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# How High Are Household Energy Burdens?

## An Assessment of National and Metropolitan Energy Burden across the United States

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# Executive Summary

## KEY TAKEAWAYS

- New research based on data from 2017 finds that high energy burdens remain a persistent national challenge. Of all U.S. households, 25% (30.6 million) face a high energy burden (i.e., pay more than 6% of income on energy bills) and 13% (15.9 million) of U.S. households face a severe energy burden (i.e., pay more than 10% of income on energy).[1]
- Nationally, 67% (25.8 million) of low-income households (≤ 200% of the federal poverty level [FPL]) face a high energy burden and 60% (15.4 million) of low-income households with a high energy burden face a severe energy burden.
- The East South Central Region (i.e., Alabama, Kentucky, Mississippi, and Tennessee) has the highest percentage of households with high energy burdens (38%) as compared to other regions.
- Black, Hispanic, Native American, and older adult households, as well as families residing in low-income multifamily housing, manufactured housing, and older buildings experience disproportionally high energy burdens nationally, regionally, and in metro areas.
- Weatherization can reduce low-income household energy burdens by about 25%, making it an effective strategy to reduce high energy burdens for households with high energy use while also benefiting the environment.
- Leading cities and states have begun to incorporate energy burden goals into strategies and plans and to create local policies and programs to achieve more equitable energy outcomes in their communities. They are pursuing these goals through increased investment in energy efficiency, weatherization, and renewable energy.

[1] Researchers estimate that housing costs should be no more than 30% of household income, and household energy costs should be no more than 20% of housing costs. This means that affordable household energy costs should be no more than 6% of total household income. For decades, researchers have used the thresholds of 6% as a high burden and 10% as a severe burden (APPRISE 2005). Note that high and severe energy burdens are not mutually exclusive. All severe energy burdens (> 10%) also fall into the high burden category (> 6%).

This report provides an updated snapshot of U.S. energy burdens (i.e., the percentage of household income spent on home energy bills) nationally, regionally, and in 25 select metro areas in the United States.[1,2] Both high and severe energy burdens are caused by physical, economic, social, and behavioral factors, and they impact physical and mental health, education, nutrition, job performance, and community development. Energy efficiency and weatherization can help address energy insecurity (i.e., the inability to adequately meet basic household heating, cooling, and energy needs over time) by improving building energy efficiency, reducing energy bills, and improving indoor air quality and comfort (Hernández 2016).

We recognize that the economic recession brought on by the global COVID-19 pandemic has greatly increased U.S. energy insecurity and also interrupted weatherization and energy efficiency programs nationally. While this report measures energy burdens using 2017 data from the American Housing Survey (AHS), we anticipate the recession will lead to a further increase in energy insecurity and higher energy burdens in 2020 and beyond.

## Methods

This study calculates energy burdens using the AHS, which includes a national and regional dataset as well as a dataset of 25 metropolitan statistical areas.[4] We calculate energy burdens across all households and in a variety of subgroups to identify those that spend disproportionally more of their income on energy bills than otherwise similar groups, analyzing across income, housing type, tenure status, race, ethnicity, and age of occupant and structure. We also calculate the percentage of households nationally, regionally, and in each select metro area that have high energy burdens (i.e., spend more than 6% of income on home energy bills) and severe energy burdens (i.e., spend more than 10% of income on home energy bills). We do not include households who do not directly pay for their energy bills.

## Energy Burden Findings

### NATIONAL ENERGY BURDENS

U.S. households spend an average of 3.1% of income on home energy bills. Figure ES1 presents our national energy burden findings by subgroup. We acknowledge that many highly burdened groups are intersectional, meaning that they face compounding, intersecting causes of inequality and injustice, with energy burden representing one facet of inequity. The following are key national findings:

- Low-income households spend three times more of their income on energy costs compared to the median spending of non-low-income households (8.1% versus 2.3%).
- Low-income multifamily households spend 2.3 times more of their income on energy costs compared to the median spending of multifamily households (5.6% versus 2.4%).
- The median energy burden for Black households is 43% higher than for non-Hispanic white households (4.2% versus 2.9%), and the median energy burden for Hispanic households is 20% higher than that for non-Hispanic white households (3.5% versus 2.9%).
- The median renter energy burden is 13% higher than that of the median owner (3.4% versus 3.0%).
- More than 25% (30.6 million) of U.S. households experience a high energy burden, and about 50% (15.9 million) of households with a high energy burden face a severe energy burden.[5]
- Of low-income households (≤ 200% FPL), 67% (25.8 million) experience a high energy burden, and 60% (15.4 million) of those households with a high energy burden face a severe energy burden.
- Low-income households, Black, Hispanic, Native American, renters, and older adult households all have disproportionately higher energy burdens than the national median household.

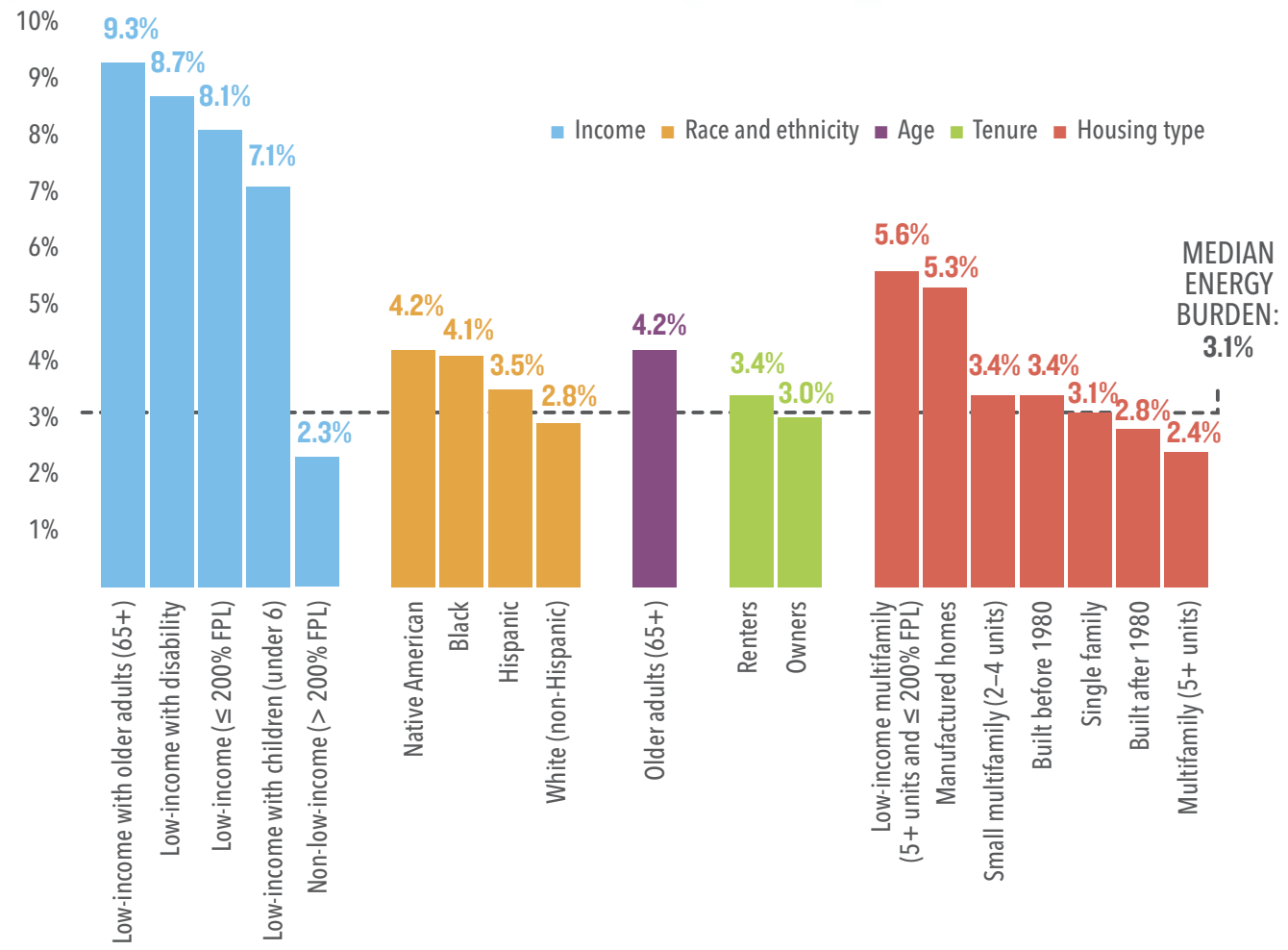
[2] This study focuses on home energy burden and includes electricity and heating fuels. Note that the study does not include transportation, water, or telecommunication cost burdens in its energy burden calculations.

[3] This report provides an update to ACEEE's previous energy burden research. Drehobl and Ross (2016) analyzed 2011 and 2013 American Housing Survey (AHS) data, and Ross, Drehobl, and Stickles (2018) analyzed 2015 AHS data. This report analyzes 2017 AHS data, the most recent data available as of publication.

[4] We include the 25 metropolitan statistical areas (MSAs) sampled for the 2017 AHS: Atlanta, Baltimore, Birmingham, Boston, Chicago, Dallas, Detroit, Houston, Las Vegas, Los Angeles, Miami, Minneapolis, New York City, Oklahoma City, Philadelphia, Phoenix, Richmond, Riverside, Rochester, San Antonio, San Francisco, San Jose, Seattle, Tampa, and Washington, DC.

[5] Note that high and severe energy burdens are not mutually exclusive. All severe energy burdens (> 10%) also fall into the high burden category (> 6%).

**FIGURE ES1. National energy burdens across subgroups (i.e., income, race and ethnicity, age, tenure, and housing type) compared to the national median energy burden**




## REGIONAL ENERGY BURDENS

We find that the national trends hold true across the nine census regions. The following are our key regional findings:

- Across all nine regions, low-income household energy burdens are 2.1–3 times higher than the median energy burden.
- The East South Central region (i.e., *Alabama, Kentucky, Mississippi, Tennessee*) has the greatest percentage of households (38%) with high energy burdens, followed by East North Central (i.e., *Illinois, Indiana, Michigan, Ohio, Wisconsin*), New England (*Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont*), and Middle Atlantic regions (i.e., *New Jersey, New York, Pennsylvania*) (all 29%).
- The gap between low-income and median energy burdens is largest in the New England, Pacific (i.e., *Alaska, California, Hawaii, Oregon, Washington*), and Middle Atlantic regions.
- The South Atlantic region (i.e., *Delaware, DC, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia*) had the greatest number of households (6.3 million) with high burdens, followed by the East North Central (5.4 million) and Middle Atlantic (4.6 million) regions.

## METRO AREA ENERGY BURDENS

National and regional patterns are mirrored in cities. The following are our key metropolitan area findings:

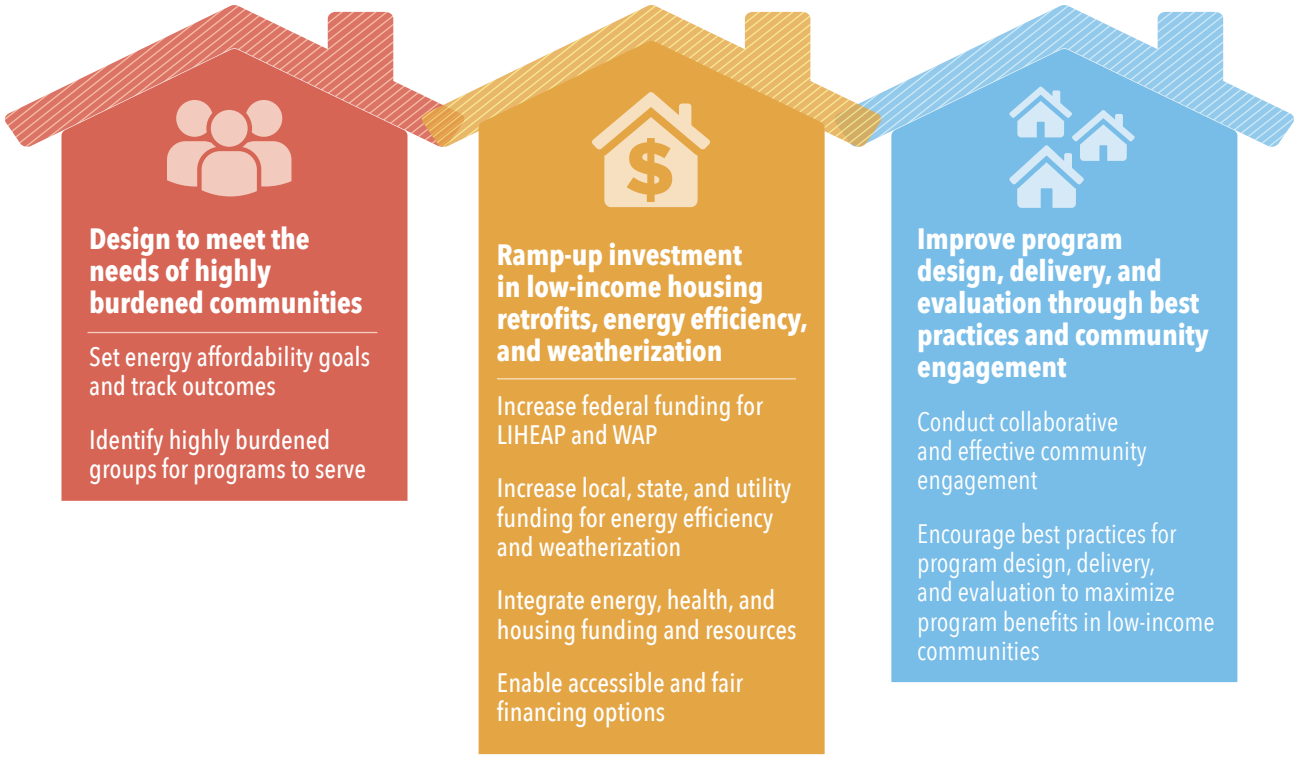
- Low-income households experience energy burdens at least two times higher than that of the average household in each metropolitan area included in the study.[6]
- Black and Hispanic households experience higher energy burdens than non-Hispanic white households; renters experience higher energy burdens than owners; and people living in buildings built before 1980 experience higher energy burdens than people living in buildings built after 1980 across all metro areas in the study.
- Six metro areas have a greater percentage of households with a high energy burden than the national average (25%), including Birmingham (34%), Detroit (30%), Riverside (29%), Rochester (29%), Atlanta (28%), and Philadelphia (26%).
- In five metro areas—Baltimore, Philadelphia, Detroit, Boston, and Birmingham—at least one-quarter of low-income households have energy burdens above 18%, which is three times the high energy burden threshold of 6%.

See the body of the report for additional images, maps, charts, and data on energy burden calculations nationally, regionally, and in metro areas.

## Strategies to Accelerate, Improve, and Better Target Low-Income Housing Retrofits and Weatherization

Clean energy investments—such as energy efficiency, weatherization, and renewable energy—can provide a long-term, high-impact solution to lowering high energy burdens. By investing in energy efficiency and weatherization first or alongside renewable energy technologies, these measures can reduce whole-home energy use to maximize the costs and benefits of

**FIGURE ES2. Strategies to improve and expand low-income energy efficiency and weatherization programs**




[6] We define the "average household" energy burden as the median across all households in the sample (i.e., in each MSA).

**Based on prior evidence of how weatherization reduces average customer bills, we estimate that it can reduce low-income household energy burden by 25%.**

additional renewable energy generation. This report focuses on weatherization and energy efficiency as long-term solutions to reducing high energy burdens; these solutions can be combined with renewable energy investments and/or electrification strategies that reduce energy bills for additional impact. Based on prior evidence of how weatherization reduces average customer bills, we estimate that it can reduce low-income household energy burden by 25%.[7]

To ensure that more low-income and highly energy burdened households receive much-needed energy efficiency and weatherization investments, we recommend that policymakers and program implementers design policies and programs to meet the needs of highly burdened communities and set up processes for evaluation and accountability processes. This involves engaging with community members from the start, increasing funding for low-income weatherization and energy efficiency, and integrating best practices into program design and implementation. Figure ES2 depicts this actionable framework. For more information about these strategies, see the full report.

## Conclusions and Next Steps

Energy affordability remains a national crisis, with low-income households, communities of color, renters, and older adults experiencing disproportionally higher energy burdens than the average household nationally, regionally, and in metro areas. This study finds that each MSA has both similar and unique energy affordability inequities. Further research can help better understand the intersectional drivers of high energy burdens and the policies best suited to improve local energy affordability. Climate change and the global pandemic also underscore the urgency in addressing high household energy burdens. As temperatures continue to rise and heat waves become more common, access to clean, affordable energy is needed more than ever to prevent indoor heat-related illnesses and deaths.

Cities, states, and utilities are well positioned to build on this research and conduct more targeted and detailed energy burden analyses, such as the Pennsylvania Public Utility Commission's study on home energy affordability for low-income customers. Studying energy burden and more broadly analyzing energy insecurity factors are first steps toward setting more targeted energy burden reduction goals and creating policies and programs that lead to more vibrant and prosperous communities.

