How Could Compounded Vulnerability reshape the Geography of Federal Energy Assistance?

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Summary: Recent studies have shown that funding from the Low Income Home Energy Assistance Program (LIHEAP) is distributed across states based on an outdated formula which is not reaching households with the highest energy burdens. Existing formulas and reforms mainly focus on energy costs monetary indicators. However, energy costs alone may not fully capture the challenges that low-income households face. For instance, two communities with similar energy burdens may have very different housing conditions, electricity reliability, and health conditions and needs, which can make the same energy burden more difficult to manage. This study asks: where does difficulty with obtaining affordable and reliable energy, which is about energy service vulnerability overlap with other vulnerabilities that could make energy burden more harmful? Through a county level analysis of vulnerability assessment in the U.S., we found that energy burden is compounded along with various dimensions of vulnerability such as energy, health, built environment, and socio-demographic. Among counties with high energy service vulnerability, 61% also face high vulnerability in at least two other dimensions. About 5.7 million low-income residents live in these counties, which are particularly concentrated in the southern United States and Appalachia area. We also find that current state LIHEAP funding allocations closely follow the number of low-income residents but there is little relationship with where these vulnerabilities overlap. Building on these findings, we will discuss how accounting for overlapping vulnerabilities could change the distribution of LIHEAP budget.

Motivation and policy context

LIHEAP is the main federal program for household energy affordability, but less than 20 percent of income-eligible families receive assistance in a year (Weintraut et al., 2026). Hence, how roughly $4 billion annual appropriation is divided among states is a policy question. Current allocations reflect rules that favor colder states. Recent studies found that energy poverty is concentrated in parts of the South and Southwest, and LIHEAP funding does not follow these patterns (Batlle et al., 2024). The LIHEAP Parity Act, introduced in March 2025, would tie allocations to each state's share of low-income home energy expenditures. Batlle et al. (2024) estimate tract-level energy burdens and show that a fixed budget allocated to shave the peak of household burdens would shift funds significantly toward the Southeast and Southwest. Weintraut et al. (2026) show that warm-weather states receive less than their share of low-income energy expenditure. Both analyses define need based on energy cost. In these studies, two households with the same burden are treated equally even if one depends on electricity-powered medical equipment, face chronic illness, or housing is old. Those conditions change the consequences of an unpaid bill or a shut-off, and energy burdens can have more severe impacts during climate disruptions. This study provides systematic evidence of where such vulnerabilities coincide and adds another question: Are places with high energy burdens and vulnerabilities also facing social, housing, and health problems that make it harder to cope? We then discuss whether recognizing these overlapping conditions would change who receives assistance.

Data and approach

We use a previously developed service-system vulnerability framework for U.S. counties (Pourmatin & Hewitt, 2026). This study holistically assessed the vulnerability of communities in the United States by integrating vulnerability features across four dimensions of energy service (ES), essential health (EH), built environment (BE), socio-demographic (SD). The ES dimension includes household energy burden, exposure to high energy bills, power interruptions, climate-related heating and cooling needs, and housing characteristics. The other dimensions describe the people, buildings, and health conditions that shape a community’s ability to handle energy problems. In this proposal, we first rank counties on each dimension and identify those in the highest third. We then examine how often high energy service vulnerability coincides with two or three other high vulnerabilities. To estimate the population

affected, we use American Community Survey (ACS) counts of residents below 150% of the federal poverty line as a consistent low-income measure. This is an analytical proxy, not an exact count of LIHEAP-eligible households, because eligibility rules differ across states.

Preliminary findings

Energy service vulnerability is strongly bundled with social and health vulnerability, and current allocations do not track that bundle as shown in figure 1 and 2.

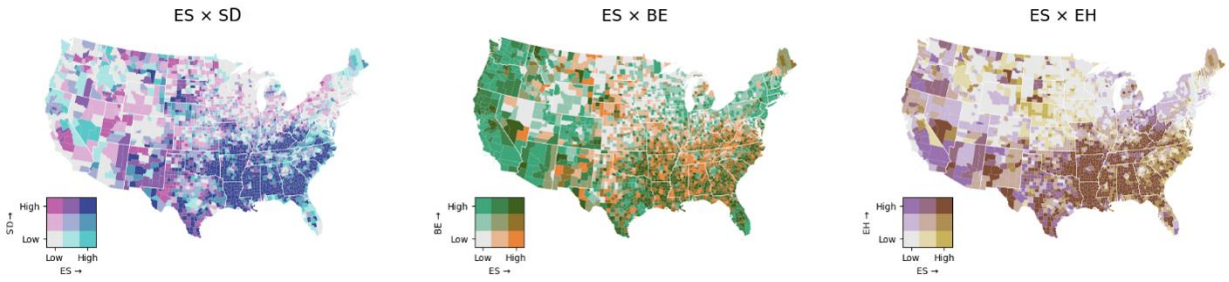


Figure 1. Geographic overlap of ES vulnerability with other dimensions of vulnerability across U.S. counties. Bivariate maps show the relationship between ES vulnerability and SD, BE, and EH

