00	1.00	1.00
Other post-secondary	2.22* (1.10, 4.50)	2.11 (0.79, 5.72)	1.96† (0.99, 3.88)
High school or less	4.20** (2.01, 8.79)	7.97** (3.11, 20.46)	4.04** (1.98, 8.23)
Household composition			
Couples w/out children	1.00	1.00	1.00
Couples with children	1.90† (0.99, 3.65)	2.29† (0.95, 5.53)	1.60 (0.84, 3.08)
Lone-parent household	2.03† (0.88, 4.70)	2.52 (0.79, 8.00)	2.54* (1.09, 5.89)
Person living alone	1.76 (0.88, 3.53)	0.90 (0.32, 2.53)	1.71 (0.86, 3.42)
Other	1.34 (0.59, 3.07)	1.41 (0.50, 3.96)	1.30 (0.57, 2.99)
Tenure			
Owner	1.00	1.00	1.00
Renter	1.30 (0.73, 2.31)	1.76 (0.87, 3.57)	1.51 (0.86, 2.63)
Need for repairs			
Regular maintenance	1.00	1.00	1.00
Minor repairs	1.51 (0.88, 2.58)	1.20 (0.56, 2.56)	1.47 (0.86, 2.51)
Major repairs	1.74 (0.85, 3.59)	2.67* (1.12, 6.38)	1.77 (0.88, 3.59)

Note: p-value below 0.10†, 0.05* and 0.01**

Table 14. Associations between the 'heat or eat' trade-off and energy poverty based on the ability to afford to keep the dwelling warm, socioeconomic characteristics, and housing variables.

Variables	Had to cut food for utilities	Had to cut back on utilities for food	Heat or eat
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Able to afford to keep dwelling warm			
Yes	1.00	1.00	1.00
No	11.11** (5.94, 20.78)	12.46** (6.09, 25.49)	10.33** (5.41, 19.73)
Gender			
Men	1.00	1.00	1.00
Women	1.64† (0.97, 2.80)	0.89 (0.45, 1.78)	1.49 (0.89, 2.48)
Age category			
35 to 64 years	1.00	1.00	1.00
19-34 years	2.16* (1.03, 4.55)	2.17† (0.92, 5.10)	1.83 (0.89, 3.80)
≥65 years	0.41** (0.22, 0.77)	0.14** (0.05, 0.36)	0.32** (0.17, 0.61)
Education level			
University degree	1.00	1.00	1.00
Other post-secondary	2.22* (1.06, 4.68)	1.74 (0.60, 5.03)	1.82† (0.91, 3.67)
High school or less	3.57** (1.63, 7.82)	8.25** (3.34, 20.38)	3.44** (1.69, 6.98)
Income level ($)			
>59,999	1.00	1.00	1.00
30,000-59,999	1.85* (1.02, 3.32)	1.52 (0.68, 3.37)	1.97* (1.11, 3.49)
<30,000	5.28** (2.15, 11.75)	5.90** (2.48, 14.01)	7.26** (3.31, 15.92)
Household composition			
Couples w/out children	1.00	1.00	1.00
Couples with children	1.86† (0.92, 3.76)	2.01 (0.79, 5.07)	1.53 (0.76, 3.07)
Lone-parent household	1.19 (0.48, 2.99)	1.18 (0.44, 3.20)	1.35 (0.57, 3.16)
Person living alone	1.02 (0.51, 2.06)	0.46† (0.19, 1.13)	0.78 (0.39, 1.57)
Other	0.86 (0.34, 2.14)	0.59 (0.18, 1.99)	0.75 (0.30, 1.88)
Tenure			
Owner	1.00	1.00	1.00
Renter	0.69 (0.36, 1.33)	1.58 (0.78, 3.20)	0.88 (0.47, 1.64)
Repairs needed			
Regular maintenance	1.00	1.00	1.00
Minor repairs	1.54 (0.91, 2.59)	1.40 (0.68, 2.88)	1.49 (0.89, 2.50)
Major repairs	1.57 (0.70, 3.49)	2.40† (0.92, 6.25)	1.68 (0.79, 3.72)

Note: p-value below 0.10†, 0.05* and 0.01**

7. DISCUSSION

Throughout my thesis, I have aimed to determine who experiences energy poverty in the Town of Bridgewater, Nova Scotia, and assess their coping strategies. To start, I measured the prevalence of energy poverty using various expenditure-based and self-reported indicators and described the housing and socioeconomic characteristics of households facing energy poverty. I also identified the strategies households implemented to cope with energy poverty, paying special attention to the 'heat or eat' trade-off to assess the distribution of the strategies across socioeconomic characteristics. I used data from a community-based survey in the Town of Bridgewater that was distributed in the spring of 2022. Through this survey, I had access to a breadth of data covering the energy use, coping strategies, housing conditions, and socioeconomic characteristics of a sample of the population of Bridgewater. While mostly quantitative data, some qualitative content was also collected and explored in my thesis. The survey was completed by 516 residents of the Town, representing over 10% of private dwellings following an extensive and successful data collection process.

Based on the vulnerability and the capabilities frameworks that guided my work, I was able to interpret my results and the ways they relate to each other for households in Bridgewater, Nova Scotia (see Figure 1, p.30). As will be described in the following sections, the ability to access or afford sufficient amounts of energy to meet one's needs is influenced by many factors, while also impacting the quality of life of individuals. My thesis offers insights on the socioeconomic and housing characteristics associated with a higher vulnerability to energy poverty, both in terms of increasing energy needs, limiting finances or flexibility, or compounding the ability to access energy. Likewise, through my analysis of coping strategies, I shed light on the capabilities of participants, noting their ability (or not) to improve their living conditions through such strategies. Finally, I aimed to explain the contextual factors that define the Town of Bridgewater, Nova Scotia, both as a community within an energy periphery, but also as a Town with agency that is trying to address the burden of energy poverty through *Energize Bridgewater*.

7.1. Summary and interpretation of main findings

7.1.1. Prevalence of energy poverty using various indicators

Depending on the expenditure-based indicator chosen, the proportion of households in the sample facing energy poverty ranged between 17.2% (when measured using the 10% threshold) to 45.9% (when using the 2M). A recent Canadian study measured that around 33% of households in Nova Scotia were in energy poverty using the 2M indicator after housing costs; and 13.0% using the 10% threshold before accounting for housing costs (Riva et al., 2021). The prevalence of energy poverty using expenditure-based measures presented in my thesis is higher to those computed for the province as a whole, pointing to a potentially higher burden of energy poverty in our sample from the Town of Bridgewater compared to the province as a whole. Different factors could help to explain this observation, namely Bridgewater being a small rural town within an energy periphery (Gibson et al., 2015; O'Sullivan et al., 2020; Roberts et al., 2015). Indeed, as described in my description of the context of thesis in chapter 4.2. and in the upcoming article by Riva, Debanné, et al. (forthcoming), factors such as the aging population in the town, the aging housing stock, lower incomes, and higher energy prices.

Using self-reported indicators, 20.5% of survey participants reported being unable to maintain an adequate temperature in their dwelling; 20.2% reported being unable to afford to keep their dwelling adequately warm; 15.2% reported indoor temperatures below WHO guidelines (below 18°C); and 20.6% and 7.6% reported, respectively, shivering and seeing their breath inside their dwelling because of the cold. Comparatively, another study computed that 12.7% of Canadian households were dissatisfied or very dissatisfied with their ability to maintain a comfortable temperature in the winter and 14.7% in the summer (Riva et al., 2023). To the best of my knowledge, my thesis, within the BridgES study, is the first Canadian study to assess energy poverty based on such a wide array of self-reported indicators. Indeed, we are the first to assess the self-reported inability to afford or access sufficient amounts of energy services to keep the dwelling warm and the physical discomforts associated with energy poverty (i.e., shivering inside, having a hard time sleeping, and seeing breath inside the dwelling because of the cold).

To understand why there are variations in the prevalence of energy poverty by indicator, we can think about the nature of these measures and how extreme of an experience of energy poverty they relate to. For example, the 10% measure is a higher threshold than the 2M measure, which currently sets the threshold at 5.4% in Canada. Likewise, being able to see your breath

inside your dwelling indicates a temperature around 10°C, which is colder than 18°C (i.e., below WHO guidelines) (Leahy, 2019; World Health Organization, 2018). These differences explain why the proportion of participants in the sample experiencing energy poverty is higher when using the 2M measure compared to the 10% threshold, and the percentage of participants reporting having seen their breath inside their home is lower than the percentage of households with usual indoor temperatures below WHO guidelines.

Considering the concordance between these indicators, 70% of the participants that reported shivering inside their dwelling and 85% of participants reporting being unable to afford to keep their dwelling adequately warm were in energy poverty according to the 2M indicator. Yet, only 35% of households in energy poverty using the 2M indicator considered themselves unable to afford their energy needs, which was the highest concordance between the indicator and the self-reported indicators used in this study. In their work on 'hidden,' 'measured,' and/or 'perceived' energy poverty, Meyer and colleagues found that 15% of households facing 'measured' energy poverty also experienced 'perceived' energy poverty; and less than 1% of households experienced all three forms of energy poverty (Meyer et al., 2018). Likewise, a Canadian study shows that 16.4% of households dissatisfied with their ability to maintain a comfortable temperature in winter experienced energy poverty based on the 2M indicator (Riva et al., 2023). While the concordances between the various indicators of energy poverty computed in my thesis is higher, my results align with these other studies, i.e., that each indicator illustrates a specific facet of energy poverty: energy burden, thermal discomfort, accessibility, energy inefficiency, or unaffordability. As has been noted in many studies on energy poverty, expenditure-based measures can underestimate the prevalence of energy poverty if households are intentionally limiting their energy use to save money (Meyer et al., 2018; Papada & Kaliampakos, 2016). Moreover, stigma around energy poverty and the normalization of one's living conditions could lead households spending a considerable share of their income on energy expenditures to feel uncomfortable reporting their experience or not recognising it as problematic (Longhurst & Hargreaves, 2019). Thus results from my study lend support to the importance of using multiple indicators of energy poverty within a study to present a more integrated portrait of the issue (Castaño-Rosa et al., 2019; Charlier & Legendre, 2021; Meyer et al., 2018; Siksnelyte-Butkiene et al., 2021; Thomson et al., 2017).

7.1.2. Socioeconomic and housing characteristics of participants facing energy poverty

The findings I present in my thesis show that the prevalence of energy poverty using different indicators varies based on socioeconomic and housing characteristics. Indeed, depending on indicator used, the proportion of participants living in households facing energy poverty was higher among women, young adults and/or older adults, people living along and/or households with children, low-income households, those with lower education levels, renters, and those living in older dwellings and dwelling in poorer conditions. Similar findings were observed in the results from the logistic regressions.

7.1.2.1. Socioeconomic characteristics

Considering the reported inability to afford their energy needs, women were twice as likely to be facing energy poverty compared to men, with 25.6% of women being in energy poverty. The higher prevalence of energy poverty among women has been reported in a number of international studies and reviews (Middlemiss, 2022; Robinson, 2019; Sánchez-Guevara Sánchez et al., 2020). Indeed, a paper on the feminisation of energy poverty in Madrid shows that 28.5% of households with women breadwinners experienced monetary and/or energy poverty in the city compared to 22.7% of all households (Sánchez-Guevara Sánchez et al., 2020). I want to briefly acknowledge some factors that might underlie this disparity. As has been noted in other international papers on energy poverty and gender (Ciciolla & Luthar, 2019; Núñez Peiró et al., 2021; Petrova & Simcock, 2021; Robinson, 2019), societal norms that support women being more involved in the management of their homes, income inequalities, and a lack of social responsibility are associated with women being more vulnerable to experiencing energy poverty, aware of the burden of energy poverty for their household, and responsible for managing the needs of household members. In an upcoming paper by Riva, Debanné, and colleagues, we assessed the relationship energy poverty and well-being using the same data from the BridgES study, demonstrating a gendered effect (Rive et al., forthcoming). Our findings suggest that the distribution of energy poverty and negative well-being implications is uneven, with women being increasingly vulnerable.

