AGING IN PLACE WITH GRACE: CONSIDERING ENERGY BURDEN AND ENERGY EFFICIENCY AS FACTORS OF AGING IN PLACE SUCCESS

Supervised Research Project

Submitted in partial fulfillment of the Master of Urban Planning degree

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Abstract:

Dialogue about aging in place—staying on one's home as one grows older—has not included housing quality or thermal efficiency in determining overall success. To assist in understanding the dynamics of aging in place, this research surveyed 50 adults over the age of 60 who reside in the Northeast Kingdom of Vermont. Surveys asked participants about heating and cooling preferences, costs, improvements, and desired improvements to weatherization and energy efficiency of their home. Findings include that: a) households with moderate to high energy burden often had major structural issues with their homes, b) energy burden may be a constraint on energy efficiency improvements, c) cost is the most prevalent barrier to improvements, d) there are gaps in resources for high energy burden households, and e) rebates are widely used as a financial resource to support weatherization, upgrades to thermal systems and home energy audits. Planning, policy and programming implications from the research are explored. They Recommendations include: stimulation of housing development that is new and energy efficient, improved information distribution about energy efficiency, expansion of federally funded Weatherization Assistance Program and Low Income Home Energy Assistance Program, as well as expansion of Efficiency Vermont rebates. Further research should be pursued on the topics of stress and energy efficiency priority, energy equity issues with renting, and thermal comfort.

Key words: Aging in Place, energy efficiency, weatherization, energy burden, structural issues, planning, policy

Resumé

Le dialogue sur le vieillissement en place [define here] n'a pas inclus la qualité du logement ou l'efficacité thermique dans la détermination du succès global. [t o assist in understanding the dynamics,] Cette recherche a porté sur 50 adultes de plus de 60 ans qui résident dans le nord-est du Vermont. Les sondages ont interrogé les participants sur les préférences de chauffage et de climatisation, les coûts, les améliorations et les améliorations souhaitées en matière de vieillissement climatique et d'efficacité énergétique de leur maison. Les données ont révélé que a) les ménages ayant une charge énergétique modérée à élevée avaient souvent des problèmes structurels majeurs avec leur maison, b) la charge énergétique peut être un obstacle à l'amélioration de l'efficacité énergétique, c) le coût est l'obstacle le plus répandu aux améliorations, d) il y a des lacunes dans les ressources pour les ménages à forte charge énergétique, e) les remises sont des ressources financières très utilisées pour soutenir la météorisation, les mises à niveau des systèmes thermiques et les audits énergétiques domestiques. Les implications en matière de planification, de politique et de programmation comprennent la stimulation du développement de logements qui est nouveau et écoénergétique, une meilleure diffusion de l'information sur l'efficacité énergétique, l'expansion des programmes Weatherization Assistance Program et Low Income Home Energy Assistance Program financés par le gouvernement fédéral, ainsi que l'expansion des rabais d'Efficiency Vermont. Des recherches plus poussées devraient être poursuivies sur les thèmes du stress et de la priorité d'efficacité énergétique, du confort thermique, et des questions d'équité énergétique avec la location.

Mots clés: Vieillissement sur place, efficacité énergétique, intempéries, charge énergétique, problèmes structurels, planification, politique

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Table of Contents

List of Tables:

List of Figures:

1. INTRODUCTION: AN AGING PLACE

The US is aging and aging rapidly. The United States Department of Housing and Urban Development report that “over the next 40 years, the population of Americans over age 65 is expected to double from 40 to 80 million, and the population over age 85 is expected to more than triple from 6 to 20 million” (US Department of Housing and Urban Development, 2013, para. 1). In Vermont, the average age is even higher and the percentage of adults over 65 is among the highest in the nation, representing the fastest growing portion of the total population (US Census Bureau, 2020, June 25). Because of the aging demographic, the topic of Aging in Place has increased importance.

Aging in place is defined by the U.S. Centers for Disease Control and Prevention (CDC) as "the ability to live in one's own home and community safely, independently and comfortably, regardless of age, income or ability level." Aging in place means living in the same community where the individual currently resides and maintaining, as the individual ages, independence, social connections, and a familiar setting. AARP, one of the largest non-partisan advocacy organizations in the US, reports that: “nearly 90 percent of people over age 65 want to stay in their home for as long as possible, and 80 percent believe their current residence is where they will always live” (Farber et al, 2011, p. 1). Older adults wish to stay in place for many reasons: financial, sense of continuity, social infrastructure, safety, and sentimentality; “for most Americans, the prospect of aging in place is not an esoteric policy discussion; instead, it strikes an intensely personal chord, touching on life, death, and the importance of family” (US Department of Housing and Urban Development, 2013, para. 2). Because of the personal significance of the home for this growing demographic, policy and programs supporting aging in place should address the changing needs of older adults. The dialogue about aging in place, according to both governmental bodies and advocacy organizations, needs to address housing, healthcare, mobility, social connection, financial wellbeing, safety, and comfort. This report focuses on the contribution that housing – and, specifically, the type of dwelling and the energy it uses- can make to enable individuals in the Northeast Kingdom of Vermont to successfully age in place. Key questions framing the report are: What factors affect the ability of older adults in northeastern Vermont to age in place? To what extent does the cost, adequacy, and efficiency of household energy affect the ability to successfully age in place? How well do existing programs and policies assist seniors to fulfill their household energy requirements? What program, policies, and additional supports are desired by older adults to help them age in place?

To address these questions, literature on aging in place was reviewed, demographic and spatial data on Northeast Kingdom compiled, relevant policies, programs, and practices analyzed, a sample of seniors surveyed as to their dwelling and household energy experiences, and policy implications explored. This report brings together the resulting information:

a) Review of the literature on factors that assist or impede seniors from successfully aging in place, zeroing in on the often-overlooked hardship of heating and cooling one's dwelling (referred to as the energy burden throughout this report),

b) Description of aging trends and typical dwellings for Northern Vermont,

c) Identification of relevant policies and programs to support a reduction in the energy burden, with specific attention to those applicable to the region of study,

d) Introduction to the methodology used to document energy burden for seniors,

e) Presentation of the results, and

f) Discussion of policy implications for renters, owners, fuel providers, and both the local and state government.

2. AGING IN PLACE: FACTORS FOR SUCCESS

While many older adults wish to age in place, the reality of Aging in Place requires connections, planning, and luck. The factors impacting successful aging in place involve the whole community at times, including livable community design and social outlets and connections. AIP also involves personal life planning, such as accessing and maintaining healthcare, financial preparedness, and planning for limited mobility and capacity. Lastly, there is the factor of luck; one individual may remain independent far longer than for a multitude of reasons including health, social and mental wellbeing, family and network support, and hardships. All of these, (connections, planning, and luck), will impact how well an older adult can maintain independence and grow old in their own residence.

Aging in Place (AIP) has gained prominence, with urban planning research, scholarly papers, and popular media identifying supporting measures and possible constraints. A central theme is that measures that assist seniors to age in place help them and the wider population; it can lead to better neighborhoods for all. The literature also addresses how design measures, at the level of the neighborhood and residence, assist aging in place; needed support from the health sector; and possible challenges related to mental and financial health. Gaps in the literature on urban planning for AIP are noted.

Aging in Place works in tandem with many planning ideas such as smart growth, livable communities, and transit-oriented neighborhoods. One relevant precept is that livable solutions for aging individuals are livable solutions for all ages (AARP Livable Communities, 2019; Partners for Livable Communities, 2010). Measures such as integrating land use, housing, and transportation; efficiently delivering services in the home; providing more transportation choices, particularly for older adults who no longer drive; and improving affordable, accessible housing to prevent social isolation target seniors but not exclusively (Farber et al., 2011). Walkable transit-oriented community design, safety, compact living, and available social amenities support adults aged 60 plus, young families, young professionals, and empty nesters.

In addition to livable communities for all, the scholarly and popular literature about aging in place discusses many topics relevant to older adults changing needs: home healthcare, design for universal access, the maintenance of social outlets, and financial wellbeing especially when unforeseen circumstances or accidents require additional supports, care, or a change of residence. Seniors trying to balance “changing healthcare needs, loss of mobility, financial concerns, home maintenance and

increasing property taxes, [may experience] significant impediments to this simple and primary desire" (Ball, (n.d.), p.3). From the number of topics mentioned above, it is evident that there are many challenges for older adults wishing to age in place (AIP).