[7] We assume 25% savings from energy efficiency upgrades based on the U.S. Department of Energy's estimate (DOE 2014) and use the median low-income household values to calculate a 25% reduction. We reduced the median low-income energy bill by 25% from $1,464 to $1,098. Using the median low-income household income of $18,000, this equates to a reduced energy burden of 6.1%. Reducing the median low-income energy burden from 8.1% to 6.1% is a 25% reduction.

# Introduction

Energy insecurity—that is, the inability to adequately meet basic household heating, cooling, and energy needs over time (Hernández 2016)—is increasingly viewed as a major equity issue by policymakers, energy utilities, and clean energy and environmental justice advocates. This multidimensional problem reflects the confluence of three factors: inefficient housing and appliances, lack of access to economic resources, and coping strategies that may lead some residents to dangerously under-heat or under-cool their homes (Hernández, Aratani, and Jiang 2014).

Household energy burden—the percentage of annual household income spent on annual energy bills—is one key element contributing to a household's energy insecurity. Energy burden as a metric helps us visualize energy affordability (i.e., the ability to afford one's energy bills); identify which groups shoulder disproportionally higher burdens than others; and recognize which groups most need targeted energy-affordability- and energy-justice-related policies and investments to reduce high energy burdens. Three strategies can reduce both energy insecurity and high energy burdens: increasing household income, increasing bill payment assistance through government or utility resources, and reducing household energy use. This study discusses policy considerations that focus on the third solution of reducing excess energy use to lower high household energy burdens.

This report provides a snapshot of energy burdens nationally and in 25 of the largest U.S. metro areas. We examine median household energy burdens among groups—varying by income, housing type and age, and tenure status—as well as the percentage of households experiencing high (> 6%) and severe (> 10%) energy burdens nationally, in metro areas, and across groups (APPRISE 2005). Building on ACEEE's 2016 urban energy burden study and 2018 rural energy burden study (Drehobl and Ross 2016; Ross, Drehobl, and Stickles 2018), this report analyzes national-, regional-, and metro-level data from the U.S. Census Bureau's most recent American Housing Survey (AHS) conducted in 2017.

Local policymakers, utilities, and advocates can use this report's data and policy recommendations to better understand both which groups tend to have disproportionally higher energy burdens and how they can measure these burdens in their communities. The subsequent policy recommendations focus on low-income energy efficiency and weatherization as high-impact strategies to alleviate high energy burdens and improve overall energy affordability.

# Background

## Systemic Patterns and Causes of Inequities

Household access to energy is central to maintaining health and well-being, yet one in three U.S. households reported difficulty paying their energy bills in 2015 (EIA 2018). Black, Indigenous, and People of Color (BIPOC) communities often experience the highest energy burdens when compared to more affluent or white households (Kontokosta, Reina, and Bonczak 2019; Drehobl and Ross 2016; Hernández et al. 2016).[8] These communities often experience racial segregation, high unemployment, high poverty rates, poor housing conditions, high rates of certain health conditions, lower educational opportunity, and barriers to accessing financing and investment (Jargowsky 2015; Cashin 2005). Many of these characteristics are due in part to systemic racial discrimination, which has led to long-standing patterns of disenfranchisement from income and wealth-building opportunities for BIPOC communities as compared to white communities (Rothstein 2017).

[8] We use the term BIPOC in this report to describe communities that experience especially acute systemic inequities, barriers, and limited access to energy programs. By specifically naming Black and Indigenous (Native American) communities, the term BIPOC recognizes that Black and Indigenous people have historically experienced targeted policies of systemic economic exclusion, classism, and racism in the United States. It is important to recognize this history and how it has led to disproportionally high energy burdens and unique barriers to accessing clean energy technologies and investments.

Policies and practices that have led to economic and/or social exclusion in BIPOC communities include neighborhood segregation and redlining, lack of access to mortgages and other loans, mass incarceration, employment discrimination, and the legacy of segregated and underfunded schools (Jargowsky 2015; McCarty, Perl, and Jones 2019).[9] These types of systemic exclusions, underinvestments, discriminative lending practices, and limited housing choices have also limited BIPOC communities' access to efficient and healthy housing (Lewis, Hernández, and Geronimus 2019). In addition, Black communities are 68% more likely to live within 30 miles of a coal-fired power plant, and properties in close proximity to toxic facilities average 15% lower property values than those in other areas (National Research Council 2010). Black children are three times as likely to be admitted to the hospital for asthma attacks than white children (Patterson et al. 2014). According to a study by the American Association of Blacks in Energy, while Black households spent $41 billion on energy in 2009, they held only 1.1% of energy jobs and gained only 0.01% of the revenue from energy-sector profits (Patterson et al. 2014).

## Limited Access to Energy Programs

A growing body of research shows that BIPOC and low-income communities experience disparate access to residential energy-saving appliances and other energy efficiency upgrades. While low-income and communities of color on average consume less energy than wealthier households, they are more likely to live in less-efficient housing (Bednar, Reames, and Keoleian 2017). Researchers found that, when holding income constant, BIPOC households experience higher energy burdens than non-Hispanic white households (Kontokosta, Reina, and Bonczak 2019). BIPOC and low-income communities also may experience higher costs when investing in energy-efficient upgrades. For example, a study based in Detroit found that energy-efficient lightbulbs were less available in high-poverty areas and smaller stores, and when they were available, they were more expensive than in other areas (Reames, Reiner, and Stacey 2018).

Others have found that untargeted utility-administered energy efficiency programs do not effectively reach BIPOC and low-income communities—particularly those living in multifamily buildings (Frank and Nowak 2016; Samarripas and York 2019). Low-income communities face economic, social, health and safety, and information barriers that impact their ability to access programs, and many programs fail to address these barriers through specific targeting practices. Limited access to energy efficiency resources and investments coupled with lower incomes increase the proportion of income that low-income and BIPOC households spend on energy bills (Jessel, Sawyer, and Hernández 2019; Berry, Hronis, and Woodward 2018).

**Systemic exclusions, under-investments, discriminative lending practices, and limited housing choices have limited Black, Indigenous, and People of Color communities' access to efficient and healthy housing.**

Where utilities do administer programs targeted at low-income customers, participant needs far exceed available resources. Reames, Stacy, and Zimmerman (2019) found that 11 large investor-owned utilities across six states have distributional disparities in low-income investments; that is, they do not spend energy efficiency dollars proportionally on programs designed to reach low-income populations. A 2018 report found that only 6% of all U.S. energy efficiency spending in 2015 was dedicated to low-income programs (EDF APPRISE 2018). Most states require that utility energy efficiency program portfolios be cost effective, often using tests that focus mostly on direct economic costs to the utility (Woolf et al. 2017; Hayes, Kubes, and Gerbode 2020). This requirement places an additional burden on utilities, states, and local governments that invest in programs that serve low-income communities because it does not account for nonenergy and additional health, economic, and community benefits in program planning and evaluations.

## Definition and Drivers of High Energy Burdens

*High energy burdens* are often defined as greater than 6% of income, while *severe energy burdens* are those greater than 10% of income (APPRISE 2005).[10] Past research found that low-income, Black, and Hispanic communities, as well as older adults, renters, and those residing in low-income multifamily buildings experienced disproportionally higher energy burdens than other households (Drehobl and Ross 2016; Ross, Drehobl, and Stickles 2018).

[9] *Redlining* is the discriminatory practice of fencing off areas in which banks would avoid investments based on community demographics. Redlining was included in local, state, and federal housing policies for much of the 20th century. For more information on historical forms of economic and social exclusion, see *The Color of Law: A Forgotten History of How Our Government Segregated America* by Richard Rothstein.

[10] Researchers estimate that housing costs should be no more than 30% of household income, and household energy costs should be no more than 20% of housing costs. This means that affordable household energy costs should be no more than 6% of total household income.

| TABLE 1. Key drivers of high household energy burdens | |
|---|---|
| **Drivers** | **Examples of factors that affect energy burden** |
| **Physical** | Housing age (i.e., older homes are often less energy efficient) |
| | Housing type (e.g., manufactured homes, single family, and multifamily) |
| | Heating and cooling system (e.g., system type, fuel type, and fuel cost) |
| | Building envelope (e.g., poor insulation, leaky roofs, inefficient and/or poorly maintained poorly maintained heating and cooling systems (HVAC), and/or inadequate air sealing) |
| | Appliances and lighting efficiency (e.g., large-scale appliances such as refrigerators, washing machines, and dishwashers) |
| | Topography and location (e.g., climate, urban heat islands) |
| | Climate change and weather extremes that raise the need for heating and cooling |
| **Socioeconomic** | Chronic economic hardship due to persistent low income |
| | Sudden economic hardship (e.g., severe illness, unemployment, or disaster event) |
| | Inability to afford (or difficulty affording) up-front costs of energy efficiency investments |
| | Difficulty qualifying for credit or financing options to make efficiency investments due to financial and other systemic barriers |
| | Systemic inequalities relating to race and/or ethnicity, income, disability, and other factors |
| **Behavioral** | Information barriers relating to available bill assistance and energy efficiency programs and relating to knowledge of energy conservation measures |
| | Lack of trust and/or uncertainty about investments and/or savings |
| | Lack of cultural competence in outreach and education programs |
| | Increased energy use due to occupant age, number of people in the household, health-related needs, or disability |
| **Policy-related** | Insufficient or inaccessible policies and programs for bill assistance, energy efficiency, and weatherization for low-income households |
| | Utility rate design practices, such as high customer fixed charges, that limit customers' ability to respond to high bills through energy efficiency or conservation |

*Source:* Updated from Ross, Drehobl, and Stickles 2018

Drivers of high household energy burdens are often the result of the systemic factors, barriers, and challenges that these households face. Previous research identified drivers that can raise energy burdens, including the dwelling's physical structure, the resident's socioeconomic status and behavioral patterns, and the availability of policy-related resources (Drehobl and Ross 2016; Ross, Drehobl, and Stickles 2018). Table 1 shows an updated list of key drivers of high energy burdens.

## ENERGY INEFFICIENCY AS A DRIVER OF HIGH ENERGY BURDENS

While low incomes are a substantial factor driving higher energy burdens, inefficient housing is also a contributor. According to the 2017 AHS data, 9% of total U.S. households completed an energy-efficient improvement in the past two years, but only 17% were low-income households (Census Bureau 2019). Low-income households (≤ 200% of the federal poverty level [FPL]) make up about 30% of the population, which means that they are underrepresented in households completing energy efficiency upgrades and thus are not proportionally accessing and benefiting from these investments.

Additional research examining energy benchmarking data in a few major cities has found that households from both the lowest- and highest-income brackets had the highest *energy use intensity* (EUI)—that is, they had

the highest energy consumption per square foot. While consumption behaviors are regarded as the driver for high EUI among higher-income households, the researchers point to inefficient heating and lighting infrastructure to help explain the high EUI among low-income households (Kontokosta, Reina, and Bonczak 2019). High-income households use large amounts of energy to power larger homes—as well as more electronics and devices that use large amounts of energy—while low-income households tend to use fewer, less-efficient devices that require relatively large amounts of energy due to the inefficiency of the dwelling or the appliance itself. Therefore, household inefficiencies rather than inefficient behaviors tend to lead to higher energy use and expenditures for low-income households. Generally, energy efficiency investments can allow households to engage in the same activity while using less energy, thus reducing high energy burdens and improving comfort, health, and safety.

## Adverse Effects of High Energy Burdens

Our comprehensive evaluation of energy burden research reveals both that low-income households spend, on average, a higher portion of their income on energy bills than other groups, and that energy burdens are also higher for communities of color, rural communities, families with children, and older adults (Brown et al. 2020; Lewis, Hernández, and Geronimus 2019; Reames 2016; Hernández et al. 2016; Drehobl and Ross 2016; Ross, Drehobl, and Stickles 2018). Energy burden is one indicator to measure energy insecurity, and high energy burdens are associated with inadequate housing conditions and have been found to affect physical and mental health, nutrition, and local economic development.

### EXCESSIVE ENERGY COST CAN IMPACT RESIDENTS' HEALTH AND COMFORT.

Researchers have found that many households with high energy burdens also live in older, inefficient, and unhealthy housing. Inefficient housing is associated with other health impacts, such as carbon monoxide poisoning, lead exposure, thermal discomfort, and respiratory problems such as asthma and chronic obstructive pulmonary disease (COPD); it is also associated with the potential for hypothermia and/or heat stress resulting from leaky and/or unrepaired heating and cooling equipment (Brown et al. 2020; Norton, Brown, and Malomo-Paris 2017).

Households experiencing energy insecurity may forego needed energy use to reduce energy bills, forcing them to live in uncomfortable and unsafe homes. Hernández, Phillips, and Siegel (2016) found that half of the study's participants who experienced high monthly utility bills engaged in coping strategies such as using secondary heating equipment (i.e., stoves, ovens, or space heaters) to compensate for inefficient or inadequate heating systems. Employing this coping measure can compromise resident safety and comfort, and it may increase exposure to toxic gases. Teller-Elsberg et al. (2015) found that excess winter deaths potentially caused by fuel poverty kill more Vermonters each year than car crashes. In addition, according to the Residential Energy Consumption Survey, one in five U.S. households reported reducing or forgoing necessities such as food or medicine to pay an energy bill (EIA 2018). These tradeoffs can impact long-term health and well-being.

Climate change, rising temperatures, and subsequent cooling demands will continue to exacerbate household energy burdens—and prove deadly for some. In Maricopa County, Arizona—one of the hottest regions in the southwest—more than 90% of residents have access to a cooling system, yet up to 40% of heat-related deaths occur indoors (Maricopa County Department of Public Health 2020). A recent survey of homebound individuals found that one-third faced limitations on home cooling system use, with the overwhelming majority (81%) citing the "cost of bills" as a contributing factor (Maricopa County Department of Public Health 2016). As residents are increasingly forced to weigh the cost of properly cooling their homes, high energy burdens will likely become an even greater public health priority in the years to come.

### HIGH ENERGY BURDENS IMPACT MENTAL HEALTH OF RESIDENTS.

High energy burdens can have mental health impacts—such as chronic stress, anxiety, and depression—associated with fear and uncertainty around access to energy, the complexities of navigating energy assistance programs, and the inability to control energy costs (Hernández, Phillip, and Siegel 2016). In addition, Hernández (2016) found that low-income residents who were experiencing energy insecurity worried about losing their parental rights as they struggled to maintain essential energy services, such as lighting, in their homes.

### HIGH ENERGY BURDENS CAN LIMIT INDIVIDUALS' ABILITY TO BENEFIT FROM ECONOMIC DEVELOPMENT IN THEIR COMMUNITIES.

Households with high energy burdens are more likely to stay caught in cycles of poverty. After controlling for common predictors of poverty status such as income loss, illness, health, marital status, education, health insurance, and head of households—Bohr and McCreery (2019) found that, on average, energy-burdened households have a 175–200% chance of remaining in poverty for a longer period of time compared to nonenergy-burdened households.[11] BIPOC communities, older adults, and low-income households often experience this pernicious cycle, which includes persistent income inequality along with limited funding to invest in education or job training, and high energy burdens can perpetuate this cycle (Bohr and McCreery 2019; Lewis, Hernández, and Geronimus 2019).

## Impact of COVID-19 on Energy Insecurity

As the world enters a global recession in the wake of the coronavirus pandemic, more households—especially in BIPOC communities—may have difficulty paying their energy bills due to massive job losses; reduced income; a warming climate; and higher energy bills resulting from more time at home due to stay-at-home orders and to students and adults learning and working from home, respectively. For example, in March and April 2020, the California Public Utility Commission stated that residential electricity usage increased by 15–20% compared to the previous year (CPUC 2020). Because such factors lead to higher home energy bills, energy burdens will increase for households across the United States.

**Households with high energy burdens are more likely to stay caught in cycles of poverty.**

COVID-19 disproportionally impacts BIPOC communities due to many of the policies that have led to systemic economic and social exclusion. These policies have led to BIPOC communities experiencing higher rates of underlying health conditions, a lack of health insurance or access to testing, and a higher likelihood of working in the service industry or in other essential worker roles that do not allow for teleworking (SAMHSA 2020; CDC 2020). COVID-19 has also impacted the ability of energy efficiency and weatherization programs to operate, and limited the mix of measures that can be installed; many energy efficiency and weatherization programs have slowed down or are on hold (Ferris 2020). Policies and programs that address energy insecurity are even more important now in the face of rising energy bills and burdens.

Given these factors, energy burdens in 2020 are likely to be much higher than the burdens we calculate in this report, which uses 2017 data. The economic situation has clearly shifted drastically since 2017. While we expect post-2020 burden trends to be similar, yet more acute, we cannot visualize the full extent of current and future energy burdens until the release of post-2020 data in the 2023 AHS, which will include data from 2021.

[11] This study does not examine the relationship between energy burden and rent burden (i.e., the percentage of income spent on housing costs). Studies have found that rent burdens are also increasing, especially for communities of color, older adults, and families (Currier et al. 2018).