An intriguing finding from my thesis is the disparity observed in the prevalence of energy poverty by age groups. When using expenditure-based indicators, the prevalence of energy poverty was higher among older adults; when measured using self-reported indicators, it was

higher among young adults. As physiological thermoregulation changes over time, older adults become more sensitive and vulnerable to the cold (O'Sullivan, 2016). In their work on the experience of thermal discomfort among older adults in England, Day and Hitchings report that older adults described a more acute experience the cold (2011). Likewise, Chard and Walker studied the lived experience of older adults coping with energy poverty (2016). The article reveals some of the extreme measures undertaken by older adults to keep warm, such as turning the heating down or off, using thick curtains on windows, and wearing winter coats indoors. Yet, participants did not describe the use of coping strategies as negative, but as part of their normal routine and 'matter of fact' (Chard & Walker, 2016). Hence, the higher proportion of older adults with a higher energy burdens could point to this demographic wanting to maintain thermal comfort and warmth in their dwelling despite the cost. The lower energy burden among younger adults and higher proportion of them reporting experiences of energy poverty potentially suggest a limitation of energy spending at the expense of thermal comfort in this demographic group. These results align with other studies that have found younger adults more likely to experience energy poverty, normalise their sub-optimal living conditions, and undertake riskier behaviours to save money (Butler & Sherriff, 2017; Petrova, 2018). Furthermore, Charbonneau and colleagues (2006) found that many younger adults, especially university students, were often willing to live in dwellings in poor condition in order to be in a central location or to save money on rent. This trade-off would also be associated with living in dwellings that are less energy efficient, making them harder and more expensive to keep warm. Considering the classification explored in Meyer et al.'s work (2018), younger adults could be considered to be facing 'hidden' and 'perceived' energy poverty whereas older adults would be experiencing 'measured' energy poverty).

Similarly, the proportion of persons living alone facing energy poverty was higher than other household compositions using expenditure-based measures, whereas a higher proportion of households with children were identified as facing energy poverty when using self-reported indicators. Concerning people living alone, social isolation and living alone has been observed to be associated with energy poverty in other studies (Grossmann et al., 2021; Middlemiss et al., 2019; Riva et al., forthcoming). The cost of living for individuals living alone is much higher than for those living with others in households with multiple incomes and shared expenditures, which could explain the higher energy burden in the context of Bridgewater. The link between social isolation and energy poverty in Bridgewater is also explored in more detail in the

upcoming paper by Riva, myself, and colleagues (Riva et al., forthcoming). Our findings show that those experiencing energy poverty were more likely to be socially isolated or with limited social networks. Conversely, a higher proportion of households with children reported being unable to afford their energy needs or unable to maintain comfortable temperatures in their dwelling. These households appear more aware of their living conditions and experience of energy poverty, probably due to the health and well-being implications of energy poverty and the underdeveloped thermoregulation of children (K. O'Sullivan et al., 2016; K. C. O'Sullivan, 2019). International studies have also identified this association, explaining that parents and guardians are further burdened by energy expenditures and energy poverty (Brunner et al., 2012; McKague et al., 2016; O'Sullivan & Chisholm, 2020; Tod et al., 2016).

Within the sample, the proportion of participants in energy poverty was higher among households with lower education levels and with lower incomes. These results support prior research, namely synthesized in systematic reviews by Jessel and colleagues (2019) and Middlemiss (2022), and studies conducted across Canada (Das et al., 2022; Riva et al., 2021). Individuals with lower levels of education might struggle to navigate the bureaucracy and regulations associated with energy access and services (Jessel et al., 2019). Additionally, as household income is used when calculating energy poverty using expenditure-based indicators, the energy burden of low-income households is likely to be higher (Charlier & Legendre, 2021; Palmer et al., 2008). Beyond struggling to afford their utilities, households with lower incomes might also be unable to access and afford energy efficient housing options (Bouzarovski et al., 2018), as is assessed through the self-reported indicators of energy poverty used in my thesis.

7.1.2.2. Housing characteristics

Across all indicators, the proportion of renters facing energy poverty was observed to be significantly higher than among owners. Other studies have also highlighted this disparity, using both expenditure-based and self-reported indicators. Indeed, Riva and colleagues identify this same association at the national level in Canada using expenditure-based measures (Riva et al., 2021). A research report conducted in Ireland measured that the prevalence of energy poverty was higher among renters compared to home-owners using self-reported indicators, reporting inadequate levels of heat (Barrett et al., 2022). Barret and colleagues hypothesize that lower housing conditions and the correlation with other socioeconomic factors (such as younger adults

and lower incomes) could explain the disparity. Furthermore, as described by Bird & Hernández, the split incentive leads landlords to either increase rental prices when energy efficiency improvements are made, while also deterring them from undertaking such improvements as they will not directly benefit from them if they do not live in the buildings (Bird & Hernández, 2012). Hence, many renters cannot afford or access energy efficient dwellings, making them more likely to experience energy poverty.

Participants living in older dwellings and dwellings in need of repairs were more likely to experience energy poverty in the sample using all indicators. Similar findings have been noted in many international studies and papers (Bartiaux et al., 2021; Healy & Clinch, 2002; Petrova et al., 2013; Swope & Hernández, 2019). Housing conditions and energy efficiency have long been considered to directly influence energy poverty (Boardman, 1991), with older homes and dwellings in need of major repairs often being less energy efficient (Sharpe et al., 2018). The findings from my thesis align and support the literature, while also furthering our understanding of the burden of the old housing stock in Atlantic Canada and Nova Scotia (Beaton, 2004), a factor contributing to the peripherilization of the province (O'Sullivan et al., 2020; Riva et al., forthcoming). With the housing crisis continuing to threaten housing security in the province, efforts to increase housing conditions without leading to low-carbon gentrification would be needed to attain energy and housing justice in the province (Bouzarovski et al., 2018).

7.1.3. Strategies implemented by households to cope with energy poverty

To answer my third research objective, I assessed the use of coping strategies to alleviate the burden of energy poverty by 'keeping warm,' 'increasing energy efficiency,' 'limiting energy use,' and making 'financial trade-offs.' Results show that 12% of the sample used their oven to increase warmth in their dwelling, 9% hung blankets on door frames to insulate rooms, and 26% turned their heating off to save money. The proportion of participants using coping strategies was generally higher for participants reporting lower thermal comfort and difficulty affording energy services (self-reported indicators of energy poverty) compared to those with a high energy burden (expenditure-based measures of energy poverty). Within self-reported indicators, different categories of coping strategies were used more commonly; namely, the use of coping strategies used to 'keep warm' was higher among participants in energy poverty based on their reported inability to maintain warmth in their dwelling and reporting having shivered inside their home.

The use of ‘financial trade-offs’ was highest for those in energy poverty based on their inability to afford to keep their dwelling warm compared to all other indicators.

Overall, both active coping strategies (i.e., with the intentional purpose of addressing the problem) and avoidant coping strategies (i.e., with the purpose of eliminating stress) were used about equally to increase thermal comfort and decrease financial strain within the sample (Holahan & Moos, 1987). The coping strategies explored in my thesis relate to the classification proposed by Skinner and colleagues (2003) that was described in my literature review in chapter 2.5. One of the advantages of their classification is the way different coping strategies can fall within different classifications, as can be seen throughout the coping strategies used in my thesis. Indeed, coping strategies aimed at ‘keeping warm’ can be classified as ‘problem solving,’ and ‘accommodation’ as they provide momentary thermal comfort to the individual. Strategies to ‘increase energy efficiency’ are means of ‘problem solving’ as well as ‘self-reliance’ as they are intentional efforts to increase quality of life within the home. To ‘limit energy use,’ participants engage in ‘helplessness,’ ‘negotiation,’ and ‘submission’ as they are not sustainably alleviating energy poverty but are making sacrifices to make ends meet. ‘Trade-offs’ can be classified as ‘self-reliance’ and ‘negotiation’ since they are tangible expressions of priorities being set based on the resources of a household. Finally, participants reporting leaving their dwelling because of the heat or cold were ‘escaping,’ physically avoiding the space where they experience energy poverty.

Few studies have measured and compared the use of coping strategies using quantitative data. In a study conducted in a small town in Greece, researchers report that 65% of their sample restricted other essentials (i.e., food, water heating, lighting, appliances, medicine, and clothes) to meet their energy needs; with 15% cutting back on food (Balaskas et al., 2021). While the overall proportion cutting back on essentials is higher in their sample compared to what I observed (i.e., 35% of participants reporting having to juggle bills), the proportion of participants cutting back on food is double, at 31% in the Bridgewater sample. Furthermore, this paper also describes that 2% of their sample turned their heating off; and 29% only heated some part of their dwelling (Balaskas et al., 2021). Again, the proportions reported in my thesis for these coping strategies are considerably higher, with 26% turning their heating off and 53% heating some rooms only. Given the drastically different climatic, economic, and social conditions in these two small towns, one being in Greece and the other in Atlantic Canada, I will not overly extrapolate the

meaning of these differences except to say that coping with energy poverty might have become increasingly commonplace for those living in Bridgewater given the widespread burden of energy poverty within the community.

In the United States, Hernández and Laird analysed the use of coping strategies among households who had faced a disconnection notice (Hernández & Laird, 2021). Their findings show that as households receive more disconnection notices, they resort to more coping strategies, leading to more extreme sacrifices. The coping strategies examined in their study are: forgoing of necessities, maintaining unhealthy temperatures, and receiving energy assistance (Hernández & Laird, 2021). As I did not quantify the use of coping strategies per participant, I cannot fully compare my results with these findings. Nonetheless, I observe a similar pattern in my results: under the assumption that self-reported indicators of energy poverty refer to a more 'extreme' experience of energy poverty than the 2M indicator, we notice a superior use of coping strategies among those facing a more 'extreme' experience of energy poverty. In continuing to explore the data from the BridgES study in future work, replicating a similar quantitative analysis of coping strategies as that used by Hernández and Laird (2021) could be pertinent.

Considering socioeconomic variations, significant results indicate that, compared to men, women use more certain coping strategies to keep warm and to make financial trade-offs. As described above regarding the higher prevalence of energy poverty among women, these findings align with the literature that suggests women are having to cope with energy poverty more than men given an increased vulnerability to energy poverty and responsibility to be caretakers within their households (Ciciolla & Luthar, 2019; Núñez Peiró et al., 2021; Petrova & Simcok, 2021; Robinson, 2019). As women are more likely to be in households with children and responsible for their care (Robinson, 2019), these findings are also likely to be associated with the use of coping strategies being more common among households with children than other household compositions. In their qualitative study, Brunner and colleagues observed that households with children were less likely to limit their energy use in order to maintain adequate temperatures (Brunner et al., 2012), which differed from my findings. Indeed, participants living in households with children within my sample reported limiting their energy use more than others. My findings seem to further align with the study conducted by Tod and colleagues (2016), in which they report the common use of pre-payment meatures among parents, through which parents would be able to turn their heating off to exercise a sense of control. As both aforementioned studies used

qualitative methods (Brunner et al, 2012; Tod et al., 2016), and my work is quantitative, our results are illustrating the use of coping strategies at different scales. Furthermore, different contextual factors such as climate and social norms could be leading parents to prioritise their energy needs differently, choosing whether or not to limit energy use to save money.

