Towards a National Energy Poverty Strategy

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ABSTRACT

Our understanding of energy poverty within the United States relies on a combination of data sources that when pieced together, offer a fragmented snapshot of household energy needs. While tools exist to calculate measures such as household energy burden, we lack an empirical approach to evaluate the scope and depth of energy poverty across the U.S.. The unpreceded funding levels available for home energy improvements present a pivotal moment to address the cumulative burdens faced by energy insecure communities. Against this backdrop, we introduce a national framework to guide target investments and establish a foundation for treating the underlying conditions of household energy poverty.

This paper introduces the Department of Energy's effort to develop a national energy poverty framework alongside initial baseline estimates. Drawing on existing activities across Europe, we highlight the key elements of a new framework within the United States. We explore the merits of adapting a new model to measure energy poverty and the broader implications on how household energy insecurity is conceptualized today.

Introduction

Federal recognition of energy poverty traces back to the early 1970s oil crisis as the cost of energy skyrocketed. In response, a national energy policy agenda took form to advance energy conservation, expand domestic energy production, and protect the welfare for all households. Congress would formally establish the Department of Energy's (DOE) Weatherization Assistance Program (WAP) in 1976 and authorize the Low-Income Energy Assistance Program (LIHEAP) in 1981 (GAO 1990). During that same period, the U.S. Energy Information Administration (EIA) would begin conducting the Residential Energy Consumption Survey (RECS) to better understand household energy trends and the effectiveness of federal energy programs.

Discourse surrounding household energy affordability has progressed to recognize the broader socioeconomic conditions that contribute to high household energy burdens. Despite decades of federal programming and data, we have a limited understanding as to whether household energy needs have improved over time. At its core, the United States lacks a comprehensive strategy to address energy poverty (Bednar and Reames 2020). As the US embarks on its energy transition, a new federal approach is needed to assess the state and condition of household energy poverty. In this context, energy poverty is defined as the inability of households to affordably meet basic energy services.

This paper introduces a Department of Energy project to develop a national energy poverty framework. The term energy poverty is intended to represent not just to economic facets of household energy burdens, but the structural, economic, and social drivers associated with energy poverty. This framing offers a more explicit direct linkage between broader housing and economic vulnerability, building energy characteristics, and the fluid state of energy

affordability. The proposed framework will advance our ability to measure both the number and depth of households in energy poverty.

The paper introduces key tenets of a national energy poverty framework based on parallel efforts within the European Union (EU) and United Kingdom (UK). We primarily focus on the UK's energy poverty strategy and its evolution over the past twenty years. Exploring the trajectory of international energy poverty frameworks sheds valuable insight as to how key metrics, methodological decisions, and policy priorities shape national agendas today. We discuss the primary objectives and application of a national energy poverty framework, laying the groundwork for ongoing feedback and input from interested parties.

U.S.-EU Just Transition Workshop on Energy Poverty

Government-to-government cooperation is critical for the coordination of a global energy transition. The U.S.-EU Energy Council recently held a two-part Just Transition Workshop on Energy Poverty, convening government representatives and policymakers. For Europe, the Directorate-General for Energy (DG ENER) is responsible for developing and implementing European Energy Policy and ensuring that all Europeans have access to clean, secure, affordable, and reliable energy. While in the United States, the Department of Energy's (DOE) mission is primarily driven by energy technology development, the department is serving an elevated role a convening body to propel the clean energy transition. Both entities currently have aims to decarbonizing their regions economy by speeding up the deployment of clean energy across all sectors and are doing so through specific policies. DG ENERG is pursuing the European Green Deal objectives while DOE is implementing Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) programs.

The first workshop, hosted in September 2023. focused on understanding the landscape of each region, on identifying similarities and differences in approaches to tackling energy poverty, and on sharing best practices and areas for growth. The second workshop was held in May 2024 and had three goals: (1) Reinforce mutual understanding of energy poverty issues domestically, regionally, and internationally, with a view towards ongoing cooperation in the field, (2) Identify similarities and differences in approaches to tackling energy poverty and share best practices and areas for growth; and (3) explore challenges and successes of U.S. State and EU Member State implementation of policies relating to energy poverty.

