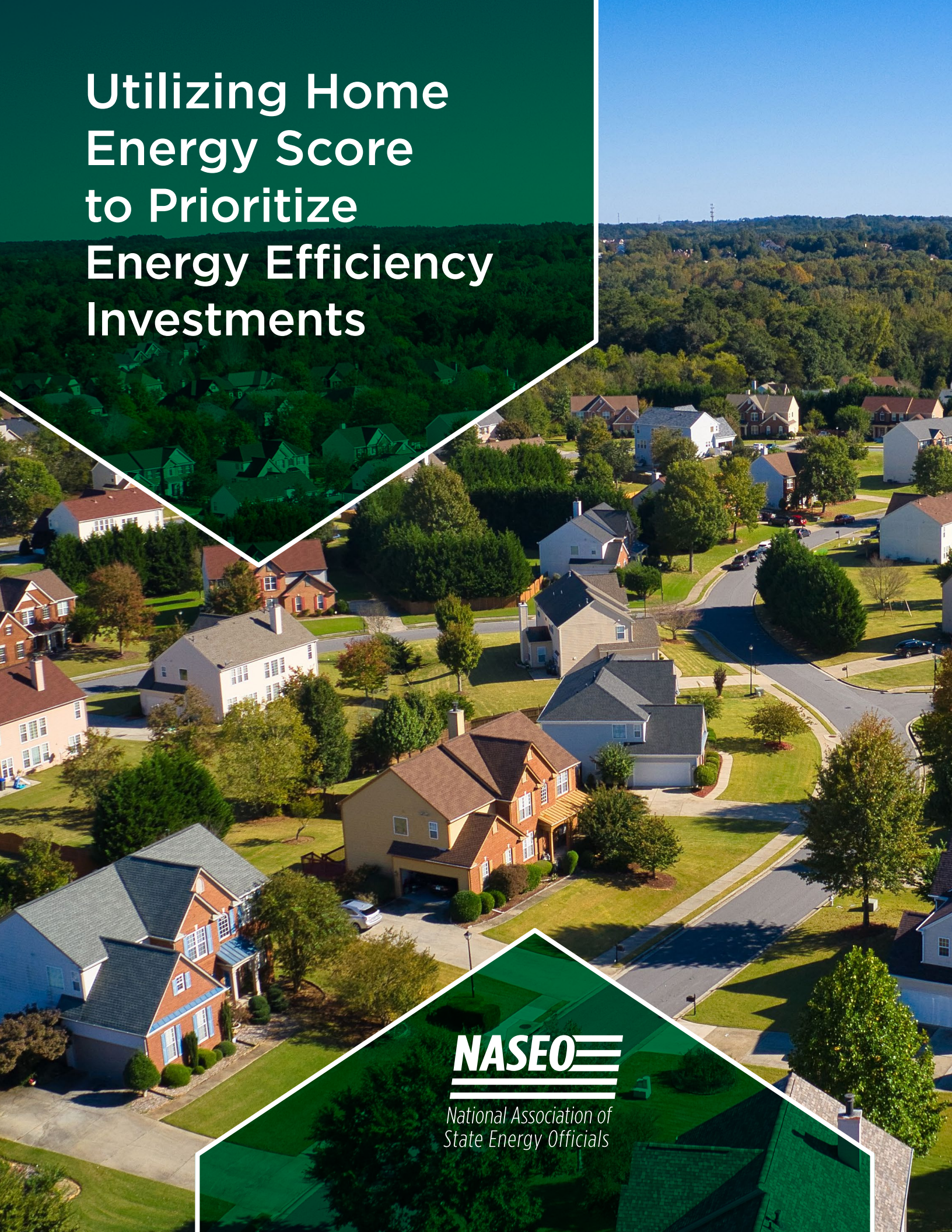
Utilizing Home Energy Score to Prioritize Energy Efficiency Investments



