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## Understanding ‘energy insecurity’ and why it matters to health

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### Abstract

Energy insecurity is a multi-dimensional construct that describes the interplay between physical conditions of housing, household energy expenditures and energy-related coping strategies. The present study uses an adapted grounded theory approach based on in-depth interviews with 72 low-income families to advance the concept of energy insecurity. Study results illustrate the layered components of energy insecurity by providing rich and nuanced narratives of the lived experiences of affected households. Defined as an inability to adequately meet basic household energy needs, this paper outlines the key dimensions of energy insecurity-economic, physical and behavioral- and related adverse environmental, health and social consequences. By thoroughly examining this understudied phenomenon, this article serves to raise awareness of an increasingly relevant issue that merits more attention in research and policy.

### Keywords

United States; Energy insecurity; Vulnerable populations; Social; Economic and environmental determinants of health; Housing and health; Grounded theory; In-depth interviews

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*“I mean, no bill drives me crazy like my gas bill.” – Erica, mother of two and market rate renter*

*“My apartment was huge but it was awful too because of the heating system. It was never constant, consistent heat. So that basically was the start of my high gas bill ‘cause I had to keep running that ‘senseless’ heat.”–Nicole, mother of three and housing subsidy recipient*

## 1. Introduction

### 1.1. Energy as a critical social and public health matter

Erica and Nicole’s experiences are emblematic of a source of hardship that affects an estimated 16 million low-income households in the United States (Power, 2006). For this segment of the population, the struggle to meet basic household energy needs is a common strain that remains hidden in plain sight (Hernández, 2013). The World Health Organization (2006) affirms that “energy is essential to meeting our basic needs: cooking, boiling water, lighting and heating. It is also a prerequisite for good health-a reality that has been largely

ignored by the world community.” The lack of attention to energy-related hardship, particularly in the U.S. context impels a need to further explore this issue in order to better understand its implications at the nexus of place, health and socioeconomic factors.

Energy is an increasingly important social and public health concern. As costs for residential heating, cooling and other household energy needs steadily increase, they account for a higher percentage of household budgets and represent emerging disparities between richer and poorer households (American Coalition for Clean Coal Electricity, 2012). An economic ratio, represented as “low household income/high energy expenditures,” is used to estimate energy burden in the US and fuel poverty in Europe (Residential Energy Consumption Survey, 2012; Power, 2008; Moore, 2012). Both energy burden and fuel poverty ensue when energy expenditures exceed ten percent of a household’s income. Recent data shows that most U.S. households at or near the federal poverty line are significantly burdened by energy costs (Hernández et al., 2014, 2016). However, this economic ratio captures only one dimension of energy-related hardship and otherwise fails to account for additional factors that contribute to energy burden such as housing conditions and energy behavior.

## 1.2. Energy insecurity as a needed conceptual framework

One factor that contributes to energy as an ignored hardship is the lack of an appropriate label and related conceptual framing. While the term “energy insecurity” exists in the literature, the phenomenon is not well understood. Existing studies have utilized the term to understand its connection to low socioeconomic status and other social disadvantages, negative health outcomes, and in conjunction with other economic and environmental insecurities. First, socioeconomic status and race/ethnicity are closely linked to the experience of economic energy insecurity. Hernández et al. (2016; 2014) demonstrated that households near or below the federal poverty line were more likely to surpass the ten percent threshold on energy expenditures. The authors also found that African Americans across the economic spectrum experienced economic energy insecurity at the highest rates while Asian and Latino immigrants were the least burdened (Hernández et al, 2014, 2016). Second, energy insecurity has been linked to health and other hardships (Cook et al., 2008; Smith et al., 2007 Frank et al., 2006; Nord and Kantor, 2006). Cook et al. (2008) found that children in moderately and severely energy insecure homes are more prone to food insecurity, hospitalizations, poorer health ratings, and developmental concerns than children in ‘energy secure’ homes. The “heat or eat” dilemma demonstrates the trade-offs that low-income householders make in order to meet the basic necessities of life whereby at-risk groups are forced to decide between food and energy, often sacrificing one for the other (Frank et al., 2006; Nord and Kantor, 2006; Food Research and Action Center, 2005; Bhattacharya et al., 2002). Third, energy insecurity has also been linked to other insecurities such that rising energy costs have also impacted access to clean and safe water (Eichelberger, 2010). Beyond these limited examples, attention to energy insecurity remains scant and research in this area is severely underdeveloped (Hernández, 2013).

This article fills a critical gap in the literature by more comprehensively operationalizing the concept of “energy insecurity.” Energy insecurity is defined here as “an inability to adequately meet basic household energy needs.” Besides offering this definition, the present

study advances this concept by highlighting its primary dimensions-economic, physical and behavioral- and exploring the mutually reinforcing nature of this phenomenon. Based on an adapted grounded theory analytical framework, this paper gives meaning to the term *energy insecurity*-by providing real world examples of how energy insecurity is experienced and the different forms it takes in the lives of vulnerable groups.

## 2. Methods

### 2.1. Research questions

The key dimensions of energy insecurity emerged using an adapted grounded theory approach in a qualitative study originally conducted to explore broad housing problems among low-income families (Hernández, 2016a; 2016b). The present analysis focused on energy as a unique housing problem and addressed the following research questions: (a) What are the primary dimensions of energy insecurity? (b) How is the experience of energy insecurity related to the larger landscape of material hardship for low-income households? and (c) What are the health and social implications of energy insecurity?.