# Methods

This analysis builds on the methods used in ACEEE's previous two energy burden studies, *Lifting the High Energy Burden in American's Largest Cities* (Drehobl and Ross 2016) and *The High Cost of Energy in Rural America* (Ross, Drehobl, and Stickles 2018). This new study analyzes 2017 data from AHS, which is issued by the U.S. Department of Housing and Urban Development (HUD). The AHS is a biennial household-level survey by the Census Bureau that collects wide-range housing and demographic data from a nationally and regionally representative cross section of households across the United States and in a subset of metropolitan statistical areas (MSAs). The AHS includes household-level income data and energy cost data that we use as the basis of our energy burden calculations. The AHS models its energy cost data based on household characteristics ascertained through its survey and also uses data collected through the Residential Energy Consumption Survey (RECS) for a different national set of households.[12]

As we noted earlier, we define households with high energy burdens as those spending more than 6% of their income on electricity and heating fuel costs, and households with severe energy burdens as those spending more than 10% of their income on energy costs.[13] These two categories are not mutually exclusive; *severe burden* is a worse-off subset of high burden households.

[12] Beginning with the 2015 edition, the AHS stopped including questions on energy costs. Previously, the majority of these data was self-reported. As part of the 2015 AHS redesign, researchers began estimating energy costs through regression-model–based imputation. They created the utility estimation system (UES) to estimate annual energy costs using regression models developed from the RECS, which collects administrative data from suppliers on actual billing amounts. This estimate was divided by 12 to calculate average monthly energy costs. The RECS also collects some housing characteristics similar to those the AHS collects, which allows the construction of models that can then be applied to the AHS. For more on the energy cost estimation model development and decisions for the 2015 AHS, see www.huduser.gov/portal/sites/default/files/pdf/American-Housing-Survey.pdf.

[13] HUD determines affordable housing costs to be 30% of total household income. Researchers have determined that, typically, 20% of total housing expenses are energy costs. This equates to 6% of total income spent on energy bills as an affordable level (Fisher Sheehan & Colton 2020). We consider energy burdens above 6% to be high burdens, with burdens above 10% to be severe. This method is in line with other research (APPRISE 2005).

The following are our study's inclusion and exclusion criteria:

- *Electricity and heating fuels*. The study does not include water, transportation, telecommunications, or Internet costs. Although such costs can create additional monetary burdens for households, we include only electricity and heating fuel costs in our energy burden calculations.
- *Households must report household income and the amount they pay for their electricity and their main heating fuel*.[14] If households did not include all three factors, we did not include them in our analysis.

We examine energy burdens for a variety of household subsets at the national, regional, and metropolitan levels, including the following:

- *Income level*. All households that fall into low-income (≤ 200% FPL) and non-low-income (> 200% FPL) categories.[15]
- *Low-income households with vulnerable persons at home*. Low-income households with a household member over the age of 65, under the age of 6, or who has a disability.
- *Housing type and age*. Single-family, small multifamily (two to four units), large multifamily (five or more units), low-income multifamily (five or more units and ≤ 200% FPL), manufactured housing, buildings built before 1980, and buildings built after 1980.[16]
- *Tenure*: Renters and owners.
- *Race and ethnicity*. Black, Hispanic, and non-Hispanic white households. We also include Native American households in the national analysis.
- *Age*. Households with one or more adults over the age of 65.

## Limitations

We included 48 MSAs in our last urban energy burden report, which used both 2011 and 2013 AHS data. This report uses only 2017 data, which limits our sample to 25 MSAs (AHS 2019). AHS includes modeled energy costs, which are determined by matching characteristics of households in the AHS to characteristics of households in the RECS. We also exclude households that do not report income, do not have a heating source, or do not pay for their heating costs. Thus, our report findings do not include data on renters who pay for their heating and/or electricity in their rent, or households with no annual income reported.

Our study does not explore causality, so we cannot determine *why* energy burdens differ across metro areas and demographic and other groups. Additional research is needed to determine the causes of disproportionate energy burdens, which can include building efficiency, income and poverty rates, and other timely economic factors. We are unable to compare trends across our energy burden reports, as this study does not explore why and how energy burdens may have changed over time.

Finally, our study includes only the 25 metro areas sampled by the AHS, which are not necessarily the best or worst performing metro areas regarding energy burdens. Ranking metro areas is thus limited since this is only a partial sample of cities. ACEEE plans to update this research with additional metro areas as more AHS data are available in the fall of 2020.

The following are the 25 MSAs with representative samples in the 2017 AHS dataset:

| | | | | |
|---|---|---|---|---|
| 1. Atlanta | 6. Dallas | 11. Miami | 16. Phoenix | 21. San Francisco |
| 2. Baltimore | 7. Detroit | 12. Minneapolis | 17. Richmond | 22. San Jose |
| 3. Birmingham | 8. Houston | 13. New York City | 18. Riverside | 23. Seattle |
| 4. Boston | 9. Las Vegas | 14. Oklahoma City | 19. Rochester | 24. Tampa |
| 5. Chicago | 10. Los Angeles | 15. Philadelphia | 20. San Antonio | 25. Washington, DC |

[14] AHS calculates household income as total money before taxes and other payments, including Social Security income, cash public assistance, or welfare payments from the state or local welfare office, retirement, survivor or disability benefits, and other sources of income such as veterans' payments, unemployment and/or worker's compensation, child support, and alimony. For more information, see: www2.census.gov/programs-surveys/ahs/2017/2017%20AHS%20Definitions.pdf.

[15] In ACEEE's 2016 urban energy burden report, we defined low-income as 80% of the area median income (AMI), while this report defines low-income as 200% FPL. We made this change due to data availability. The 200% FPL definition also lines up with the Weatherization Assistance Program and is the most common qualification criterion for utility-led low-income programs. Because of this, low-income data in the 2016 and 2020 reports do not use the same definitions and are therefore not directly comparable.

[16] We chose 1980 as our cutoff point as states and cities began adopting the first building energy codes in the late 1970s and early 1980s. At this time, builders around the country began to consider energy and minimal energy efficiency measures due to increasing awareness of efficiency measures and concerns about energy as a result of the energy-related economic shocks of the 1970s.

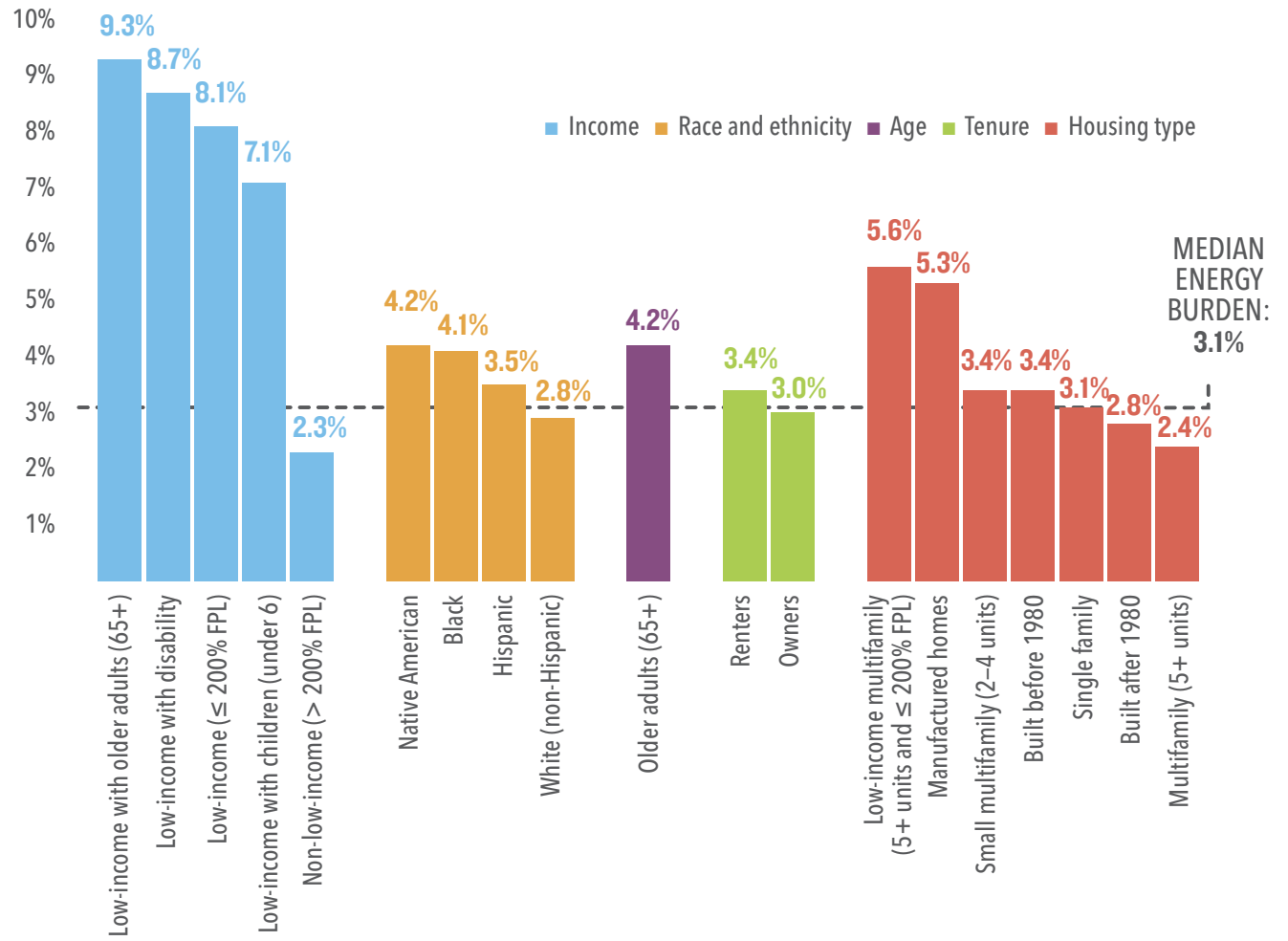
# Energy Burden Findings

The results of this energy burden analysis reflect previous ACEEE studies in finding that nationally, regionally, and across all 25 metro areas, particular groups experience disproportionately high energy burdens. See **Appendices A** and **B** for tables including national, regional, and metro energy burden data.

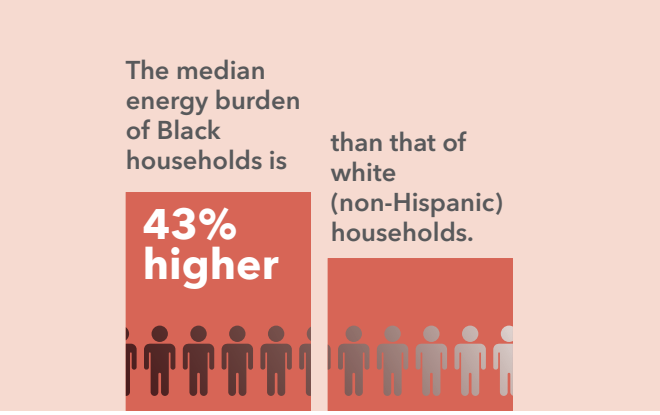
## National Energy Burdens

Across the nationally representative sample, we find that low-income, Black, Hispanic, renter, and older adult households have disproportionately higher energy burdens than the average household. Figure 1 shows the median energy burden for different groups nationally, across categories of income, race and ethnicity, age, tenure status, and housing type. We find that the median national energy burden is 3.1%, and that the median low-income (≤ 200% FPL) household energy burden is 3.5 times higher than the non-low-income household energy burden (8.1% versus 2.3%).

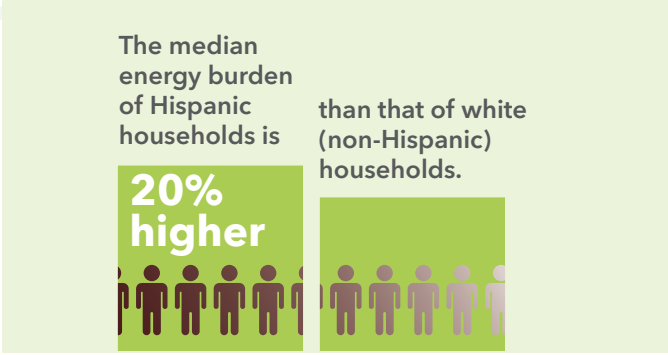
**FIGURE 1. National energy burdens across subgroups (i.e., income, race and ethnicity, age, tenure, and housing type) compared to the national median energy burden**



Many groups experience disproportionately high energy burdens, with low-income households having the highest energy burdens. These households have limited discretionary income and often have older, less-efficient housing stock and appliances that lead to higher energy bills. Even for cases in which monthly energy costs are similar between low-income and non-low-income households, the former devote a greater proportion of their income to these costs. Given this, reducing excess energy use in low-income households is critical for addressing energy insecurity.




We also recognize that many highly burdened groups are intersectional—that is, they face compounding, intersecting causes of inequality and injustice. For example, nearly half of the older adult population in general is economically vulnerable, as are the majority of older Black and Hispanic households (Cooper and Gould 2013). Policies and programs that focus on addressing low-income household energy burdens will likely intersect with other highly burdened groups. Further research can help identify how high energy burdens are impacted by differences in race, ethnicity, income, education, housing type, occupant age, and other factors.

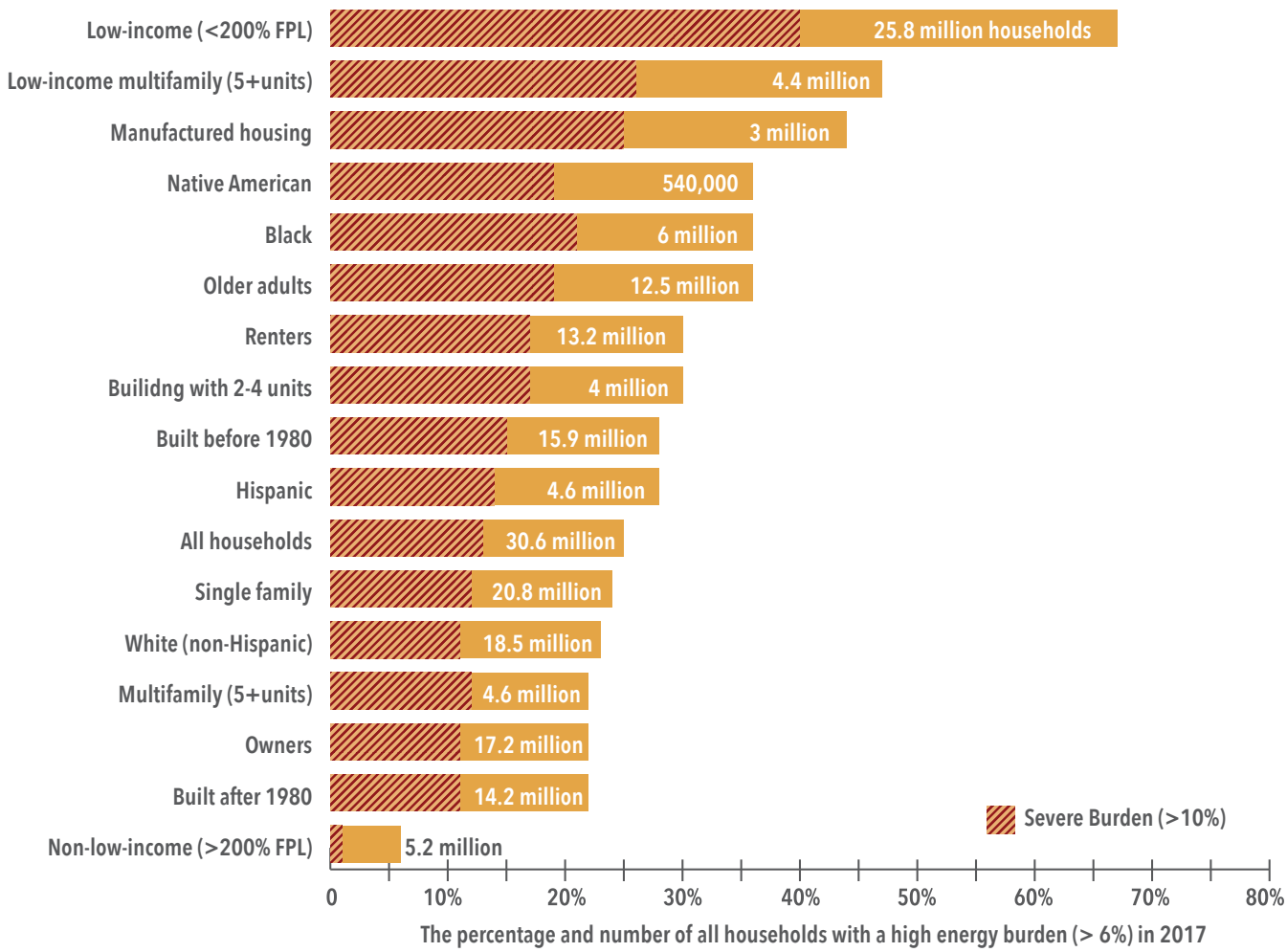



## NATIONAL DATA: HIGH AND SEVERE ENERGY BURDENS

Median energy burdens allow us to compare burdens between groups, yet they do not illustrate how many people experience the impacts of energy insecurity, or the degrees to which they experience it. We therefore also calculate the percentage of households that experience high and severe energy burdens for different demographic groups. Figure 2 shows the percentage of households across subgroups that experience a high energy burden (above 6%), along with the total number of households experiencing a high energy burden. Figure 2 also indicates the percentage of those households that experience a severe energy burden (above 10%).