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Contents

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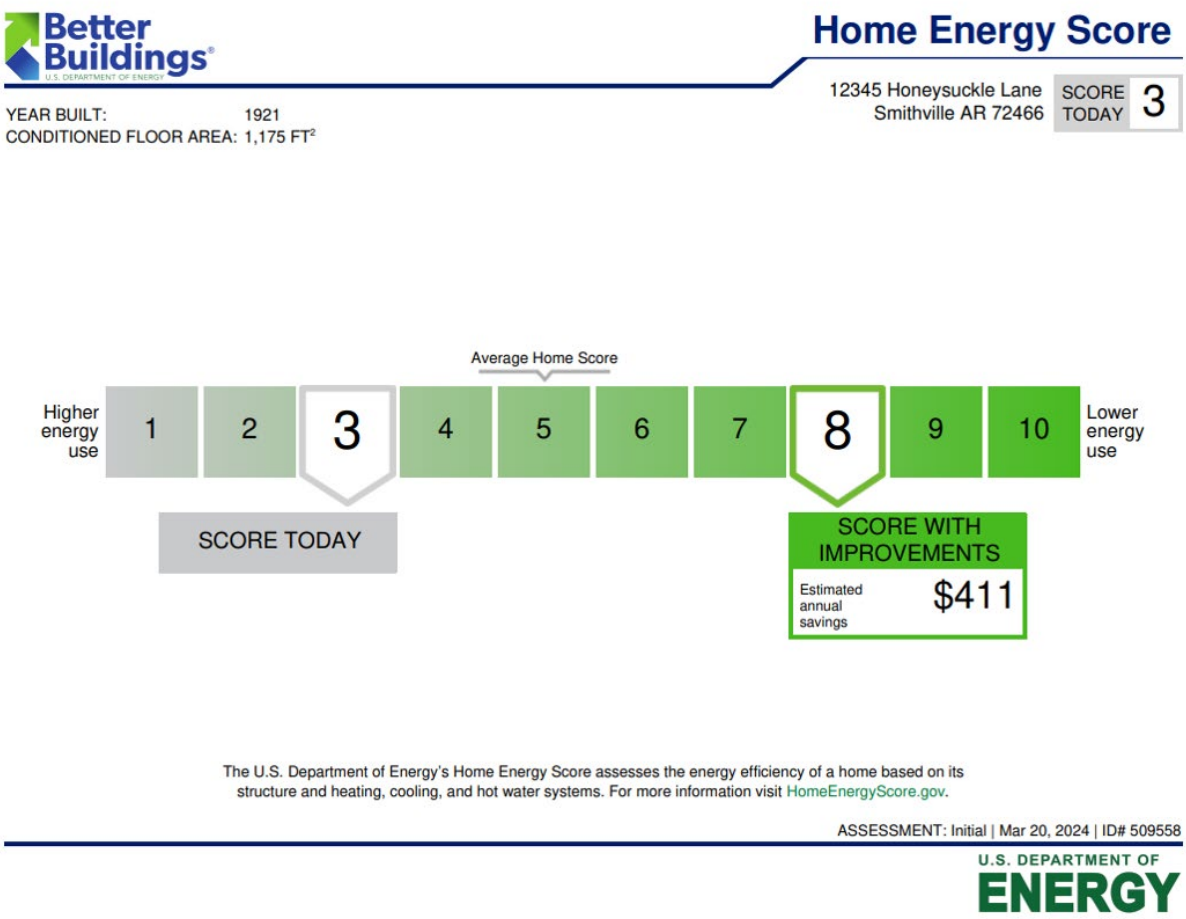
Introduction

Energy-related hardship is complex and multifaceted, and not easily described with existing terminology. State and Territory Energy Offices ("State Energy Offices") have access to frameworks that cover some dimensions. Energy burden and energy poverty capture the difficulty of paying energy bills. Energy insecurity describes coping mechanisms for handling uncomfortable temperatures. But a component is missing from the literature: a framework to assess the energy performance of a home.

Energy performance impacts comfort, affordability, and energy use. For many State Energy Offices, those issues are critical parts of equity, access, and inclusion goals that can help assure state energy policies, spending, and investments reach those with the greatest need. A framework for identifying and prioritizing home performance upgrades is necessary, and an existing tool from the U.S. Department of Energy (DOE) can be adapted for this purpose.

DOE's Home Energy Score™ is an energy model that communicates a home's level of energy efficiency on a 1-to-10 scale (See Figure 1). It also indicates the potential score that a home could achieve with cost-effective energy efficiency upgrades. Knowing the difference between the two scores can be instrumental to prioritize the need for energy efficiency improvements. Homes with the greatest difference between their existing Home Energy Score and their potential Home Energy Score are the ones with the most opportunity for savings. Layered with other variables (e.g., income, building type, and vintage), Home Energy Scores can help State Energy Offices prioritize energy efficiency spending.

Figure 1. Sample Home Energy Score. Source: U.S. Department of Energy



Energy Hardship Frameworks

To assess the value of using current and potential Home Energy Scores as an indicator of energy hardship, this section reviews frameworks for the inclusion of home energy performance. A summary is available in Appendix A. The most similar framework is **Low Income Low Energy Efficiency**, a metric used by the United Kingdom's Department for Business, Energy, and Industrial Strategy to determine if a household is "fuel poor." The metric has two components: an energy efficiency rating and a determination of a household falling below the poverty line after paying modeled energy costs.[1] The energy efficiency rating is based on the English Standard Assessment Procedure but includes the impact of energy cost reduction programs for a result on a scale from A (the highest rating) to G (the lowest rating). Households whose homes score D or below with incomes below the poverty level after modeled energy expenses are considered fuel poor.[2] This is the only framework that includes energy efficiency as a contributing factor.