### 2.2. Sample

A convenience sample of 72 participants was recruited from community health centers in the Boston area. The author approached families in the waiting areas of pediatric departments and asked willing parties to answer a 10-question screen to determine their eligibility for the study. Eligible participants included those with: a) at least one self-reported housing hardship, ranging from housing affordability, to frequent moves, to hazardous housing conditions, b) an income at or below \$32,000, which equals 150 percent of the 2008 federal poverty level and c) residence in Dorchester, Massachusetts.

A sample consisting of 70 female and 2 male heads of household ranging in age from 18 to 59 were enrolled in the study. Most participants were single mothers (97%), racial/ethnic minorities (47% African American; 29% Latino), native-born (62%), English (72%) or Spanish (25%) speakers, and had a high school education or higher (85%). The median annual income was \$30,000 and the majority received housing subsidies (65%).

### 2.3. Data collection

Participants underwent a home-based, semi-structured interview to understand their housing and neighborhood environments, the coping strategies that participants used to deal with housing problems, the use of safety net resources, and parental and child health. The housing, energy and health questions included: "Please describe any problems you've had with respect to your housing" "What have you done to deal with/fix this problem?" "Now, I'm going to ask you about your housing expenses including the rent and utilities." "How, if at all, has your housing affected you and/or your children in terms of health?" In addition, respondents were asked to give the interviewer a tour of their home in order to document the housing conditions described in the interview such as drafty windows, faulty thermostats, poor lighting, electrical hazards, outdated appliances and pest infestations. Observations from the walkthroughs were captured in field notes. Interviews were conducted in English and Spanish by the author and in Vietnamese with the assistance of a translator. Interviews

were digitally recorded and transcribed; the average duration was 90 min. Respondents were compensated \$25 in cash.

This study was approved by Institutional Review Boards at Cornell University, Boston University Medical Center, and Beth Israel Deaconess Medical Center, and by participating community health centers not affiliated with academic institutions. All study participants provided informed consent. Identifying information has been removed to protect the confidentiality of study participants.

#### 2.4. Data analysis

Interview transcripts and field notes were systematically coded for emergent themes using an adapted grounded theory analytical approach involving a two-phase coding process (Charmaz, 2006). Two coders (the principal investigator and a graduate-level research assistant) reviewed the transcripts and field notes several times in order to become deeply familiar with the data. This process was aided by qualitative data analysis software (Atlas.TI version 6.0), which facilitates the systematic analysis of qualitative data and assists in the process of categorization and coding, developing themes and organizing data segments (Creswell, 2012). Following an inductive analytic approach characteristic of grounded theory, we employed open and axial coding techniques. In the open coding phase small segments of the data were summarized to offer basic descriptions of the text and enable the grouping and categorization of thematically similar codes. These codes included descriptive terms such as “light,” “gas,” “heat,” “bills,” “boiler,” “utilities,” and “shut-offs” and *in vivo* terms (in participant’s own language) such as “NSTAR” and “ABCD,” which respectively referenced the local utility company and a popular fuel assistance organization. During the axial coding phase, several codes were selected for in-depth analysis on the evolving topic of energy-related hardship. The analysis yielded emergent themes that demonstrate repeated categories of information and the nature of their associations. The process of analysis linked codes and traced processes that ultimately led to the observed outcomes related to the three dimensions of energy insecurity and related consequences (see Tables 1–4). Collectively the data conveyed a tale of material hardship, inefficient building infrastructure, complex coping strategies, and limited options for assistance as illustrated below.

### 3. Results

#### 3.1. The three dimensions of energy insecurity: economic, physical and behavioral

An understanding of the challenges associated with energy insecurity was shaped by the rich and detailed narratives of participants who described energy as a main source of hardship. Three primary dimensions of energy insecurity emerged: economic, physical and behavioral. The presentation of findings is organized to explain each dimension followed by a discussion of the environmental, health and social consequences of this phenomenon.

#### 3.2. Economic energy insecurity

Economic energy insecurity represents the disproportionate financial burden that high energy costs impose on low-income households. Participants reported a wide range of household energy expenditures, from as low as \$30 a month to, in some cases, as high as

\$650 a month at the height of the heating season. On average, participants reported monthly bills between \$100 and \$300 dollars, with considerable variations by season and housing type. To put this economic burden in perspective, according to Massachusetts State guidelines in 2012 a household of four receiving public assistance would net \$691 in cash assistance, a portion of which would need to be allocated to utility expenses (Community Resources Information). Utilities bills at \$200 per month would represent nearly thirty percent of household income and therefore a significant, and likely unaffordable, expense. This would also render those at the federal poverty line (\$23,050 for a family of four in 2012) as energy insecure using the 10 percent threshold.

The experience of economic energy insecurity is linked to financial hardship and the prioritization of basic needs. Many participants attributed low household incomes to unstable employment, low wages and the “cliff effect” (Prenovost and Youngblood, 2010; Romich et al., 2007). “Cliff effects” occur when households become ineligible for safety net benefits despite not experiencing full economic self-sufficiency through employment, a circumstance described by one participant as a “catch-22.” Further, in comparison to other household expenses such as housing and food, utilities were often considered less of a priority and were handled with more flexibility because service interruptions take time to ensue and can be avoided. Nevertheless, participants expressed an ethos of responsibly “paying the bills,” except many simply could not afford the monthly utility payments and were often “playing catch up.” This vicious economic cycle borne from a process of prioritization and trade-offs complicates the already fragile financial profiles of low-income ratepayers.

The economic hardships associated with unaffordable utility bills resulted in arrearages often marked by thousands of dollars of debt to utility companies and brought consequences which included limits to energy access as well as restrictions on the ability to change residences. Utility arrearages reflected financial hardship but were also linked to billing issues, landlord improprieties and seasonal variations as well as building-level inefficiencies that increased costs. Shut-off threats and the disruption of utility service were a persistent cause for concern among those behind on their bills, though some families were able to seek shut-off protection by leveraging medical vulnerabilities.