Nationally, more than 25% (30.6 million) of all households experience a high energy burden, and about 50% (15.9 million) of all households that experience a high energy burden have a severe energy burden. These burdens are even more acute for low-income households, of which 67% (25.8 million) experience a high energy burden and 60% (15.4 million) of those experience a severe energy burden. **Appendix B** includes high and severe energy burden percentages and total households that experience a high and severe

## FIGURE 2. The percentage and number of households nationally with a high energy burden (> 6%) across different subgroups in 2017

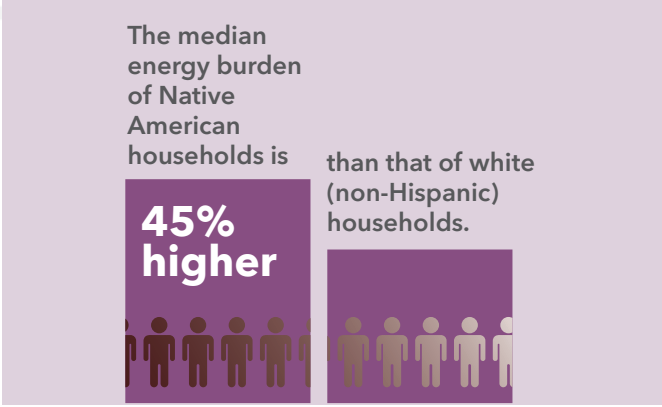


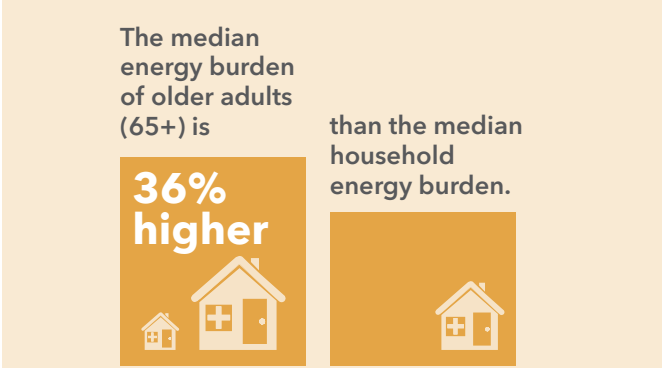

Note: High and severe energy burdens are not mutually exclusive, meaning that the number of households experiencing a severe burden are also counted in the percentage that experience high burdens. All severe energy burdens (> 10%) also fall into the high burden category (> 6%). The red and orange bars in figure 2 sum to the total high energy burdened households, and the number of households is the total that experience a high energy burden.

burden nationally, regionally, and in each MSA across all households and across low-income, Black, Hispanic, older adult, and renting households.

As figure 2 illustrates, U.S. residents experience high and severe energy burdens at different rates depending on factors such as income, occupant age, race, and tenure. Almost 50% of low-income multifamily residents; 36% of Black, Native American, and older adult households; 30% of renters; and 28% of Hispanic households experience a high energy burden.

Many households also have severe energy burdens, spending more than 10% of their income on energy. For example, 21% of Black households experience severe energy burdens as compared to 1% of non-low-income and 9% of non-Hispanic white households. For context, households with severe energy burdens spend at least three times more of their income on home energy bills than the median household.




## Regional Energy Burdens

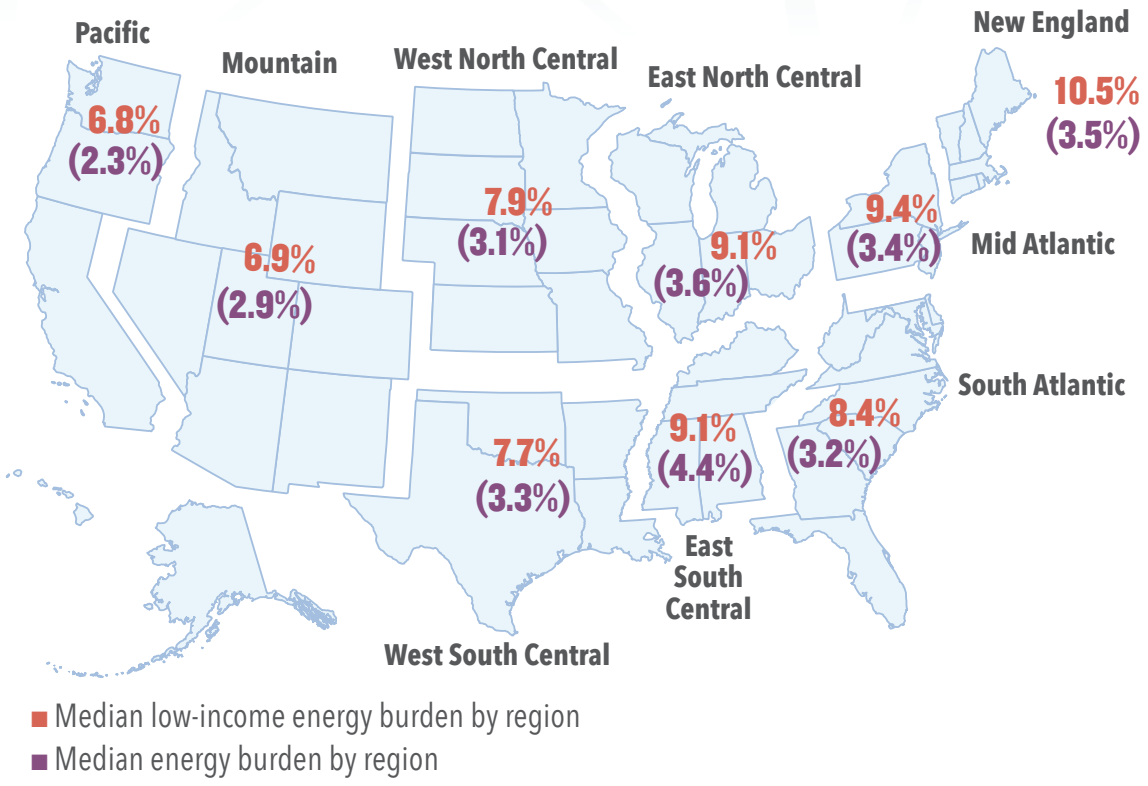
National patterns play out across all regions, where low-income, Black, and Hispanic households; renters; manufactured housing residents; and older adults all have disproportionately higher energy burdens than each region's average household. Table 2 shows the states in each census region in the study.

Across all nine regions, low-income household energy burdens are 2.1–3 times higher than the median energy burden. The gap between low-income and median energy burdens is largest in the New England, Pacific, and Mid-Atlantic regions (3.0, 2.9, and 2.8 times higher, respectively). Figure 3 illustrates low-income energy burdens and the median energy burden across the nine census regions.

**TABLE 2. States within each census region**

| Region | States |
|---|---|
| **New England** | Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont |
| **Middle Atlantic** | New Jersey, New York, Pennsylvania |
| **East North Central** | Illinois, Indiana, Michigan, Ohio, Wisconsin |
| **West North Central** | Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota |
| **South Atlantic** | Delaware, DC, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia |
| **East South Central** | Alabama, Kentucky, Mississippi, Tennessee |
| **West South Central** | Arkansas, Louisiana, Oklahoma, Texas |
| **Mountain** | Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming |
| **Pacific** | Alaska, California, Hawaii, Oregon, Washington |

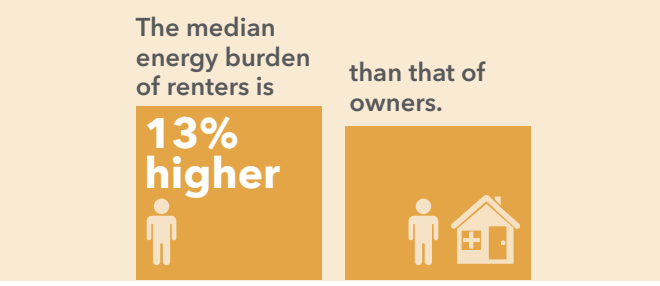
FIGURE 3. Median low-income (< 200% FPL) energy burdens by region (red) compared to median energy burdens by region (purple)




## REGIONAL DATA: HIGH AND SEVERE ENERGY BURDENS

Figure 4 shows the percentage and total number of households that experience high and severe energy burdens in each region.

The percentage and total number of households that experience a high energy burden vary across regions. The East South Central region has the greatest percentage of households with high energy burdens (38%), followed by East North Central, New England, and Middle Atlantic regions, all with 29%. The South Atlantic region had the greatest number of households (6.27 million) with high burdens, followed by the East North Central (5.40 million) and Middle Atlantic (4.57 million) regions. See **Appendix B** for the total number of highly burdened households across different groups in each region.

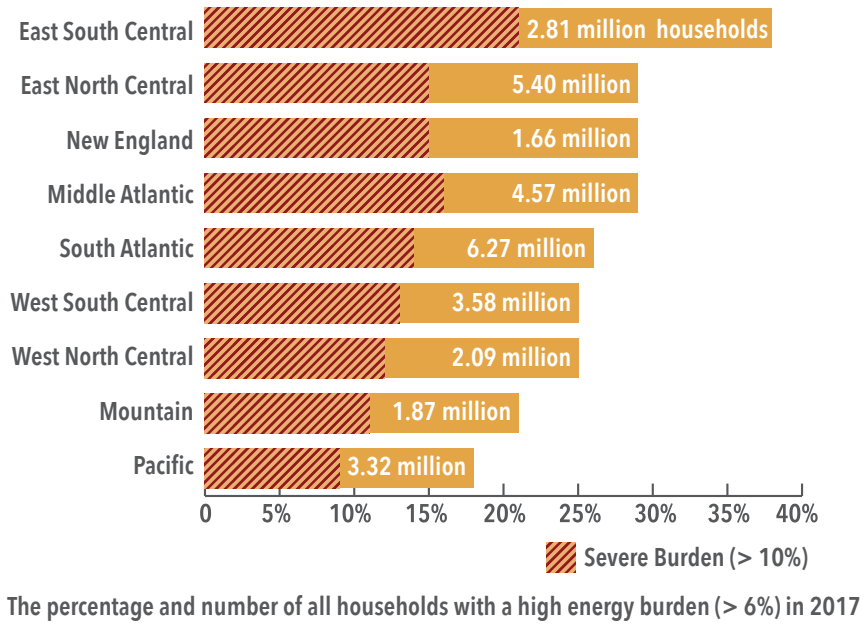


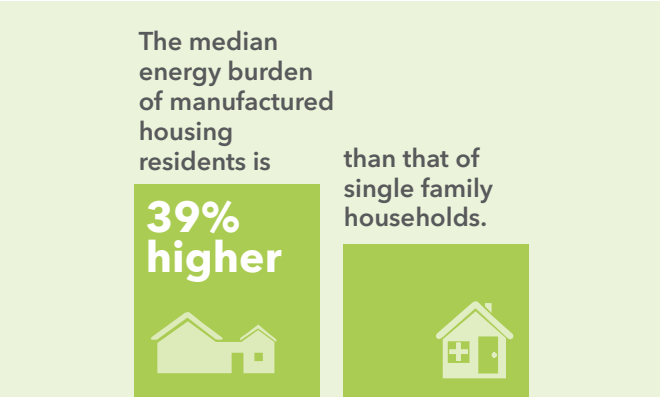

## Metro Area Energy Burdens

Across the select MSAs—which represent 38% of all households nationally—low-income households, low-income multifamily households, and older adult households are the most energy burdened groups. Groups with the lowest energy burdens are non-low-income, those living in buildings built after 1980, and those living in market-rate multifamily housing. Table 3 includes the median energy burdens for the most highly burdened groups in each metro area; **Appendices A** and **B** offer more details.[17]

[17] **Appendix A** includes national, regional, and metro area sample sizes, median energy burdens, median incomes, median monthly bills, upper-quartile energy burdens, percentage with a high burden, and percentage with a severe burden. **Appendix A** also includes median and upper-quartile energy burdens for subgroups nationally, regionally, and in metro areas, including low-income, low-income with older adults, low-income with a child under 6, low-income with disability, low-income multifamily, non-low-income, Black, Hispanic, non-Hispanic white, older adult, renters, owners, multifamily, built before 1980, and built after 1980. **Appendix B** includes the number of households nationally, regionally, and in metro areas that experience a high or severe energy burden.

**FIGURE 4. The percentage and number of all households with a high energy burden (> 6%) in each region in 2017**




Across the 25 MSAs, low-income households experience energy burdens at least two times higher than the average household in all cities. In all metro areas, Black and Hispanic households experience higher energy burdens than non-Hispanic white households. Renters and people living in buildings built before 1980 experience higher energy burdens than owners in almost all metro areas in the study.

Median energy burdens do not tell the whole energy affordability story, as half of households in each group experience a higher energy burden than the median.

Figure 5 includes the energy burdens at the median and upper quartile, showing that 50% of households in each city experience a burden above the median and 25% experience a burden above the upper quartile. For example, in Baltimore, 25% of low-income households experience an energy burden above 21.7%, which is seven times the national median burden. In five cities—Baltimore, Philadelphia, Detroit, Boston, and Birmingham—a quarter of low-income households have energy burdens above 18%, which is three times the 6% high energy burden threshold.

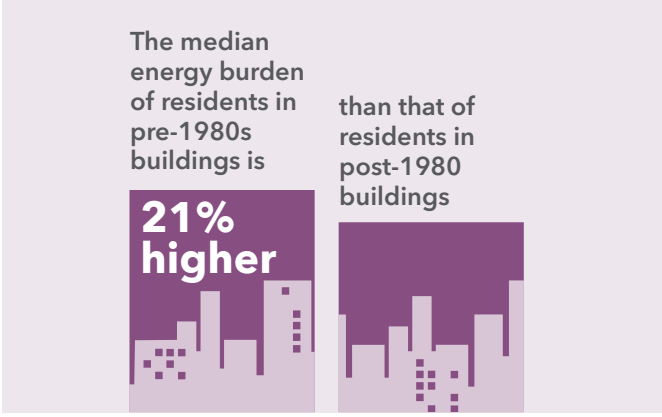
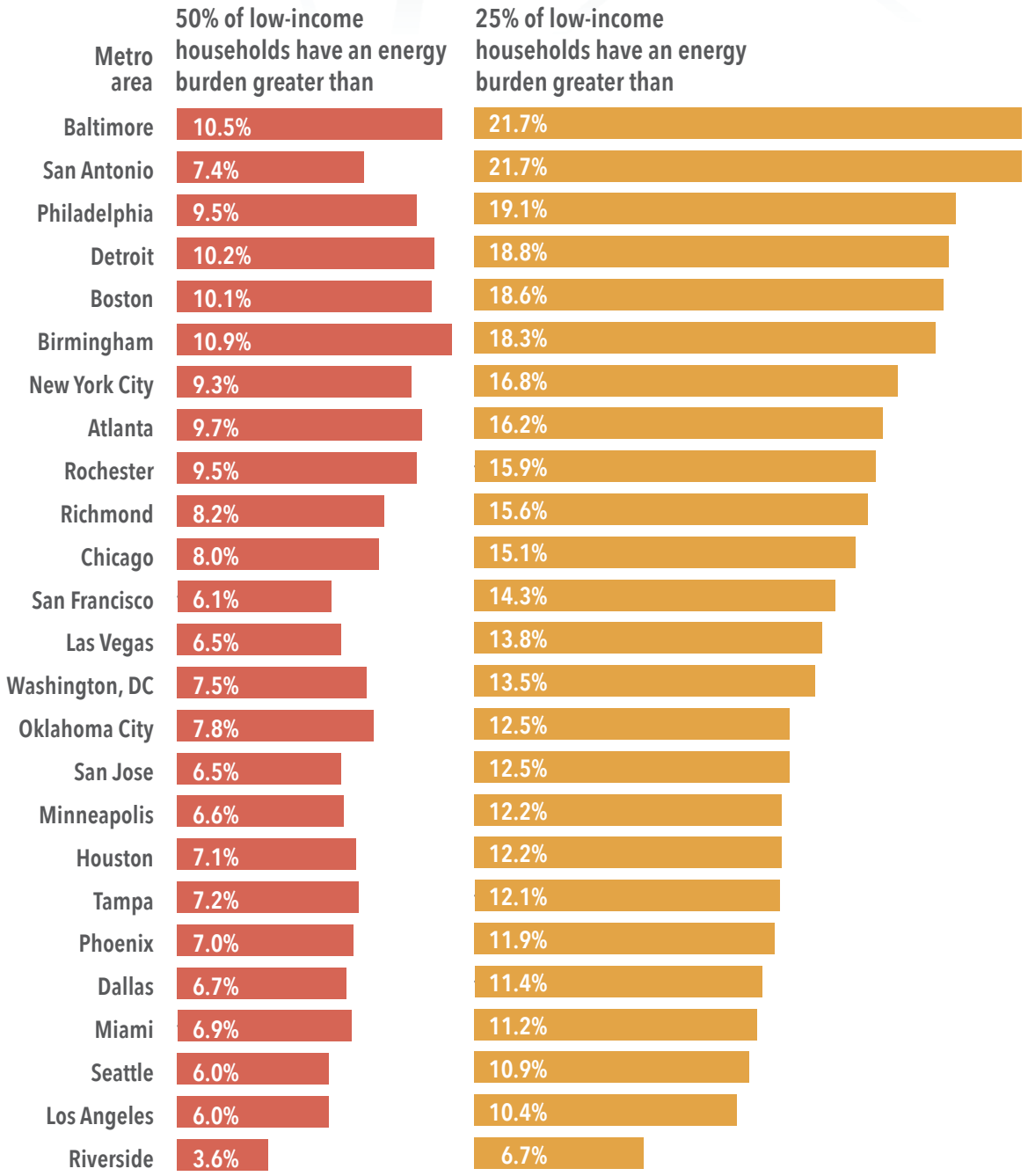