Other perspectives include **energy insecurity**, an often-used concept that captures the varied experiences of meeting energy needs in one's home. Diana Hernández at the Columbia University Mailman School of Public Health defines energy insecurity as the inability to meet basic household energy needs. Energy costs, a lack of thermal comfort, and adaptive strategies — such as portable space heaters or use of a stove or oven for space heating — emerged in her work as common experiences for people who face energy insecurity and are unable to use energy to meet their needs.[3] Poor home energy performance is implied in the experience of energy insecurity but is not explicitly captured in the same way as Home Energy Score.

Another commonly used framework is **energy burden**, the percentage of household income spent on home energy bills.[4] Households that spend more than six percent of income on energy bills are considered to have high energy burdens and households that spend more than 10 percent of income on home energy bills are considered to have severe energy burden.[5] This metric is popular among policymakers as an easy-to-understand method to prioritize households for energy interventions. DOE funded the Low-Income Energy Affordability Data Tool to provide energy burden information at the census tract level to inform program design.[6] Energy burden could be a companion with the use of Home Energy Score to capture the hardships associated with both high energy costs and low energy efficiency.

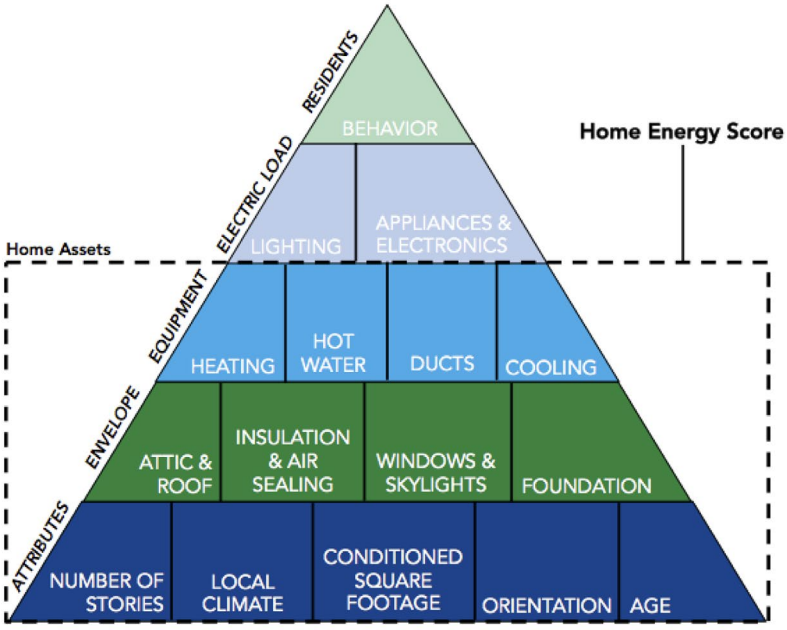
A new proposal among energy vulnerability frameworks is the **energy equity gap**. Proposed by Cong et al., it measures the difference in the outdoor temperature at which low-income and high-income groups start using cooling devices in their homes.[7] In a 2022 study they estimate the energy equity gap to be between 4.7 and 7.5 degrees Fahrenheit. Energy equity gap is another layer of insight on the experience of using energy at home. They found little overlap between households with energy burdens of 10 percent or more and households categorized as experiencing the energy equity gap, leading the authors to conclude that one measurement of energy vulnerability alone cannot capture the lived experience.[8] It is compelling insight on the use of energy technologies in homes, but it doesn't shed light on the performance of technology or the building shell in the way that Home Energy Score can.

Other frameworks include the **Household Energy Insecurity Indicator,** which categorizes households as energy secure, moderately energy insecure, and severely energy insecure depending on experiences with utility shutoffs and coping behaviors. **Indicators of Energy Insecurity** calculates the impacts of energy price increases on consumers. The **Ability to Pay Index** estimates households' ability to pay utility bills based on housing expenses and income.[9] **Thermal poverty**, as defined by Katarzyna Świerszcz, refers to a lack of energy necessary to perform basic household functions.[10] The International Energy Agency defines **energy access** as having reliable and affordable access to cooking facilities and electricity.[11] The **basic bundle of energy services** describes the amount of power needed to operate at least several lightbulbs, phone charging, and a radio.[12] All of these terms can add depth to an understanding of home energy experiences but none reflect the importance of energy efficiency in buildings. Home Energy Score can be the tool that communicates which homes have the greatest opportunity for energy savings, greater comfort and lower utility bills.