The second workshop focused on local policies and programming to address energy poverty. State and local representatives from San Diego and New York participated alongside counterparts from Ireland and Barcelona. The European perspective offered valuable insight as to how EU-wide recognition of energy poverty—first formalized by policy in 2009— has translated into policy and investment schemes within its member states. From initial directives to define energy vulnerable households within the evolving context of gas and electricity markets, the EU approach is closely tied to evolving energy reforms and associated financial implications. As such, EU members may adapt their own respective strategies to measure energy poverty.[1]

The two workshops offer a timely reminder of the importance of building collective knowledge. A just energy transition must contend with rising energy prices, the growing frequency of extreme weather events, and the geopolitical pressures that place adverse pressures

[1] Several EU countries refer to energy poverty as fuel poverty. For the purposes of this paper, we chose to only use the term energy poverty.

on energy vulnerable households. EU workshop attendees noted that mutual learnings between member states have helped expedite national commitments and policy. In turn, it is incumbent for the United States to build on existing energy poverty frameworks in the development of its own national strategy.

Need for a National Framework

Dependence on Reactive Energy Indicators

The impact of early COVID-19 mandates raised national-level coverage of utility disconnection policies. With economic activity at a halt, many states passed disconnection moratoria to protect households without consistent income. As unpaid utility bills continued to increase, Congress passed legislation to repay an estimated $1.25 billion of unpaid utility bills (Lawson and Mills 2023). Numerous studies have shown that it would have cost just 8.5% of the bailout money to directly payoff customers' debt (Jean Su and Kuveke 2021). Relying on disparate shutoff and arrearage data collected from a handful of state regulatory commissions, taxpayer dollars were distributed without full recognition of the problem at hand.

The federal and state response illustrates the disposition towards reactive, temporary solutions driven by utility arrearages and bill assistance (Bednar and Reames 2023). While the bailout helped erase the cumulative debt for millions of households, it failed to establish more preventative actions. Too often, the national agenda around household energy insecurity is approached through one-off solutions that fail to deliver deeper improvements for households. As highlighted in Figure 1 below, a national energy poverty strategy much shift to focusing on metrics and measures that deliver more sustained progress over time.

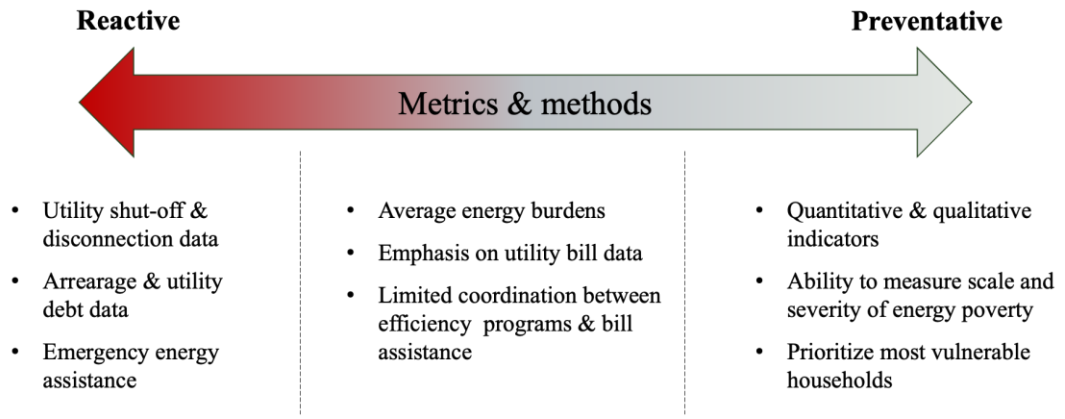

Figure 1: Household energy indicator map.

Where Energy Burden as a Metric Falls Short

By and large, household energy burden is the predominant metric used to measure household energy affordability. Energy burden is a useful indicator to capture an economic snapshot of a household's energy costs as a function of their income. While tools such as DOE's Low-Income Energy Affordability Data (LEAD) Tool can generate granular energy burden estimates, the estimation process relies on a complex methodology to correlate household energy

use estimates with income and geospatial data (Ma et al. 2019). Such tools are a tremendous resource to understand current household energy statistics but may not necessarily suit longer-term studies.