**TABLE 3. Median energy burdens in metro areas for all households and highly impacted groups, including low-income, Black, Hispanic, older adult (65+), renters, low-income multifamily residents, and those residing in buildings built before 1980**

| Metro area | All households | Low-income (≤ 200% FPL) | Black | Hispanic | Older adults (65+) | Renters | Low-income multifamily* | Built before 1980 |
|---|---|---|---|---|---|---|---|---|
| **National data** | 3.1% | 8.1% | 4.2% | 3.5% | 4.2% | 3.4% | 3.1% | 3.4% |
| **Atlanta** | 3.5% | 9.7% | 4.1% | 4.7% | 5.1% | 3.7% | 6.6% | 4.5% |
| **Baltimore** | 3.0% | 10.5% | 3.8% | 3.3% | 4.1% | 3.2% | 2.5% | 3.6% |
| **Birmingham** | 4.2% | 10.9% | 5.6% | 4.8% | 5.8% | 5.2% | 6.8% | 5.1% |
| **Boston** | 3.1% | 10.1% | 3.7% | 3.6% | 4.4% | 3.2% | 6.6% | 3.2% |
| **Chicago** | 2.7% | 8.0% | 4.1% | 3.0% | 3.7% | 3.1% | 6.4% | 2.9% |
| **Dallas** | 2.9% | 6.7% | 3.3% | 3.8% | 3.8% | 2.9% | 5.0% | 3.5% |
| **Detroit** | 3.8% | 10.2% | 5.3% | 4.5% | 5.2% | 4.6% | 6.0% | 4.3% |
| **Houston** | 3.0% | 7.1% | 3.5% | 3.4% | 4.1% | 3.3% | 5.8% | 3.4% |
| **Las Vegas** | 2.8% | 6.5% | 3.2% | 3.0% | 3.4% | 3.0% | 5.3% | 3.6% |
| **Los Angeles** | 2.2% | 6.0% | 3.6% | 2.6% | 3.2% | 2.4% | 4.8% | 2.3% |
| **Miami** | 3.0% | 6.9% | 3.4% | 3.1% | 4.2% | 3.1% | 5.5% | 3.3% |
| **Minneapolis** | 2.2% | 6.6% | 2.6% | 2.7% | 3.0% | 2.3% | 4.3% | 2.5% |
| **New York City** | 2.9% | 9.3% | 3.6% | 3.8% | 4.2% | 3.3% | 8.0% | 3.0% |
| **Oklahoma City** | 3.3% | 7.8% | 3.9% | 4.2% | 4.0% | 3.9% | 6.5% | 3.8% |
| **Philadelphia** | 3.2% | 9.5% | 4.4% | 5.2% | 4.4% | 3.9% | 6.5% | 3.6% |
| **Phoenix** | 3.0% | 7.0% | 3.2% | 3.6% | 4.0% | 2.8% | 4.6% | 3.6% |
| **Richmond** | 2.6% | 8.2% | 3.4% | 2.9% | 3.5% | 2.9% | 5.0% | 3.1% |
| **Riverside** | 3.6% | 8.7% | 3.9% | 3.7% | 5.1% | 4.0% | 6.1% | 4.3% |
| **Rochester** | 3.8% | 9.5% | 5.1% | 5.4% | 4.8% | 4.3% | 6.0% | 4.0% |
| **San Antonio** | 3.0% | 7.4% | 3.1% | 3.4% | 4.1% | 3.1% | 4.8% | 3.9% |
| **San Francisco** | 1.4% | 6.1% | 2.4% | 1.2% | 2.4% | 1.4% | 4.9% | 1.4% |
| **San Jose** | 1.5% | 6.5% | 1.8% | 1.9% | 2.4% | 1.5% | 4.7% | 1.6% |
| **Seattle** | 1.8% | 6.0% | 2.3% | 2.0% | 2.4% | 1.8% | 4.1% | 2.0% |
| **Tampa** | 2.8% | 7.2% | 3.6% | 3.5% | 3.8% | 2.8% | 4.9% | 3.3% |
| **Washington, DC** | 2.0% | 7.5% | 2.9% | 2.7% | 2.9% | 2.0% | 5.2% | 2.3% |

* Low-income multifamily households are below 200% FPL and in a building with five or more units.

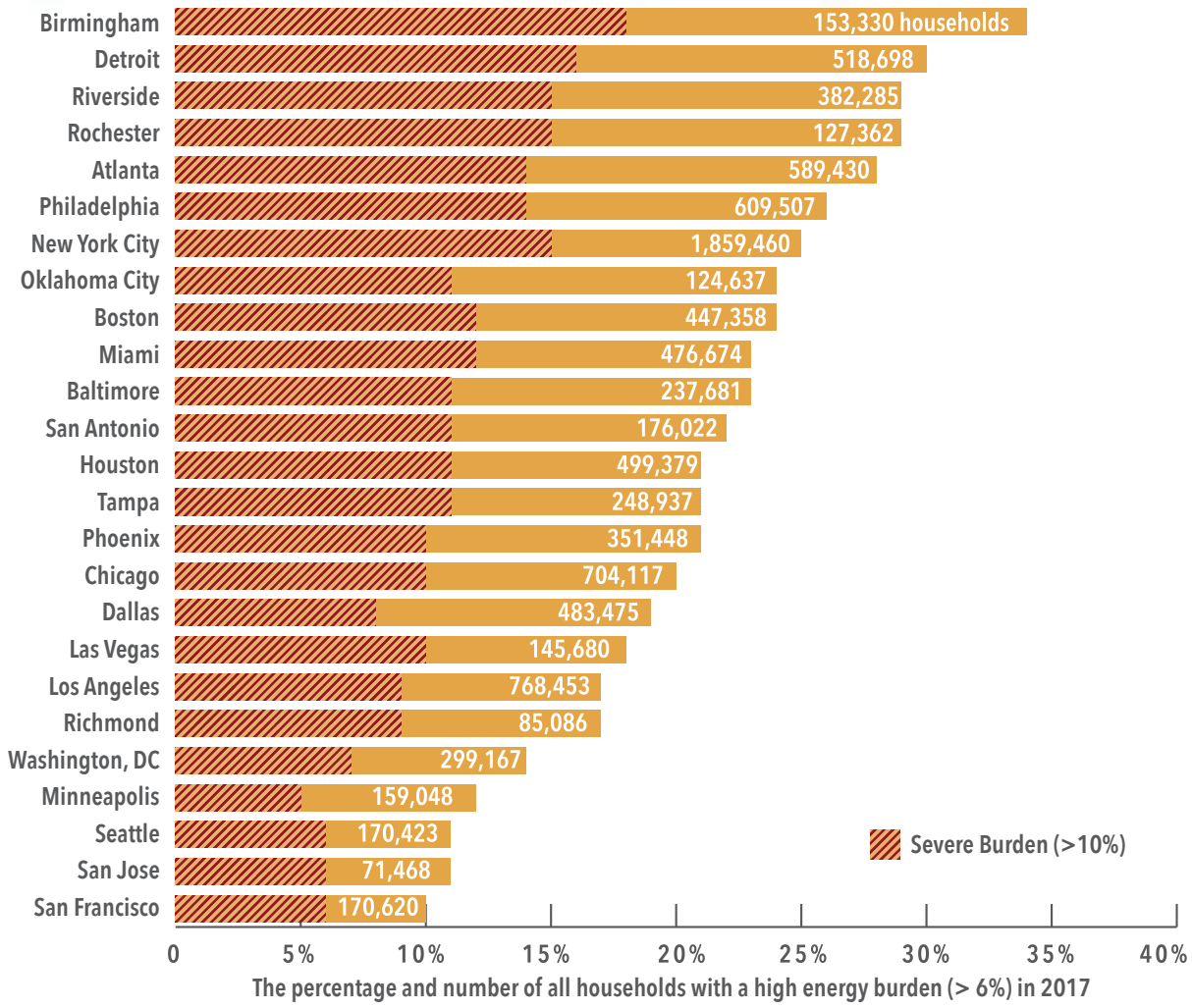
FIGURE 5. Energy burden experienced by 50% and 25% of low-income households in 25 metro areas




## METRO DATA: HIGH AND SEVERE ENERGY BURDENS

The percentage of households experiencing a high energy burden varied across the select metro areas, with up to one-third of residents in some cities facing a high energy burden. Figure 6 shows the percentage and total number of households in each metro area that experience high and severe energy burdens. Six metro areas have a greater percentage of households with a high energy burden than the national average (25%), including Birmingham (34%), Detroit (30%), Riverside (29%), Rochester (29%), Atlanta (28%), and Philadelphia (26%).

FIGURE 6. The percentage and number of all households with a high energy burden (> 6%) in each of the 2017 AHS MSAs




**Appendix B** includes data on high and severe energy burdens in each metro area in our sample. In nine metro areas, 12% or more of households experienced a severe energy burden, spending more than 10% of their income on energy bills; among these are 1.1 million households in New York City, 333,000 in Philadelphia, and 288,000 in Atlanta.

As these findings illustrate, high and severe energy burdens are both a national and a local challenge. Even though some metro areas have lower percentages of households with high energy burdens than the national average, each city has tens to hundreds of thousands of households with high energy burdens. In addition, both the national energy burden trends and the metro-level trends show similar patterns of energy burden vulnerability for specific groups and are therefore likely reflected in other metro areas nationally as well. This indicates that both the metro areas studied and other cities have energy burden disparities in their communities. They also have opportunities to create policy and programs to lower these energy burdens for their residents.

By focusing on the needs of those who are disproportionally burdened—particularly at the intersection of criteria such as of low-income, communities of color, older adults, and renters—policymakers can set policies and create programs that have the greatest impact on energy insecurity. As they do so, they should recognize that many households—especially those with high energy use due to building inefficiencies—experience much higher than average energy burdens. These households are therefore likely to need targeted and long-lasting interventions, such as energy efficiency and weatherization, to achieve long-term affordability.

# Low-Income Weatherization Can Reduce High Energy Burdens

Energy efficiency and weatherization provide a long-term solution to reducing high energy burdens, while also complementing bill payment assistance and programs aimed at energy-saving education and behavior change. *Weatherization* refers to programs that address the efficiency of the building envelope and building systems (such as unit heating, cooling, lighting, windows, and water heating) through energy audits; these audits identify cost-effective energy efficiency upgrades provided through energy efficiency programs. Other low-income energy efficiency programs may include additional measures such as appliance replacements, efficient lighting, and health and safety measures. While these recommendations focus on weatherization and energy efficiency as a long-term solution to reducing high energy burdens, these investments can be combined with renewable energy technologies and/or electrification strategies to further reduce energy bills.

Energy efficiency programs and investments that provide comprehensive building upgrades—such as insulation, air sealing, heating and cooling systems, appliances, lighting, and other baseload measures—can strongly impact long-term energy affordability, as low-income households tend to live in older buildings and have older, less-efficient appliances than higher income households (Cluett, Amann, and Ou 2016). Research suggests that weatherization measures can reduce energy use by 25–35% (DOE 2014, 2017; DOE 2011). Assuming a 25% reduction in energy use and using the 2017 AHS data, we estimate that energy efficiency and weatherization can reduce the energy burden of the average low-income household by 25%.[18]

Low-income energy efficiency and weatherization programs are especially important in the wake of the economic recession and pandemic. These programs can both reduce high energy burdens and help stimulate the economy through local job creation and workforce development. Policies that accelerate investment in, improve the design of, and better target low-income energy efficiency, weatherization, and housing retrofit programs can have a high impact on long-term energy affordability.

[18] We assume a 25% savings from energy efficiency upgrades based on the U.S. Department of Energy's estimate (DOE 2014) and use the median low-income household values to calculate a 25% reduction. We reduced the median low-income energy bill by 25% from $1,464 to $1,098. Using the median low-income household income of $18,000, this equates to a reduced energy burden of 6.1%. Reducing the median low-income energy burden from 8.1% to 6.1% is a 25% reduction. Following this same methodology, our 2016 metro energy burden report estimates a 30% reduction based on the 2011 and 2013 AHS data.

# Strategies to Accelerate, Improve, and Better Target Low-Income Housing Retrofits, Energy Efficiency, and Weatherization

Many local and state governments, utilities, and community-based organizations have already begun to identify energy efficiency as a key strategy for lowering high energy burdens. To date, we have identified nine cities (Atlanta, Cincinnati, Houston, Minneapolis, New Orleans, Oakland, Philadelphia, Pittsburgh, Saint Paul) and six states (Colorado, New Jersey, New York, Oregon, Pennsylvania, Washington) that have set energy-burden-focused policies, goals, or programs with energy efficiency as a key component (see **Appendix C**). For example, the State of Oregon's *Ten-Year Plan to Reduce the Energy Burden in Oregon Affordable Housing* states that its goal is to "reduce the energy burden on the low-income population in Oregon, while prioritizing energy efficiency to achieve that reduction" (OR DOE, OR PUC, and OHCS 2019). At the city level, Philadelphia's Clean Energy Vision Plan set a goal to eliminate the energy burden for 33% of Philadelphians. To accomplish this, the city has designed and funded multiple pilot programs to reduce high energy use in multifamily and single-family buildings. See **Appendix C** for more information on energy-burden-focused city- and state-led actions.

**FIGURE 7. Key strategies to lower high energy burdens by better targeting low-income energy efficiency programs, ramping up investment, and improving program design and best practices**

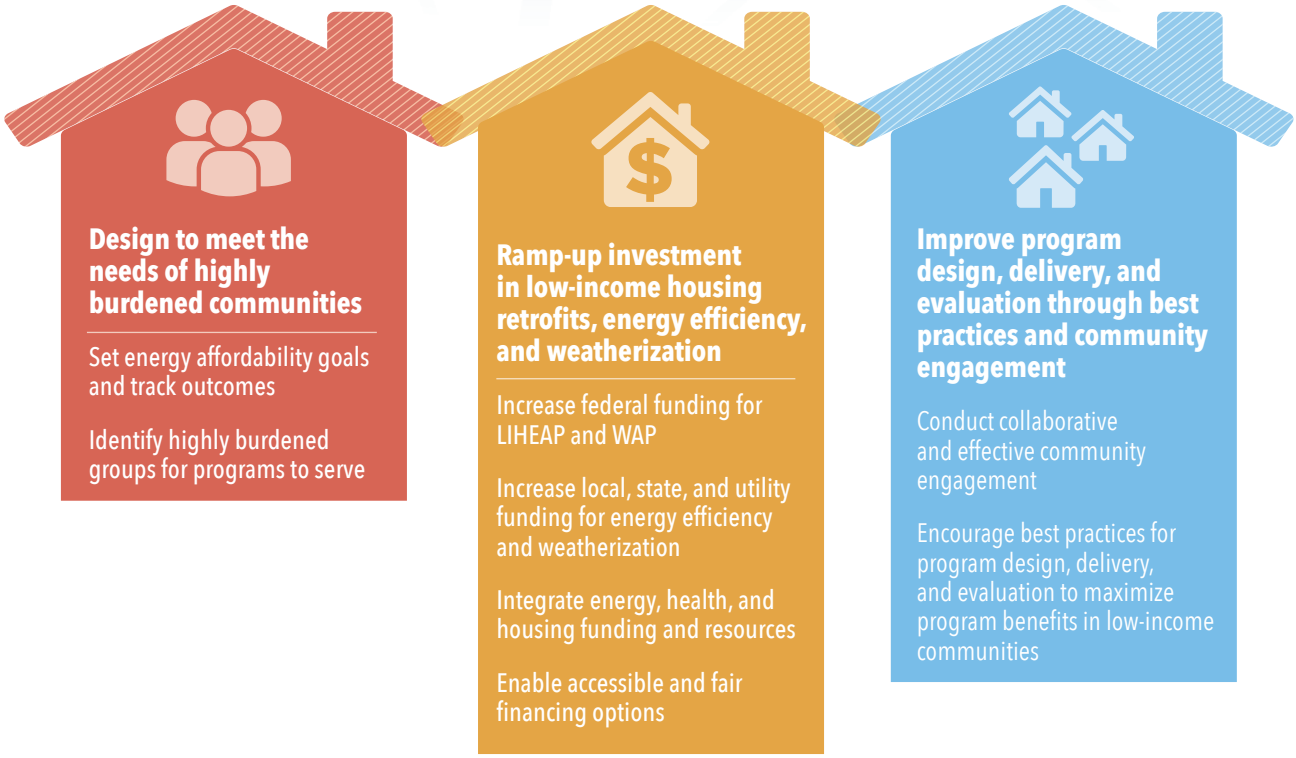



Figure 7 illustrates the key strategies to design programs to meet the needs of highly burdened communities, increase funding, and improve program design to have the greatest impact.