Moving represented a challenge for families with accumulated utilities debt seeking to transfer service accounts to a new residential address. Under these circumstances, some participants elected to put services in the name of other household members including underage householders. As a vivid illustration of this point, Nicole accumulated \$5000 in utilities debt after a year and a half of paying for the “senseless heat” (meaning: inadequate) she referenced in the opening quote. She considered moving, but essentially was stuck until she could pay off the debt as the utility company barred arrearage transfers. Nicole attributed this conundrum to living in subsidized housing. She noted that while mobile voucher program recipients have more housing choices they are often limited to subpar units where they cannot control the efficiency of the dwelling’s appliances and heating/cooling systems and seldom have utilities included in the rent.

Economic energy insecurity thus reflects the financial hardship associated with making ends meet on limited budgets and the consequences of exorbitant utility bills. The economic challenges are further exacerbated by surplus costs stemming from inefficiencies in the physical environment, reflecting the second dimension of energy insecurity.

### 3.3. Physical energy insecurity

Physical energy insecurity is defined as deficiencies in the physical infrastructure of the home environment that impact thermal comfort, induce harmful exposures and increase energy costs. Examples of such deficiencies include but are not limited to malfunctioning heating and cooling systems, outdated plumbing and electrical systems, poor lighting, and inefficient appliances. In some instances physical energy insecurity stemmed from the overall poor quality of the housing unit marked by a lack of upgrading in older housing, the use of subpar building materials and inadequate maintenance practices. Facing limited housing options due to lack of affordability, many poor renters and homeowners alike are at increased risk of living in lower-quality housing. Renters are at a significant disadvantage when landlords have little incentive to improve older, less efficient building systems and appliances particularly when the onus of payment falls on the tenants (Bird and Hernández, 2012). In this sample, energy-specific inefficiencies deriving from drafty doors and windows, faulty thermostats and lack of insulation resulted in significant heat loss and thermal discomfort. Further, participants noted that the transition from oil to gas, often a more efficient option, resulted in less comfort and unexpected bills. These conditions not only caused further economic hardship, but contributed to unsafe living conditions. In response to these challenges, study participants often devised a variety of behavioral strategies to manage the physical and economic facets of energy insecurity.

### 3.4. Behavioral energy insecurity

Behavioral energy insecurity is defined by strategies used to cope, improvise and counteract the impacts of economic and physical energy insecurity. This dimension is marked by both positive and negative behavioral approaches. Positive strategies had environmental and economic benefits and demonstrated resourcefulness; negative strategies presented risks to health, safety and residential stability. Strategies revolved around three inter-related categories: energy conservation and/or thermal comfort compensation, bill-paying, and shut-off avoidance and compensation.

Participants described a range of energy conservation strategies, some more elaborate than others. Many practiced vigilance in energy consumption using lights, heating equipment and other appliances sparingly so as to minimize costs. Some participants sought thermal comfort by insulating their homes to reduce drafts and addressing other sources of heat loss. However, the inability to regulate temperatures and the consideration of costs led some to sacrifice comfort and jeopardize health and safety. For example, under desperate circumstances, some described using space heaters to compensate for inadequate thermal comfort, and others used the stove or oven as improvisational heating methods.

Bill-paying behaviors described by participants included juggling expenses by paying down utilities debt using funds from annual tax returns when available or making partial payments

to keep the services on while simultaneously accruing debt for the unpaid portion. Some enrolled in “balanced billing” to better predict expenses based on a monthly average of the annual energy costs for the home, that is then billed evenly across the year by the utility company. Other participants drew on external resources such as fuel assistance administered through local organizations to help pay bills. Fuel assistance is typically applied directly to the utility bill and renewed annually for those fortunate to qualify and enlist when resources are available. However, several participants described being turned away as federal and state-sponsored fuel assistance resources are often quickly exhausted in high demand areas such as Boston, leaving needy households with few options for relief.

In the event of a shut-off, households sacrificed by drawing on basic survival skills using non-energy sources to store and prepare food until they obtained the needed funds to reinstate the services. Many utility companies offer shutoff protection for eligible households, including those with very young children and elderly inhabitants or those with medical conditions that require household energy, though this stipulation varies by utility company and state-level policy (U.S. Department of Health and Human Services). At the time of data collection, shut-off protection in Massachusetts required a letter from a qualified medical provider and was subject to renewal every 90 days. Many study participants with young children or medical conditions such as asthma, diabetes or mental health disabilities qualified for this renewable protection. However, leveraging medical vulnerabilities proved an insufficient and unsustainable method of shielding a household from energy insecurity since arrearages mounted and participants were, in essence, trapped when unable to transfer accounts with balances to a new residence.

Participants noted key challenges in receiving helpful information on energy savings and available resources in marginalized communities, feeling that nothing could be done to improve the circumstances. Still others simply hoped for more and had faith that they would overcome the energy hardships they encountered. Ultimately, the persistence of such economic and physical deficiencies posed significant environmental, health and social risks.

### **3.5. Adverse consequences of energy insecurity**

Study participants identified a number of adverse environmental, health and social consequences related to the energy insecurity problem. Whether renters or owners, the economic and physical housing hardships and negative behavioral strategies significantly compromised resident health and environmental quality as well as exacerbated conditions of social disadvantage. Poor housing quality and lack of proper maintenance (i.e. poor insulation, limited ventilation, and malfunctioning heating and cooling systems) often caused harmful environmental exposures including extreme home temperatures, gas leaks and dampness, mold and humidity. Further, the use of stoves for heat was a common strategy for seeking thermal comfort yet doing so induces harmful exposures shown to jeopardize health and safety (Lanphear et al., 2001; Garrett et al., 1998). The lack of comfortable home temperatures also exacerbated asthma symptoms, particularly during winter months.