Secondly, the use of bill data to estimate energy burden may offer an incomplete picture of a household's true energy needs. If households are under -consuming energy due to affordability concerns, their energy burden may properly identify their condition. In other instances, households may lack access to certain energy services, such as air conditioning. Relying on the energy burden metric alone would treat the addition of cooling and other energy services as a negative bill impact; where in reality the additional of air conditioning is an improvement to the livability of a residence (Cong et al. 2022). A more comprehensive energy poverty strategy should leverage multiple metrics that recognizes the goal of achieving parity in technology access and livability.

Lastly, energy burden, as an absolute metric, must be compared to fixed thresholds (ie., 6% energy burden is considered high) that provide a limited understanding of the key contributing factors. A comprehensive strategy must recognize how drivers beyond energy efficiency factor into energy poverty.

Recognition of the Energy Transition Underway

For the United States to meet any of its climate policy commitments, the energy and utility sector will need to undergo a massive transformation. 2023 saw the largest jump in electricity rate increase proposals as utilities look to upgrade aging infrastructure through traditional energy rate increases (Lowrey 2024). Rising temperatures and electricity demand across the board is anticipated to further increase future energy prices. The ability to offset large-scale infrastructure costs will require a shift towards distributed energy resources and greater flexibility of energy demand. These shifts can unintentionally shift undue costs onto lower-income communities that lack the resources and technology to benefit from a more dynamic energy system (Olson et al. 2024).

At the same time, the federal Inflation Reduction Act (IRA) and Bipartisan Infrastructure Law (BIL) provides nearly $50 billion in funding for energy efficiency with dedicated carveouts for low-income households. The creation of a new Home Energy Rebates Program alongside increases for the Weatherization Assistance Program presents an unprecedented opportunity to invest in household energy efficiency. BIL and IRA investment for grid infrastructure and energy production will also catalyze the modernization of our energy system.

The new paradigm in energy programming necessitates new methods to assess the state of household energy needs and track progress to improve household energy burdens. The proposed framework will allow us to also understand future scenarios based on different energy prices and efficiency gains. While in its early stages, the proposed methodology can leverage program energy audit and retrofit data to a real-time understanding of impacts and set appropriate targets.

Development of U.S. Energy Poverty Framework

This framework is not intended to replace existing tools and methods. Complementary activities, such as qualitative surveys, utility programming, and local engagement, are needed to adequately capture household experience. Rather, it is meant to improve the federal government's ability to understand household energy poverty and establish a standardized

mechanism to measure progress over time. Longer term, framework is intended to support the buildout of a more coordinated federal strategy to address household energy poverty. We use this paper as an opportunity to introduce the key components of the framework and provide discussion to help conceptualize the merits of a new approach.

Initial Overview of Proposed Framework

The proposed framework is led by the Department of Energy's Office of Energy Justice & Equity (EJE), with funding for Lawrence Berkeley National Laboratory to develop the initial methodology and baseline estimates. The full framework and results are anticipated to be released in Fall of 2024. The methodology is adapted of the United Kingdom's Fuel Poverty Strategy[2] using data from the Energy Information Administration (EIA)'s Residential Energy Consumption Survey (RECS) alongside the National Renewable Energy Laboratory's ResStock Model. These sources are processed to represent household energy costs that with US Census data, provide the basis for energy poverty estimates. Future activities to enhance data inputs and statistical representations are discussed in the final section.

The framework utilized a new measure to estimate household energy poverty based on the UK's Low Income Low Energy Efficiency (LILEE). Compared to energy burden calculations, this new metric is based on modeled energy use as opposed to actual bill data. Rather than applying a 6% spending threshold based on household income, a household's energy costs are compared to an affordability standard. The affordability standard, or 'livability standard' represents the core definition of energy poverty: the ability to affordably meet basic energy services. Household energy use is modeled based on standard assumptions for heating and cooling temperatures, water heating, cooking, lighting, and the use of major appliances. As such, the goal is to ensure all households are able to afford a basic standard of living.