Much of the literature about AIP addresses the need for in home healthcare services (Molinsky, 2017, Khalfani-Cox, 2017). This literature notes that while live-in senior and assisted healthcare centers are available for older adults, they are often very expensive. Home healthcare brings medical services to aging individuals in their place of residence. A home visit by a nurse, or other health professional, supports seniors with medical needs, and can also lead to identification of other needs, such as home mobility retrofits and food resources, and is an important social connection for the aging individual. Home healthcare visits thereby allow aging adults to stay in their homes longer.

The Homefit Guide from AARP (2020) discusses the safety within the home. It highlights the need for minor adjustments to the home, such as non-slip surfaces, door levers, adequate and appropriate lighting, and spacing around furniture for mobility. Bigger design retrofits are also recommended, such as zero-step entry, wide doorways to accommodate a wheelchair, as well as a first-floor bedroom and bathrooms. The National Association of Home Builders has created a Certified Aging-in-Place Specialist program, to meet the growing demand for this type of interior home design (National Association of Home Builders, 2021).

Social isolation is a potential challenge for seniors wishing to AIP, especially as mobility decreases or transportation options become more limited. Loss of a driver's license can have a significant impact on an older adult's ability to maintain social ties, particularly if they reside in poor public transportation areas such as suburbia and rural areas (Molinsky, 2017). COVID-19 has further highlighted the fragility of social connections in low-density areas. How do communities ensure well-being during times of social distancing and the closure of many social outlets?

Also apparent in the literature is attention to financial considerations for older adults wishing to AIP. There are economic benefits with AIP, e.g., it is often much cheaper to remain in the home and pay for some home healthcare than to move into a residential senior living or assisted living facility (US Department of Housing and Urban Development, Fall 2013). AARP offers a multitude of resources for older adults, many who are living on fixed incomes, to give insights into saving money, bargain shopping, and seeking out discounts. Forward-thinking financial planning can also support adults wishing to stay in their home (AARP, 2021). Financial wellbeing is tied in with aging in place especially in the situations

where dramatic change in physical or mental wellbeing requires additional home support, healthcare, retrofits, or change of residence.

Surprisingly, the AIP literature does not specifically discuss how home energy systems and types of residential structures may be influential in successful aging in place. It is a missing component, and one of particular importance in colder regions of the country. Many older adults have concerns about their household's energy burden and ways to improve energy efficiency, but this topic is missing in AIP literature and popular media coverage. Energy burden is the percentage of household income spent on energy costs. The higher the percentage, the more money that is spent on energy leaves less to cover expenses such as transportation, healthcare, or food and the more energy burden the household may experience. In the literatures reviewed, one source made mention of the physical structure in which adults live and its importance to overall wellbeing, as follows: "above and beyond their own physical, socio-emotional, and mental frailties, older adults' ability to successfully age in place will hinge on the age and structural condition of their dwelling, whether they own or rent, and their current family living arrangements. These factors will influence their ability to pay for needed modifications of an existing dwelling or relocation to alternative housing that is age friendly" (Johnson and Appold, 2017, p. 2). While Johnson and Appold examined the age and structural condition of the dwelling, energy systems were not linked into the overall wellbeing of older adult's wishing to age in place. Only one mention in the literature of housing quality and energy system efficiency effects on Aging in Place indicates the dearth of research on the topic. The research on this topic needs to expand, inform policy, and become a major conversation among the popular literature about AIP.

This report, and the research on which it is based, tackles the issue of energy systems because housing quality is critical for successful AIP. The building's age, structural condition, and energy efficiency will influence the older adult's ability to be safe, comfortable, and to financially sustain their future. As Snyder & Baker (2010, p. 8) observe, "unaffordable home energy bills pose a serious and increasing threat to the health and well-being of a growing number of older people in low- and moderate-income households''. After personal safety, retired older adults living on fixed incomes often worry about paying rising rents and property taxes (Ball, n.d.). But expenses do not stop at rent and taxes. Energy expenses can account for a large proportion of homeowner and renter monthly bills such that "the rising cost of home energy service curtails the ability of many elders, whose finances are often limited, to afford to age in place" (Howat & Taormina, 2008, p. 552). How do older adults, many living on fixed incomes, meet seemingly ever-expanding energy expenses and make the, sometimes costly,

upgrades to their home to improve energy efficiency? Beyond just keeping up with rising fuel costs, older adults may have to make tough decisions between energy home improvements that can be costly and paying other bills. Fausset et al. (2011, para. 2) notes that "the specific obstacles that older adults encounter in home maintenance are not well documented" and the obstacles that they do face are often outsourced and require hiring someone to do the work, which takes money, or are neglected all together. They further observe, (Fausset at al., 2011, para. 3) that neglecting home maintenance and energy issues can be harmful to wellbeing since "If older adults are experiencing difficulties in maintaining their homes, their goal of aging in place is threatened". Much of the maintenance discussed in Fausset's research addresses routine maintenance. There is no mention of larger scale energy efficiency tasks such as updating thermal systems, improving weatherization, or reducing energy expense via conservation or fuel switching efficiency. Improving energy affordability and efficiency are AIP topics of concern for any community.

An additional factor of relevance is the type of housing tenure. Residential owners and renters have distinct domains in which they can make changes to their dwelling and face different cost-benefit trade-offs. Much of what is written about aging in place and modifications to the physical structure of the dwelling pertains to owners and renters alike. Adding handrails in the bathroom, removing slippery floor surfaces, or adding a ramp so there is a zero-step entry can be done at most residences. While an owner can choose to make such modifications, renters often must negotiate any such changes to the dwelling with the property manager or owner (Hernandez & Bird, 2010). An additional challenge for renters wishing to AIP is the split incentives with energy retrofits and building efficiency improvements. To AIP well, older adults need residences that are warm in the winter, cool in the summer, and not costing too much to climate control. Often the heating and cooling systems of a residence, as well as the quality of weatherization, are the responsibility of the landlord not the tenant. Split incentives are present in a rental situation, where the renter is the payee for the utility fuels, but the landlord is the payee for the thermal systems and structure. In such cases, "by virtue of their tenure status, renters are totally reliant on landlords or property owners to make the necessary renovations that will allow them to age in place—an unlikely occurrence in the absence of proper incentives and/or government mandates" (Kenan Institute, Sept 2017). There are few incentives for a landlord to update a heating system to a more fuel-efficient model or to invest money into improved weatherization when the economic gains of doing these modifications are not pocketed by the landlord; instead, they are

pocketed by the tenant. In contrast, when the owner is also a resident (a homeowner), any such investments in improvements to the structure can generate direct benefits.

3. THE NORTHEAST KINGDOM of VERMONT: A SPECIAL CASE of ENERGY BURDEN

The Northeast Kingdom (NEK) of Vermont is composed of the three most rural counties in Vermont's northeastern corner, Orleans, Essex, and Caledonia. The NEK is the most economically depressed area in the state, with median income ranging from $41,045 in Essex County, to $47,915 in Orleans and $49,348 in Caledonia County, as compared to $60, 076 median income between 2014-2018 for Vermont overall (US Census Bureau, 2019).

Figure 1: Vermont's Northeast Kingdom: Orleans, Essex, and Caledonia Counties *(shown in green)*
Source: Vermont Head Start Association, 2021

Unemployment and poverty levels are also more pronounced in the NEK. Statewide unemployment in June 2019 was 2.4%. In Caledonia, Essex and Orleans county in June 2019 unemployment rates were 3.0%, 2.8%, and 3.6% respectively (Vermont Department of Labor, Economic & Labor Market Information, 2021, April 16). A similar trend is present in poverty levels; Vermont overall has 10.2% persons in poverty while the three counties of the NEK range from 12.3% to 14.8% (US Census Bureau, 2019).