The proportion of young adults using coping strategies was higher than older adults across every coping strategy. Again, these findings relate back to the discussion on the higher proportion of young adults facing energy poverty when using self-reported indicators than other age groups (see above). Sherriff and Butler offer a qualitative study on the lived experience of young adults facing energy poverty in Salford (United Kingdom) and discuss their use of coping strategies (2017). The results presented in my thesis, which are quantitative, compliment their work. They describe the ingenious ways young adults delt with energy poverty, also explaining the problematic ways they were willing to make some trade-offs in order to save money (Butler & Sherriff, 2017). The participants in their study reported using pre-payment meters and often choosing to disconnect themselves, which allowed them to maintain control despite the meters being a more expensive means of energy provision. Such risky behaviours would align with some of the findings I present, with a high proportion of young adults in the sample reporting to have limited their use of heating and making financial trade-offs.

Findings from the content analysis offer a broader look into the complex ways households are living with energy poverty and reveal how experiencing energy poverty can limit the scope of one's quality of life. Most notably, the participant that described making spending priorities to manage their finances showed the mental burden individuals have to deal with when having to meet their needs, and the potential sacrifices they are making. Likewise, the use of blankets on the window that then needed to be cleaned because of the formation of mould showed the layered experience of energy poverty, which compromised both thermal comfort and housing conditions.

Participants described coping strategies that had not been included in the survey, while also explaining in more detail how they resorted to multiple coping mechanisms to meet their needs. For example, additional strategies included staying in bed for long periods of time, using electricity during off-peak hours, and driving around with the air conditioning on to escape the heat. Some of these have been reported in other studies, such as staying in bed for long periods of time (Brunner et al., 2012; Chard & Walker, 2016; Harrison & Popke, 2011; Longhurst & Hargreaves, 2019; McKague et al., 2016) and limiting the use of the dryer (Longhurst &

Hargreaves, 2019). Other strategies were some I had not yet seen reported in the literature, especially those relating to 'third places' –i.e., places such as libraries, community centers, malls, or restaurants, which are outside of the home (first places) and the workplace (second places) (Oldenburg & Brissett, 1982).

To the best of my knowledge, Ambrose and colleagues were the first to make the link between energy poverty and third places (Ambrose et al., 2021). In their article, they observed the importance of third places among individuals as a way of coping with energy poverty and the ways the COVID-19 pandemic limited this option. Other papers reported spending time in second places, such as the homes of friends or family, or staying late at school or work (Harrison & Popke, 2011; Stojilovska et al., 2021; Tod et al., 2016). Longhurst and Hargreaves (2019) mention participants in their study going to public places with friends, but without making the direct link to the concept of 'third places.' Participants in the sample noted places I believe to be novel information, such as going to the hospital, community centers, and the grocery store to escape thermal discomfort in the dwelling.

7.1.4. The 'heat or eat' trade-off

Finally, an important contribution of my thesis is the exploration of the association between the 'heat or eat' trade-off and energy poverty in the Canadian context. Within the sample, 31.9% of respondents cut back on food to pay for utilities; 18.6% cut back on utilities for food; and 34.2% resorted to the 'heat or eat' trade-off. Participants in the survey who reported being unable to afford keeping their dwelling warm were more than ten times as likely to cut back on food to pay for utilities, and/or to cut back on utilities to pay for food; and resort to the 'heat or eat' trade-off than those not in energy poverty. Likewise, participants in energy poverty based on the 2M indicator were over three times more likely to resort to the 'heat or eat' trade-off than those not in energy poverty. Again, these findings suggest that self-reported indicators of energy poverty might present a more 'extreme' experience of energy poverty than the 2M indicator given the comparatively higher use of the 'heat or eat' trade-off.

Within the sample, women were more likely to cut back on food for utilities compared to men. These findings align with my previous discussion on the higher prevalence of energy poverty among women and the more common use of coping strategies given gendered inequalities and social expectations around care and domestic responsibilities (Ciciolla & Luthar, 2019; Núñez Peiró et al., 2021; Petrova & Simcok, 2021; Robinson, 2019). In most cases,

younger adults were more likely to resort to the ‘heat or eat’ trade-offs than middle-aged adults, while older adults were less likely to. As presented throughout this discussion, my findings point to younger adults engaging (or being forced to engage) in riskier behaviour when faced with energy poverty, such as limiting their energy use and heating and/or grocery expenditures to save money. Additionally, while the prevalence of energy poverty is higher amongst older adults, both in the sample (using expenditure-based measures) and across Canada (Riva et al., 2021), the results from the logistic regressions suggest that this demographic is less willing to sacrifice their thermal comfort and other expenses to alleviate the burden of energy poverty.

At first glance, the results, indicating older adults were less likely to resort to the ‘heat or eat’ trade-off, could seem to contradict other studies that analyse the use of coping strategies of older adults, as was done by Chard and Walker (2016) and Day and Hitchings (2011). However, my thesis is not analysing the use of coping strategies implemented by older adults, but how they compare to that of other age groups. I am not suggesting that older adults do not have to cope with energy poverty, but that their coping differs from that of younger aged adults within the sample, notably by having different priorities when it comes to needs and spending. Yet, in their study on the ‘heat or eat’ trade-off in the United Kingdom, Beatty and colleagues observed that older adults in low-income households were most likely to decrease their food spending during cold spells (Beatty et al., 2014). These results thus oppose those from my thesis, indicating that older adults in different contexts cope with energy poverty in different ways. My findings could inform our understanding of the capabilities of older adults in this context, with older adults demonstrating a limited ability or desire to adopt coping strategies at the expense of thermal comfort to lessen the financial burden of energy poverty.

In certain cases, couples with children were significantly more likely to resort to the use of these trade-offs than other household type. Notably, couples with children were around 1.9 times more likely to limit their spending on food to pay for energy compared to couples without children. In a qualitative study on the ‘heat or eat’ trade-off in the United Kingdom, Snell and colleagues (2018) describe that the decision-making of parents and guardians was more nuanced than what is often considered around ‘heat or eat’ trade-off. Participants in their study reported only heating when their kids were home and increasing spending when they had guardianship.

Participants with lower education levels and with lower household incomes were significantly more likely to resort to the ‘heat or eat’ trade-off than participants with a university

degree or with higher household incomes. Considering the correlation between lower education levels and lower income levels, these results reflect the limited disposable income available to many households, leading to hard decisions having to be made around spending priorities and sacrifices. Furthermore, apart from experiencing energy poverty, results from the logistic regressions indicate that income level and/or education level were the variable with the strongest associations with the trade-offs. This association is the most common one that has been noted in the literature. In fact, Battacharya and colleagues (2003) measured that while both higher and lower income households in the United States increased their fuel expenditures during cold spells during the winter, lower incomes households were consequently decreasing their food expenditures, which was not observed among higher income households. Likewise, Beatty and colleagues (2014) report that households in the poorest quarter in the United Kingdom were most likely to decrease their food consumption in response to the coldest weather, especially among older adults. And in a study on the 'heat or eat' trade-off in the United Kingdom, results indicate a decreased consumption of fruits and vegetables in households using pre-payment meters, which are most commonly used among low-income households (Burlinson et al., 2022). My thesis hence aligns with these other studies, suggesting lower-income households in yet another geographical context are more likely to resort to the 'heat or eat' trade-off than other income groups.

Findings around the 'heat or eat' trade-off in my thesis contribute to other work on the subject in Canada. To the best of my knowledge, only two other peer-reviewed studies have explored the 'heat or eat' trade-off in Canada (Emery et al., 2012; Fafard St-Germain & Tarasuk, 2018). In one study, the link between a rise in energy prices and a subsequent increase in food insecurity over a four-year period was analysed (Emery et al., 2012). A geographical and spatial disparity was observed, with Albertans being most likely to experience food insecurity; as well as homeowners compared to renters (Emery et al., 2012). My thesis does not offer a similar geographical consideration but does shed light on the experience within a specific community in Atlantic Canada. Furthermore, my results differ from Emery and colleagues (2012) as tenure had no significant association with the 'heat or eat' trade-off in the sample.

Fafard St-Germain and Tarasuk offer insights on the spending pattern of households facing food insecurity (2018). While not explicitly analysing the 'heat or eat' trade-off, energy expenditures were considered in the study within housing costs. Their findings suggest that

households facing food insecurity prioritize essential spending above other spending, leading to sacrifices being made to balance their finances (Fafard St-Germain & Tarasuk, 2018). Their work offers important insights as they consider housing, groceries, and healthcare, as well as transportation, leisure, and investments. My thesis is complimentary to this work, showing that beyond having to choose between essential vs non-essential spending, households are also having to make prioritizations within their basic needs, i.e., heating and eating. As was also noted by one participant in the BridgES sample, healthcare and medication could also be forgone when money was tight. The addition of qualitative data enriches the analysis of the 'heat or eat' trade-off I offer in my thesis. With the current state of inflation, and increasing energy and food prices, namely in Nova Scotia (Lam, 2023; Ziafati, 2023), the pressure on households to make spending priorities could be exacerbated.

Moreover, I want to stress the challenge of measuring a trade-off such as the 'heat or eat' trade-off. As described by other scholars and noted in my literature review (Chapter 2.5.1.) and my discussion, households facing energy poverty and financial hardships are having to make more complex trade-offs than the simplification assessed through 'heat or eat' (Snell et al., 2018; Fafard St-Germain & Tarasuk, 2018). In the survey, respondents were asked whether they had cut back on groceries to be able to pay for utilities, and vice-versa, from which I created a binary, compound variable. Given the significance of my results and the potential implications for well-being of the 'heat or eat' trade-off, it would be beneficial to dig deeper into this concept to assess both extent and depth within the context of Bridgewater and Canada. By extent, we can think of the different basic needs being cut at different times by households due to of limited finances, including health care, social outings, clothing, housing, etc. Depth would refer to a quantification and description of 'how much' is being sacrificed through both quantity and quality. Understanding how households make these decisions, and what and whose needs are being prioritized, would highlight the potential balancing act households are having to manage when having to live on limited budgets and guide aid programs that support households facing energy poverty. Furthermore, important benefits would be achieved by exploring the nexus between energy and food insecurity in Canada, as well as other forms of deprivation, opening the door for research collaborations between experts of these different yet interrelated topics.

7.2. Contributions to existing knowledge

Through this thesis, I trace a portrait of those experiencing energy poverty in the Town of Bridgewater, Nova Scotia using data from the BridgES study. This study is one of the first localised and in-depth analysis of energy poverty in a small town in Canada. I see this work as complementary to other studies that have quantified energy poverty at the national level (Das et al., 2022; Riva et al., 2021) and Rezaei's ethnographic work exploring the implications of energy justice in Indigenous communities in British Columbia (Rezaei, 2017). Along with these studies, results from my thesis could help to draw attention to energy poverty in Canada and put a face to the individuals and households unable to afford or access enough energy services to live healthy and dignified lives.

Using data collected through the BridgES study, I provide novel and relevant evidence on energy poverty at the local level, with also contribute to knowledge at the national and international levels. First, by measuring the concordance between indicators of energy poverty, I offer quantitative evidence suggesting we use multiple indicators of energy poverty in research. While scholars have suggested that using multiple indicators was good practice (Castaño-Rosa et al., 2019; Meyer et al., 2018; Okushima, 2017; Sokołowski et al., 2020; Tait, 2017), few studies had shown the necessity based on the low concordance levels between indicators, as was done in my thesis. Moreover, by measuring the associations between energy poverty and socioeconomic and housing variables, my thesis presents the diverse ways households experience and recognize energy poverty. Through this work, I hoped to offer a strong argument for the use of multiple indicators in Canadian research and policy if we hope to adequately track and tackle energy poverty in the country, as will be done in the Town of Bridgewater through BridgES as they continue to implement *Energize Bridgewater.* As has been suggested by other Canadian scholars (Das & Martiskainen, 2022; Riva et al., 2023), there is a need for national surveys to collect additional information pertaining to the energy security of Canadians in order to research to better assess the extent and depth of energy poverty across the country. Notably, data to compute energy poverty using a wider array of self-reported indicators, such as thermal comfort in the summer and winter.