The LILEE metric offers a more complex measure of energy poverty that accounts for both the number of households and the cumulative depth in which households fall into energy poverty. The depth of energy poverty is described as the 'energy poverty gap' representing the reduction in energy costs needed for a household to not be considered in energy poverty. We specifically explore the following elements of a new framework:

- Standardized metrics to define and estimate energy poverty.
- Shift toward minimum energy standards .
- Examining energy costs within broader household financial needs.

Metrics to Define Energy Poverty

As previously mentioned, no single metric can sufficiently capture the state of household energy conditions at a national level. EIA's Residential Energy Consumption Survey asks several energy insecurity questions to capture how households respond to high energy costs. These questions were also included in the weekly US Census Housing Pulse Survey that launched during the pandemic.

[2] See UK Fuel Poverty Methodology Handbook for further detail: Fuel poverty methodology handbook (Low Income Low Energy Efficiency) 2024 (publishing.service.gov.uk)

As a inform assessment measure, self-reported metrics present several challenges. As highlighted during the EU-U.S. workshop, the recent increase in energy prices due to the Russia-Ukraine conflict and inflation over time resulted in much wider variability in their self-reported indicators (Ireland 2022). As shown in Figure 2 below, the self-reported deprivation indicator (such as ability to pay bills or ability to adequately keep home warm) showed a rapid increase in energy poverty not reflected by the traditional 10% energy burden threshold indicator.

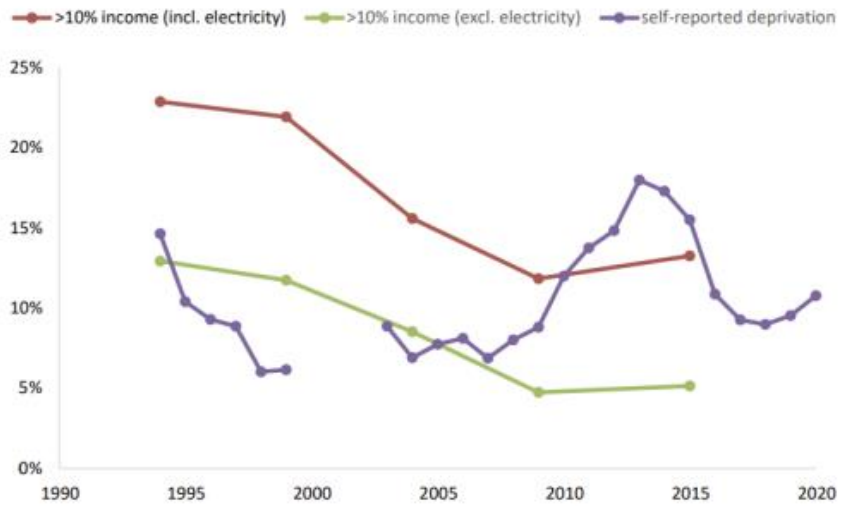

Figure 2: Comparison of Ireland's energy poverty indicators, 1990-2020(percentage of households). *Source*: Ireland Department of the Environment Climate and Communications 2022.

The evolution of UK's primary energy poverty metric offers a similar perspective, highlighting the need for a more dynamic indicator. Hills (2011) governmental review of energy poverty introduced the shift away from the traditional energy burden measure, which used a 10 percent threshold of energy spending over income, to a relative indicator that could capture both the number of households in energy poverty and the aggregate gap of energy costs to overcome energy poverty. As shown in Figure 3 below, households are classified as falling into energy poverty if they exceed the median required energy costs and fall below an income threshold.