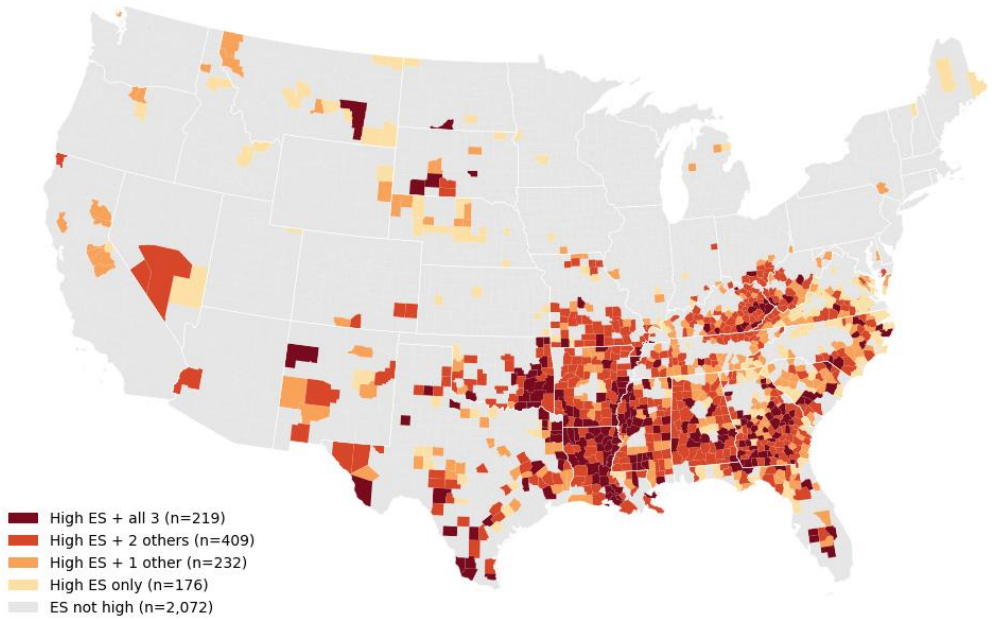


Figure 2. Geographic distribution of counties experiencing multiple dimensions of vulnerability. Counties with high ES vulnerability (top national third) are classified by the number of additional dimensions in which they also have high vulnerability.

Compound vulnerability: Of the 1,036 high-ES counties, 61 % are also high on at least two other dimensions and there are 219 counties that are high on all four dimensions of vulnerability. These counties are not spread evenly across the country. Many are in the Mississippi Delta, the Black Belt, and Central Appalachia.

Compounded counties are poorer. The share of residents below 150% of poverty rises from 19.5% in counties without high energy service vulnerability to 33.8% in counties high on all four dimensions.

Low-income affected. 5.7 million low-income residents live in high ES counties with at least two other high vulnerabilities, concentrated in the Mississippi Delta, the Black Belt, and Central Appalachia. In Mississippi (58 %) and Louisiana (53 %), more than half of low-income residents live in such counties.

Allocations track headcount, not compounding. State funding shares correlate with low-income headcount but not with compounded need, as the table shows. States with more compounded need receive less per low-income resident ($\rho = -0.60$).

As shown in figure 3, based on the number of low-income residents in each state, average allocations range from about $26–38 in Georgia, Louisiana, Mississippi, Arkansas, and Alabama to $90–142 in New York, Wisconsin, Minnesota, Massachusetts, and Connecticut. Ten Southern states hold 79 % of compounded need and receive 15 % of funds. Threshold-based need measures assign zero to some states, so these comparisons are descriptive and not proposed allocations; the allocation model below avoids that by keeping every eligible household eligible.

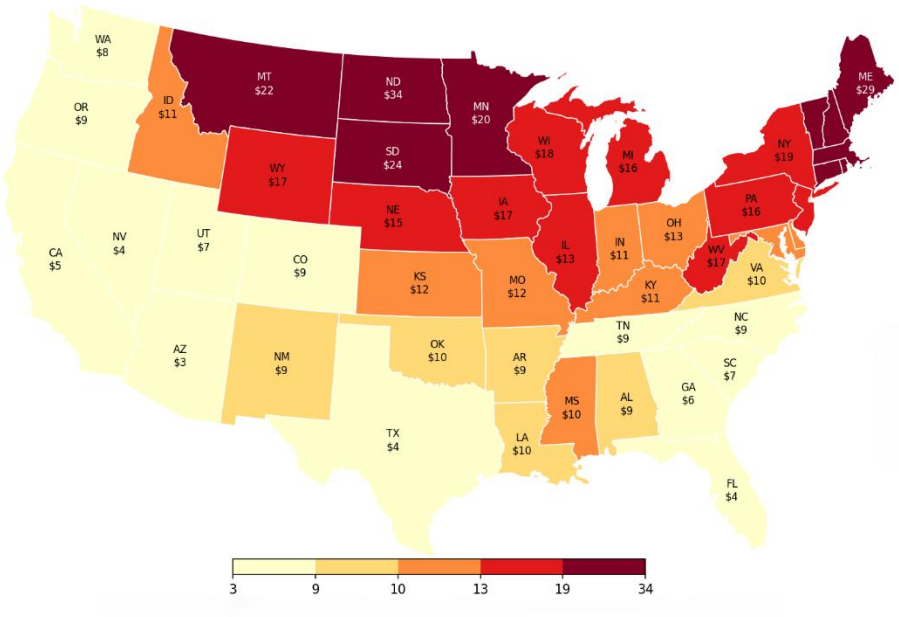


Figure 3. Geographic distribution of LIHEAP funding per low-income resident across U.S. states.

References

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