Through my analysis on the coping strategies of households within the sample, I offer insights on the ways households consider they can manage their energy needs. While being ingenious at times, some coping strategies highlight the (sometimes) desperate situations

households are living in. Few studies on the coping strategies of households facing energy poverty have explored such a wide array of coping strategies using quantitative methods. To the best of my knowledge, my thesis is among the first to have measured the use of coping strategies based on the socioeconomic characteristics of respondents, namely in the Canadian context. My findings thus point to potential priorities of individuals when living and coping with energy poverty.

Lastly, my thesis contributes to our understanding of the 'heat or eat' trade-off in Canada along with the two studies that have previously explored the trade-off in the country (Emery et al., 2012; Fafard St-Germain & Tarasuk, 2018). My findings reveal that experiencing energy poverty is significantly associated with participants resorting to the 'heat or eat' trade-off, which had not yet been assessed in the country. I also present findings that indicate that certain socioeconomic characteristics are associated with a higher likelihood of resorting to the 'heat or eat' trade-off. These findings are especially relevant with the current state of inflation and rising food prices in Nova Scotia and the country as a whole (Lam, 2023; Ziafati, 2023).

7.3. Strengths and limitations

As with every research project, my thesis and its methods have its strengths and its limitations. The response to the survey was overwhelmingly positive. With 516 individuals having completed the survey, representing 13% of households in the Town, we were encouraged by the community's by-in and stunned by the response rate we achieved with the help of the municipality, local businesses, and community organisations. The sample size achieved contributes to the rigour of the BridgES study and my thesis. I still note that the data from this survey is from a sample of the population from one community in Nova Scotia, Canada. Results cannot be generalized to the whole province of Nova Scotia nor to other Canadian communities. Nevertheless, this work contributes to the body of literature on energy poverty and the coping strategies of households facing energy poverty, especially in the Canadian context.

A value of our research lies in the breadth of data that was collected through the survey, allowing to measure energy poverty using various expenditure-based and self-reported indicators, as well as to consider socioeconomic characteristics, housing variables, coping strategies, and well-being implications. Limited studies in Canada have used such extensive data from a community-based survey, this study being the most detailed on energy poverty in the country to

date. Additionally, as the survey permitted participants to qualify more extensively some of their answers to survey questions, this offered a broader look into the experience of energy poverty. While limited, the mixed of quantitative and qualitative data provided invaluable data, which can lead to the formation of new research questions to explore in the future.

While the profile of survey participants is mostly representative of the population of the Town of Bridgewater (see Appendix A), sampling errors are nonetheless possible. Despite our efforts, the sample had an underrepresentation of men, lone-parent households, individuals with lower education levels, renters, and people living in multi-unit apartment buildings which might explain the marginal and non-significance of certain results.

Some of the survey data was prone to error or bias. While measuring energy poverty based on expenditure-based measures, some data is missing or imprecise. Some participants living in rented dwellings indicated that their utilities were included in their rent payments. In this case, it was not possible for their share of energy expenditure to household income to be measured. While being a limitation of the study, this missing data also represents a limitation of expenditure-based measures of energy poverty in general. Additionally, some participants opted to report their income level category instead of their actual income. While their share of energy expenditures to household income was still measured using the midpoint of the income bracket, the ratio could be higher or lower than in reality. As mentioned in the methods and results sections, some socioeconomic variables were not specific within the survey. Namely, ability limitations were not explained in the survey. In future surveys, a clearer definition of ability limitations to explore the relation with energy poverty with more rigour would be valuable.

8. CONCLUSIONS

Through this thesis, I aimed to answer the questions: *Who faces energy poverty in the Town of Bridgewater, Nova Scotia? How do they cope?* I have answered these questions using data from a community-based survey completed by a considerable sample size within the Town of Bridgwater. My findings show that around 45% of households in the sample experienced energy poverty. Women, younger and older adults, people living along, households with children, low-income households, those with lower education levels, renters, and those living in older dwellings and dwelling in poorer conditions were more likely to experience energy poverty. To cope, participants reported using strategies aimed at increasing warmth at a personal level, increasing the energy efficiency of their dwelling, decreasing their energy use, and making financial trade-offs; with the use of coping strategies varying based on socioeconomic characteristics. Indeed, when looking at the 'heat or eat' trade-off, we observe that woman, young adults, households with children, and those with lower education and income levels were more likely to resort to this coping strategy.

As we come to the end of my thesis, I am thinking back on my literature review and the conceptual frameworks of vulnerability and capabilities that guided my thesis. At many scales, I have aimed to locate my thesis within geographical research, starting from geography as the study of the 'home' (Tuan, 1991). The home is one of the most intimate geographies we experience and should provide a healthy, safe, and comfortable place for us to live (Bonnefoy, 2007). As survey participants were asked about their ways of coping with energy poverty, they described altering their dwellings when it was not meeting their needs and leaving their dwelling to find comfort somewhere else. From the literature and my findings, we conclude that energy poverty acts as a barrier to healthy housing (Swope & Hernández, 2019). At a larger scale, my findings further the understanding of the province of Nova Scotia, including the Town of Bridgewater, as an energy periphery (Golubchikov & O'Sullivan, 2020; Riva et al., forthcoming). With vulnerability factors such as an aging housing stock and overall poorer housing conditions, lower incomes, rurality, and high cost of energy, it is somewhat not surprising to see that energy poverty represents such an important burden for individuals, households, and the community as a whole. Through an analysis of the distributional dimension of energy injustice, I have identified who experiences energy poverty in the Town of Bridgewater, while considering the larger

context of the municipality. Hopefully, this work will help guide efforts to create energy justice across all three dimensions, i.e., distributional, recognition, and procedural justice.

Indeed, my thesis offers important insights to the Town of Bridgwater as they aim to tackle energy poverty in their community, highlighting where the extent of energy poverty is greater among socioeconomic groups and housing types. Throughout the writing of my thesis, I shared results from my work with the Town in the form of conference presentations, posters, and the working draft of a journal article. Namely, the Town could focus efforts to alleviate energy poverty among young adults, renters, low-income households, households with children, and dwellings in poorer conditions. Furthermore, my analysis of the coping strategies identifies the ways individuals consider they are able to lessen the burden of energy poverty for their household. These findings reveal that many households are having to undertake extreme measures, such as the 'heat or eat' trade-off, to manage their needs and finances. From these findings, the Town can create new programs to support households facing energy poverty based on their needs, such as workshops on energy literacy, support negotiating with power companies, financial aid programs focused on energy expenditures, and energy efficiency improvement financing programs for lower income households and renters.

As Canada pursues a low-carbon energy transition, climate change threatens the health and well-being Canadians, and the housing crisis threatens the housing security of many, more research should explore the intersection between energy, housing, climate and health in the country. More research should explore how climate change and extreme weather events can exacerbate the experience of energy poverty. Continued research in Nova Scotia could explore the impacts of events such as the wildfires, ice storms, floods, and heat waves the province has experienced in the last few years (CBC News, 2023; Hollingsworth & Pickrell, 2023; Withers, 2022). Research projects similar to the BridgES study should be conducted in other communities around the country to draw a broader picture of energy poverty in Canada, continuing to put a face to those unable to afford their energy needs, as well as to assess the impacts of community-led intervention strategies. While more quantitative studies are needed to analyse energy poverty in the country, qualitative approaches would enrich our understanding of the issue and describe the lived experience of households facing energy poverty. If we hope to see Canada's energy transition be just, research should continue to assess policy and strategies tackling energy poverty in the country to identify effective solution pathways that bring all Canadians toward energy

security. Such research would also steer governments at the municipal, provincial and national level through the implementation of inclusive and relevant energy policies.

REFERENCES

Adger, W. N. (2006). Vulnerability. *Global Environmental Change*, *16*(3), 268–281. https://doi.org/10.1016/j.gloenvcha.2006.02.006

Ambrose, A., Baker, W., Sherriff, G., & Chambers, J. (2021). Cold comfort: Covid-19, lockdown and the coping strategies of fuel poor households. *Energy Reports*, *7*, 5589–5596. Scopus. https://doi.org/10.1016/j.egyr.2021.08.175

Anderson, W., White, V., & Finney, A. (2012). Coping with low incomes and cold homes. *Energy Policy*, *49*, 40–52. https://doi.org/10.1016/j.enpol.2012.01.002

Arsenault, C. (2021, February 12). COVID-19 prompts a spike in Nova Scotia home prices. *The Globe and Mail*. https://www.theglobeandmail.com/business/economy/article-covid-19-prompts-a-spike-in-nova-scotia-home-prices/

Awaworyi Churchill, S., & Smyth, R. (2020). Ethnic diversity, energy poverty and the mediating role of trust: Evidence from household panel data for Australia. *Energy Economics*, *86*, 104663. https://doi.org/10.1016/j.eneco.2020.104663

Awaworyi Churchill, S., & Smyth, R. (2021). Energy poverty and health: Panel data evidence from Australia. *Energy Economics*, *97*, 105219. https://doi.org/10.1016/j.eneco.2021.105219

Baka, J., & Vaishnava, S. (2020). The evolving borderland of energy geographies. *Geography Compass*, *14*(7), e12493. https://doi.org/10.1111/gec3.12493

Balaskas, A., Papada, L., Katsoulakos, N., Damigos, D., & Kaliampakos, D. (2021). Energy poverty in the mountainous town of Metsovo, Greece. *Journal of Mountain Science*, *18*(9), 2240–2254. Scopus. https://doi.org/10.1007/s11629-020-6436-1

Barrett, M., Farrell, N., & Roantree, B. (2022). Energy poverty and deprivation in Ireland. Research Series.

Bartiaux, F., Day, R., & Lahaye, W. (2021). Energy Poverty as a Restriction of Multiple Capabilities: A Systemic Approach for Belgium. *Journal of Human Development and Capabilities*, *22*(2), 270–291. https://doi.org/10.1080/19452829.2021.1887107

Beaton, E. (2004). *Housing in Atlantic Canada: The poverty factor i Director of the Centre for Housing Initiatives*.

Beatty, T. K. M., Blow, L., & Crossley, T. F. (2014). Is There a 'Heat-or-Eat' Trade-Off in the UK? Journal of the Royal Statistical Society Series A: Statistics in Society, 177(1), 281–294. https://doi.org/10.1111/rssa.12013

Bednar, D., & Reames, T. (2020). Recognition of and response to energy poverty in the United States. *Nature Energy*, *5*, 1–8. https://doi.org/10.1038/s41560-020-0582-0

Bhattacharya, J., DeLeire, T., Haider, S., & Currie, J. (2003). Heat or Eat? Cold-Weather Shocks and Nutrition in Poor American Families. *American Journal of Public Health*, *93*(7), 1149–1154. https://doi.org/10.2105/AJPH.93.7.1149

Bird, S., & Hernández, D. (2012). Policy options for the split incentive: Increasing energy efficiency for low-income renters. *Energy Policy*, *48*, 506–514. https://doi.org/10.1016/j.enpol.2012.05.053

Bligh, D. C., & Ismet Ugursal, V. (2012). Extended exergy analysis of the economy of Nova Scotia, Canada. *Energy*, *44*(1), 878–890. https://doi.org/10.1016/j.energy.2012.04.061

Boardman, B. (1991). *Fuel poverty: From cold homes to affordable warmth*. Pinter Pub Limited.