## Design to Meet the Needs of Highly Burdened Communities

Focusing low-income energy efficiency and weatherization investment on residents with the highest burdens can greatly alleviate energy insecurity. Local and state governments and utilities can conduct more granular and detailed energy insecurity studies or analyses to help identify which local communities have the highest burdens. They can also use other energy equity and justice-related metrics and indicators to target resources to and investment in these communities. One tool for doing this analysis is the U.S. Department of Energy (DOE) Low Income Energy Affordability Data (LEAD) tool (see text box 1). Policymakers and program implementers can use a community-based approach to develop programs to invest in communities with high burdens. Cities and states can also set energy affordability goals and policies, and then track outcomes to ensure that the communities most impacted by energy insecurity receive the benefits of energy efficiency investments.

### TEXT BOX 1. ENERGY BURDEN ASSESSMENTS: LOW INCOME ENERGY AFFORDABILITY DATA (LEAD) TOOL

The Department of Energy's Low Income Energy Affordability Data Tool (LEAD), developed with the National Renewable Energy Laboratory, aims to help states, communities, and other stakeholders create better energy strategies and programs by improving their understanding of low-income housing and community energy characteristics. LEAD is a web-accessible interactive platform that allows users to build their own state, county, and census tract and city profiles with specific household energy characteristics associated with various income levels and housing type, vintage, and tenure. The tool provides three principal metrics—energy burden, annual average housing energy costs, and housing counts—along with map and chart-based visualizations (Ma et al. 2019). States and local governments have begun using the LEAD tool in planning. For example, New Jersey cited its use of LEAD in the development of its new Office of Clean Energy Equity (New Jersey Legislature 2020).

LEAD is available for free at energy.gov/eere/slsc/maps/lead-tool.

## SET ENERGY AFFORDABILITY GOALS AND TRACK OUTCOMES

State and local policymakers can set energy affordability and energy burden goals as a first step to addressing energy insecurity in their communities. Examples of such goals include reducing energy burdens by certain percentages, lowering energy burdens for all households to a certain threshold, or targeting resources toward individuals with high energy burdens. By focusing on the needs of those who are disproportionally burdened—particularly at the intersection of criteria such as income, race and ethnicity, and age—policymakers can set policies and create programs that have the greatest impact on addressing energy insecurity. Table 4 lists cities that have established energy burden and affordability goals. **Appendix C** includes additional city and state energy burden policies.

To establish energy burden goals, cities, states, and utilities can conduct baseline studies to understand the state of energy burdens, poverty, housing, and access to energy efficiency investments in their communities. They can then establish an appropriate goal and strategies to accomplish that goal.

Coordinating goal setting with other state and local priorities can help cities to streamline their efforts. Some cities—such as Minneapolis and New Orleans—include energy burden goals in their climate action plans as a strategy to reduce greenhouse gas emissions and achieve more equitable outcomes. States such as New York have also used energy burdens in statewide energy affordability policy plans.

Energy burden maps and visualizations are a useful tool for cities and states to achieve more equitable and affordable energy in their communities, move resources toward overburdened communities, and address other climate and equity goals. The DOE's LEAD tool provides one way to create energy burden visualizations. Plans should include specific strategies for lowering high energy burdens, as well as methods and strategies to track iterative progress.

In addition to goals, some cities have begun using energy burden as an equity indicator metric. For example, the city of Oakland includes energy cost burden as a metric in its *2018 Equity Indicators* report (City of Oakland 2018) to measure equity within essential housing services. The city found that energy burdens were higher for Black, Hispanic, and Asian households in the city as compared to white households. Similarly, the Minneapolis Climate Action Plan indicates that reporting on plan progress should also include equity indicators to measure whether energy burden reductions are equitable (City of Minneapolis 2013). Text box 2 offers examples of how governors and policymakers in four states—Pennsylvania, New York, Oregon, and Washington—created goals and policies around energy burdens to address energy insecurity in their states. To date, energy burden goals are largely set and acted upon by climate and energy officials at the city and state level. Such metrics and goals are rarely part of larger

**TABLE 4. Cities with energy burden goals and strategies**

| City | Description | Data source |
|---|---|---|
| **Atlanta** | The Resilience Strategy includes action to lift energy burden on 10% of Atlanta households. | City of Atlanta 2017 |
| **Cincinnati** | The Green Cincinnati Plan set a goal to reduce household energy burdened by 10% compared to current levels. | City of Cincinnati 2018 |
| **Houston** | The Climate Action Plan includes a goal to promote weatherization programs to reduce residential energy consumption and focus on reducing energy burdens of low-income populations. | City of Houston 2020 |
| **Minneapolis** | The Climate Action Plan states that the city will prioritize neighborhoods with high energy burdens for strategy implementation. | City of Minneapolis 2013 |
| **New Orleans** | The Climate Action Plan includes two strategies to reduce the high energy burdens of the city's residents. | City of New Orleans 2017 |
| **Philadelphia** | The Clean Energy Vision Plan set a goal to eliminate the energy burden for 33% of Philadelphians. | City of Philadelphia 2018 |
| **Saint Paul** | The city set a 10-year goal to reduce resident energy burden so that no household will spend more than 4% of its income on energy bills. | City of Saint Paul 2017 |

### TEXT BOX 2. CASE STUDIES: STATE-LED ENERGY AFFORDABILITY EFFORTS

***New York Energy Affordability Goal***. In 2016, Governor Andrew M. Cuomo became one of the first U.S. government officials to issue a policy aimed at addressing high energy burdens. Through the state's first ever Energy Affordability policy, he aims to ensure that no New Yorker spends more than 6% of their household income on energy (New York 2016). New York continues to explore pathways to reducing energy burden to 6% for all New Yorkers through a combination of enhanced bill assistance, energy efficiency, and increased coordination among state agencies responsible for energy, bill assistance, and affordable housing.

Oregon's Strategies to Achieve Affordability. Issued by Governor Kate Brown in 2017, Executive Order 17-20 targets state agencies to improve energy efficiency. Section 5(b) emphasizes a prioritization of energy efficiency in affordable housing to reduce utility bills (Oregon 2017). In response to this directive, the Oregon Housing and Community Service Department partnered with the DOE and the Public Utility Commission to develop an assessment to identify the energy burden of Oregon's low-income population and also prioritize energy efficiency. The interagency assessment concluded that energy costs for low-income Oregonians are nearly $350 million per year, and it identified more than $113 million annual potential energy cost savings that can be achieved through low-income energy efficiency programs across the state (OR DOE, OR PUC, and OHCS 2019). The order identifies a number of strategies to achieve these cost savings, such as adopting energy codes for new buildings and including retrofit measures, such as smart thermostats and replacing electric resistance heating.

Pennsylvania Energy Affordability Study. In 2019, the Pennsylvania Public Utility Commission (PA PUC) released a report that examined home energy affordability for the state's low-income customers (Pennsylvania PUC 2019a). The report's goal was to determine what constitutes an affordable energy burden for low-income households in the state, which would advise changes to the bill payment assistance programs to achieve these affordable energy burden levels. In 2020, the PA PUC set a new policy to direct the state's regulated utilities to ensure that low-income customers spend no more than 10% of their income on energy bills and that the lowest-income customers spend no more than 6% of their income on energy bills (Pennsylvania PUC 2019b).

Washington Clean Energy Transformation Act. In 2019, Governor Jay Inslee passed the Clean Energy Transformation Act (CETA), which sets specific goals to achieve 100% clean electricity across Washington by 2045. Under CETA, the Washington Department of Commerce will assess the energy burdens of low-income households and the energy assistance offered by electric utilities. The department will consult with local advocates of vulnerable populations and low-income households to improve energy assistance programs. The department will publish a statewide summary to include the estimated level of energy burden and energy assistance among electric customers, identify drivers of energy burden and energy efficiency potential, and assess the effectiveness of current utility programs and mechanisms to reduce energy burdens (Washington State Department of Commerce 2020).

public health strategies and priorities despite their wide-reaching health implications.

## IDENTIFY HIGHLY BURDENED GROUPS FOR PROGRAMS TO SERVE

Overburdened households, especially Black, Native American, Hispanic, and other communities of color, often are either marginalized and overlooked by utilities' energy efficiency program marketing or face additional barriers to program participation, such as high cost or financing barriers (Leventis, Kramer, and Schwartz 2017). Creating targeted energy efficiency marketing beyond direct billing mailers can drive positive outcomes for the whole system.

Policymakers can also look beyond energy burden as an indicator to identify highly burdened groups, taking into account factors such as income, unemployment rates, race and ethnicity, geography, education, and multiple other stressors—including air pollution and health indicators. By using metrics beyond energy burden, policymakers and program implementers can better invest resources in communities that experience the highest levels of marginalization underinvestment, and negative social and health impacts (Lin et al. 2019). Policymakers can design and implement programs that meet the needs of highly burdened groups through robust community engagement. For example, local governments can design programs to improve access to affordable, energy-efficient housing by mandating or incentivizing stringent energy efficiency standards, streamlining permit and inspection processes, and amending zoning codes for construction of more housing units, while also using neighborhood approaches to involve and empower community members in these processes (Samarripas and de Campos Lopes 2020).

### TEXT BOX 3. MEETING THE NEEDS OF HIGHLY BURDENED GROUPS: CASE STUDIES

***Minneapolis Green Zones***: The Minneapolis Climate Action Plan's Environmental Justice Working Group developed the idea of *Green Zones*, a place-based policy initiative aimed at improving health and supporting economic development. The city used data to identify two such zones—a Northern Green Zone and a Southern Green Zone—where residents face disproportionate burdens across areas such as equity, displacement, air quality, brownfields and soil contamination, housing, green jobs, food access, and greening (City of Minneapolis 2020). Once created, the city designed programs to direct investment into these communities. The Green Zones provide an example of how policymakers can work to identify highly burdened communities and create programs that meet the needs of residents in these areas.

***Energy Burden as a Program Qualification: Efficiency Vermont***. Efficiency Vermont (EVT), the energy efficiency program implementer for the state's utility-funded energy efficiency programs, conducted a 2018 study of equity measurements to better understand how the clean energy industry defines, collects, analyzes, and reports data on equity. This study informed changes to the design of EVT's Targeted High Use Program, which launched in 2011 and originally qualified customers based on two factors: income (< 80% of Area Median Income [AMI]) and a minimum energy use of 10,000 kWh/year. The program historically served approximately 350 households per year, working with the DOE's Weatherization Assistance Program (WAP) to conduct energy assessments and then install LEDs and water-saving measures, identify appliances for replacement, and replace high-efficiency heat pumps and heat pump water heaters where appropriate. Through its equity analysis, EVT determined that the energy use threshold was too high and excluded many customers with high energy burdens—but lower energy use—from accessing the program. In 2019, EVT changed the program qualification to two factors: income (< 80% AMI) and electric energy burden (≥ 3%). This change allowed it to recenter the program around energy burden reduction by qualifying not only more customers but also those who have high energy burdens yet may have previously been disqualified based on their energy use.

Efforts to alleviate high energy burdens should aim not only to identify those with high burdens and energy use but also to understand who has been overlooked by past efforts and develop strategies to address the needs of these households. Text box 3 contains additional case studies of city- and utility-led strategies to meet the needs of their overburdened communities.

## Accelerate Investment in Low-Income Housing Retrofits, Energy Efficiency, and Weatherization

The current need for low-income energy efficiency and weatherization far exceeds allocated resources. In 2017, utility-led energy efficiency administrators allocated only 5% of electric and 22% of natural gas energy efficiency expenditures to low-income programs (CEE 2019). This funding allocation shows that energy efficiency funds are not currently distributed to ensure that low-income households have equitable access to these investments and their benefits.

Policymakers and advocates can work toward leveraging and allocating additional funding for low-income energy efficiency and weatherization programs. They can also help ensure that these programs follow best practices to increase their impact. Following are several useful strategies for ramping up additional funding for low-income energy efficiency and weatherization.

### INCREASE FEDERAL FUNDING FOR LIHEAP AND WAP

Although an estimated 36 million U.S. households are currently eligible for weatherization, the DOE's Weatherization Assistance Program (WAP) has served only 7 million households over the past 40 years (Bullen 2018; DOE 2016). WAP serves about 100,000 homes per year through DOE and leveraged funds, which is far fewer than both the eligible households nationally and the 15.7 million severely energy burdened households estimated in this study (NASCSP 2020b). At the current rate, it would take 360 years to weatherize all eligible households through WAP—assuming no more households become WAP-eligible over time.

Congress funds WAP and allows funds to be transferred to the program from the Department of Health and Human Services' Low-Income Home Energy Assistance Program (LIHEAP). WAP can also utilize additional leveraged funds. States can transfer 15% (or up to 25% with a waiver) of LIHEAP bill assistance funds to WAP to supplement DOE weatherization funding. Over the past 10 years, annual expenditures directed toward weatherization have ranged from $1 billion to $3 billion per year, with the American Recovery and Reinvestment Act greatly increasing low-income funding for WAP (Brown et al. 2019). The National Association for State Community Services Programs' 2018 funding report estimates that WAP grantees had access to $1.1 billion in total available funding in 2018, with $247 million direct base funding from the DOE, $453

million from LIHEAP-transferred funding, and $408 million from utilities, state-sourced revenue, and other sources (NASCSP 2020b). Non-DOE WAP funds in 2018 added an additional $861 million, or $3.48 for every DOE-invested dollar (NASCSP 2020b).

The federal government has the ability to increase both WAP and LIHEAP budgets to better meet households' needs. From 2008 to 2018, DOE base funding for WAP has fluctuated from a high of $450 million in 2009 to a low of $68 million in 2012 (DOE 2009, 2012). In 2020, Congress allocated $305 million to WAP—a 23% increase ($58 million) compared to the funds allocated in 2018 (DOE 2020). Even so, leveraging additional state, local, and other funding helps supplement and increase available weatherization funds. In addition, states can decide to increase the LIHEAP percentage they transfer to WAP to better support the program. Further, it is essential that the increased demand for adequate cooling systems be assessed in the allocation of WAP and LIHEAP funds. For households across the South, rising temperatures and the increasing frequency and duration of heat waves are likely to increase cooling needs—and thus energy expenses (Berardelli 2019).

The COVID-19 pandemic has added to the urgency of increasing support for low-income bill payment assistance. On May 8, 2020, the federal government authorized $900 million in supplemental LIHEAP funding to help "prevent, prepare for, or respond to" home energy needs surrounding the national emergency created by COVID-19 (HHS 2020). On May 15, 2020, the U.S. House of Representatives passed the Health and Economic Recovery Omnibus Emergency Solutions (HEROES) Act, which would add an additional $1.5 billion for LIHEAP to address energy access and security issues resulting from the COVID-19 pandemic (116th Congress 2020). As of publication, the Senate has not passed this legislation.

## INCREASE STATE, LOCAL, AND UTILITY FUNDING FOR ENERGY EFFICIENCY AND WEATHERIZATION

Funding from states, local governments, and utilities can also support low-income energy efficiency and weatherization efforts. In many states, PUCs can set low-income energy efficiency spending and/or savings requirements—as well as energy burden reduction targets—for their regulated utilities. As of 2017, of the 27 states with electric and/or natural gas Energy Efficiency Resource Standards (EERS), 18 had low-income energy efficiency spending requirements in place (Berg and Drehobl 2018; Gilleo 2019). States and local governments can also fund and implement their own energy efficiency and weatherization programs separately from WAP or as a WAP add-on. They can, for example, allocate funds—such as from Community Development Block Grants (CDGB)—to joint or independent energy efficiency and weatherization programs.

**Policy approaches can be aligned to leverage funding resources and maximize benefits for residents, including reduced energy burdens and safer and healthier housing.**

**Appendix C** and text box 4 include examples of cities and states that created independent energy efficiency and weatherization programs to address high energy burdens.

## INTEGRATE ENERGY, HEALTH, AND HOUSING FUNDING AND RESOURCES.

High energy burdens, housing, and health are inextricably linked. In our study, many of the groups who experience high energy burdens also live in inadequate housing and disproportionally suffer from a variety of other harms, including higher than average exposures to environmental pollution (Tessum et al. 2019) and higher than average rates of certain preventable illnesses and diseases (CDC 2013). Although the recent COVID-19 pandemic has sharply illustrated this disparity, the same story plays out across a variety of preventable harms.[19] Policy approaches can be aligned to leverage funding resources and maximize benefits for residents, including reduced energy burdens and safer and healthier housing.