During the summer of 2020, Energy Action Network of Vermont explored energy burden- understood as the percentage of household annual income spent on energy utilities, with households spending more than 26% of their annual income on energy to be considered highly energy burdened- in

the NEK as part of their advocacy mission for energy equity in the state. Energy Action Network's research found energy burden in the NEK to be at the highest percentage as compared to other areas in the state. (Santi, 2020). Figure 2 shows the levels of energy burden by county for all of Vermont. Households in the darkest green counties spend on over 15% of incomes on energy. The Northeast Kingdom has been outlined in yellow.

Figure 2: Energy Burden by Vermont County

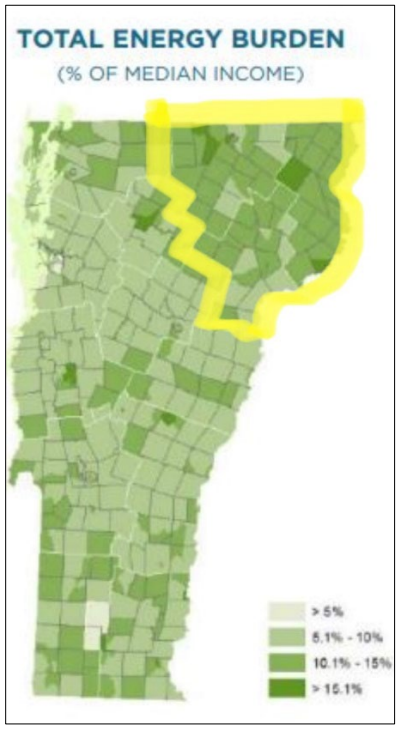

Figure 2: Energy Burden by Vermont County

Source: Energy Action Network, 2018, April 25.

Several forces compound to increase energy burden on residents of the NEK: lower incomes, higher unemployment, increased poverty rates, an aging housing stock, and numerous single person and senior (over the age of 65) households. There are also barriers to information access about heating and cooling efficiency and weatherization improvements, partially because of spotty internet and cell phone service, and partially because there are few suppliers of weatherization and efficiency services. Residents of the Northeast Kingdom suffer from poor internet connectivity, making it harder to know about available incentives and rebates for energy efficiency, to learn about alternative heating and cooling options, and connect with knowledgeable technical support. The lack of energy efficiency

suppliers is another challenge. Even if a household chooses to do energy efficiency work, there may be few, if any, technicians and contractors in the region to do the work.

Housing stock in the Northeast Kingdom is relatively old, with nearly a third of owner-occupied homes built before 1940, which makes heating efficiently difficult. Old homes are more expensive and less efficient to heat and can require complicated (and expensive) weatherization or other efficiency retrofits (NVDA Regional Plan, 2018, p. 137). Home ownership in the region is high, around 70%. Many older adults over 65 years still have mortgages. For them, a relatively larger proportion of income goes towards paying the mortgage or maintaining the home, leaving less disposable income available for energy upgrades. In addition to housing payments, homeowners have other housing related expenses, such as property taxes, homeowner's insurance, and utilities.

In 2010, 35% of all households in the Northeast Kingdom were non-family households (household members are not related by birth, adoption, or marriage) and 79% of these households were individuals living alone, a significant proportion of them aged 65 or older. These households may be less likely or able to invest income in energy upgrades (NVDA Regional Plan, 2018, p. 139). With limited alternative housing options such as co-ops or shared living arrangements in the area, the financial burden of energy provision falls onto one person.

Although a few heating fuel suppliers in the region may also provide weatherization services, most suppliers do not focus services on transitioning households away from oil and propane fuels for heating toward more efficient renewable fuels. There is a lack of innovative fuel suppliers, which is a barrier to further scaling up energy efficiency and beneficial electrification in the region (Santi, 2020). There are several alternative fuel suppliers in the state of Vermont, such as Bourne's Energy and the Energy Co-Op, which provide energy services that transition customers away from non-renewable fuels to efficient use of electric heat pumps for heating and cooling. However, there are no companies providing alternative fuel services to the Northeast Kingdom currently.

Finally, increased financial insecurity, disability, and poverty affect stress levels amongst seniors. When under stress, households may be less capable of future-oriented thinking. Research about the effectiveness of energy efficiency investments in low-income households found that bounded rationality may prevent a household from seeking out changes that would have long-term benefits when the present situation takes priority. As Fowlie et al. (2018) describes bounded rationality as the process by which people seek and make satisfactory decisions rather than optimal ones. Given limits of time,

mental energy, or income, people may settle for heating sources that satisfy their needs, even if an upgrade may save them money. This dynamic of focusing on what can be easily managed in the short term applies to all household makeups but can significantly affect senior households.

4. FUNDING FOR FUEL, WEATHERIZATION, AND TECHNICAL ASSISTANCE

There are programs in place to help older adults manage their heating and cooling expenses. Programs include the federally funded Department of Health and Human Services' Low Income Home Energy Assistance Program (LIHEAP) and Department of Energy's Weatherization Assistance Program (WAP), as well as direct payment discount options with fuel providers. The federal programs are income restricted, which may leave a portion of the population aged 65+ vulnerable. Individuals who have more income than is allowed for subsidy, but not enough to undertake the energy efficiency improvements themselves, may opt to do nothing to decrease their energy burden and make their homes safer and more comfortable. Even though payment discounts with fuel providers are not income restricted, there is often more hardship for households to preemptively enter payment plans that can take advantage of financial benefits.

Fuel and Efficiency Funding Programs:

There are two principal federal programs that address the energy burden faced by low-income Americans: The Department of Health and Human Services' Low Income Home Energy Assistance Program (LIHEAP) and the Department of Energy's Weatherization Assistance Program (WAP). LIHEAP provides direct assistance to help households cover their energy costs and keep their utilities running. LIHEAP has historically received between **$2.5 and $4.5 billion in congressional appropriations** and provides roughly **6.7 million households** throughout the US with heating or cooling assistance in a typical year. The WAP focuses on installing energy conservation and energy efficiency measures in low-income households, such as blower door directed air sealing, exterior wall insulation, attic insulation, furnace repair or replacement, duct sealing, and refrigerator replacements. These services can save a low-income family between **$250 and $450** annually in energy costs **for up to 30 years**.

LIHEAP and WAP work hand in hand to help low-income families combat the financial burden associated with high energy bills and are often programs run by and offered by the same agency. In an extreme winter or brutal heatwave, LIHEAP is a critical, if not lifesaving, resource in keeping utility services up and running when financial circumstances could result in a shut off. Weatherization, under the same conditions, is *a long-term solution* to fix the underlying efficiency problems that continually strain a family's utility costs and contribute to the high energy bills. Therefore **current regulations** allow states to spend up to 15% of their LIHEAP allocation on weatherization. As opportunities arise, some

states will utilize up to 25% of their allocation towards weatherization with LIHEAP's Good Cause Waiver. (NASCSP, 2020)

There is criticism of the WAP and LIHEAP programs. In Vermont, WAP is very popular, and the waiting lists often stretch from months to years long. Vermont has established a statewide goal of weatherizing 80,000 homes by 2020 with 20,000 of these low-income homes. However, as of July 2020, only about 10,000 homes (of all income levels) have been weatherized. As Snyder and Baker (2010, p.9) summarize, "the Low-Income Home Energy Assistance Program (LIHEAP) improves access to home energy, but it has not kept pace with need and does not guarantee basic, affordably priced utility service. In fiscal year 2009, the federal appropriation for LIHEAP nearly doubled from $2.57 billion to $5.1 billion, yet the 7.7 million households that received LIHEAP during 2009 was less than one-quarter of the number estimated to be income-eligible. Moreover, most states offer limited protections against the shutoff of home utility service for nonpayment". Goals are often more ambitious than how quickly implementation can progress.

Prompt Pay Discounts & Efficiency Rebates: Lowering the cost of existing fuel consumption and the upfront cost of efficiency improvements

Outside of subsidy and federal funding for fuel assistance, strong partnership between utility fuel providers and users of fuel can impact the expense of fuel and efficiency of thermal systems. There are many households that are unable to access federally funded and income restricted programs to help with fuel costs and energy improvements. When considering energy burden, it is important to look at gaps in support. Households that can afford energy will have less energy burden and households that can tap into fuel assistance programs will have less energy burden. However, it is the households that still have a lower income but do not qualify for federal fuel assistance that may remain highly energy burdened. Finding additional means to lowering this burden, either by lowering the cost of fuel or decreasing consumption by improving efficiency, will help the households that fall into the gap.