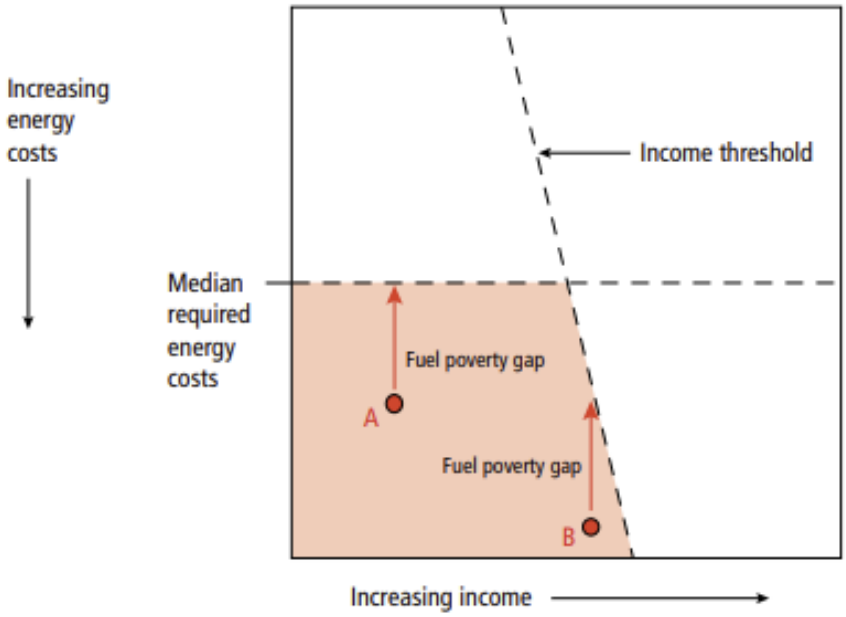

Figure 3 : Diagram demonstrating UK's Low Income High Costs (LIHC) energy poverty definition where shaded area represents households with low incomes and high energy costs. *Source:* Hill, 2011.

It is important to note that the LIHC indicator is a relative metric, which results in roughly 10-12% of the population remaining in fuel poverty at any given time (England 2021).The UK now utilizes the Low-Income Low Energy Efficiency metric that sets the median required energy cost threshold based on target energy efficiency standards, marking a shift towards a more absolute measurement. Households are considered in energy poverty if their residence is below a national energy performance rating, and their income after housing and energy cost estimates fall below the official poverty line. This allows for a more level comparison between years to support tracking efforts.

LILEE is intended to place much greater focus on energy efficiency improvements shaped by building energy performance targets. Yet some advocates argue that this measure places too much emphasis on energy performance and may exclude certain households with lower incomes (Semple et al. 2024).

Implications for U.S. Framework. We observe that upgrades to the UK energy poverty indicator are aimed at improving the government's ability to monitor energy within a rapidly shifting economic landscape. The rapid rise in household costs alongside energy prices warranted a suitable metric to control for both trends Bouzarovski et al 2020). This same challenge was evident in the United States following the federal moratorium ban that took place from March to November 2020. As the total number of households behind on their bills fluctuated, the cumulative bill debt steadily rose, implied that the most energy insecure households were falling deeper into energy poverty.