Economic hardships and poor physical conditions also contributed to chronic stress (Evans and Kantrowitz, 2002; McEwen, 1998). Participants described feeling worried about fuel bills and the deteriorated conditions of their home environments. The experience of energy

insecurity also triggered mental health disorders such as anxiety and depression. Several participants mentioned involvement with medical providers for adversity-related mental health treatment or to leverage a medical vulnerability for shut-off protection purposes. The constant threat of service interruptions due to non-payment fueled parental fear and stigma. Parents felt judged by persistent surveillance on the part of child protective services and feared losing parenting privileges to the State with the concern that being unable to “keep the lights on” could be considered a marker of inadequate parenting. Some participants expressed feelings of shame and a disruption of family life when living through a utility service disconnection. Moving represented a way out of the discomfort with some participants moving frequently to escape both faulty heating systems and high bills. However, this coping strategy brings with it negative consequences, as residential instability spurs the loss of social network and institutional ties, which comes at a significant cost in terms of social capital.

#### **4. Strengths, limitations and future directions**

This article presents a comprehensive view of a hidden source of hardship-energy insecurity. Although the original purpose of this study was to examine housing problems experienced by low-income householders, the phenomenon of energy insecurity emerged from a rigorous examination of the data using an adapted grounded theory approach. This process uncovered the dimensions of energy insecurity along with its adverse environmental, health and social consequences. Notwithstanding these strengths, the exploratory nature of the research may omit other critical aspects of this phenomenon that did not surface in the analysis. Also, this study was conducted in the Northeast where cold weather and home heating issues factored prominently into participants’ narratives. Warm weather burdens and cooling hardships borne by those in hotter climates should be explored in future research. These results should be used to inform larger epidemiological studies to validate the links between energy insecurity and various health outcomes pertaining to overall health and in particular respiratory and mental health. These findings should also motivate refinement of existing measures of energy insecurity, which to date focus heavily on shut-offs, inability to pay and using alternative heating sources rather than the more comprehensive dimensions of energy insecurity exposed in the present article (U.S. Department of Health and Human Services, Office of the Administration for Children and Families).

#### **5. Discussion**

##### **5.1. The energy insecurity pathway to disease and disadvantage**

The present analysis focused on the lived experiences of energy insecurity among low-income householders. The evocative narratives presented above highlight the salience of material hardship in determining an outcome of vulnerability that renders keeping the lights on and staying warm an everyday challenge for poor households throughout the United States. As demonstrated by the results, energy insecurity is an important social, economic and environmental determinant of health. It is a manifestation of poverty comprised not only of an imbalanced ratio of household income to energy expenditures but also one that includes physical and behavioral realms of hardship. In this way, energy insecurity is akin to



food insecurity. In fact, an almost equal number of U.S. households encounter food insecurity as do experience energy insecurity (16 million versus 17 million, respectively) (Power, 2006; Coleman-Jensen et al., 2015). Many are burdened by both. Similar to food insecurity, where affordability and access to quality food matters, energy insecurity is determined by access to decent, efficient and affordable housing. Both are embedded within larger contexts of material deprivation and neighborhood disadvantage. Still, food is generally considered indispensable whereas energy is often perceived as an amenity. As most of people would cringe at the thought of hunger-prone families, few shudder at the notion of poor households living in the cold and in the dark, accruing debt to fulfill a basic need (Fig. 1).

The energy insecurity phenomenon is predicated on markers of social disadvantage such as low socioeconomic status, race, ethnicity, family composition and housing tenure; all considered key social determinants of health. In addition, energy insecurity acts as a mediator in the poor housing to poor health continuum. Set within the larger context of neighborhood disadvantage, factors such as racial residential segregation, concentrated poverty, limited social cohesion and deficient institutions produce a backdrop of structural challenges with direct implications for the availability of a decent housing stock. Unsafe neighborhood conditions also amplify the salience of the home environment as people stay home more often to avoid violence and danger (Hernández, 2016a,b). As an additional layer of disadvantage, housing marked by deficiencies in quality and lacking modern efficiencies affect the conditions of the home environment and the costs associated with its operation (i.e. utility expenses). Individuals living under these circumstances proceed to interact with the physical and economic aspects of housing and energy according to available material, informational and institutional resources. If limited by poverty and low social capital, householders may cope in ways that are detrimental to health and well-being (i.e. experiencing a shut-off, thermal discomfort). The environmental, health and social consequences of this phenomenon are thus the result of a “pathway of disadvantage” in which energy insecurity plays a unique mediating role. Its position reflects and exacerbates layers of ecological disadvantage from household income at the micro-level to housing cost and quality at the meso-level to low resource neighborhood settings and lack of adequate policies at the macro-level.

Literature suggests that housing interventions that promote warmth and energy efficiency are among the most effective options to improve health outcomes by way of housing conditions and the socio-economic determinants of health (Thomson and Thomas, 2015). While evidence in this area is still emerging in the U.S. context, researchers in Europe and New Zealand have established that investments in warmth and energy efficiency improve housing conditions, reduce fuel costs, and increase comfort and a sense of pride in one’s home, which then lead to direct and indirect improvements in general health, respiratory health and mental health. Further, cycles of disadvantage are thwarted by reduced time off from school and work thereby increasing parental and child productivity (Thomson and Thomas, 2015). The intergenerational promise of such interventions is critical given the deleterious impact of adverse childhood experiences and chaotic environments on child development (Shonkoff et al., 2012; Evans et al., 2005). Therefore, addressing energy insecurity through energy

efficiency interventions has the potential to break chronic cycles of hardship along this path of disadvantage.