Some programming offered by fuel providers that can assist households in lowering energy expenses include fuel pre-buy, price-capped fuel, budget payment plans, and on-time payment discounts. [1] Any of these options require advanced planning and advanced prepayment, either to lock in the lower fuel price, enter a budget payment plan, or take advantage of on-time payment. A household

[1] See Appendix A for fuel discount program definitions

that is lower income may struggle to gather the upfront funds to take advantage of these monetary benefits. There seems to be room for existing fuel assistance programs to support lower-income senior Vermonters in pre-buying or locking in a capped price on their fuel to save more money in the long run, and therefore lowering the energy burden on the household.

Some companies use Effective Utility Arrearage Management Programs, which can help households pay off their back-payments to get ahead and prepare for the upcoming heating/cooling seasons. Seniors who struggle to make their fuel payments on time, may fall behind. Without support to get back on top of payments, the senior household may perpetually be behind in payments, and may not be eligible to pre-buy fuel at a lower rate in the next heating season.

Santi (2020) acknowledges the need for fuel companies to have an incentive to improve efficiency in the homes they serve. Companies that supply biofuel and wood pellets for heating, such as Bourne's Energy, have an incentive to help customers fuel switch and improve thermal efficiency. When a household makes the switch with Bourne's, the company retains the household as a customer, now providing them with biofuel or wood pellets. In the cases where the household switches to electric for heating, via heat pump, Bourne's can do the installation and maintain the heating unit's functioning. A company that only supplies heating fuel and propane has benefits locked into inefficient housing structures and outdated thermal systems that require more fuel. When client households must use more fuel each season, the fuel company wins.

Questions arising from the current situation include:

- Should companies have benchmarks of efficiency upgrades in which to meet?
- Are market driven efficiency improvements enough to advance the efficiency of a house?

With utility and supplier incentives to support transitions to more energy efficient heating and cooling solutions, there may be a bigger uptake in energy improvements.

Efficiency rebates and utility incentives are a way for households to lower upfront costs associated with energy efficiency improvements. Created in 1999, Efficiency Vermont is an independent nonprofit energy services organization. Efficiency Vermont covers all of Vermont; providing consistent and comprehensive energy services to help households reduce energy costs and protect the environment. In 2008, Efficiency Vermont received authorization to offer thermal efficiency services to help Vermonters

reduce their use of fossil fuels, improve their comfort, and save on heating costs. Offering rebates, product and technology reviews and recommendations, and technical support services including energy assessments, financing, and contractor networks, Efficiency Vermont saves households money and energy (Efficiency Vermont, 2021).

Advocacy and Technical Assistance:

There are several organizations that work to provide technical assistance for households wishing to improve their efficiency and advocate at the state level to keep funding available for heating efficiency and weatherization rebates and incentives. As advocates note, "increased attention must be devoted to the design and funding of energy efficiency programs that replace old, inefficient appliances (& heating equipment) owned or operated by low-income elders living at home" (Howat & Taormina, 2008, p. 556). The following organizations work in the Northeast Kingdom of Vermont to help households improve their energy efficiency, energy self-reliance, and housing comfort.

· NeighborWorks of Western Vermont founded and operates Heat Squad, a branch of their company that provides low-to- moderate income residents with low-cost energy audits and assistance in identifying, contracting, and financing weatherization improvements. Heat Squad recently expanded into the Northeast Kingdom with an estimate of completing 233 home energy retrofits. Heat Squad engages with the household to determine the scope and sequence of energy efficiency improvements and can help coordinate the use of rebates and additional financing if needed to complete the projects.

· 3E Thermal is a statewide program focusing on energy in affordable apartment housing. The program is made possible with WAP funds. For owners of affordable apartment buildings, 3E assists with efficiency and weatherization projects, similar to the work Neighborworks of Western Vermont does for individual households. The program plugs into networks of contractors and funding sources.

· Efficiency Vermont is a non-profit organization dedicated to helping Vermonters improve their energy futures. Efficiency Vermont works with partners throughout Vermont to save customers money, strengthen the state's economy, and lower carbon emissions. The organization supports homeowners, small scale landlords, building trades professionals, and affordable housing developers in funding projects that improve a building's energy efficiency. Through their Healthy Homes initiatives, Efficiency Vermont recently began a pilot study in the Northeast Kingdom by partnering with the Northeastern

Vermont Regional Hospital to provide joint weatherization and health services to ten low-income households containing at least one person with chronic respiratory issues (Santi, 2020).

· Local town energy committees have had some success with Button Up!, Weatherize! and fuel switching campaigns. Several town energy committees collaborate with other businesses to provide weatherization services (such as the Window Dresser's program in Glover Vermont), where the local energy committee aggregates and allocates resources to support efficiency improvements in the homes of seniors in the town.

There are several challenges in getting senior households involved with energy transformations. Household members may have trepidation about new technologies. Will the insulation work as well as traditional batt insulation? What about off-gassing? There is also the challenge of spreading the information to those who could take advantage of the programs. Information dispersal is a challenge for any program in the Northeast Kingdom; to ensure broad range and reach, many channels must be used: social media, newspapers, radio advertising, pamphlets at service provider offices, and direct outreach from the organizations themselves. A last challenge can be financing the project cost beyond available rebates, incentives, or discounts. While some of these programs, such as the Window Dresser's program in Glover, VT are free to older adults in the community, many of the programs offer partial rebates and incentives: The project still costs the household money, sometimes quite a bit. As Ball (n.d., p.13) states:

> *Many homes require remodeling or retrofitting to accommodate changes in an occupant's mobility. Programs should be available to provide service assistance and/or grants to maintain or modify homes to meet needs of senior occupants. Older adults may have difficulty paying for and accessing maintenance services. Very poor owners and renters, particularly those living alone, are even more likely to occupy deteriorating dwellings. Problems can include faulty electricity, plumbing and kitchen inadequacies, roof leaks, heating and cooling deficiencies and various upkeep concerns.*

If the retrofit cannot be paid for out of pocket, financing services may be required, and with financing, a household will need good credit which may not be possible for the neediest of senior households.

Researchers and practitioners agree that programs that provide subsidy for low- and moderate-income households to make the energy switches, upgrades and weatherization needed to curb

consumption, emissions, and waste should continue (Hernandez & Bird, 2010; Howat & Taormina, 2008; Snyder & Baker, 2010; US Department of Energy, 2019). Expansion of programming and funding would extend services to many more households in need. “The federal government also should expand funding and streamline the application process for the USDA Section 504 Home Repair program which provides “grants to [rural] elderly very-low-income homeowners to remove health and safety hazards” (Johnson and Appold, 2017, p. 23-24). In expanding the program, the government should stipulate that renovations must be done by certified aging in place contractors and according to the universal design guidelines recommended by the National Homebuilders Association. The combination of funding, program expansion, and quality retrofitting will support older adults in securing an energy efficient dwelling that will aid them in successful aging in place.

Repeatedly researchers, advocacy organizations, and the federal department of Housing and Urban Development state the imperative that quality of housing for seniors be better addressed. The Joint Center of Housing Studies of Harvard University (2018, p. 10) found that “providing safe, affordable and accessible housing to the nation’s aging population is an immediate challenge. Many households currently in their 50s and early 60s are not financially prepared for retirement, with lower homeownership rates than their predecessors and meager gains in income and wealth”. Before our nation responds with building more homes, Fausset et al. (2011, Discussion para. 6) reminds us that “highlighting trouble areas for older adults and understanding the nature of the solutions older adults’ employ is an important first step in supporting aging in place”. Housing safety and affordability is directly linked to energy. We must begin to address the building envelope, heating and cooling systems, and overall building wellbeing. There is a need for increased research and dialogue about AIP and the condition of housing and heating if we wish to support older adults' ability to age in place safely, comfortably, and economically.