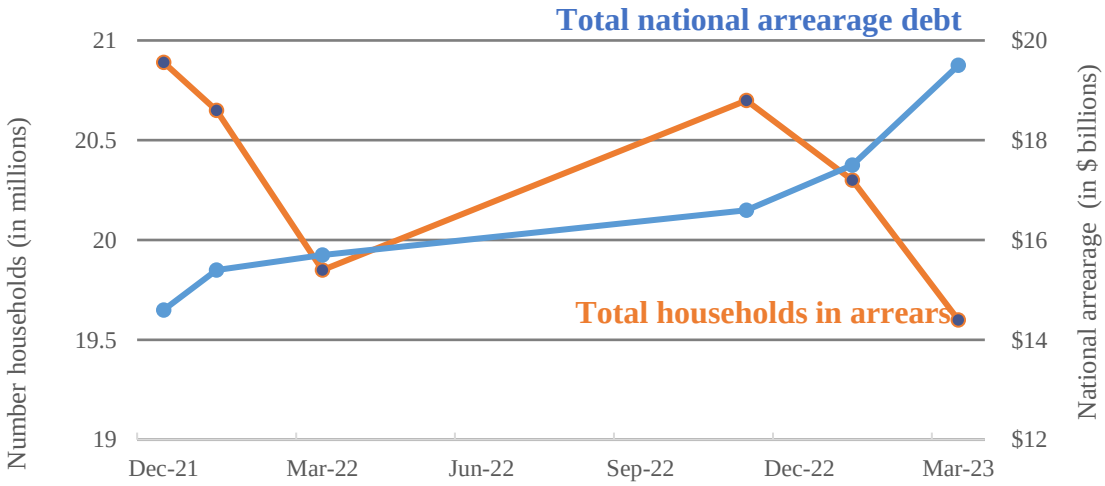

Figure 4: U.S. household arrearage data following utility shut-off moratorium. *Source:* National Energy Affordability Directors Association 2024.

It is key that any framework is capable of accounting for such phenomena that can inform potential interventions. As echoed in similar U.S. studies, this approach also allows us to better isolate energy poverty from overall household poverty categorizations (Scheier & Kittner 2022). We intend to pursue future work that ties energy poverty more appropriately into broader household affordability considerations. We discuss this further in the next section.

Minimum Energy Standards

Another key change is the use of modeled energy consumption- as opposed to actual household bills. For the U.S. Low-Income Energy Affordability Data (LEAD) Tool, household energy burdens are calculated using actual reported bill data, although this data comes with its own respective pitfalls (Ma et al. 2019). As mentioned in the introduction, the reliance on actual bill data leads to underreporting, as households who may be under-consuming energy are not effectively captured. The shift to modeled energy costs helps isolate household coping mechanisms from the definition to focus more on the physical energy requirements needed to maintain safe thermal conditions (Boardman 2012).

In the UK, a household's modeled energy costs are compared against a target threshold, representing the gap to bring a household out of energy poverty. The modeled energy costs for a household are calculated based on prescribed temperature setpoints that represent a minimum thermal comfort standard (BEIS 2021). In other words, the modeled energy calculation assumes a livability standard: a household can maintain safe indoor conditions based on the energy

characteristics of a given home. Yet the energy required to satisfy this standard are going to vary by the local climate and household characteristics including number of occupants and size of the dwelling. To account for such factors and other considerations for households with vulnerable individuals, energy costs are equivalized.

In Europe, more countries are moving towards an energy poverty indicator based on modeled energy. Furthermore, this shift can be attributed to a growing body of research that indicates actual expenditure data underestimates measures of energy poverty (Antepara et al. 2020). An indicator based on modeled energy costs can help identify households that are under-consuming energy, maintaining undesirable indoor temperatures, or simply lack sufficient heating and cooling systems. This approach is particularly useful in the U.S. context where energy vulnerability is a byproduct of both heating and cooling needs (Thomson et al. 2019).

Cooling needs and access to air conditioning. It is anticipated that energy costs for cooling will rise by at least 8% as compared to the 2023 summer (NEADA 2024). The increase in cooling demand, particularly in northern climates where many homes lack central cooling systems, can be a major driver of bill increase. (Ortiz et al. 2022) estimate that in New York, the adoption of air conditioning is the leading driver in energy burdens. These emerging trends are compounded by the fact that much of federal energy assistance is designed around heating demand. Similar conditions in southern Europe have led EU policymakers to adopt household heat exposure into definitions of energy poverty.

While estimates for household energy burdens typically include cooling costs, a new U.S. framework is needed to understand approaches that expand access to air conditioning without compromising affordability. As summarized in Table 1 below, about 1 in 10 U.S. households have no air conditioning (AC). While nearly 85% of energy insecure households (as reported to EIA) use some form of air conditioning, they are less likely to have centralized systems. Using modeled energy use as the primary indicator provides a more robust framework to tailor retrofit strategies that enable AC adoption while reducing energy poverty.

Table 1. Percent of U.S. households with air conditioning (AC)

	Use AC equipment	Central	Window or wall unit	Do not use AC
All U.S. households	109.5 (88.7%)	82.7 (66.9%)	21.4 (17.3%)	14.0 (11.3%)
Households reporting energy insecurity	28.5 (84.8%)	18.4 (54.7%)	8.4 (25.1%)	5.1 (15.2%)

Source: EIA 2020.