Boardman, B. (2009). *Fixing Fuel Poverty | Challenges and Solutions* (1st Edition). Routledge. https://www.taylorfrancis.com/books/mono/10.4324/9781849774482/fixing-fuel-poverty-brenda-boardman

Bonnefoy, X. (2007). Inadequate housing and health: An overview. *International Journal of Environment and Pollution*, *30*(3–4), 411–429.

Bouzarovski, S. (2014). Energy poverty in the European Union: Landscapes of vulnerability. *WIREs Energy and Environment*, *3*(3), 276–289. https://doi.org/10.1002/wene.89

Bouzarovski, S., Frankowski, J., & Herrero, S. T. (2018). Low-Carbon Gentrification: When Climate Change Encounters Residential Displacement. *International Journal of Urban and Regional Research*, *42*(5), 845–863. https://doi.org/10.1111/1468-2427.12634

Bouzarovski, S., & Petrova, S. (2015). A global perspective on domestic energy deprivation: Overcoming the energy poverty–fuel poverty binary. *Energy Research & Social Science*, *10*, 31–40. https://doi.org/10.1016/j.erss.2015.06.007

Bouzarovski, S., Petrova, S., & Tirado-Herrero, S. (2014). *From Fuel Poverty to Energy Vulnerability: The Importance of Services, Needs and Practices.*

Bouzarovski, S., & Simcock, N. (2017). Spatializing energy justice. *Energy Policy*, *107*, 640–648. https://doi.org/10.1016/j.enpol.2017.03.064

Bouzarovski, S., Thomson, H., & Cornelis, M. (2021). Confronting Energy Poverty in Europe: A Research and Policy Agenda. *Energies*, *14*(4), Article 4. https://doi.org/10.3390/en14040858

Bouzarovski, S., & Tirado Herrero, S. (2017). Geographies of injustice: The socio-spatial determinants of energy poverty in Poland, the Czech Republic and Hungary. *Post-Communist Economies*, *29*(1), 27–50.

Bradshaw, J., & Hutton, S. (1983). Social policy options and fuel poverty. *Journal of Economic Psychology*, *3*(3), 249–266. https://doi.org/10.1016/0167-4870(83)90005-3

Brown, M. A., Soni, A., Lapsa, M. V., Southworth, K., & Cox, M. (2020). High energy burden and low-income energy affordability: Conclusions from a literature review. *Progress in Energy*, *2*(4), 042003. https://doi.org/10.1088/2516-1083/abb954

Brunner, K.-M., Spitzer, M., & Christanell, A. (2012). Experiencing fuel poverty. Coping strategies of low-income households in Vienna/Austria. *Energy Policy*, *49*, 53–59. https://doi.org/10.1016/j.enpol.2011.11.076

Burholt, V., & Windle, G. (2006). Keeping warm? Self-reported housing and home energy efficiency factors impacting on older people heating homes in North Wales. *Energy Policy*, *34*(10), 1198–1208. Scopus. https://doi.org/10.1016/j.enpol.2004.09.009

Burlinson, A., Davillas, A., & Law, C. (2022). Pay (for it) as you go: Prepaid energy meters and the heat-or-eat dilemma. *Social Science & Medicine*, *315*, 115498. https://doi.org/10.1016/j.socscimed.2022.115498

Butler, D., & Sherriff, G. (2017). 'It's normal to have damp': Using a qualitative psychological approach to analyse the lived experience of energy vulnerability among young adult households. *Indoor and Built Environment*, *26*(7), 964–979. Scopus. https://doi.org/10.1177/1420326X17708018

Calvert, K. (2016). From ‘energy geography’ to ‘energy geographies’: Perspectives on a fertile academic borderland. Progress in Human Geography, 40(1), 105–125. https://doi.org/10.1177/0309132514566343

Campbell K. Even without carbon tax, heating oil still the most expensive way to heat your home. CBC [Internet]. 2023 Oct 31 [cited 2023 Nov 29]; Available from: https://www.cbc.ca/news/canada/prince-edward-island/heating-oil-carbon-tax-pei-1.7012855

Canada Energy Regulator. (2021, March 17). *Provincial and Territorial Energy Profiles – Nova Scotia*. https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-nova-scotia.html

Castaño-Rosa, R., Solís-Guzmán, J., Rubio-Bellido, C., & Marrero, M. (2019). Towards a multiple-indicator approach to energy poverty in the European Union: A review. *Energy and Buildings*, *193*, 36–48. https://doi.org/10.1016/j.enbuild.2019.03.039

CBC News. (2023, January 16). Freezing rain causes power outages throughout N.S. | CBC News. *CBC*. https://www.cbc.ca/news/canada/nova-scotia/power-outages-nova-scotia-1.6715110

Charbonneau, P., Johnson, L. C., & Andrey, J. (2006). Characteristics of university student housing and implications for urban development in mid-sized cities. Canadian Journal of Urban Research, 15(2), 278–300.

Chard, R., & Walker, G. (2016). Living with fuel poverty in older age: Coping strategies and their problematic implications. *Energy Research and Social Science*, *18*, 62–70. Scopus. https://doi.org/10.1016/j.erss.2016.03.004

Charlier, D., & Legendre, B. (2021). Fuel poverty in industrialized countries: Definition, measures and policy implications a review. *Energy*, *236*, 121557. https://doi.org/10.1016/j.energy.2021.121557

Charlier, D., Risch, A., & Salmon, C. (2015). Les indicateurs de la précarité énergétique en France. *Revue française d'économie*, *XXX*(4), 187–230. https://doi.org/10.3917/rfe.154.0187

Ciciolla, L., & Luthar, S. S. (2019). Invisible Household Labor and Ramifications for Adjustment: Mothers as Captains of Households. *Sex Roles*, *81*(7–8), 467–486. https://doi.org/10.1007/s11199-018-1001-x

Clark, I. K. H., Chun, S., O'Sullivan, K. C., & Pierse, N. (2022). Energy Poverty among Tertiary Students in Aotearoa New Zealand. *Energies*, *15*(1), Article 1. https://doi.org/10.3390/en15010076

CMHC. (2022, July 19). *National Occupancy Standard*. Canada Mortgage and Housing Corporation. https://www.cmhc-schl.gc.ca/professionals/industry-innovation-and-leadership/industry-expertise/affordable-housing/provincial-territorial-agreements/investment-in-affordable-housing/national-occupancy-standard

Cnockaert, J. (2022, March 2). Canada's economy may not benefit from spike in oil prices, say economists. The Hill Times. https://www.hilltimes.com/story/2022/03/02/canadas-economy-may-not-benefit-from-spike-in-oil-prices-say-economists/230022/

Cramer, P. (1998). Coping and Defense Mechanisms: What's the Difference? *Journal of Personality*, *66*(6), 919–946. https://doi.org/10.1111/1467-6494.00037

Cronin de Chavez, A. (2017). The triple-hit effect of disability and energy poverty. In N. Simcock, H. Thomson, S. Petrova, & S. Bouzarovski (Eds.), *Energy poverty and vulnerability* (p. 169).

Cuerdo-Vilches, T., Navas-Martín, M. Á., & Oteiza, I. (2021). Behavior patterns, energy consumption and comfort during COVID-19 lockdown related to home features, socioeconomic factors and energy poverty in Madrid. *Sustainability (Switzerland)*, *13*(11). Scopus. https://doi.org/10.3390/su13115949

CUSP. (2019). *Energy Poverty in Canada: A CUSP Backgrounder*. CUSP. https://energypoverty.ca/backgrounder.pdf

Das, R. R., & Martiskainen, M. (2022). *Keeping the Lights On: Ensuring energy affordability, equity, and access in the transition to clean electricity in Canada*. David Suzuki Foundation. https://davidsuzuki.wpenginepowered.com/wp-content/uploads/2022/10/DSF_Keeping-Lights-On_Das-Martiskainen_Oct2022_Final.pdf

Das, R. R., Martiskainen, M., Bertrand, L. M., & MacArthur, J. L. (2022). A review and analysis of initiatives addressing energy poverty and vulnerability in Ontario, Canada. *Renewable and Sustainable Energy Reviews*, *165*, 112617. https://doi.org/10.1016/j.rser.2022.112617

Das, R. R., Martiskainen, M., & Li, G. (2022). Quantifying the prevalence of energy poverty across Canada: Estimating domestic energy burden using an expenditures approach. *The Canadian Geographer / Le Géographe Canadien*, *n/a*(n/a). https://doi.org/10.1111/cag.12750

Day, R., & Hitchings, R. (2011). 'Only old ladies would do that': Age stigma and older people's strategies for dealing with winter cold. *Health & Place*, *17*(4), 885–894. https://doi.org/10.1016/j.healthplace.2011.04.011

Day, R., Walker, G., & Simcock, N. (2016). Conceptualising energy use and energy poverty using a capabilities framework. *Energy Policy*, *93*, 255–264. https://doi.org/10.1016/j.enpol.2016.03.019

Department for Energy Security & Net Zero. (2023). Annual Fuel Poverty Statistics in England, 2023 (2022 data). National Statistics, England.

Dogan, E., Madaleno, M., & Taskin, D. (2021). Which households are more energy vulnerable? Energy poverty and financial inclusion in Turkey. *Energy Economics*, *99*, 105306. https://doi.org/10.1016/j.eneco.2021.105306

Dunn, J. R., Hayes, M. V., Hulchanski, J. D., Hwang, S. W., & Potvin, L. (2006). Housing as a Socio-Economic Determinant of Health: Findings of a National Needs, Gaps and Opportunities Assessment. *Canadian Journal of Public Health = Revue Canadienne de Santé Publique*, *97*(Suppl 3), S12–S17. https://doi.org/10.1007/BF03405392

Dupuis, A., & Thorns, D. C. (1998). Home, Home Ownership and the Search for Ontological Security. *The Sociological Review*, *46*(1), 24–47. https://doi.org/10.1111/1467-954X.00088

Emery, J. C. H., Bartoo, A. C., Matheson, J., Ferrer, A., Kirkpatrick, S. I., Tarasuk, V., & McIntyre, L. (2012). Evidence of the Association between Household Food Insecurity and Heating Cost Inflation in Canada, 1998-2001. *Canadian Public Policy / Analyse de Politiques*, *38*(2), 181–215. https://www.jstor.org/stable/41756754

Energize Bridgewater. (2023). *McGill University and Energize Bridgewater release report on energy needs, housing, and well-being*.

Fafard St-Germain, A.-A., & Tarasuk, V. (2018). Prioritization of the essentials in the spending patterns of Canadian households experiencing food insecurity. *Public Health Nutrition*, *21*(11), 2065–2078. https://doi.org/10.1017/S1368980018000472

Fell, M. J. (2017). Energy services: A conceptual review. *Energy Research & Social Science*, *27*, 129–140. https://doi.org/10.1016/j.erss.2017.02.010

Fell, M. J., Pagel, L., Chen, C., Goldberg, M. H., Herberz, M., Huebner, G. M., Sareen, S., & Hahnel, U. J. J. (2020). Validity of energy social research during and after COVID-19: Challenges, considerations, and responses. *Energy Research & Social Science*, *68*, 101646. https://doi.org/10.1016/j.erss.2020.101646

Fowler, T., Southgate, R. J., Waite, T., Harrell, R., Kovats, S., Bone, A., Doyle, Y., & Murray, V. (2015). Excess winter deaths in Europe: A multi-country descriptive analysis. The European Journal of Public Health, 25(2), 339–345.