Home Energy Score

Home Energy Score is a standardized system for measuring energy efficiency, akin to a miles-per-gallon rating for vehicles. It considers a home's shell, heating, cooling, and hot water equipment and excludes thermostat settings, appliances, or plug loads so that houses can be compared independent of occupant behavior.[13] Figure 2 demonstrates which aspects of home energy use are included in Home Energy Score calculations. A Home Energy Score requires an in-home assessment completed by an expert (Home Energy Score Certified Assessor™) and can typically be conducted in one hour or less. There are methods available to estimate Home Energy Scores that do not require home visits and can be used for planning and design purposes but are considered "unofficial scores." Unofficial Home Energy Scores do not conform with standardization and quality assurance requirements and would not be appropriate for inclusion in a multiple listing service, in financial products, or other opportunities.

Figure 2. Home Energy Use Pyramid. Source: U.S. Department of Energy



Home Energy Score uses the EnergyPlus building simulation model, a free, open-source software funded by DOE that performs hourly simulations to estimate energy use. The energy use estimate determines how a home rates on the 1-to-10 scale. A home that uses an average amount of energy scores a 5. A home with a score of 10 uses less energy than 90% of homes in the country. The definition of the "bins" (each number along the Home Energy Score scale) varies depending on weather station. Homes are mapped to the closest weather station so that the Home Energy Score can account for local weather conditions in energy use calculations and recommendations for improvements.[14] As a result, Home Energy Scores can be compared across the country. State Energy Offices can use the results for a straightforward understanding of home energy performance without any adjustments for location or home size.

In addition to analyzing pre-retrofit scores, State Energy Offices can choose to use Home Energy Scores after home energy projects are complete to document changes in homes. A comparison between the pre-project Home Energy Scores and the post-project Home Energy Scores can show the improvement in energy efficiency and communicate related improvements in affordability and comfort. The documentation can also be used with prospective buyers or renters to demonstrate energy efficiency improvements. In some jurisdictions, real estate agents, appraisers, and multiple listing services already fold energy efficiency communications and valuations into their practices. Home Energy Scores can be included in that infrastructure, or future iterations of it, should a State Energy Office or another party want to support the development of an energy efficiency and real estate ecosystem.

Conclusion

Using Home Energy Score to identify and prioritize energy efficiency investments can have a direct impact on residents who would most benefit from them. This paper proposes using Home Energy Score as a tool to aid State Energy Offices in the prioritization of energy efficiency spending. The Home Energy Score is a measure of the energy efficiency of homes on a 1-to-10 scale, and the potential benefits if cost-effective improvements are made. The homes with the largest difference between their current Home Energy Score and their potential Home Energy Score have the greatest opportunity for savings. This application of Home Energy Score is an addition to the spectrum of energy vulnerability frameworks, as most existing energy vulnerability tools do not address residential energy efficiency or its impact.

The integration of Home Energy Score in state policy development, program design, and decision-making represents a unique opportunity for State Energy Offices. At a high level, it is directly applicable to the achievement of state energy efficiency goals by identifying homes with the greatest opportunity for energy use reductions. Home Energy Score is a powerful tool to help prioritize spending and track the impacts of various interventions as State Energy Offices continue to navigate federal funding opportunities to invest in home energy efficiency, beneficial electrification, and renewable energy. Finally, as State Energy Offices continue to prioritize equity, access, and inclusion in their design and implementation of policies and programs, Home Energy Score can be part of a critical toolset that directs investments to the people, homes, and communities with the greatest vulnerability and need.

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Appendix A

Summary of Energy Hardship Terms

Ability to Pay Index	A scale of 0-1,000 where 1,000 represents households with the least ability to pay energy bills based on a combination of income and housing costs.[15]
Energy access	A household having reliable and affordable access to both cooking facilities and electricity.[16]
Energy burden	Percentage of household income spent on energy costs.[17]
Energy equity gap	The difference in the outdoor temperatures when households of various income groups begin using cooling systems.[18]
Energy insecurity	An inability to adequately meet basic household energy needs.[19]
Household Energy Insecurity Indicator	Households are considered "energy secure" when there are no issues accessing or affording energy. "Moderately energy insecure" households face possible utility shutoffs. "Severely energy insecure" households experience utility shutoffs, use dangerous coping behaviors to heat or cool their homes, or have spent at least one day without heating or cooling.[20]
Indicators of Energy Insecurity	Suite of three metrics that assess the financial ramifications of energy price increases. The metrics are the difference between gross income and energy costs, the number of households that fall below the poverty line when energy prices increase, and the change to energy burden after energy price increases.[21]
Low Income Low Energy Efficiency	Metric for fuel poverty used by the English government. A household is fuel poor if the energy efficiency rating is a "D" or below and income after paying modeled energy costs is below the official poverty line.[22]
Thermal poverty	Shortage of heat for the implementation of basic household functions.[23]

Endnotes

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