The benefits of these programs can be much greater when the goals of saving energy and protecting health are sought in tandem. Typical energy efficiency and weatherization services can provide a range of health benefits. Poorly sealed building envelopes allow pests, moisture, and air pollution to infiltrate (Institute of Medicine 2011), which can harm respiratory health through pest allergies, mold growth, and lung disease. Leaky windows, faulty HVAC systems, and poor insulation can lead to cold drafts and extreme home temperatures during summer and winter months. This can trigger heat-related illnesses and asthma attacks, as well as exacerbate other respiratory illnesses (AAFA 2017; American Lung Association 2020; CDC 2016). Addressing these issues through energy efficiency and weatherization will result in improved health outcomes; it will also reduce household energy burdens.

[19] For more on the disparities among COVID-19 fatalities, see Malcolm and Sawani (2020); Hooper, Nápoles, and Pérez-Stable (2020); and CDC (2020).

## TEXT BOX 4. CITY- AND STATE-FUNDED ENERGY AFFORDABILITY PILOT PROGRAMS

***Philadelphia***: To meet its energy burden goals, Philadelphia has partnered on multiple pilot programs to reduce high energy burdens for low-income single and multifamily households. In 2017, the Philadelphia Energy Authority (PEA) launched its Multifamily Affordable Housing Pilot program in partnership with public and private-sector groups, including the local electric and natural gas utilities, property owners, energy service companies, program implementers, contractors, and technology providers (PEA 2020a). The program's goal was to deliver deep energy savings of more than 30% to low-income multifamily building residents in the city. In 2018, PEA and partners completed the program's first phase, which included low-cost measures and measures to collect energy data. These data were then used in the second phase to design deeper savings measures, such as HVAC and building envelope measures.

In response to COVID-19, PEA is developing a platform with its partners and advocates to coordinate and streamline low-income homeowner services aimed at improving home safety, health, affordability, and comfort (PEA 2020b). Set to launch in 2021, PEA's Built to Last pilot program aims to deliver comprehensive home improvements that will reduce energy burden while improving health and safety. The program will serve 80–100 homes and will streamline benefit screening, property assessment, and construction management. To cover program costs, Built to Last aims to combine available funding with grants and microfinancing options. PEA plans to deploy the Built to Last program at a larger scale in 2022 (PEA 2020b).

***Pittsburgh***. The city recognized that while Pittsburgh residents have some of the lowest utility rates in the country, they still pay almost twice the national average for their energy bills, leading to high energy burdens. Over the course of a few years, Pittsburgh developed a Climate Action Plan and launched both its resilience strategy (OnePGH) and its equality indicator project. These three projects helped the city identify residential energy burden as one of the primary challenges that local communities face (City of Pittsburgh 2019). As part of the Bloomberg Mayor's Challenge, Pittsburgh created Switch PGH to address high energy burdens through a civic engagement tool that gamifies home improvement (Mayors Challenge 2018). Switch PGH helps residents make lasting energy efficiency behavior changes and incentivizes home upgrades to reduce energy burdens.

***Colorado***. The Colorado State Energy Office awarded GRID Alternatives, a solar installer that focuses on the low-income market, a $1.2 million grant to launch a demonstration project with the goal of reducing the energy burden for more than 300 low-income households. The program also aimed to improve understanding of how to make community solar programs with low-income participants mutually beneficial for both utilities and participants (Cook and Shah 2018) Through this program, households saved from 15% to more than 50% on their utility bills, with an average annual savings of $382.

Myriad programs exist to address health and safety issues within homes, as well as to preserve and grow the affordable housing stock. Opportunities exist to integrate these programs and resources to more comprehensively address the energy, health, and housing needs of the households most in need of assistance.[20] For example, many homes must defer energy efficiency investments due to a home's physical issues, such as those related to structural deficiencies, moisture, and/or mold. According to Rose et al. (2015), WAP agencies estimated that such issues led to a 1–5% deferral rate for WAP income-eligible homes. In some areas, however, the problem is worse. In western Wisconsin, for example, a Community Action Agency and WAP provider serving four counties reported a deferral rate approaching 60% (NASCSP 2020a). Addressing nonenergy-related housing issues would allow more homes to be weatherization-ready.

Integrating programs creates opportunities to streamline administration and reduce operating redundancies that can leave more funding for energy efficiency and weatherization measures that enable households to save on energy costs. Pooling resources and establishing cross-sector referral networks not only stretches program budgets, but it also can make programs more accessible for residents by streamlining eligibility and enrollment processes. For instance, offering a single contact point or a streamlined process can give participants a variety of services simultaneously to meet their energy, health, and housing needs (Levin, Curry, and Capps 2019). This can help mitigate barriers that arise when people have to navigate multiple separate services with varying eligibility requirements and enrollment processes. Efficiency Vermont's Healthy Homes Initiative (HHI) is one such example. A partnership between the state's WAP partners and community-based organizations that offer health interventions, HHI is coordinated through Vermont's Office of Economic Opportunity. Using

[20] ACEEE recently published several reports exploring the intersection of health and energy, including *Protecting the Health of Vulnerable Populations with In-Home Energy Efficiency: A Survey of Methods for Demonstrating Health Outcomes* (www.aceee.org/research-report/h1901); *Making Health Count: Monetizing the Health Benefits of In-Home Services Delivered by Energy Efficiency Programs* (www.aceee.org/research-report/h2001); and *Braiding Energy and Health Funding for In-Home Programs: Federal Funding Opportunities* (www.aceee.org/research-report/h2002).

One Touch, an electronic platform for healthy home resources, HHI has established a robust referral network and successfully integrated healthy home principles into its residential energy efficiency program design.

The health sector is also beginning to realize the efficiencies of combining health and energy assessments and interventions (Hayes and Gerbode 2020). For example, a single contractor could be trained to both identify and address a family's asthma triggers, energy efficiency needs, and fall risks, thereby reducing the associated logistical burden on residents who might otherwise have to coordinate each service individually. Efforts such as this are beginning to appear across the country. In 2015, the state of Washington directed more than $4 million in competitive grants to fund collaborations among clinical practitioners, home retrofitters, and community service organizations as a means of empowering clinicians and others to refer participants for a range of coordinated services (e.g., comprehensive in-home repairs and community health worker visits) (Levin, Curry, and Capps 2019). In New York, the State Energy Research and Development Authority (NYSERDA) recently kicked off a value-based payment pilot program that seeks to implement a healthy homes approach; through this program, Medicaid managed care organizations will partly cover residential upgrades when healthcare cost savings and benefits to residents are verified (NYSERDA 2018). Such cross-sectoral approaches to energy efficiency and weatherization seek to address some of the major root causes of health and energy inequities while making enrollment and participation feasible and accessible for residents. The benefits of energy efficiency cut across the health and energy sectors; by working to integrate resources, policymakers can maximize these benefits.

Housing policy can also help ensure that energy efficiency is integrated into efforts to upgrade and expand the affordable housing stock. State and local governments can play a key role in these integrating approaches. For example, a growing number of state housing finance agencies (HFAs)—state-chartered entities responsible for ensuring affordable housing across states—have included energy efficiency requirements in their allocation criteria for low-cost financing programs such as federal Low-Income Housing Tax Credits and grant programs administered to local governments. The same is true for local housing authorities, which increasingly incorporate energy efficiency into the maintenance and repair of their subsidized housing stock (EPA 2018). Text box 5 offers a brief case study of how one local government systematically required energy efficiency in its rental certification process, ensuring that all types of rental housing meet a specific level of energy performance.

### ENABLE ACCESSIBLE AND FAIR FINANCING OPTIONS

Many low-income households face barriers—such as credit eligibility—to investing in energy efficiency; these barriers can prevent them from participating in energy efficiency programs or installing energy efficiency upgrades that require financing for up-front costs. With the right consumer protections in place, financing can enable households to undertake cost-effective energy efficiency investments to lower their energy usage and bills. Local and state governments, utilities, private lenders, and nonprofit or community-based organizations can act to create and/or enable low- or no-cost financing options (i.e., payments are offset by energy cost savings) for energy efficiency investments.

Several types of financing instruments, such as on-bill payment (i.e., loan repayments included on the utility bill) and energy service agreements are becoming more common (Leventis, Kramer, and Schwartz 2017). Similarly, opportunities such as Commercial Property Assessed Clean Energy (C-PACE) can increase energy efficiency financing in the affordable multifamily sector. SEE Action's 2017 report, *Energy Efficiency Financing for Low- and Moderate-Income Households,* provides a comprehensive overview of the pros and cons of various financing options for both single and multifamily low-income households (Leventis, Kramer, and Schwartz 2017).

## Improve program design, delivery, and evaluation through best practices and community engagement

Program designers and implementers can collaborate and effectively engage with a community to create programs that fit its specific needs rather trying to fit the community into an existing program design. They can also incorporate best practices into their program design, delivery, and evaluation, and can emulate successful peer program models to increase program effectiveness and impact.

### CONDUCT COLLABORATIVE AND EFFECTIVE COMMUNITY ENGAGEMENT

To create programs that effectively reduce high energy burdens, energy efficiency and renewable energy program designers and implementers can work to engage and include local stakeholders throughout the program planning and implementation processes.

By connecting with, listening to, and partnering with community-serving organizations and community members in highly impacted communities, program

### TEXT BOX 5. THE CITY OF BOULDER'S SMARTREGS PROGRAM

In 2010, the city council in Boulder, Colorado, adopted SmartRegs, a program that requires all rental housing units in the city to demonstrate that their efficiency approximates or exceeds the standards set by the 1999 Energy Code. The program was integrated into the city's existing rental license program, which requires a rental property to obtain and renew its rental license every four years. This renewal entails an inspection for health and safety measures, and SmartRegs added energy efficiency requirements that must be met to certify that the property is approved for rental. All single- and multifamily units that offer long-term licensed rental housing are subject to the requirement. For larger multifamily buildings, a sample of representative apartments can be inspected.

Boulder also offers a companion EnergySmart program that provides technical assistance, help with selecting contractors for energy efficiency improvements, and financial incentives beyond those offered by the local utility. EnergySmart is funded primarily by Boulder County and provides services to all municipalities in the county.

SmartRegs has been recognized not only for saving energy and related costs but also for leading to widescale upgrades in the city's rental housing stock. Over the course of the eight-year compliance timeline, nearly all of the approximately 23,000 licensed rental units have become compliant (City of Boulder 2020a). The most common upgrades were attic, crawlspace, and wall insulation. The average upgrade cost has been about $3,000 per unit, of which an average of $579 was paid by city- and utility-sponsored rebates. As of 2018, the city estimates that the program has saved about 1.9 million kWh of electricity, 460,000 therms of natural gas, $520,000 in energy costs, and 3,900 million metric tons of carbon dioxide. The city estimates the total investment in the program at just over $8 million, including nearly $1 million in rebates (City of Boulder 2020b).

administrators can identify the best measures, financing options, delivery methods, and marketing strategies to help residents reduce high energy burdens and meet their needs. Achieving this connection requires partnering with the community on program design and identifying and addressing barriers to participation for key stakeholders. This often requires engagement and trust-building over a long time period.

Robust community engagement incorporates the voices of and/or delegates power to community members. Such engagement can help develop neighborhood-centered programs that are most successful when combined with consistent funding, quality delivery infrastructure, and targeted outreach and engagement (USDN 2019). For more information on best practices in stakeholder engagement, see the DOE's Clean Energy for Low-Income Communities (CELICA) Online Toolkit at betterbuildingssolutioncenter.energy.gov/CELICA-Toolkit/stakeholder-engagement.

To include residents with high energy burdens in policy and program design, cities, states, and utilities can establish working groups, task forces, committees, and other structures that give residents a formal decision-making role. Creating this engagement when energy insecurity strategies, goals, and/or programs are first being developed allows for more input and direction from community members. Local energy planning efforts can also start with a community needs assessment led by a formal body of community residents. Local government and community leaders can then use this assessment's findings to drive local energy affordability policies and program developments based on the findings' prioritized needs and strategies.

Policymakers and program implementers can minimize stakeholder and community participation barriers by funding or compensating participants for their time and participation in stakeholder engagement processes. For example, offering stipends to compensate participants for their time and expertise, setting realistic time expectations, creating accessible logistics, and offering additional incentives can increase participation and access (Curti, Andersen, and Write 2018). Other incentives to reduce engagement barriers include childcare, meals, and transit passes.

Policymakers can also move to a model of *energy democracy* in which community residents are innovators, planners, and decision makers on how to use and create energy in a way that is local, renewable, affordable, and just (Fairchild and Weinrub 2017). Communities that have transitioned to an energy democracy have shifted away from "an extractive economy, energy, and governance system to one that is regenerative, provides reparations, transforms power structures, and creates new governance and ownership practices (ECC 2019)." The Emerald Cities Collaborative led the creation of an *Energy Democracy Scorecard*, which provides a framework for communities to move toward an energy democracy. Policymakers can work to create energy democracy frameworks in their communities by working with community members to recognize power

imbalances and create dialogues about systemic barriers that must be addressed in order to correct long-standing injustices and inequalities in the energy and related sectors. This can help move the energy planning model to one of community self-determination and shared ownership. For more information, see emeraldcities.org/about/energy-democracy-scorecard.

## ENCOURAGE BEST PRACTICES FOR PROGRAM DESIGN, DELIVERY, AND EVALUATION TO MAXIMIZE BENEFITS IN LOW-INCOME COMMUNITIES

Researchers from ACEEE and other organizations have established numerous best practice strategies and case studies of ways to improve and expand low-income energy efficiency programs and investments (Aznar et al. 2019; Nowak, Kushler, and Witte 2019; EDF 2018; Gilleo, Nowak, and Drehobl 2017; Samarripas and York 2019; Cluett, Amann, and Ou 2016; Ross, Jarrett, and York 2016; Reames 2016).

Table 5 includes low-income program best practices across five categories: coordination, collaboration, and segmentation; funding and financing; measures, messaging, and targeting; evaluation and quality control; and renewables and workforce development. **Appendix D** offers more detailed descriptions and examples of each of these best practices.

**TABLE 5. Low-income program best practices by category**

| Coordination, collaboration, and segmentation | Funding and financing | Measures, messaging, and targeting | Evaluation and quality control | Renewables and workforce development |
|---|---|---|---|---|
| Community engagement and participatory planning | Leverage diverse funding sources | Include health and safety measures and healthier building materials | Collect and share metrics | Integrate energy efficiency and solar |
| Statewide coordination models | Inclusive financing models | Prioritize deep energy-saving measures | Conduct robust research and evaluation | Support the development of a diverse and strong energy efficiency workforce |
| One-stop-shop program models | Align utility and housing finance programs | Integrate direct-installation and rebate programs | Include quality control | |
| Market segmentation | | Target high energy users and vulnerable households | Incorporate nonenergy benefits | |
| Fuel neutral programs | | Incorporate new and emerging technologies in low-income programs | | |
| | | Effectively message programs in ways that provide clear value and actionable guidance | | |

# Conclusions and Further Research

High energy burdens and energy insecurity are well-documented and pervasive national issues. Even in 2017, a time of economic prosperity, well over one-quarter of all U.S. households experienced a high energy burden. As this indicates, we need a renewed focus on equitable clean energy development and just energy transitions to ensure that investments in energy efficiency and renewable energy address energy insecurity. Climate change also underscores the urgency in addressing high household energy burdens. As temperatures continue to rise and heat waves become more common, access to clean, affordable energy is needed more than ever. We need cross-sectoral approaches that address the intersection of energy, health, and housing in the face of climate change.

Both nationally and in metro areas, this study finds that certain groups pay disproportionally more of their income on energy costs, including low-income households, communities of color, older adults, renters, and those residing in older buildings. Even though each metro area has a unique energy burden landscape, all cities have energy security inequities and can work to address them through collaborative policy and program decisions. Policymakers at the local, state, and utility levels can direct energy efficiency and renewable energy investments to disadvantaged and historically underinvested communities. They can then measure and ensure that these investments provide equitable benefits to local jobs, community health, and residential energy affordability.

Energy burdens are not the sole indicator of energy insecure households but rather provide one metric for determining energy insecurity. Further research is needed to identify the main physical drivers of high energy burdens, as well as the policies best suited to address the needs of the most highly energy burdened households. To better understand their communities' energy insecurity landscape, cities and states—and their energy, health, and housing agencies—as well as utilities are well-positioned to conduct detailed energy burden analyses, including qualitative data collection and interviews. Such studies would enable a first step toward setting more targeted energy affordability and energy burden goals and creating equitable, cross-sectoral policies and programs for achieving greater access to affordable energy for all.

# References

# References


116th Congress. 2020. *A Bill Making Emergency Supplemental Appropriations for the Fiscal Year Ending September 30, 2020, and for Other Purposes; Health and Economic Recovery Omnibus Emergency Solutions (HEROES) Act*. H.R. 6800, May 12. Washington, DC: 116th Congress. docs.house.gov/billsthisweek/20200511/BILLS-116hr6800ih.pdf.

AAFA (Asthma and Allergy Foundation of America). 2017. "Weather Can Trigger Asthma." www.aafa.org/weather-triggers-asthma/.

American Lung Association. 2020. "Winter Weather." www.lung.org/clean-air/emergencies-and-natural-disasters/winter-weather.

APPRISE (Applied Public Policy Research Institute for Study and Evaluation). 2005. *LIHEAP Energy Burden Evaluation Study*. Washington, DC: HHS (Department of Health and Human Services). www.acf.hhs.gov/sites/default/files/ocs/comm_liheap_energyburdenstudy_apprise.pdf.