Frydenberg, E. (2014). Coping research: Historical background, links with emotion, and new research directions on adaptive processes. *Australian Journal of Psychology*, *66*(2), 82–92. https://doi.org/10.1111/ajpy.12051

Füssel, H.-M. (2007). Vulnerability: A generally applicable conceptual framework for climate change research. *Global Environmental Change*, *17*(2), 155–167. https://doi.org/10.1016/j.gloenvcha.2006.05.002

Gaede, J., Nippard, A., Haley, B., & Linders, A. (2022). *2022 Canadian Energy Efficiency Scorecard: Provinces and Territories*. Efficiency Canada, Carleton University.

Galea, S., & Tracy, M. (2007). Participation Rates in Epidemiologic Studies. *Annals of Epidemiology*, *17*(9), 643–653. https://doi.org/10.1016/j.annepidem.2007.03.013

Garvey, A., Norman, J. B., Büchs, M., & Barrett, J. (2022). A “spatially just” transition? A critical review of regional equity in decarbonisation pathways. *Energy Research & Social Science*, *88*, 102630. https://doi.org/10.1016/j.erss.2022.102630

Gatrell, A. C., & Elliott, S. J. (2014). *Geographies of Health: An Introduction*. John Wiley & Sons.

Gibson, R., Fitzgibbons, J., & Nunez, N. R. (2015). *State of Rural Canada 2021: Opportunities, Recovery, and Resiliency in Changing Times* (pp. 65–72). Canadian Rural Revitalization Foundation.

Golubchikov, O., & O’Sullivan, K. (2020). Energy periphery: Uneven development and the precarious geographies of low-carbon transition. *Energy and Buildings*, *211*, 109818. https://doi.org/10.1016/j.enbuild.2020.109818

Graff, M., Carley, S., Konisky, D. M., & Memmott, T. (2021). Which households are energy insecure? An empirical analysis of race, housing conditions, and energy burdens in the United States. *Energy Research & Social Science*, *79*, 102144. https://doi.org/10.1016/j.erss.2021.102144

Graff, M., Konisky, D. M., Carley, S., & Memmott, T. (2022). Climate change and energy insecurity: A growing need for policy intervention. *Environmental Justice*, *15*(2), 76–82.

Green, K. P., Jackson, T., Herzog, I., & Palacios, M. (2016). *Energy Costs and Canadian Households: How much are we spending?* Fraser Institute.

Grossmann, K., Jiglau, G., Dubois, U., Sinea, A., Martín-Consuegra, F., Dereniowska, M., Franke, R., Guyet, R., Horta, A., Katman, F., Papamikrouli, L., Castaño-Rosa, R., Sandmann, L., Stojilovska, A., & Varo, A. (2021). The critical role of trust in

experiencing and coping with energy poverty: Evidence from across Europe. *Energy Research & Social Science*, *76*, 102064. https://doi.org/10.1016/j.erss.2021.102064

Harrison, C., & Popke, J. (2011). "Because You Got to Have Heat": The Networked Assemblage of Energy Poverty in Eastern North Carolina. *Annals of the Association of American Geographers*, *101*(4), 949–961. https://doi.org/10.1080/00045608.2011.569659

Health Canada. (2018, November 23). *Knowledge Translation Planner* [Education and awareness]. https://www.canada.ca/en/health-canada/corporate/about-health-canada/reports-publications/grants-contributions/knowledge-transfer-planner.html

Healy, J. D. (2017). *Housing, Fuel Poverty and Health: A Pan-European Analysis*. Routledge.

Healy, J. D., & Clinch, J. P. (2002a). Fuel poverty in Europe: A cross-country analysis using a new composite measurement, Environmental Studies Research Series. *University College Dublin*.

Healy, J. D., & Clinch, J. P. (2002b). Fuel poverty, thermal comfort and occupancy: Results of a national household-survey in Ireland. *Applied Energy*, 15.

Healy, J. D., & Clinch, J. P. (2004). Quantifying the severity of fuel poverty, its relationship with poor housing and reasons for non-investment in energy-saving measures in Ireland. *Energy Policy*, *32*(2), 207–220. https://doi.org/10.1016/S0301-4215(02)00265-3

Hernández, D. (2016). Understanding 'energy insecurity' and why it matters to health. *Social Science & Medicine*, *167*, 1–10. https://doi.org/10.1016/j.socscimed.2016.08.029

Hernández, D., & Laird, J. (2021). Surviving a Shut-Off: U.S. Households at Greatest Risk of Utility Disconnections and How They Cope. *American Behavioral Scientist*. Scopus. https://doi.org/10.1177/00027642211013401

Hills, J. (2012). *Getting the measure of fuel poverty: Final Report of the Fuel Poverty Review*.

Holahan, C. J., & Moos, R. H. (1987). Personal and contextual determinants of coping strategies. *Journal of Personality and Social Psychology*, *52*, 946–955. https://doi.org/10.1037/0022-3514.52.5.946

Hollingsworth, P., & Pickrell, A. (2023, July 7). Heat warnings in effect across the Maritimes to kick off the weekend. *CTV News Atlantic*. https://atlantic.ctvnews.ca/heat-warnings-in-effect-across-the-maritimes-to-kick-off-the-weekend-1.6471235

Housing Nova Scotia. (2022). *Housing Nova Scotia*. https://housing.novascotia.ca/

Howden-Chapman, P., Viggers, H., Chapman, R., O'Sullivan, K., Telfar Barnard, L., & Lloyd, B. (2012). Tackling cold housing and fuel poverty in New Zealand: A review of policies, research, and health impacts. *Energy Policy*, *49*, 134–142. https://doi.org/10.1016/j.enpol.2011.09.044

Huber, M. (2015). Theorizing Energy Geographies. Geography Compass, 9(6), 327–338. https://doi.org/10.1111/gec3.12214

Hughes, L. (2010). Eastern Canadian crude oil supply and its implications for regional energy security. *Energy Policy*, *38*(6), 2692–2699. https://doi.org/10.1016/j.enpol.2010.01.015

Infrastructure Canada. (2020, August 26). *Infrastructure Canada—Smart Cities Challenge*. https://www.infrastructure.gc.ca/cities-villes/index-eng.html

Isherwood, B. C., & Hancock, R. M. (1979). Household expenditure on fuel: Distributional aspects. *Economic Adviser's Office, DHSS, London*.

Ivanova, D., & Middlemiss, L. (2021). Characterizing the energy use of disabled people in the European Union towards inclusion in the energy transition. *Nature Energy*, *6*(12), 1188–1197.

Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. *Energy Research & Social Science*, *11*, 174–182. https://doi.org/10.1016/j.erss.2015.10.004

Jenkins, K., Sovacool, B. K., & McCauley, D. (2018). Humanizing sociotechnical transitions through energy justice: An ethical framework for global transformative change. *Energy Policy*, *117*, 66–74. https://doi.org/10.1016/j.enpol.2018.02.036

Jenkins, K., Spruit, S., Milchram, C., Höffken, J., & Taebi, B. (2020). Synthesizing value sensitive design, responsible research and innovation, and energy justice: A conceptual review. *Energy Research & Social Science*, *69*, 101727. https://doi.org/10.1016/j.erss.2020.101727

Jessel, S., Sawyer, S., & Hernández, D. (2019). Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature. *Frontiers in Public Health*, *7*, 357. https://doi.org/10.3389/fpubh.2019.00357

Kantamneni, A. (2021, December 13). A national energy poverty strategy for Canada? *Efficiency Canada*. https://www.efficiencycanada.org/national-energy-poverty-strategy/

Kantamneni, A., & Haley, B. (2022). Efficiency for All: A review of provincial/territorial low-income energy efficiency programs with lessons for federal policy in Canada. Efficiency Canada, Carleton University.

Kawar, R. (2019). Passive House Standard: A Strategic Mean for Building Affordable Sustainable Housing in Nova Scotia. In T. Walker, C. Krosinsky, L. N. Hasan, & S. D.

Kibsey (Eds.), *Sustainable Real Estate: Multidisciplinary Approaches to an Evolving System* (pp. 347–378). Springer International Publishing. https://doi.org/10.1007/978-3-319-94565-1_14

Kimemia, D., Vermaak, C., Pachauri, S., & Rhodes, B. (2014). Burns, scalds and poisonings from household energy use in South Africa: Are the energy poor at greater risk? *Energy for Sustainable Development*, *18*, 1–8. https://doi.org/10.1016/j.esd.2013.11.011

Kingunza Makasi, S. (2023). *Energy poverty: Understanding its impact on hospitalization among Canadian adults aged 40 and older* [Master's thesis]. McGill University.

Klinenberg, E. (2016). Social Isolation, Loneliness, and Living Alone: Identifying the Risks for Public Health. *American Journal of Public Health*, *106*(5), 786–787. https://doi.org/10.2105/AJPH.2016.303166

Kothari, A., & Wathen, C. N. (2017). Integrated knowledge translation: Digging deeper, moving forward. *J Epidemiol Community Health*, *71*(6), 619–623.

Krieger, J., & Higgins, D. L. (2002). Housing and health: Time again for public health action. *American Journal of Public Health*, *92*(5), 758–768.

Kutuka, S., Riva, M., Breau, S., Kaiser, D., O'Sullivan, K. C., & Winter, M. (forthcoming). The association between energy poverty and cardiovascular hospitalizations in Canada.

Kwon, H. J., & Jang, M. (2017). Housing quality, health and fuel poverty among U.S. seniors. *Indoor and Built Environment*, *26*(7), 951–963. https://doi.org/10.1177/1420326X17710807

Lam, A. (2023). N.S. inflation slows to 4.6% in March, but food, housing prices expected to remain high. *CBC*. https://www.cbc.ca/news/canada/nova-scotia/nova-scotia-inflation-slows-food-and-housing-remain-high-1.6820555

Leahy, B. (2019, June 18). Weather questions: How cold does it have to be to see your breath? *NZ Herald*. https://www.nzherald.co.nz/nz/weather-questions-how-cold-does-it-have-to-be-to-see-your-breath/PRDKYWVITOISJ42A62JLPTZXLE/

Legendre, B., & Ricci, O. (2015). Measuring fuel poverty in France: Which households are the most fuel vulnerable? *Energy Economics*, *49*, 620–628. https://doi.org/10.1016/j.eneco.2015.01.022

Liddell, C., & Guiney, C. (2015). Living in a cold and damp home: Frameworks for understanding impacts on mental well-being. *Public Health*, *129*(3), 191–199. https://doi.org/10.1016/j.puhe.2014.11.007

Liddell, C., & Morris, C. (2010). Fuel poverty and human health: A review of recent evidence. *Energy Policy*, *38*(6), 2987–2997. https://doi.org/10.1016/j.enpol.2010.01.037

Liddell, C., Morris, C., McKenzie, S. J. P., & Rae, G. (2012). Measuring and monitoring fuel poverty in the UK: National and regional perspectives. *Energy Policy*, *49*, 27–32. https://doi.org/10.1016/j.enpol.2012.02.029

Liu, E., & Judd, B. (2019). Regional variations in the experiences of energy poverty across Australia. *Energy and Buildings*, *196*, 293–298. https://doi.org/10.1016/j.enbuild.2019.05.023

Longhurst, N., & Hargreaves, T. (2019). Emotions and fuel poverty: The lived experience of social housing tenants in the United Kingdom. *Energy Research & Social Science*, *56*, 101207. https://doi.org/10.1016/j.erss.2019.05.017

MacArthur, J. L., Hoicka, C. E., Castleden, H., Das, R., & Lieu, J. (2020). Canada's Green New Deal: Forging the socio-political foundations of climate resilient infrastructure? *Energy Research & Social Science*, *65*, 101442. https://doi.org/10.1016/j.erss.2020.101442

Mallett, S. (2004). Understanding Home: A Critical Review of the Literature. *The Sociological Review*, *52*(1), 62–89. https://doi.org/10.1111/j.1467-954X.2004.00442.x

Marmot, M., & Team, M. R. (2011). *The Health Impacts of Cold Homes and Fuel Poverty (2011)*.