## 5.2. Energy insecurity and housing-related factors

Energy insecurity is impacted by housing type, tenure and quality whereby one's status as an owner or renter determines if and how one experiences this phenomenon. The majority of study participants that experienced economic energy insecurity were either a) housing choice voucher recipients, which provides the option to rent market rate apartments using a subsidy that covers two-thirds of the rental amount; b) renters in market rate apartments or c) low-income homeowners; all in a low resource neighborhood context. For renters, subsidized and market rate alike, decisions regarding the quality of the building and energy infrastructure remain outside of their control and mostly favored the interests of landlords and property managers. At times, energy-related infractions qualified as housing violations and in most instances exhibited egregious abuses of power and privilege on the part of landlords. As shown above, landlord improprieties, maintenance practices and choices to improve property (or not) had a direct impact on the quality of household energy, with implications for cost and comfort on the part of tenants. The "split-incentive problem," whereby landlords lack clear incentives to invest in the most efficient options when they are not responsible for utility costs, further exacerbates the dilemma of energy insecurity for renters (Bird and Hernández, 2012). Renters would have further recourse with revised and better enforced housing codes related to energy as well as further financial incentives for landlords to upgrade properties in order to decrease costs, mitigate risks and increase comfort.

Among renters, energy expenditures were often cited as a significant consideration in choosing to move to or from apartments that required tenants to pay utilities. Many ultimately chose poorer quality apartments in lieu of utilities payments. Public housing residents and a handful of participants for whom utilities were included in the rent were spared from the financial hardships associated with economic energy insecurity. Nonetheless, these economic protections did not always shield against the physical and behavioral aspects of energy insecurity, for instance, over- and under-heating, poor insulation, drafts and malfunctioning appliances. In fact, the experience of those who did not pay for utilities but still encountered energy challenges formed the basis for further exploration of the various dimensions of energy insecurity beyond the economic component. In order to address both the cost and conditions issues presented by energy insecurity, the U.S. should consider adopting an energy rating system for all buildings, already implemented throughout Europe, to increase transparency in energy performance in all housing types but especially in rental properties (Bio Intelligence Service et al., 2013).

Unlike renters, low-income homeowners shouldered the entire burden of economic responsibilities related to housing and energy expenditures, and as such the onus and associated trade-offs were more severe for this group. Further, the costs to properly maintain and upgrade older homes were often prohibitively expensive given the upfront costs of upgrades and the broader housing and economic crises occurring at the time of data collection. So, while homeowners enjoyed some measure of control over the structural

conditions of their home, their low-income status constrained opportunities to increase the energy efficiency of their property. Safety net benefits should look to especially target low-income homeowners with subsidies to improve housing conditions, increase efficiency, and decrease costs so as to promote economic and residential stability in this vulnerable group.

### 5.3. Addressing energy insecurity through policy and advocacy

Energy insecurity is impacted by gaps in energy-related safety net policies and by the lack of sufficient protection for low-income energy consumers. As a critical component in alleviating poverty, addressing energy insecurity at the policy level necessitates a closer look at the current options to support affected populations. The Low-Income Home Energy Assistance Program and the Weatherization Assistance Program are the most relevant federal-level initiatives seeking to provide fuel assistance and weatherization services to eligible households. However, both programs have historically been underfunded and subject to budget cuts particularly in recent years, thus preventing low-income households from accessing needed resources to address energy-related hardships (Hernández and Bird, 2010). Greater awareness of the dimensions of energy insecurity and accompanying advocacy may lead to more comprehensive policy measures to expand existing programs in order to ensure that the needs of low-income householders are better met (Bird and Hernández, 2012; Hernández and Bird, 2010).

State-level policy and utility companies play critical roles in the problem of energy insecurity. State disconnection policies vary substantially but most cover medically vulnerable households and often contain seasonal policies barring shut-offs during extreme weather (U.S. Department of Health and Human Services). Nevertheless, many of these policies are time limited taking effect for a year or less on average and thereby dismissing the chronic nature of energy-related hardship (U.S. Department of Health and Human Services). Comprehensive measures are needed to a) better protect households from the experience and threat of utility disconnection; b) mandate more favorable rates for indigent households; and c) defend against the accumulation of debt and related account transfer restrictions. Utility companies may be compelled to realize such priorities as non-payment marks a financial liability and shut-offs are an encumbrance for all. Pressure by lawmakers and advocates may help propel these changes as utility companies (like landlords) may otherwise lack incentives to act in the best interest of low and moderate-income ratepayers.

The present research has implications for revising standards for healthy *and* sustainable housing to ensure that low-income households across the U.S. can access higher quality, health-conducive and energy secure housing environments. The Centers for Disease Control and the U.S. Department of Housing and Urban Development (HUD) have issued healthy housing guidelines in order to reduce exposure to environmental hazards in the home and promote healthful indoor living environments (Centers for Disease Control and Prevention and U.S. Department of Housing and Urban Development, 2006). However, thermal comfort and energy efficiency are not comprehensively included in the various health and safety measures covered by current national-level initiatives. For example, HUD-subsidized housing, including the housing choice voucher program and public housing, does not enforce an energy efficiency standard leaving tenants more susceptible to energy insecurity.

Nevertheless, energy and health are becoming more integrated in affordable housing development via mechanisms such as the Enterprise Green Communities Criteria and Certification, which provides a framework to ensure that low-income housing is healthier, more efficient and incorporated into the fabric of communities thereby promoting resident well-being and sustainability. Improved standards and integrative housing development are a critical application of “health in all policies” that should apply to both new construction and existing buildings.