5. THE ENERGY BURDEN FOR NORTHEAST KINGDOM SENIORS: AN EMPRICIAL STUDY

To assess the energy burden and related housing issues affecting the ability to age in place, a survey of seniors 60+ years of age was conducted in February 2021. The research was designed to respond to the larger questions motivating this report, namely: (1) What impact does energy burden have on older adults' ability to age in place? (2) What changes to existing programs and policies would better meet the energy burden and energy efficiency concerns older adults face? (3) Are there additional supports desired by older adults to help them age in place and relieve energy burden? The survey focused on housing and energy use information of seniors aged 60+ living in the three counties of the Northeast Kingdom of Vermont. The sample included residents over the age of 60 who's primary residence is in one of the Northeast Kingdom counties. Participant recruitment was voluntary and unpaid. Posters were placed in two Area Agency on Aging offices in Newport and St. Johnsbury, Vermont, and word-of-mouth communications encouraged among community members sought out participants. Participants could withdraw from the study at any time up to completion of this research report. Information was compiled to assure the anonymity of individual participants; no names or addresses of participants was collected. Consent forms were sent to participants. By completing and submitting survey responses, participants consented to taking part in the research study. A Google Forms link was sent to participants unless a paper copy was requested. Both renters and homeowners were targeted, provided they lived independently.

In total, 50 people responded to the survey. They had the following characteristics:

- aged 60- 90 years of age,
- 47 homeowners and 3 renters, and
- average household size of 2 persons.

The survey consisted of 30 questions that included open-ended responses, multiple choice, and ranking of statements on a 5-point Likert scale. See Appendix A for a copy of the questionnaire. The survey was administered via a Google Forms link with the option to pick up a paper copy of the survey at the two Area Agency on Aging offices in Newport and St. Johnsbury, Vermont. The paper copies were returned to the offices in sealed envelopes to maintain confidentiality.

After data was collected, descriptive statistics and cross tabulations were compiled for the following topics: 1) age of dwelling, 2) structural issues, 3) energy improvements taken, 4) barriers to energy improvements, 5) resources used to support energy improvements, and 6) perceived energy burden (how energy costs affect the households' ability to cover other basic expenses). Each is presented below.

Figure 3 shows the number and percentage of homes in the sample built before 1940, between 1941 and 1970, between 1971 and 2000, and since 2001. Of a total of fifty homes in the study, only six, or twelve percent of the total, were constructed between 2001 and 2021. Over forty percent (twenty homes) are old, constructed before 1940 and an additional sixteen percent, somewhat old. The distribution is demonstrative of the entire housing stock in the Northeast Kingdom, where "nearly a third of owner-occupied homes were built before 1940" (NVDA Regional Plan, 2018, p.137).

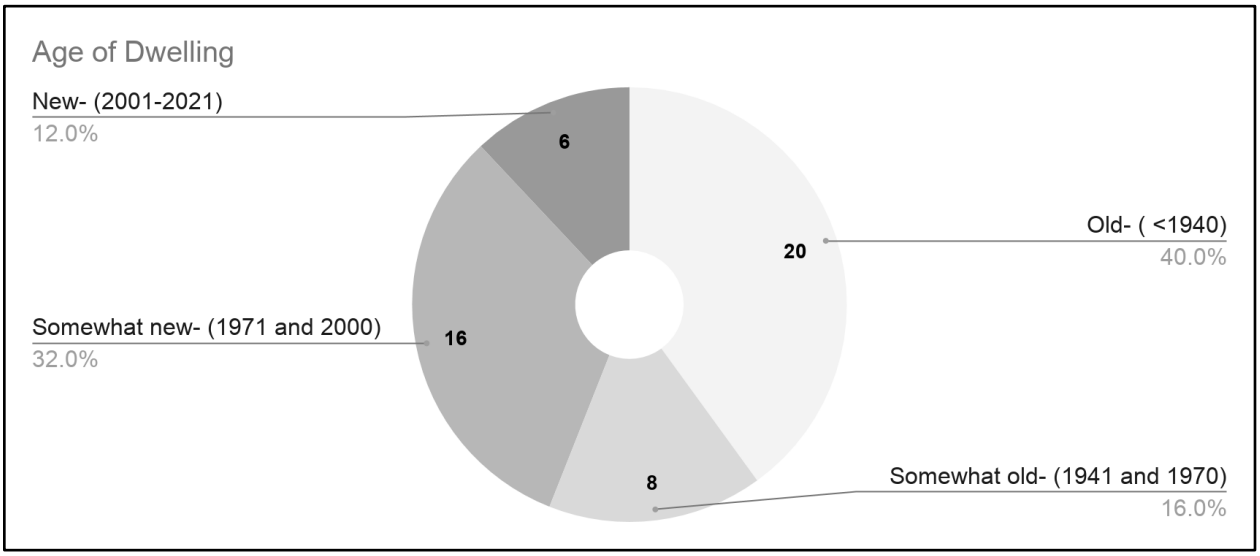

Figure 3. Age of Dwelling by frequency and percentage *(frequency is noted in black on the pie pieces and the percentages are on the legend labels)*

Energy costs did not seem a heavy burden for most of the respondents. Respondents ranked their perceived energy burden on a Likert scale of 1-5, where 1 represented no energy burden and 5 the highest burden level. Out of fifty respondents, thirty-four (68 percent) chose 1 or 2 (no or little burden); eight (16 percent) were households with moderate energy burden (level 3); and nine (18 percent) indicated moderately high and highest energy burden (4 or 5). This indicates that while this is a small sample and few households experience energy burden, there are still seventeen participants (34 percent) that experience energy burden. This study is seeking information about how energy burden is

impacting aging in place, and households without perceived energy burden may provide insights into programming and policy that has supported them in no or lower energy burden.

Structural issues with the residence appeared linked to a heavy energy burden. Of the fifty participants in the survey, sixteen noted structural issues with their dwelling. The breakdown of different issues is depicted in Table 1. All the participants who reported electrical and foundation issues also identified themselves as moderately to highly energy burdened (categories 3-5). The moderately to highly energy burdened population also accounted for three of the four respondents who noted issues with roofing.

The age of the building is linked to structural problems. Of the sixteen participants who reported structural concerns and issues, eight had homes built before 1940 with two participants noting that their homes were built in the 1890's. Three participants indicated structural problems had homes built between 1941 and 1970, four had homes built between 1970 and 2000, and one had a home built after 2001. But the age of the home is not uniformly linked to energy burden (see discussion below); it depends on the type of structural problems experienced.

Table 1: Structural concerns for entire sample and energy burdened sample

	Framing	Doorways and access points	Siding and exterior	Electrical	Old or broken windows	Roof issues	Foundation leaks, cracks, or crumbling walls
Entire sample (n=50)	2	9	3	3	7	4	3
Count for energy burdened (levels 3-5) (n=17)	0	3	1	3	3	3	3
Rate (%) of energy burdened homes with structural issues	0%	33.3%	33.3%	100%	42.9%	75%	100%

Survey participants were asked about energy improvements, specifically whether they had engaged in an energy audit, weatherization (such as air sealing and insulating), an upgrade of their appliances to Energy Star, or an upgrade of their heating systems to more efficient models. (The three respondents who rented their homes did not respond to this question). Weatherization projects were most prevalent, with thirty households out of forty-seven reporting that they had added insulation, improved the thermal barrier, or installed new airtight windows or doors (see Table 2). Over half of the households (25 of 47) reported upgrading their heating or hot water system within the past five years

while less than a third, had done an energy audit to better know where to make energy improvements and which projects should have priority.

Table 2: Energy Improvement Measurements Undertaken (2016-2021)

	Energy Audit	Weatherization	Upgrade to Energy Star appliances	Upgrade heating or hot water systems
Yes	14	30	17	25
No	33	17	30	22

**n=47, the three renting households did not respond to this question*

The surveys provide insights into the barriers households face to implementing energy efficiency improvements. Respondents identified numerous factors (see Table 3), ranging from lack of time or needed skills, to expense to, lack of information about where to start in energy efficiency improvements. Renters cited additional barriers specific to the split incentives and decision-making power between the landlord and the renter; renters mention lack of money for upfront costs for improvements, limitations on getting funding (e.g. loans) for desired projects, and little control (decision-making) over the building or improvements. Skill and time composed the highest percentage of responses, each with thirty-eight percent (see Table 3). Both skill and time can be a derivative of a cost barrier. If a household is unable to do the work themselves, they will have to seek outside services to complete the upgrades and improvements. Hiring services to do the work costs more than a homeowner taking on the project themselves, which could prevent the household from doing the project all together. Table 4 and Figure 3 show the frequency and percentages for each barrier type.