Mayo Clinic Staff. (2021, June 8). *Humidifiers: Ease skin, breathing symptoms*. Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/common-cold/in-depth/humidifiers/art-20048021

McIntyre, L., Wu, X., Fleisch, V. C., & Herbert Emery, J. C. (2016). Homeowner versus non-homeowner differences in household food insecurity in Canada. *Journal of Housing and the Built Environment*, *31*(2), 349–366. https://doi.org/10.1007/s10901-015-9461-6

McKague, F., Lawson, R., Scott, M., & Wooliscroft, B. (2016). Understanding the energy consumption choices and coping mechanisms of fuel poor households in New Zealand. *New Zealand Sociology*, *31*(1), 106–126. Scopus. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013029097&partnerID=40&md5=d7b6bc567187854067e033b4ce2db1ea

Meyer, S., Laurence, H., Bart, D., Middlemiss, L., & Maréchal, K. (2018). Capturing the multifaceted nature of energy poverty: Lessons from Belgium. *Energy Research & Social Science*, *40*, 273–283. https://doi.org/10.1016/j.erss.2018.01.017

Middlemiss, L. (2022). Who is vulnerable to energy poverty in the Global North, and what is their experience? *WIREs Energy and Environment*, *n/a*(11), e455. https://doi.org/10.1002/wene.455

Middlemiss, L., Ambrosio-Albalá, P., Emmel, N., Gillard, R., Gilbertson, J., Hargreaves, T., Mullen, C., Ryan, T., Snell, C., & Tod, A. (2019). Energy poverty and social relations: A

capabilities approach. *Energy Research & Social Science*, *55*, 227–235. https://doi.org/10.1016/j.erss.2019.05.002

Middlemiss, L., & Gillard, R. (2015). Fuel poverty from the bottom-up: Characterising household energy vulnerability through the lived experience of the fuel poor. *Energy Research & Social Science*, *6*, 146–154. https://doi.org/10.1016/j.erss.2015.02.001

Mohan, G. (2021). Young, poor, and sick: The public health threat of energy poverty for children in Ireland. *Energy Research & Social Science*, *71*, 101822. https://doi.org/10.1016/j.erss.2020.101822

Moore, R. (2012). Definitions of fuel poverty: Implications for policy. *Energy Policy*, *49*, 19–26. https://doi.org/10.1016/j.enpol.2012.01.057

Natural Resources Canada. (2021). *Energy Fact Book 2021-2022*. Government of Canada. https://www.nrcan.gc.ca/sites/nrcan/files/energy/energy_fact/2021-2022/PDF/section1_energy-factbook_december9_en_accessible.pdf

Nova Scotia Department of Finance. Nova Scotia Department of Finance - Statistics [Internet]. Finance and Treasury Board. 2023 [cited 2023 Feb 1]. Available from: https://novascotia.ca/finance/statistics/archive_news.asp?id=18529&dg=&df=&dto=0&dti=3

Núñez Peiró, M., Sánchez, C., Sanz-Fernández, A., Heredia, M., López-Bueno, J., Neila, J., Linares, C., Díaz, J., & Muñoz, G. (2021). *Exposure and Vulnerability towards Summer Energy Poverty in the City of Madrid: A Gender Perspective* (pp. 481–495). https://doi.org/10.1007/978-3-030-57332-4_34

Nussbaum, M. C. (2003). Capabilities as fundamental entitlements: Sen and social justice. *Feminist Economics*, *9(2-3)*, 33–59.

Okushima, S. (2016). Measuring energy poverty in Japan, 2004–2013. *Energy Policy*, *98*, 557–564. https://doi.org/10.1016/j.enpol.2016.09.005

Okushima, S. (2017). Gauging energy poverty: A multidimensional approach. *Energy*, *137*, 1159–1166.

Oldenburg, R., & Brissett, D. (1982). The third place. *Qualitative Sociology*, *5*(4), 265–284. https://doi.org/10.1007/BF00986754

Oppenheimer, M., Maximiliano Campos, Rachel Warren, Joern Birkmann, George Luber, Brian O'Neill, & Kiyoshi Takahashi. (2014). Emergent Risks and Key Vulnerabilities. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1039–1099). Cambridge University Press.

Osbaldeston, J. (1984). Fuel poverty in UK cities. *Cities*, *1*(4), 366–373.

O'Sullivan, K. C. (2019). Health impacts of energy poverty and cold indoor temperature. *Elsevier Encyclopedia of Environmental Health*, 436–443.

O'Sullivan, K. C., & Chisholm, E. (2020). Baby it's hot outside: Balancing health risks and energy efficiency when parenting during extreme heat events. *Energy Research & Social Science*, *66*, 101480. https://doi.org/10.1016/j.erss.2020.101480

O'Sullivan, K. C., Howden-Chapman, P. L., & Fougere, G. M. (2015). Fuel poverty, policy, and equity in New Zealand: The promise of prepayment metering. *Energy Research & Social Science*, *7*, 99–107. https://doi.org/10.1016/j.erss.2015.03.008

O'Sullivan, K. C., Howden-Chapman, P., Sim, D., Stanley, J., Rowan, R. L., Harris Clark, I. K., & Morrison, L. L. A. (2017). Cool? Young people investigate living in cold housing and fuel poverty. A mixed methods action research study. *SSM - Population Health*, *3*, 66–74. https://doi.org/10.1016/j.ssmph.2016.12.006

O'Sullivan, K., Golubchikov, O., & Mehmood, A. (2020). Uneven energy transitions: Understanding continued energy peripheralization in rural communities. *Energy Policy*, *138*, 111288. https://doi.org/10.1016/j.enpol.2020.111288

Padgett, D. K. (2007). There's no place like (a) home: Ontological security among persons with serious mental illness in the United States. *Social Science & Medicine*, *64*(9), 1925–1936.

Palmer, G., MacInnes, T., & Kenway, P. (2008). Cold and Poor: An analysis of the link between fuel poverty and low income. *Report New Policy Institute*.

Pannell, M., & Yeakey, C. C. (2013). To Heat or to Eat. In *Urban Ills: Twenty-first-Century Complexities of Urban Living in Global Contexts* (Vol. 1, pp. 59–100). Lexington Books.

Papada, L., & Kaliampakos, D. (2016). Measuring energy poverty in Greece. *Energy Policy*, *94*, 157–165. https://doi.org/10.1016/j.enpol.2016.04.004

Petrova, S. (2018). Encountering energy precarity: Geographies of fuel poverty among young adults in the UK. *Transactions of the Institute of British Geographers*, *43*(1), 17–30. https://doi.org/10.1111/tran.12196

Petrova, S., Gentile, M., Mäkinen, I. H., & Bouzarovski, S. (2013). Perceptions of Thermal Comfort and Housing Quality: Exploring the Microgeographies of Energy Poverty in Stakhanov, Ukraine. *Environment and Planning A: Economy and Space*, *45*(5), 1240–1257. https://doi.org/10.1068/a45132

Petrova, S., & Simcock, N. (2021). Gender and energy: Domestic inequities reconsidered. Social & Cultural Geography, 22(6), 849–867. https://doi.org/10.1080/14649365.2019.1645200

Rankin, A. (2023, January 5). Nova Scotia's housing crisis: Why it's getting tougher to keep a roof over your head | SaltWire. *Saltwire*, online. https://www.saltwire.com/atlantic-canada/news/nova-scotias-housing-crisis-why-its-getting-tougher-to-keep-a-roof-over-your-head-100811010/

Reames, T. G. (2016). Targeting energy justice: Exploring spatial, racial/ethnic and socioeconomic disparities in urban residential heating energy efficiency. *Energy Policy*, *97*, 549–558. https://doi.org/10.1016/j.enpol.2016.07.048

Rezaei, M. (2017). *Power to the people: Thinking (and rethinking) energy poverty in British Columbia, Canada* [University of British Columbia]. https://doi.org/10.14288/1.0351974

Rezaei, M., & Dowlatabadi, H. (2016). Off-grid: Community energy and the pursuit of self-sufficiency in British Columbia's remote and First Nations communities. *Local Environment*, *21*(7), 789–807. https://doi.org/10.1080/13549839.2015.1031730

Rice, J. L., Cohen, D. A., Long, J., & Jurjevich, J. R. (2020). Contradictions of the Climate-Friendly City: New Perspectives on Eco-Gentrification and Housing Justice. *International Journal of Urban and Regional Research*, *44*(1), 145–165. https://doi.org/10.1111/1468-2427.12740

Riva, M., Debanné, L., & Bertheussen, M. (2022). *Energy Needs, Housing, and Well-Being in the Town of Bridgewater* [Summary Report]. McGill University, Town of Bridgewater. https://static1.squarespace.com/static/618a847db0da28769687653a/t/6441280ff292784ad1a367ae/1681991705809/Energy+Needs+Housing+Wellbeing+in+Bridgewater+Final+Report.pdf

Riva, M., Debanné, L., Kutuka, S., Bertheussen, M., O'Sullivan, K. C., Das, Runa. (forthcoming). Energy poverty, well-being, and gender: an in-depth quantitative assessment in a small town in Atlantic Canada

Riva, M., Kingunza Makasi, S., Dufresne, P., O'Sullivan, K., & Toth, M. (2021). Energy poverty in Canada: Prevalence, social and spatial distribution, and implications for research and policy. *Energy Research & Social Science*, *81*, 102237. https://doi.org/10.1016/j.erss.2021.102237

Riva, M., Kingunza Makasi, S., O'Sullivan, K. C., Das, R. R., Dufresne, P., Kaiser, D., & Breau, S. (2023). Energy poverty: An overlooked determinant of health and climate resilience in Canada. *Canadian Journal of Public Health*. https://doi.org/10.17269/s41997-023-00741-0

Roberts, D., Vera-Toscano, E., & Phimister, E. (2015). Fuel poverty in the UK: Is there a difference between rural and urban areas? *Energy Policy*, *87*, 216–223. https://doi.org/10.1016/j.enpol.2015.08.034

Robinson, C. (2019). Energy poverty and gender in England: A spatial perspective. *Geoforum*, *104*, 222–233. https://doi.org/10.1016/j.geoforum.2019.05.001

Robinson, C., Bouzarovski, S., & Lindley, S. (2018). 'Getting the measure of fuel poverty': The geography of fuel poverty indicators in England. *Energy Research & Social Science*, *36*, 79–93. https://doi.org/10.1016/j.erss.2017.09.035

Sagar, A. D. (2005). Alleviating energy poverty for the world's poor. *Energy Policy*, *33*(11), 1367–1372. https://doi.org/10.1016/j.enpol.2004.01.001

Sanchez-Guevara, C., Núñez Peiró, M., Taylor, J., Mavrogianni, A., & Neila González, J. (2019). Assessing population vulnerability towards summer energy poverty: Case studies of

Madrid and London. *Energy and Buildings*, *190*, 132–143. https://doi.org/10.1016/j.enbuild.2019.02.024

Sánchez-Guevara Sánchez, C., Sanz Fernández, A., & Núñez Peiró, M. (2020). Feminisation of energy poverty in the city of Madrid. *Energy and Buildings*, *223*, 110157. https://doi.org/10.1016/j.enbuild.2020.110157

Sareen, S., Thomson, H., Tirado Herrero, S., Gouveia, J. P., Lippert, I., & Lis, A. (2020). European energy poverty metrics: Scales, prospects and limits. *Global Transitions*, *2*, 26–36. https://doi.org/10.1016/j.glt.2020.01.003

Saulnier, C., & Plante, C. (2021). *The Cost of Poverty in the Atlantic Provinces*. Canadian Centre for Policy Alternatives, Nova Scotia Office.