Finally, the concept of energy insecurity provides a useful framework to fuel advocacy. “Energy justice”, which seeks equity for vulnerable populations along the energy production and consumption continuum, recognizes sacrifice and insecurity as central tenets of the present energy landscape in the U.S. (Hernández, 2015). While the call for energy justice is broad and includes imperatives to move toward healthy, sustainable energy production and access to the best available energy infrastructure, the movement relates directly to energy insecurity with demands for affordable energy and uninterrupted energy service. Housing, poverty and public health advocates should consider promoting energy justice in order to address the complex social, environmental and public health problem that is energy insecurity.

## 6. Conclusion

This article describes three key dimensions of energy insecurity: economic, physical, and behavioral that are premised on poverty and carry adverse environmental, health and social consequences. Study results help to uncover the layered components of energy insecurity by providing rich and nuanced narratives of the lived experiences of those affected by this form of hardship. As a construct, energy insecurity reveals and amplifies other chronic and interactive vulnerabilities that low-income householders encounter. The economic hardship associated with energy insecurity is indicative of low incomes relative to high energy expenditures. In addition to the constraints caused by poverty, the problem of economic energy insecurity might be viewed from a structural perspective, as exemplified by the participant who aptly attributed energy insecurity to the poorer quality of housing available to low-income renters. In its physical form, energy insecurity encompasses inadequate housing conditions such as drafts from windows/doors and holes/cracks in the walls, floors or ceilings that induce energy inefficiencies and reduce “tightness” in the home. These conditions, in turn, create difficulties in regulating home temperatures and produce vulnerabilities in a home’s physical infrastructure that provoke mental health risks and unhealthy exposures. Combined, the physical and economic challenges associated with energy insecurity prompt coping strategies in the form of behavioral responses to energy inefficiencies that sacrifice comfort and potentially safety in response to energy costs (e.g. using space heaters or ovens for heating, carrying utility arrearages due to making partial bill payments). Paradoxically, these practices may lead to higher utility bills compared to more efficient alternatives. Some energy conservation methods used by study participants did result in economic and environmental benefits and the ingenuity employed under these circumstances demonstrated resourcefulness. However, there were several adverse health and social consequences to the energy insecurity problem including environmental hazards, parental fear and stigma as well as residential instability. Critical issues pertaining to energy

insecurity such as the role this phenomenon plays along the pathway of disadvantage and the salience of housing type, tenure and quality were discussed alongside the need for policy-level changes to better address energy insecurity and advance energy justice.

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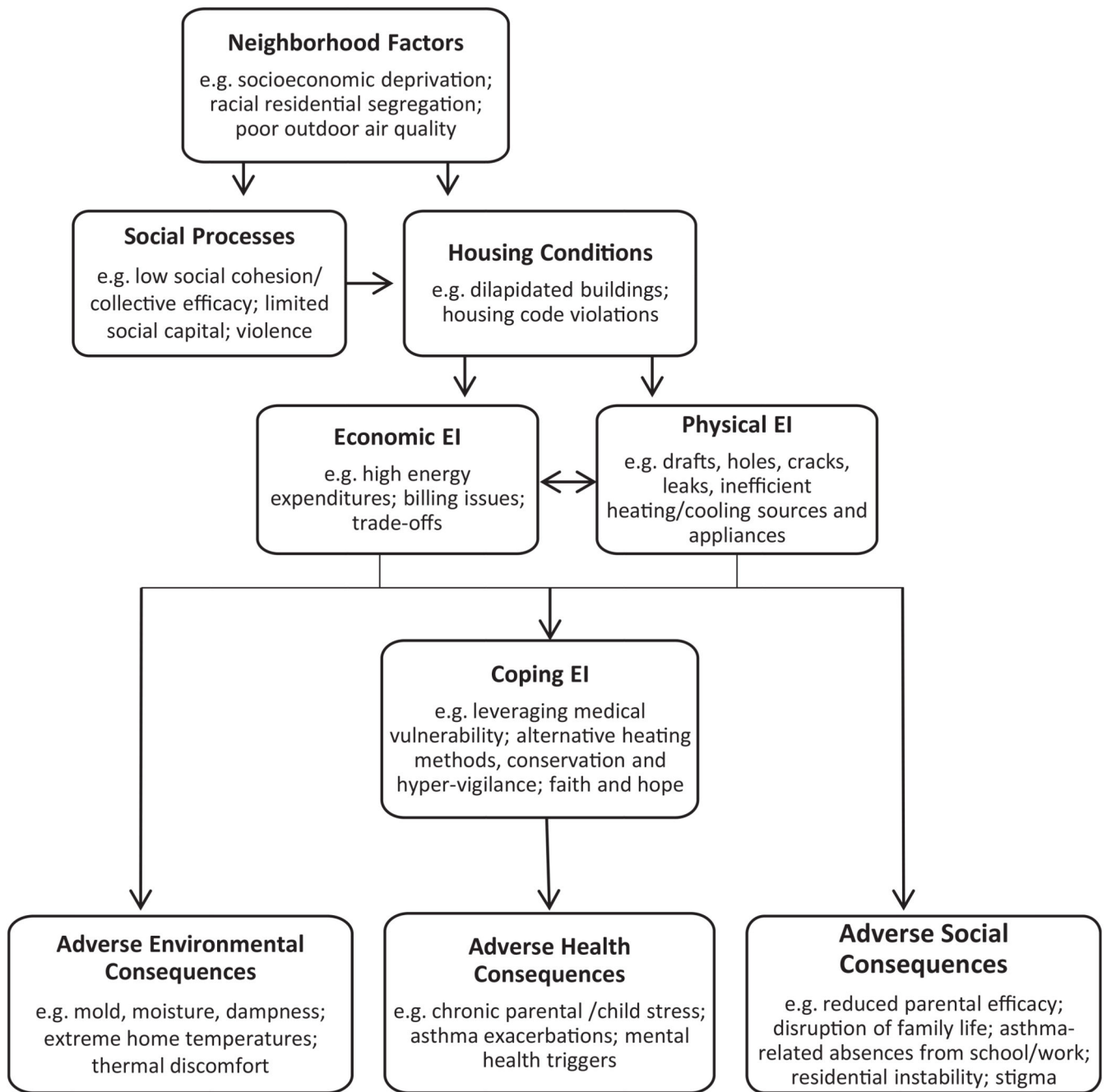
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**Fig. 1.** Energy insecurity: a pathway to disease and disadvantage.