In developing the framework, additional analysis is likely needed to understand regional differences in household cooling regimes. The U.S. has over eight distinct climate zones where household comfort preferences and equipment usage patterns vary widely (Parker 2015; Zhivov et al. 2023). We plan to initially adopt the standard setpoints as used in model energy code, with supporting analysis to understand the sensitivity in temperature setpoints on the energy poverty threshold.

Accounting for other energy uses. The UK energy poverty definition estimates energy requirements based only on heating, cooling, water heating, lighting, cooking, and major

appliances. As such, the definition is focused on the ability of households to meet basic energy services. In the United States, as much as 30% of residential energy use is attributed to miscellaneous energy loads (Center for Sustainable Systems 2023). Given the challenge of capturing energy usage outside of major end uses, a minimum energy requirement standard may be easier to define focused only on major end uses and appliances. This is not to say that plug-loads, such as televisions and charging devises, should be omitted from the conversation around energy affordability. Instead, we argue that from a federal monitoring and framework perspective, it is more important to focus on critical energy loads.

Exploration of Energy Costs Alongside Household Finances

The last component to investigate is the incorporation of household income and spending data. Little discussion of household energy burdens within U.S. literature investigates energy spending as a function of net income that considers the broader scheme of household finances (Bohr and McCreery 2020). Within the UK, energy poverty is calculated after housing costs and other taxes are incorporated. Additional studies within the EU observe that factoring in other household expenditures into calculations identifies additional households in energy poverty that are historically missed due to higher gross incomes (Thomson et al 2019).

One important feature of UK energy poverty framework is the ability to analyze the impact of changing fuel prices. Highlighted in Figure 5 below, the UK government is able to estimate and predict the underlying mechanisms that result in changes to national energy poverty statistics. As discussed by representatives from Spain during the EU-U.S. workshop, Spain's national strategy includes a heavy focus on bill discounts. This is partially due to the fact that Spain's energy prices are about 20 percent above the EU average (Barrella 2020).

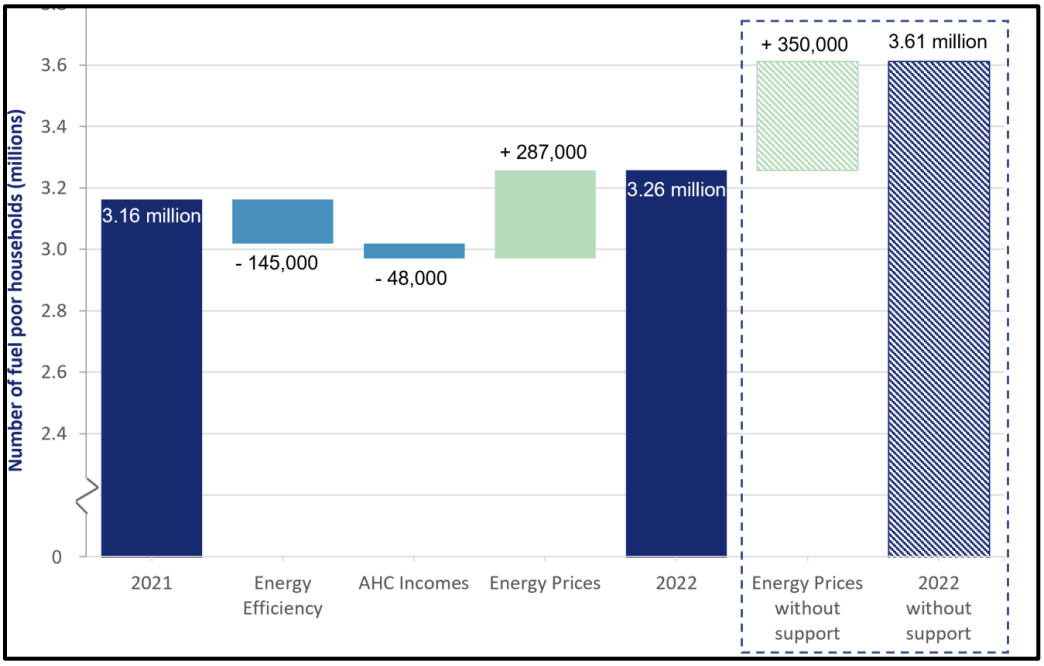

Figure 5: Annual Fuel Poverty Statistics in England, 2023. *Source*: Department for Energy Security & Net Zero 2023.