Sen, A. (1993). Capability and well-being. In A. Sen & M. C. Nussbaum (Eds.), *The quality of life* (Vol. 30, pp. 30–53). Oxford University Press.

Sharpe, R. A., Taylor, T., Fleming, L. E., Morrissey, K., Morris, G., & Wigglesworth, R. (2018). Making the Case for "Whole System" Approaches: Integrating Public Health and Housing. *International Journal of Environmental Research and Public Health*, *15*(11), Article 11. https://doi.org/10.3390/ijerph15112345

Siksnelyte-Butkiene, I., Streimikiene, D., Lekavicius, V., & Balezentis, T. (2021). Energy poverty indicators: A systematic literature review and comprehensive analysis of integrity. *Sustainable Cities and Society*, *67*, 102756.

Sinclair, P. (2010). Energy in Canada. In *OUP Catalogue*. Oxford University Press. https://ideas.repec.org/b/oxp/obooks/9780195433869.html

Skinner, E. A., Edge, K., Altman, J., & Sherwood, H. (2003). Searching for the structure of coping: A review and critique of category systems for classifying ways of coping. *Psychological Bulletin*, *129*, 216–269. https://doi.org/10.1037/0033-2909.129.2.216

Snell, C., Bevan, M., & Thomson, H. (2015). Justice, fuel poverty and disabled people in England. *Energy Research & Social Science*, *10*, 123–132. https://doi.org/10.1016/j.erss.2015.07.012

Snell, C., Lambie-Mumford, H., & Thomson, H. (2018). Is there evidence of households making a heat or eat trade off in the UK? *Journal of Poverty and Social Justice*, *26*(2), 225–243. WorldCat.org. https://doi.org/10.1332/175982718X15200701225205

Sokołowski, J., Frankowski, J., & Lewandowski, P. (2020). *Energy poverty, housing conditions, and self-assessed health: Evidence from Poland*. https://doi.org/10.13140/RG.2.2.30423.29607

Sokołowski, J., Lewandowski, P., Kiełczewska, A., & Bouzarovski, S. (2020). A multidimensional index to measure energy poverty: The Polish case. *Energy Sources, Part B: Economics, Planning, and Policy*, *15*(2), 92–112. https://doi.org/10.1080/15567249.2020.1742817

Sovacool, B. K. (2011). Security of energy services and uses within urban households. *Current Opinion in Environmental Sustainability*, *3*(4), 218–224. https://doi.org/10.1016/j.cosust.2011.06.004

Sovacool, B. K., Axsen, J., & Sorrell, S. (2018). Promoting novelty, rigor, and style in energy social science: Towards codes of practice for appropriate methods and research design. *Energy Research & Social Science*, *45*, 12–42. https://doi.org/10.1016/j.erss.2018.07.007

Sovacool, B. K., & Dworkin, M. H. (2015). Energy justice: Conceptual insights and practical applications. *Applied Energy*, *142*, 435–444. https://doi.org/10.1016/j.apenergy.2015.01.002

Sovacool, B. K., Heffron, R. J., McCauley, D., & Goldthau, A. (2016). Energy decisions reframed as justice and ethical concerns. *Nature Energy*, *1*(5), Article 5. https://doi.org/10.1038/nenergy.2016.24

StataCorp. (2021). *Stata Statistical Software: Release 17* [Computer software]. StataCorp LLC.

Statistics Canada. (2013, August 14). *Housing Reference Guide, National Household Survey, 2011*. Statistics Canada. https://www12.statcan.gc.ca/nhs-enm/2011/ref/guides/99-014-x/99-014-x2011007-eng.cfm#a1

Statistics Canada. (2022a, February 9). *Profile table, Census Profile, 2021 Census of Population—Bridgewater, Town (T) [Census subdivision], Nova Scotia*. https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E

Statistics Canada. (2022b, February 15). *Equivalized household disposable income quintiles*. Statistics Canada. https://www150.statcan.gc.ca/n1/pub/13-607-x/2016001/931-eng.htm

Statistics Canada. (2022c, September 20). *Shelter cost of private household*. https://www23.statcan.gc.ca/imdb/p3Var.pl?Function=DEC&Id=103403

Statistics Canada, S. C. (2017, February 8). *Census Profile, 2016 Census—Bridgewater [Population centre], Nova Scotia and Nova Scotia [Province]*. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=POPC&Code1=0096&Geo2=PR&Code2=12&SearchText=Bridgewater&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=0096&TABID=1&type=0

Stojilovska, A., Yoon, H., & Robert, C. (2021). Out of the margins, into the light: Exploring energy poverty and household coping strategies in Austria, North Macedonia, France, and Spain. *Energy Research & Social Science*, *82*, 102279. https://doi.org/10.1016/j.erss.2021.102279

Swope, C. B., & Hernández, D. (2019). Housing as a determinant of health equity: A conceptual model. *Social Science & Medicine*, *243*, 112571. https://doi.org/10.1016/j.socscimed.2019.112571

Tait, L. (2017). Towards a multidimensional framework for measuring household energy access: Application to South Africa. *Energy for Sustainable Development*, *38*, 1–9.

Thomson, H., Bouzarovski, S., & Snell, C. (2017). Rethinking the measurement of energy poverty in Europe: A critical analysis of indicators and data. *Indoor and Built Environment*, *26*(7), 879–901. https://doi.org/10.1177/1420326X17699260

Thomson, H., Simcock, N., Bouzarovski, S., & Petrova, S. (2019). Energy poverty and indoor cooling: An overlooked issue in Europe. *Energy and Buildings*, *196*, 21–29. https://doi.org/10.1016/j.enbuild.2019.05.014

Thomson, H., & Snell, C. (2013). Quantifying the prevalence of fuel poverty across the European Union. *Energy Policy*, *52*, 563–572. https://doi.org/10.1016/j.enpol.2012.10.009

Thomson, H., Snell, C., & Bouzarovski, S. (2017). Health, Well-Being and Energy Poverty in Europe: A Comparative Study of 32 European Countries. *International Journal of Environmental Research and Public Health*, *14*(6), Article 6. https://doi.org/10.3390/ijerph14060584

Tirado Herrero, S. (2017). Energy poverty indicators: A critical review of methods. *Indoor and Built Environment*, *26*(7), 1018–1031. https://doi.org/10.1177/1420326X17718054

Tod, A. M., Nelson, P., Cronin de Chavez, A., Homer, C., Powell-Hoyland, V., & Stocks, A. (2016). Understanding influences and decisions of households with children with asthma regarding temperature and humidity in the home in winter: A qualitative study. *BMJ Open*, *6*(1), e009636. https://doi.org/10.1136/bmjopen-2015-009636

Town of Bridgewater. (2019). *Energy Poverty in Bridgewater: Energy Poverty Research Program Findings*. Town of Bridgewater.

Tuan, Y.-F. (1991). A View of Geography. *Geographical Review*, *81*(1), 99–107. https://doi.org/10.2307/215179

Turner, B. L., Kasperson, R. E., Matson, P. A., McCarthy, J. J., Corell, R. W., Christensen, L., Eckley, N., Kasperson, J. X., Luers, A., Martello, M. L., Polsky, C., Pulsipher, A., & Schiller, A. (2003). A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences*, *100*(14), 8074–8079. https://doi.org/10.1073/pnas.1231335100

Tutton, M. (2021, June 23). N.S. tenants say existing law too weak to protect from rent hikes, mistreatment | CBC News. *The Canadian Press*. https://www.cbc.ca/news/canada/nova-scotia/housing-concerns-persist-despite-rent-control-1.6076444

Urban, R. (2021, March 11). *Electricity Prices in Canada 2021*. Energyhub.Org; Rylan Urban. https://www.energyhub.org/electricity-prices/

Ürge-Vorsatz, D., & Tirado Herrero, S. (2012). Building synergies between climate change mitigation and energy poverty alleviation. *Energy Policy*, *49*, 83–90. https://doi.org/10.1016/j.enpol.2011.11.093

Walker, G., & Day, R. (2012). Fuel poverty as injustice: Integrating distribution, recognition and procedure in the struggle for affordable warmth. *Energy Policy*, *49*, 69–75. https://doi.org/10.1016/j.enpol.2012.01.044

Wang, Q., Kwan, M.-P., Fan, J., & Lin, J. (2021). Racial disparities in energy poverty in the United States. *Renewable and Sustainable Energy Reviews*, *137*, 110620. https://doi.org/10.1016/j.rser.2020.110620

Willand, N., Ridley, I., & Maller, C. (2015). Towards explaining the health impacts of residential energy efficiency interventions – A realist review. Part 1: Pathways. *Social Science & Medicine*, *133*, 191–201. https://doi.org/10.1016/j.socscimed.2015.02.005

Withers, P. (2022, December 5). Climate crisis means more extreme weather, N.S. assessment predicts | CBC News. *CBC*. https://www.cbc.ca/news/canada/nova-scotia/climate-crisis-means-more-extreme-weather-ns-predicts-1.6675182

World Health Organization. (2018). *WHO housing and health guidelines*.

Ziafati, N. (2023, August 6). Canada's inflation rate is falling, so why are grocery prices still so expensive? *CTVNews*. https://www.ctvnews.ca/business/canada-s-inflation-rate-is-falling-so-why-are-grocery-prices-still-so-expensive-1.6509093

APPENDICES

Appendix A. Comparison of the socioeconomic and housing characteristics of the survey sample with the population of the Town of Bridgewater using data from the 2021 Canadian Census (Riva et al., 2022).

Characteristic	Proportion in the sample (%)	Proportion in Bridgwater according to the Census (%)
Age		
19 to 34 years	15.9	18.8
35 to 44 years	18.0	12.6
45 to 54 years	12.2	13.8
55 to 64 years	20.7	18.9
≥ 65 years	33.1	35.8
Gender		
Woman	61.2	53.6
Man	36.8	46.3
Cultural identity/ethnicity		
White/Caucasian	94.6	94.2
African Nova Scotian, Asian, Latinx or Indigenous	5.4	5.2
Married or in a common law relationship	54.5	55.0
Median total income of households ($) [a]	50,000	51,600
Household income		
< $20,000	9.1	6.5
< $50,000	46.7	43.5
≥ $50,000	52.0	56.7
≥ $100,000	17.6	21.4
Education (among those aged ≥ 15 years)		
Less than secondary school	8.7	23.4
Secondary school or equivalent	26.9	25.3
Postsecondary certificate	64.3	51.3
In employment (full-time or part-time)	50.6	57.6
Dwelling type		
Single-detached house	52.1	48.1
Semi-detached house	5.8	5.8
Mobile home	13.6	11.5
Apartments	28.5	31.9
Year of construction		
Before 1961	30.0	27.3
After 1995 [b]	24.0	31.7
Major repairs needed	12.4	8.5
Tenure		
Owner	64.7	58.0
Renter	35.3	42.0
Household composition		
Single-person households	28.7	38.8
Households with children	28.1	28.8
Lone-parent households	11.2	19.6

[a] For census data, median total income of household before tax in 2020 is reported

[b] For Census data, this corresponds to dwellings built after 1990.