Table 3: Barriers to Energy Efficiency Improvements

	frequency	Percentage
Information	7	14%
Cost	18	36%
Skill	19	38%
Time	19	38%
Split incentives (renter)	3	6%
None	17	34%

Of the fifty respondents, ten had completed no improvements or upgrades, and an additional three only engaged in an appliance upgrade. The remaining thirty-seven respondents who had made energy efficiency improvements relied on a range of financial resources to do so. The breakdown of the resources used is detailed in Table 4. About one-third (13) of households had used personal savings and/or credit to cover the costs, without further outside support. Others used one or more external resources to cover the costs of improvement. For example, a household could have used a rebate, a loan, and fuel assistance (for that reason, the frequency of responses is greater than the number of households undertaking improvements). Rebates and incentives were the external resource with the highest number of users, (18 of 37 households). Nine households of thirty-seven had used a loan, and three accessed NETO weatherization (WAP) or LIHEAP fuel assistance.

Table 4: Financing of energy improvements and upgrades (n=37)

Resource used:	frequency
No Outside financial resources used but had made upgrades/improvements	13
Rebate or Incentive	18
Loan	9
NETO Weatherization (WAP)	3
Fuel Assistance (LIHEAP)	3
No resource used but had made upgrades/improvements	13
TOTAL RESPONSES:	46

Understanding links between housing type, energy burden, and energy efficiency

Using the survey data, six questions were assessed. Each question is directed at understanding how housing interacts with aging in place. Specifically, the data were examined to look for links between the following: housing condition and energy burden (Q1): and perceived energy burden and propensity to improve the efficiency of the dwelling's heating and cooling functions (Q2). The four subsequent questions focus on factors impeding or assisting a household to make energy improvements to their dwelling. Questions focus on specific sub-groups and comparisons across them, i.e., those who report

moderate to high energy burdens, those who do not (or do) undertake energy improvements, and those who use specific financial support programs.

Question #1: Is there a link between structural issues and those who experience greater energy burden?

As shown in Table 5, seven (44 percent) of the seventeen participants who said they had moderate to high energy burden (levels 3, 4, or 5) had major structural issues with their homes. In such cases, the significant energy burden may well be linked to structural issues that impede higher energy efficiency.

Table 5: Structural issues and levels of energy burden

	Structural Issues	No structural issues	TOTAL
Burden (level 3-5)	7	10	17
Little to no burden (level 1-2)	9	24	33
TOTAL	16	34	50

The other ten participants had dwellings, often old to very old, with major structural issues yet reported a low energy burden. Three responses from such participants were interesting in that the respondents expressed interest in WAP or LIHEAP federal funding to support weatherization and fuel assistance; those federal funding sources have income eligibility requirements. These three participants did not report having used WAP or LIHEAP resources in the past; it is unknown whether the household met eligibility for these programs, chose not to participate, or exceeded the eligibility threshold. While these individuals may have found ways to handle energy expenses, and thus feel little energy burden, the structural issues and the desire to see WAP or LIHEAP funds may indicate an energy burden that has been well managed but is still present.

#2 Which households are making energy efficiency improvements?

The survey results suggest that energy efficiency improvements are being made by all owner households, including those indicating a moderate, high or the highest level of energy burden; but those with little to no energy burden are undertaking more improvements (see Table 6). Aside from renters, none of whom reported improvements, all of those reporting the highest burden level engaged in one

or more energy efficiency improvements. Yet, across the board, those who report little or no energy burden undertook more energy efficiency home improvements than those with higher levels of energy burden. This apparent paradox suggests that the same factors that contribute to perceived energy burden act as a constraint on improvements.

***Table 6*: Number of efficiency improvements, by owner household's energy burden level**

	No energy efficiency improvements	One energy efficiency improvement	Two energy efficiency improvements	Three or more energy efficiency improvements
1.No burden	7	8	7	3
2.Little burden	1	3	0	3
3.Moderate burden	2	0	3	3
4.High burden	1	1	0	1
5.Highest burden	0	1	3	0

The next questions focus, first, on the group of households in columns 2 and 3 of Table 6- the ones who undertook one or fewer improvements- are examined to assess the barrier they face. Then the analysis zooms in on energy burdened households to assess the constraints they face and their use of different financing programs. Finally, the use of one program- the rebate- is explored to see how well it is serving different households; the rebate was selected because a high percentage of participants had used a rebate or utility incentive to improve energy efficiency in the past five years (n=18, 36%), and an even larger percentage of participants reported interest in using a rebate or incentive in future energy efficiency upgrades (n=33, 66%). The use of a rebate seemed to be a preferred and trusted form of financial support when considering energy improvements.

#3 What barriers are faced by households with the fewest energy improvements?

Twenty-three participants out of the fifty total participants reported 0 or 1 energy efficiency improvements to their current home (see Table 7). Participants were able to choose as many barriers as they experienced. So, a household could select both time and skill as barriers. Cost was selected as the most frequent barrier (11 of 23), followed by skill (9 of 23) and time (8 of 23). As noted above, skill and time barriers can be a derivative of a cost barrier. If a household is unable to do the work themselves, they will have to seek outside services to complete the upgrades and improvements. Hiring services to

do the work costs more than a homeowner taking on the project themselves, which could prevent the household from doing the project all together.

Table 7: Barriers experienced by households with the fewest number of improvements

# of improvements	Total count:	Number of which are energy burdened (levels 3-5)	No barriers	Information	Skill	Cost	Time
0	10	3	3	4	4	4	5
1	13	1	2	3	5	7	3
TOTAL:	23	4	5	7	9	11	8

The five participants noting 'no barriers' but who have not engaged in energy efficiency improvements predominantly live in newer homes, built in the 1970's or later and do not have any structural issues with their homes.

#4 What resources are being used by the most energy burdened populations to engage in energy efficiency projects?

Figure 4 shows that the federal weatherization and fuel assistance programs, WAP and LIHEAP, are being used by the targeted population, those with the greatest energy burden (level 5). The sample size is small, but it is interesting to note that level 3's and level 5's are using rebate resources but level 4's are not. While level 4's are quite constrained financially, they may not be income eligible for WAP or LIHEAP and are also not seeking out rebates or loans of their own to help cover energy efficiency improvement costs. The upfront cost may be too substantial for this population to take on, there may be a lack of information about available resources, or the data pool may be too small to get an accurate picture of what level 4 energy burden households are using for resources.