Table 1

Economic Energy Insecurity- Definition, related codes and exemplary quotes.

Dimension	Related codes	Exemplary quotes
<b>Economic energy insecurity</b> Definition: <i>Financial hardship associated with the cost of energy relative to income and other expenses.</i>	Poverty, material hardship and tenuous employment	<i>We're definitely not making ends meet between the price of food, the gas is killing us, just the normal day [things] ... It's hard to keep up. At the time I was working part-time and I just couldn't give them anything. I know sooner or later they'd probably be taking me to court for non-payment but it's sad because even then I could never get no help also for my high gas bills. If I had access to a job or a little bit more money it would be so much easier to pay these bills and stuff, you know, 'cause I don't like owing anybody anything. I'm playing catch-up with my light bill because like I said, for two years, I wasn't really working. When I moved here my light bill was I think 800, almost 1000 dollars. So shortly after I moved here, I went back to my real job. Then I got laid-off in January but I went back to work in February. It's just playing catch-up If I go back to work he says that I will lose the food stamps. We'll lose the fuel assistance, and he feels like we really won't be any better off. So I feel like it's a catch-22.</i>
	Energy-specific financial hardship	<i>I'm having a hard time keeping up with the utilities. It's just really throwing me over the edge financially. The only difficulty we have is the lights. Other than that, we make it. It's just been high, high, high! And it's like when you pay all the bills, they let you know you're gonna get another light bill ... It's like it's not going anywhere. My electric bill has gone way out of whack. I mean, I have a 700 dollar electric bill. The bill is at \$7000.00. I told the representative to do a payment plan that is no more than \$60.00, because I honestly can't pay any more than \$60.00 plus the regular bill. It's too much for me.</i>
	Priorities and trade-offs	<i>If I had to choose between paying my rent, paying my utilities, and feeding my children, I'd feed my children and I'd worry about that later. But I do. My rent's always paid. He'll tell you. My rent's right there. Because I figure, at least I've got a roof over their head, you know. I have difficulty paying the utilities. Sometimes I have to pay one and then pay the other. I'm always pay my rent 'cause I'm not trying to be out there on the [street] you know what I'm sayin'. It's either pay the electricity bill or do what I gotta do for my kids and to be honest with you I'd rather just turn all this stuff off.</i>
	Seasonal variations	<i>The bills vary by season. For example, summertime gas is slightly lower than electricity and then you know, wintertime gas is much, much higher – extremely higher than electricity. As for summertime, electricity is obviously higher because of air-conditioning. It's so hot and we live on the third floor. It is burning hot. It is extremely hot.</i>
	Billing issues	<i>Sometimes your gas bill you get charged twice on your gas bill. You get charged a gas supply charge and a delivery charge. So that's what gets you. They had to give my niece \$2000 back 'cause they overcharged her. She was paying for [her neighbors too].</i>
	Landlord improprieties	<i>I never took any landlords to court though I should've one time because this landlord was using my electricity to clean out his units and ran me a bill for almost \$9000. When I wasn't home, I was at school, he's using my socket from outside.</i>
	Discontinued service due to non-payment	<i>Well the light just came as a new bill for \$120.00. Earlier it was disconnected because the account went up to \$3000.  I have difficulty paying the utilities, sometimes I have to pay one and then pay the other. They threatened to shut off my gas and I was like, 'Listen, I can't do it. I only get one check.' I can't afford it, you know what I'm sayin'. I got the rent, lights, gas and everything but it's just me ...</i>

Table 2

Physical Energy Insecurity- Definition, related codes and exemplary quotes.

Dimension	Related codes	Exemplary quotes
<b>Physical energy insecurity</b> <u>Definition:</u> <i>Deficiencies in the physical infrastructure of the home environment that impact thermal comfort, induce harmful indoor exposures and increase energy costs.</i>	Poor overall housing quality	<i>The disadvantage of having a Section-8 voucher is that these landlords tend to take advantage. In a lot of Section-8 apartments, none of them provide you with heat and hot water. It's always no utilities. It's not the best apartments. I'm quite sure it's not the best heating systems 'cause like I said, I've lived there. I'm a prime example. That's why people have to know their rights as a tenant. There's no insulation in the house. That's why it's cold, and the heating's always gone so ... The electrical is outdated, and the plumbing.</i>
	Faulty building infrastructure	<i>If I open this door you feel like you're standing outside. There's no heat in here and there's no heat in the kitchen but it's big, huge, empty house. Our heater goes down to 60, 61, 62 [degrees] tops all year-round but the walls were never insulated, so the heat goes right out the window. The thermostat, if you turn it off, the heat will still be on, and that runs up the bill. I want Boston Gas to come out here so they can look at the boiler for themselves 'cause the first [inspector], when I first got my energy report he told me it looked like I was heating the whole of Boston. Then I get the next [inspector's] report and his report is just as bad as the first man's report. What don't they understand? Don't go after me. Go after the landlord 'cause I can only afford to give you \$200 a month and that's all I can give you</i>
	Changes in building energy systems	<i>We didn't have to pay for the heat, it was oil based and the landlords paid for it themselves. Then about a year later they changed it, without notice and they didn't even tell us. The bill just came. It was very warm before, now you put that thing on and you'll still feel cold ...</i>

Table 3

Behavioral Energy Insecurity- Definition, related codes and exemplary quotes.