This framework also improves the study of energy assistance and bill discounts as part of the energy poverty reduction strategy (BEIS 2023). The ability to compare bill discounts alongside efficiency interventions would help unify the two largest federal programs, the Department of Energy's Weatherization Assistance Program and Department of Health & Human Services' Low Income Energy Assistance Program. While these programs primarily rely on household income to determine eligibility, Scheier and Kittner (2022) found that more than 5.2 million households would qualify when local economic disparities are considered.

For the development of a U.S. energy poverty measure, the availability of compatible datasets will likely dictate whether additional household spending information can be incorporated into the framework. NASEM (2023) recently conducted a report on behalf of the U.S. Census Bureau recommending the expansion of federal poverty measures to more comprehensively account for household expenditures. The proposed poverty measure represents a household's capacity to achieve a given level of wellbeing and closely aligns with the key principles of the energy poverty framework.

We hope to incorporate housing costs into our initial baseline estimates. Initial discussions are underway with external research partners to develop income data based on a household's disposable income. Such work could help inform the design of utility bill discounts, rate design, and the appropriate balance between bill assistance and energy efficiency interventions. The development of this framework presents a unique opportunity to engage a wider group of researchers and policymakers.

Key Takeaways and Next Steps

We anticipate that the full framework along with baseline estimates will be released in the fall of 2024. This paper presents our initial progress and opportunity to discuss key elements through the lens of existing scholarship. As presented, this initiative aimed at expanding the federal government's ability to measure energy poverty and evaluate national policy interventions. We summarize additional considerations and potential applications of the framework below.

- **Cycles of energy poverty:** The broader study of household energy insecurity is inextricably linked to race, income, and other sociodemographic characteristics (Hernández; Reames and Bednar; Sovacool and Dworkin). Energy insecurity is not static but rather a cycle driven by various factors tied to poverty, accessibility, and the efficiency of homes. One of the frameworks goals is to improve our understanding of how households fall in and out of energy poverty. The different iterations of the UK strategy improved their approach to effectively capture this phenomenon accordingly (Hills 2012). Research also shows that households apply different coping mechanisms to navigate energy insecurity that can vary by season or billing cycle (Simes, Rahaman, and Hernández). In turn, intervention strategies and policies can be tailored to respond to household needs more effectively. For instance, programs that provide access to free air conditioners can include bill credits or program incentives to offset the increased costs.

- **Account for Sociodemographic factors:** The broader study of household energy insecurity is inextricably linked to race, income, and other sociodemographic characteristics (Hernández; Reames and Bednar; Sovacool and Dworkin). These factors influence energy consumption patterns and the dependence on certain energy-consuming

devices. For instance, households that include an elderly family member or infant may require additional energy for medical devices or for certain indoor temperatures. The framework's 'energy livability' standard utilizes equivalization factors to control for household conditions. Just as a household with several members consume more energy, households with certain vulnerabilities may as well. Additional work to refine these equivalization factors is needed to refine these factors. One potential opportunity is to apply the Department of Housing and Urban Development's factors used to estimate energy bill allowances for certain housing programs.

- **Inform energy policy development & energy poverty targets:** In an ideal political environment, energy policy is informed by data. In Europe, climate policy and investment packages are often designed based on specific targets and goals for energy poverty reduction. While aspirational at the federal level, the energy poverty framework can help inform state and local policy efforts. For instance, the proposed energy poverty framework can help quantify and set energy affordability standards, such as New York State's recent legislation. Ultimately, a U.S. framework allows us to set forth a path towards alleviating household energy poverty and our north star for a just energy future.

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