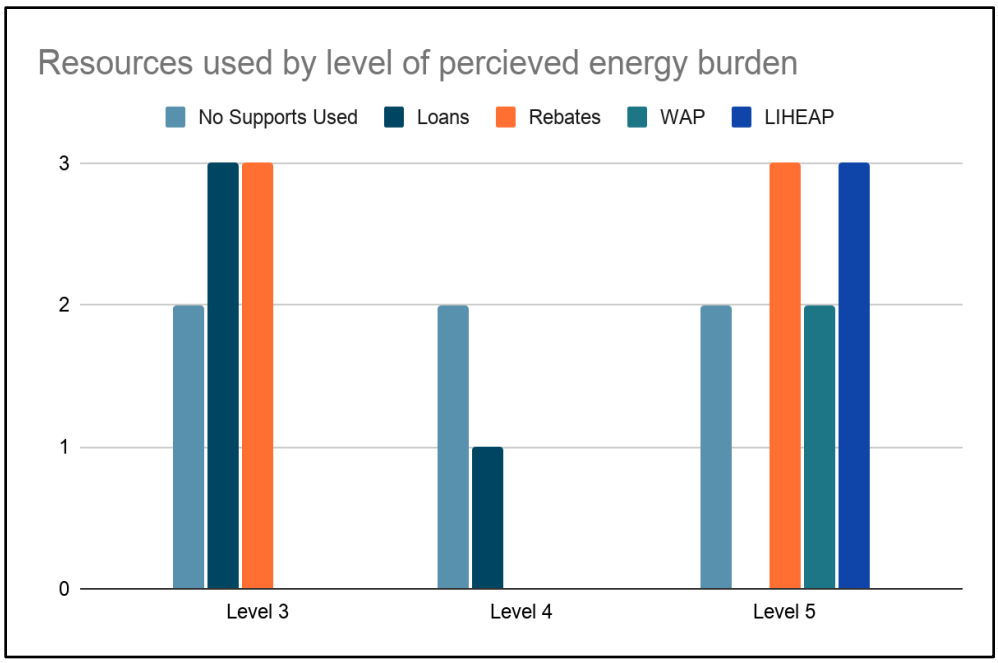

Figure 4: Resources used by perceived level of energy burden

Beyond looking at what resources are being used, the survey asked participants what resources they would be interested in using for future energy efficiency improvements. Of the seventeen participants at level 3-5, six expressed interest in WAP, LIHEAP, and rebate offers to financially help them in improving their energy efficiency. Six participants thought the use of rebates alone would support them in improving energy efficiency. Two participants expressed interest in moving to a smaller dwelling/unit to decrease energy expenses. One participant thought loans would be helpful in covering energy efficiency expenses, one person expressed interest in renting out a room in their home to help cover energy expenses, and one participant did not desire any financial supports to improve their energy efficiency.

#5 What resources are used by those who reported the fewest energy efficiency improvements compared to those who reported the greatest energy efficiency improvements?

For those with some improvements (2) and greatest improvements (3), rebates are used with more frequency (see Table 8). Those with some and greatest improvements also tap into loan resources. Those with the fewest improvements (1), do not use loans at all and a small proportion (around 33%) use rebates to support their energy efficiency improvements.

Table 8: Resources used by homeowners at differing levels of improvements

	Zero improvements (0)	Fewest improvements (1)	Some improvements (2)	Greatest improvements (3)
No resources	11	9	4	1
Rebates	0	2	4	4
Loans	0	0	2	2
Rebate & loan	0	1	1	3
LIHEAP or WAP & Rebate	0	1	2	0
TOTAL:	11	13	13	10

When looking at future energy improvements, the eleven that reported zero energy efficiency improvements did express interest in financial resources. Five expressed interest in using a rebate for future energy efficiency improvements. Three expressed interest in using a rebate and some other form of support whether loan or WAP resources. One individual selected all possible resources (rebate, loan, WAP, LIHEAP, moving to a smaller unit, and renting out a room to help cover heating expenses). Two individuals expressed no interest in resources for future improvements.

#6 What improvements are rebate users doing? Are rebates helping homeowners make improvements? Are rebates helping homeowners learn more about energy saving and efficiency? Out of forty-seven homeowner participants who answered the question about energy improvements made to their residence, seventeen reported having used a rebate or incentive as a financial support for energy related needs in the past five years. Of the seventeen that used a rebate or incentive, the breakdown of what improvements they made are in Table 9. It cannot be known from the survey data what purpose the rebate or incentive was used for. However, it seems striking that those who used rebates and incentives accounted for nine of the eleven individual households that reported having done an energy audit.

Table 9. **Improvements made by rebate users**

Audit	Weatherization	Upgrade appliances	Upgrade to system
11	16	8	12

Causality is unknown. Are those who have undertaken an energy audit then seeking rebates to undertake weatherization and energy efficiency upgrades? Or are the rebates available encouraging homeowners to undertake an audit and become more aware of the potential areas of energy efficiency improvement? Additionally, those who reported having used a rebate or incentive also contribute just over 50% of those who engaged in a weatherization project (16/30). Similarly, those who used rebates or incentives account for just under 50% of those who had a heating or hot water system upgrade (12/25). It could be that rebates and incentives are highly motivating ways for people to improve their energy efficiency. Efficiency Vermont works hard at outreach, makes rebates available to a wide income pool, and has collaborated with other agencies and utilities to wrap the rebates into other services and incentives.

6. DISCUSSION: Planning, Policy and Program Implications & Recommendations

The findings of this study suggest that energy costs, thermal comfort, and needed home repairs/upgrades are issues, and potential complicating factors, for Northeast Kingdom seniors who desire to age in place. As the US population of older adult's booms, the issues of Aging in Place as they relate to energy will continue to grow (US Department of Housing and Urban Development, 2013). We must begin to strategize solutions to support older adults' wishes to age in place while also maintaining adequate housing that is comfortable, affordable, and energy efficient. There are many policy implications behind the concept of aging in place with grace; where older adults can live their best lives not struggling to pay high energy bills.

This study found that people who experienced energy burden were more likely to have major structural issues with their homes and were less likely to have done energy efficiency improvements. Households already burdened by energy costs may not have the funds, skills, or time to make structural improvements to their homes that would help optimize their heating and cooling systems. A leaky roof must be addressed before energy efficiency improvements will have any impact.

Across all households, cost was the most prevalent barrier to energy efficiency improvements, followed by constraints of skill and time, which are derivatives of cost. Households that cannot afford the upfront costs or financing of major energy efficiency projects face a significant barrier to improving their homes' energy efficiency. Even when improvements may save the household money in the long run, startup costs prevent the household from taking on the projects.

Finally, this study looked into the monetary resources used by energy burdened households and all households. Households experiencing moderate to high energy burden were using financial resources but not equally. The highest energy burdened households were using federally funded WAP and LIHEAP resources to improve weatherization and cover heating fuel costs. Moderately burdened households were seeking out loans and rebates to partially cover energy improvement expenses. However, the group in between moderate and highest energy burden were not using federal funding sources and were also not seeking out loans and rebates. This population is experiencing a high energy burden, but is unable to tap into income eligibility capped resources and at the same time is not using or seeking out other resources.

Rebates were the most used financial resource across all households that were making energy efficiency improvements. This indicates that organizations such as Efficiency Vermont and the respective electric companies are trusted entities and are marketing well to households looking for support in energy efficiency. Of the households that used a rebate in the past five years, 94 percent of households engaged in weatherization projects. 70 percent of households upgraded their heating system and 65 percent undertook an energy audit. As stated previously, causality is not known. From this study it cannot be determined if the rebate is enticing households to engage in improvements or if the improvements are causing households to seek out rebates as a financial resource.

The costs, health and wellbeing constraints, and entrapment associated with energy burden is serious for any population, but even more so for our aging adults. If the goal is to support older adults in their wish to age in place, the physical housing structure and its energy systems must be highly efficient and in good working order. Beyond comfort, a structurally sound, well insulated, cost and energy efficient heating system, will make for better quality housing and a better living experience for aging adults.

Recommendations for future planning, programming, and policy

Stimulate housing options, specifically newer, energy efficient homes for seniors that allow them to stay in their neighborhood of residence. Old homes are more likely to have structural issues and structural issues can impede energy efficiency. While older homes are highly prevalent and perhaps even desired (house character and lower cost), their maintenance and upgrades can be expensive and difficult. When a home has a roofing issue or foundation issues, weatherization efforts may not take priority. Or, if the energy efficiency projects are done, they may not provide the same energy efficiency benefits that they might to a home without those issues. While there are many older adults that wish to stay in their homes, having options within a community to move to a newer and more energy efficient home may be enticing for those who do experience high heating costs. There are additional benefits depending on the design of newer construction homes, including many of the universal design aspects that support successful aging in place and may have wrap around services such as healthcare or social programming that older adults may enjoy taking advantage of.

Commit community leaders, organizations, and town energy committees to improve information dispersal to community members about the benefits, options, and resources for energy efficiency. Tying in with Efficiency Vermont's programming, the barrier of information gathering can be

overcome in communities. Button Up! days, pamphlets at kiosks, and online information sharing through social media can help spread the word about the advantages of energy efficiency, share information about the different options available, and point households in the direction of financial or technical resources.

Continue to explore how other stresses in life take priority over discussions about heating and energy efficiency. Many of the participants in this research study did not experience energy burden or have barriers to improving their energy efficiency. Future studies could look more closely at just households that experience energy burden to better understand what obstacles those households face and what supports would be most beneficial. Additionally, in the times of COVID-19, households may be experiencing additional stress that prevented them from participating in this study or engaging in energy efficiency improvements. When a household is worried about keeping the heat on, putting food on the table, and arranging for childcare so adults can go to work, seeking out rebates and energy efficiency improvement projects may not take center stage.