Dimension	Related codes	Exemplary quotes
<b>Behavioral energy insecurity</b> Definition: <i>Behavioral strategies used to cope, improvise and counteract the impacts of economic and structural energy insecurity.</i>	Energy conservation	<i>I use my gas wisely, you know. Only time it's on is to cook real quick or hot water for showers ... Right before its time for them to take showers I turn the heat on, and then when they get ready for bed, sometimes I'll turn it down or turn it off 'cause they're underneath the blankets. You just gotta manage how you do it ... If you don't need it you shut it off." I don't use heat all that much and we manage because the gas is budgeted ... We have been watching what we keep the thermostat at. During the day we keep off lights. The only thing that's running is the TV ... We also don't burn that much gas. We don't use that much electricity 'cause I know the electricity be sky-high if you leave the lights on and stuff.</i>
	Seeking thermal comfort	<i>In the wintertime if something happens to the heat by chance, I turn the oven on, which is my electricity. The heat goes through the place like that and then I cut it off. That's what I do. Some people also came in here and showed me how to save electric ... I pretty much did it myself—the insulation. I put the stuff under the doors and plastic over the windows [to keep the cold out].</i>
	Lump sum and partial bill payments	<i>I'm praying that I get enough money back from my tax return to pay everyone off so they can leave me alone, don't bother me no more. So the whole week [during a shut off], all we did was took a bucket like we were having a cookout. You know those buckets that you use to put sodas and stuff. Put some ice in it, it lasted for a week. Eating sandwiches, takeout. My kids said, 'Mommy, when they gonna put the gas back so we cook the fish?' I finally got two checks and turned the lights back on. You gotta sacrifice. My mother's pays like 50 dollars here, 100 dollars there, whatever she can. But even if I give them \$100 right now, I can't pay because even if I give them \$80 the bill is \$100, \$120 every month. That's why I give them \$80 'cause I can't pay the whole bill.</i>
	Fuel assistance	<i>I can go to certain places if I need help to get fuel assistance After running around trying to get help there but they helped me out finally. I did that ... fuel assistance helped me. I just started with them last year ... they gave me \$350 for the bill. Then I got a letter from them a couple of weeks ago to fill out and send back [to renew]. I could never get no help for my high gas bills. I would call the local foundations, the Salvation Army, churches and they would always say that they had no money.</i>
	Leveraging medical vulnerability	<i>They can't turn it off, basically, because my baby has asthma, for one thing. My mother has a bad heart, for another thing. I don't care how high it gets. They can keep on sending us [bills]; we'll pay what we can ... I had my son's doctor fax a letter to [the utility company] saying they can't turn off my lights because he's on an asthma machine and he needs it. So that's the only reason my lights stayed on. I have called the electric company. We're protected from our lights getting shut off for now from financial difficulties and because of [my son's] asthma.</i>
	Faith, hope and despair	<i>That's [a shut off] what was worrying me before, but I'm trusting in God. My outlook on it is that, I want better for my children. To have better for my children I need better housing. Inside these neighborhoods ain't no way for us to save no money on no electricity 'cause they come out when they want to come out and it's hard to find people to talk to [for good information]. There's nothing you can do ...</i>

**Table 4**

Environmental, health and social consequences of energy insecurity.

Consequence	Related codes	Exemplary quotes
Environmental	Hazardous exposures	<i>For three months there was a gas leak and I ended up going to the hospital. ... The smell kept on coming up [but] the [stove] pilot wasn't lit. I had to call the gas company. I said, "Look, you have to come down here. This gas is killing me." ...</i>
	Heat stress	<i>As for summertime, electricity is obviously higher because of air-conditioning. It's so hot and we live on the third floor. It is burning hot. It is extremely hot.</i>
	Cold stress	<i>If I open this door you feel like you're standing outside. There's no heat in here and there's no heat in the kitchen. He [the landlord] says it's a four bedroom but really it's a big, huge, empty house.</i>
Health	Asthma	<i>In the wintertime its more [of a problem] 'cause he [child] gets sick more with asthma.</i>
	Chronic stress	<i>"Stress. It adds stress. It's silly sometimes, but I think like, "Geez. My lights are gonna shut off." Even though I know they won't but even if I'm behind a few days a week I worry. I worry about a lot of things. I do. I mean, I know it won't happen but I worry about it. I do. I worry a lot."</i>
	Mental health trigger	<i>Every time I call I get nowhere, that's why I told my psychiatrist. Then I went into a depression, you know, 'cause I'm trying to show them my bill and everything and don't nobody ever have funds for me. So I told her I feel like I'm being targeted, which I know better, but I was just feeling low, you know ...</i>
Social	Parental fear and stigma	<i>One day I didn't have no money to pay my bill and they was gonna turn off my lights. When they turn off your lights people look at that and I didn't want nobody coming in here and take my children from me because I don't have my lights on.</i>
	Family disruption	<i>My bills started raising up and raising up and I went to the doctor's because they turned off my gas. So, I sent my kids to their aunt's house 'cause I didn't want them in the house since you can't cook or give them a bath or nothing. I didn't want them here. And then I went through my depression thing- it just went down for me.</i>
	Residential instability	<i>From all my apartments I've always had faulty heating systems and I always had to pay my own utilities. That's one of the reasons why we moved so much.</i>