Expand the income eligibility of WAP and LIHEAP programs to provide the needed support for lower income households that are beyond the income thresholds for eligibility. From this research, those with high energy burden (level 4) were not tapping into resources that are restricted to income thresholds, as WAP and LIHEAP programs are, but were also not using rebates or other incentives to help them take on energy efficiency improvements. Expanding the income eligibility of WAP and LIHEAP may support more older adults' ability to age in place successfully and more comfortably. While these federally funded programs are reaching the targeted audience, those with the highest energy burden, expansion of these programs to a wider income bracket could benefit a group of older adults that are needing financial support to take on energy efficiency improvements.

Augment the outreach and marketing of Efficiency Vermont services to continue helping the state transition to a more affordable and cleaner energy future. Expanding the rebate offerings will augment the rate and uptake of energy efficiency improvements. Rebates are highly utilized by homeowners in the Northeast Kingdom and a trusted resource for information, network contractors, and energy efficiency rebates. The barriers to energy efficiency improvements are as expected: cost, skill, and time. The participants that engaged in the most energy efficiency improvements used financial supports to overcome a portion of these barriers. Rebates through Efficiency Vermont were the most prevalent resource. The weatherization and heating and hot water system upgrade incentives pushed

out by Efficiency Vermont are working. People are taking advantage of those rebates to improve the quality of home heating. For households that engaged in two or more energy efficiency improvements, the use of rebates was the most prevalent resource used. Rebates seem to be an effective way to support households across the income spectrum to improve weatherization and energy efficiency. Many households, (33 of the 50) expressed interest in using an Efficiency Vermont rebate for a future efficiency project. Efficiency Vermont, the state organization responsible for rebates, has obviously done a great job spreading their mission out into communities. The organization is trusted and has worked hard to become a household name; a source of information and resource for households investing in energy improvements.

While this document focused on thermal energy efficiency, additional research is needed on the following themes: thermal comfort, heat waves, and renting.

Define and quantify thermal comfort. It is unknown from this research if households experience excessive heat or cool drafts in their homes. Thermal comfort is how most households will assess their current heating and cooling systems, and this measurement is subjective. As programs and policies expand and support more weatherization projects and fuel assistance, determining a range of adequate thermal comfort will help determine if a household is having trouble heating or cooling their homes to the threshold points. With a range of thermal comfort temperatures, for example 65-75 degrees F, programs such as WAP and LIHEAP can better assess whether a household is experiencing thermal discomfort and potentially energy burden. A clear definition of thermal comfort can pinpoint when heating becomes burdensome instead of manageable. Cost is one form of burden; thermal discomfort is another and it can be linked to illnesses and hinder an older adults' capacity to age in place. Further research into thermal comfort would help expand the understanding of how energy impacts aging in place.

Address the issues renting implicitly has with energy efficiency. Three participants were renters, of which two identified as experiencing highest energy burden (level 5). When a household does not control the physical structures' or heating systems' maintenance, upgrading, and efficiency it is much harder to seek improvements that would decrease the energy burden. For all three renters had units in old buildings, two built before 1940 and one built between 1940 and 1970. This returns us to the first point in the discussion about the availability of newer units, both for ownership and rental, that are

more energy efficient. Future research should focus on renters to deepen the understanding of split incentives and energy efficiency constraints this population faces.

Expand the discussion about energy efficiency to include new demands on cooling. Climate change is impacting the length of seasonal weather patterns in colder climates. While there will still be a demand for heating in the winters, households may experience excessive heat in hotter summers. Much of the information available on energy efficiency in Vermont focuses on heating. The data collected for this study also looked heavily on the energy used to heat homes. Further research on the energy used in cooling homes in the summer months is needed. While most cooling technologies do not use non-renewable fuel, and instead use electricity, the cost associated with increased electrical use during peak times in the summer could add new energy cost burdens to households that previously had a few months of heating/cooling cost reprieve.

7. CONCLUSION:

Aging in place will continue to be an important issue for senior adults, the communities in which they live, and in our national policy making. As more and more adults enter their elder years, more and more support and services will be needed to help this population be successful in aging in place. In addition to home health care, universal design, quality public transportation, and social connections, housing energy efficiency and maintenance are topics that must be addressed.

This study aimed to better understand the barriers experienced by energy burdened households in the Northeast Kingdom of Vermont as well as gain insight into the resources used by households across the region that do engage in energy efficiency improvements.

In planning for energy efficiency for the NEK, this study highlights the need for new energy efficient housing stock that is designed for universal access. “Without changes in how communities are constructed, and services are delivered, older adults may find it increasingly difficult to live in their communities and may have to consider institutional care” (Farber et al., 2011, p.2). Creating housing options that decrease energy burden may support more older adults in their wish to age in place in our communities. Additionally, organizations and committees working to improve energy efficiency should continue to share information about the available resources to overcome cost, time, and skill barriers. The rebates available through Efficiency Vermont seem to be a trusted resource which could be leveraged to expand outreach to the households most in need.

At a national level, the Weatherization Assistance Program and the Low-Income Home Energy Assistance Program are already highly utilized and sought out programs. This research noted that those just outside of the income eligibility requirements for these two programs may benefit from these resources should the eligibility requirements expand to a higher income level. While these programs aim to help the lowest income households, those just above the thresholds are not tapping into other resources to help them improve their homes’ energy efficiency.

Energy is inextricably linked to equity. All households, including those of older adults, should have the right to safe and affordable energy for their home heating. “Affordable energy policies promote population health” and environmental health. (Snyder & Baker, 2010, p. 20). Energy affordability begins with improving the physical structure and heating systems of a home. If we truly want to support older adults’ wishes of aging in place, we must address energy efficiency. With

improved energy efficiency more older adults can save money, be more comfortable in their homes, improve their health, and be better environmental stewards to our planet.

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9. APPENDIX A: Fuel Supplier Discounted Fuel Price Programs

Price Cap Program: This program provides customers with protection against unexpected increases or decreases in market conditions that effect fuel pricing. The Cap Program creates a ceiling price that will not be exceeded no matter how high oil prices increase, but it also allows the price to decrease when oil prices decrease. Customers must specify the number of gallons they want to protect during the program selection process. This program is beneficial to customers when market conditions increase or decrease during the heating season. To secure the cap price for customers, oil companies purchase oil future contracts and oil options with suppliers, thus need to charge a price protection fee for this program.

Fixed Price Program: This locks in a price that does not go up or down with the market. Fixed priced programs offer peace mind because customers know ahead of time what the price per gallon will be. This plan has some risk associated with it; if price falls, locked in price will not fall. Therefore, customers will not be able to take advantage of the lower rate. If market prices rise, the customer does benefit from the lower rate.

Daily Market Price: Also known as the floating price program, price changes with current market conditions. This program performs well when market conditions are stable or declining. Additional benefits to customers include no required contracted gallons and no enrollment fee. This program does not perform well when oil prices increase dramatically.

Budget Payment Plans: This plan allows customers to spread payments out over 12 months, even though most customers use most of their fuel in six months. This makes payments more predictable and helps avoid steep payment spikes during the heating season. The fuel provider uses an average of the last two years of heating costs and divides the cost into 12 equal amounts to estimate monthly payments. Customers make one lower priced payment each month rather than paying for heating oil after each delivery.

Pre-Buy Program: This program locks in a price per gallon for a specific number of gallons for the heating season. The locked price per gallon does not go up and does not go down with market conditions. This program provides protection against dramatic increases in oil prices and is beneficial when market conditions are stable or rising dramatically. The Pre-Buy Program is not beneficial when market prices decrease; the customers price per gallon will not go down. This program is the LOWEST priced program because it requires the customer to pay for all the oil purchased before the heating season in one lump sum. There is no enrollment fee associated with this program.

On-time Discount: Prompt payment discounts are offered to customers not enrolled in a budget payment plan or the pre-buy program. After a fuel delivery, customers that pay the total bill within one week a discount on their fuel bill. This discount is beneficial for customers that can pay on-time but is not beneficial for customers that defer payment or have insufficient funds to cover fuel costs.