Aznar, A., J. Logan, D. Gagne, and E. Chen. 2019. *Advancing Energy Efficiency in Developing Countries: Lessons Learned from Low-Income Residential Experiences in Industrialized Countries*. Prepared by USAID (U.S. Agency for International Development) and NREL. Washington, DC: DOE. www.nrel.gov/docs/fy19osti/71915.pdf.

Beaulieu, S., A. Buylova, M. Hannoosh, and P. Schaffer. 2018. *Ten-Year Plan: Reducing the Energy Burden in Oregon's Affordable Housing*. Salem: Oregon DOE (Department of Energy), Oregon PUC (Public Utility Commission), and OHCS (Oregon Housing and Community Services Department). www.oregon.gov/energy/Get-Involved/Documents/2018-BEEWG-Ten-Year-Plan-Energy-Burden.pdf.

Bednar, D., T. Reames, and G. Keoleian. 2017. "The Intersection of Energy Justice: Modeling the Spatial, Racial/Ethnic and Socioeconomic Patterns of Urban Residential Heating Consumption and Efficiency in Detroit, Michigan." *Energy and Buildings* 143: 25–34. doi.org/10.1016/j.enbuild.2017.03.028.

Berardelli, J. 2019. "Heat Waves and Climate Change: Is There a Connection?" *Yale Climate Connections*, June 25. www.yaleclimateconnections.org/2019/06/heat-waves-and-climate-change-is-there-a-connection/.

Berg, W., and A. Drehobl. 2018. "State-Level Strategies for Tackling the Energy Burden: A Review of Policies Extending State- and Ratepayer-Funded Energy Efficiency to Low-Income Households." In *Proceedings of the 2018 ACEEE Summer Study on Energy Efficiency in Buildings*. Washington, DC: ACEEE. aceee.org/files/proceedings/2018/index.html#/paper/event-data/p390.

Berry, C., C. Hronis, and M. Woodward. 2018. "Who's Energy Insecure? You Might Be Surprised." In *Proceedings of the 2018 ACEEE Summary Study on Energy Efficiency in Buildings* 13: 1–14. Washington, DC: ACEEE. www.aceee.org/files/proceedings/2018/#/paper/event-data/p393.

Bohr, J., and A. McCreery. 2019. "Do Energy Burdens Contribute to Economic Poverty in the United States? A Panel Analysis." *Social Forces* November 16. doi.org/10.1093/sf/soz131.

Brown, M., A. Soni, M. Lapsa, K. Southworth, and M. Cox. 2019. "Low-Income Energy Affordability in an Era of U.S. Energy Abundance." *Progress in Energy* 1: 1. iopscience.iop.org/article/10.1088/2516-1083/ab250b.

Brown, M., A. Soni, M. Lapsa, and K. Southworth. 2020. *Low-Income Energy Affordability: Conclusions from a Literature Review*. Prepared by Oak Ridge National Laboratory. Washington, DC: DOE. info.ornl.gov/sites/publications/Files/Pub124723.pdf.

Bullen, L. 2018. Estimated Number of Households Income-Eligible for the Department of Energy Weatherization Assistance Program as of 2015. Washington, DC: Community Action Partnership. communityactionpartnership.com/wp-content/uploads/2018/07/Estimated-Number-of-Households-Income-Eligible-for-WAP.pdf.

Cashin, S. 2004. *The Failures of Integration: How Race and Class Are Undermining the American Dream*. New York: PublicAffairs.

CDC (Centers for Disease Control and Prevention). 2013. "CDC Health Disparities and Inequalities Report—United States, 2013." *Morbidity and Mortality Weekly Report, Supplement* 2 (3): 1–187. www.cdc.gov/mmwr/pdf/other/su6203.pdf.

—. 2016. *Heat-Related Illness*. Atlanta: CDC. www.cdc.gov/pictureofamerica/pdfs/picture_of_america_heat-related_illness.pdf.

—. 2020. "Coronavirus Disease 2019—Racial & Ethnic Minority Groups." www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/racial-ethnic-minorities.html.

CEE (Consortium for Energy Efficiency). 2019. *2018 State of the Efficiency Program Industry: Budgets, Expenditures, and Impacts*. Middleton, MA: CEE. library.cee1.org/system/files/library/13981/CEE_2018_AnnualIndustryReport.pdf.

Census Bureau. 2019. *Metropolitan Area Oversample Histories: 2015 and Beyond*. Washington, DC: HUD (Department of Housing and Urban Development) and Census Bureau. www.census.gov/programs-surveys/ahs/tech-documentation/help-guides/metro_oversamp_hist_2015.html.

City of Atlanta. 2017. *Resilient Atlanta: Actions to Build an Equitable Future*. Atlanta: City of Atlanta Mayor's Office of Reslience.100resilientcities.org/wp-content/uploads/2017/11/Resilience-Strategy-Atlanta-English.pdf

—. 2019. *Clean Energy Atlanta: A Vision for a 100% Clean Energy Future*. Atlanta: City of Atlanta Mayor's Office of Resilience. www.100atl.com/.

City of Boulder. 2020a. *2019 Rental Housing License Long-Term Licenses and SmartRegs Compliance*. Boulder: City of Boulder. www-static.bouldercolorado.gov/docs/2019_RHL_Smart_Regs_Stats_for_web-1-202001230915.pdf.

—. 2020b. "SmartRegs Program Progress." bouldercolorado.gov/plan-develop/smartregs-progress.

City of Cincinnati. 2018. *2018 Green Cincinnati Plan*. Cincinnati: City of Cincinnati. cincinnati-oh.gov/oes/assets/File/2018%20Green%20Cincinnati%20Plan(1).pdf.

—. 2020. "City, Duke Energy Ohio Pilot Energy Efficiency Program for Income-Eligible Renters." *Office of Environment & Sustainability News*, February 5. www.cincinnati-oh.gov/oes/news/city-duke-energy-ohio-pilot-energy-efficiency-program-for-income-eligible-renters/.

City of Houston. 2020. *Houston Climate Action Plan*. Houston: City of Houston. greenhoustontx.gov/climateactionplan/CAP-April2020.pdf.

City of Minneapolis. 2013. *Climate Action Plan: A Roadmap to Reducing Citywide Greenhouse Gas Emissions*. Minneapolis: City of Minneapolis Sustainability Office. vote.minneapolismn.gov/www/groups/public/@citycoordinator/documents/webcontent/wcms1p-113598.pdf.

—. 2020. "Green Zone Initiative." www.ci.minneapolis.mn.us/sustainability/policies/green-zones.

City of New Orleans. 2017. *Climate Action for a Resilient New Orleans*. New Orleans: City of New Orleans. www.nola.gov/nola/media/Climate-Action/Climate-Action-for-a-Resilient-New-Orleans.pdf.

City of Oakland. 2018. *Oakland Equity Indicators: Measuring Change toward Greater Equity in Oakland*. Oakland: City of Oakland. cao-94612.s3.amazonaws.com/documents/2018-Equity-Indicators-Full-Report.pdf.

City of Philadelphia. 2018. *Powering Our Future: A Clean Energy Vision for Philadelphia*. Philadelphia: City of Philadelphia Office of Sustainability. www.phila.gov/media/20180821150658/Powering-Our-Future-Full-Report.pdf.

City of Pittsburgh. 2019. "The Mayor's Challenge." pittsburghpa.gov/dcp/mayors-challenge.

City of Saint Paul. 2017. *Saint Paul's Path to Carbon Neutrality: Buildings Sector*. Prepared by Xcel Energy. St. Paul, MN: City of Saint Paul. www.stpaul.gov/sites/default/files/Media%20Root/Mayor%27s%20Office/Saint%20Paul%27s%20Path%20to%20Carbon%20Neutrality_Buildings%20Sector%20Draft%20Plan.pdf.

Cluett, R., J. Amann, and S. Ou. 2016. *Building Better Energy Efficiency Programs for Low-Income Households*. Washington, DC: ACEEE. aceee.org/research-report/a1601.

Cook, J., and M. Shah. 2018. *Reducing Energy Burden with Solar: Colorado's Strategy and Roadmap for States*. Prepared by NREL. Washington, DC: DOE. www.nrel.gov/docs/fy18osti/70965.pdf.

Cooper, D., and E. Gould. 2013. *Financial Security of Elderly Americans at Risk*. Washington, DC: EPI (Economic Policy Institute). www.epi.org/publication/economic-security-elderly-americans-risk/.

CPUC (California Public Utilities Commission). 2020. *CPUC Works to Help Mitigate Higher Energy Bills Utility Customers May Receive Due to Shelter at Home*. Press release, April 2. docs.cpuc.ca.gov/PublishedDocs/Published/G000/M331/K358/331358410.PDF.

Currier, E., C. Key, J. Biernacka-Lievestro, W. Lake, S. Elmi, S. Kypa, and A. Lantz. 2018. *American Families Face a Growing Rent Burden*. Philadelphia: The Pew Charitable Trusts. www.pewtrusts.org/-/media/assets/2018/04/rent-burden_report_v2.pdf.

Curti, J., F. Andersen, and K. Wright. 2018. *A Guidebook on Equitable Clean Energy Program Design for Local Governments and Partners*. Waltham, MA: The Cadmus Group and USDN (Urban Sustainability Directors Network). cadmusgroup.com/wp-content/uploads/2018/09/Cadmus-USDN-Equitable-Clean-Energy-Guidebook.pdf.

DOE (Department of Energy). 2009. *Weatherization Program Notice 09-2: Program Year 2009 Grantee Allocations*. March 25. Washington, DC: DOE. www.energy.gov/sites/prod/files/2016/01/f28/WAP-WPN-09-2.pdf.

—. 2011. *Weatherization Assistance Program*. Washington, DC: DOE. www.nrel.gov/docs/fy11osti/51242.pdf.

—. 2012. *Weatherization Program Notice 12-2: Program Year 2012 Grantee Allocations*. February 8. Washington, DC: DOE. www.energy.gov/sites/prod/files/2015/12/f27/WAP-WPN-12-2.pdf.

—. 2014. *Better Buildings Neighborhood Program Summary of Reported Data from July 1, 2010–September 30, 2013*. Washington, DC: DOE. energy.gov/sites/prod/files/2014/09/f18/bbnp_summary_reported_data_9-15-2014.pdf.

—. 2016. "Celebrating 40 Years of America's Weatherization Assistance Program." www.energy.gov/eere/articles/celebrating-40-years-america-s-weatherization-assistance-program.

—. 2017. *Weatherization Works!* Washington, DC: DOE. www.energy.gov/sites/prod/files/2017/05/f34/wap_factsheet_08.2017.pdf.

—. 2020. *Weatherization Program Notice 20-2: Program Year 2020 Grantee Allocations*. February 10. Washington, DC: DOE. www.energy.gov/sites/prod/files/2020/05/f74/wpn-20-2_v2_0.pdf.

Drehobl, A., and L. Ross. 2016. *Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low-Income and Underserved Communities*. Washington, DC: ACEEE. aceee.org/research-report/u1602.

ECC (Emerald Cities Collaborative). 2019. *Energy Democracy: Reparation—Regeneration—Reinvestment*. Washington, DC: ECC. files.emeraldcities.org/Energy%20Democracy%20FINAL_Flipbook.pdf.

EDF (Environmental Defense Fund). 2018. *Low-Income Energy Efficiency: A Pathway to Clean, Affordable Energy for All*. Prepared by APPRISE. New York: EDF. www.edf.org/sites/default/files/documents/liee_national_summary.pdf.

EIA (Energy Information Administration). 2018. "One in Three U.S. Households Faces a Challenge in Meeting Energy Needs." *Today in Energy*, September 19. www.eia.gov/todayinenergy/detail.php?id=37072.

EPA (Environmental Protection Agency). 2018. *Energy Efficiency in Affordable Housing: A Guide to Developing and Implementing Greenhouse Gas Reduction Programs*. Washington, DC: EPA. www.epa.gov/sites/production/files/2018-07/documents/final_affordablehousingguide_06262018_508.pdf.

Fairchild, D., and A. Weinrub. 2017. *Energy Democracy: Advancing Equity in Clean Energy Solutions*. Washington, DC: Island Press.

Ferris, D. 2020. "Inside Clean Energy's Coronavirus Job Crash." *Energy Wire,* April 8. www.eenews.net/energywire/2020/04/08/stories/1062815823.

Fisher Sheehan & Colton. 2020. "What Is the Home Energy Affordability Gap?" www.homeenergyaffordabilitygap.com/01_whatIsHEAG2.html.

Frank, M., and S. Nowak. 2016. "Who's Participating and Who's Not? The Unintended Consequences of Untargeted Programs." In *Proceedings of the 2016 ACEEE Summer Study on Energy Efficiency in Buildings* 2: 1–13. Washington, DC: ACEEE. aceee.org/files/proceedings/2016/data/papers/2_542.pdf.

Gilleo, A. 2019. *State Energy Efficiency Resource Standards (EERS)*. Washington, DC: ACEEE. www.aceee.org/sites/default/files/state-eers-0519.pdf.

Gilleo, A., S. Nowak, and A. Drehobl. 2017. *Making a Difference: Strategies for Successful Low-Income Energy Efficiency Programs*. Washington, DC: ACEEE. aceee.org/research-report/u1713.

Hayes, S., and C. Gerbode. 2020. *Braiding Energy and Health Funding for In-Home Programs: Federal Funding Opportunities*. Washington, DC: ACEEE. aceee.org/research-report/h2002.

Hayes, S., C. Kubes, and C. Gerbode. 2020. *Making Health Count: Monetizing the Health Benefits of In-Home Services Delivered by Energy Efficiency Programs*. Washington, DC: ACEEE. aceee.org/research-report/h2001.

Hernández, D. 2016. "Understanding 'Energy Security' and Why It Matters to Health." *Social Science & Medicine* 167: 1–10. www.ncbi.nlm.nih.gov/pmc/articles/PMC5114037/.

Hernández, D., Y. Aratani, and Y. Jiang. 2014. *Energy Insecurity among Families with Children*. New York: National Center for Children in Poverty, Columbia University Mailman School of Public Health. www.nccp.org/publications/pdf/text_1086.pdf.

Hernández, D., D. Phillips, and E. Siegel. 2016. "Exploring the Housing and Household Energy Pathways to Stress: A Mixed Methods Study." *International Journal of Environment Research and Public Health* 13 (9): 916-28. www.ncbi.nlm.nih.gov/pubmed/27649222.

Hernández, D., Y. Jiang, D. Carrión, D. Phillips, and Y. Aratani. 2016. "Housing Hardship and Energy Insecurity among Native-Born and Immigrant Low-Income Families with Children in the United States." *Journal of Children and Poverty* 22 (2): 77–92. doi.org/10.1080/10796126.2016.1148672.

HHS (Department of Health and Human Services). 2020. "LIHEAP DCL 2020-10 CARES Act Supplemental Funding Release FFY20." May 8. www.acf.hhs.gov/ocs/resource/liheap-dcl-2020-10-cares-act-supplemental-funding-release-ffy20.

Hooper, M., A. Nápoles, and E. Pérez-Stable. 2020. "COVID-19 and Racial/Ethnic Disparities." *JAMA* 323 (24): 2466–7. jamanetwork.com/journals/jama/fullarticle/2766098.

Institute of Medicine. 2011. *Climate Change, the Indoor Environment, and Health*. Washington DC: The National Academies Press. healthyindoors.com/wp-content/uploads/2016/11/IOM-CLIMATE-CHANGE-AND-HEALTH-pdf-1.pdf.

Jargowsky, P. 2015. *Architecture of Segregation: Civil Unrest, the Concentration of Poverty, and Public Policy*. New York: The Century Foundation. production-tcf.imgix.net/app/uploads/2015/08/07182514/Jargowsky_ArchitectureofSegregation-11.pdf.

Jessel, S., S. Sawyer, and D. Hernández. 2019. "Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature." *Frontiers in Public Health* 7: 357. www.ncbi.nlm.nih.gov/pmc/articles/PMC6920209/.

Kontokosta, C., V. Reina, and B. Bonczak. 2019. "Energy Cost Burdens for Low-Income and Minority Households." *Journal of the American Planning Association* 86 (1): 89–105. doi.org/10.1080/01944363.2019.1647446.

Leventis, G., C. Kramer, and L. Schwartz. 2017. *Energy Efficiency Financing for Low- and Moderate-Income Households: Current State of the Market, Issues, and Opportunities*. Washington, DC: SEE Action (State and Local Energy Efficiency Action Network), DOE. emp.lbl.gov/sites/default/files/news/lmi-final0811.pdf.

Levin, E., L. Curry, and L. Capps. 2019. *Energy-Plus-Health Playbook*. Winooski, VT: VEIC. www.veic.org/clients-results/reports/energy-plus-health-playbook.

Lewis, J., D. Hernández, and A. Geronimus. 2019. "Energy Efficiency as Energy Justice: Address Racial Inequalities through Investments in People and Places." *Energy Efficiency* 13: 419–32 doi.org/10.1007/s12053-019-09820-z.

Lin, J., K. Marshall, S. Kabaca, M. Frades, and D. Ware. 2019. "Energy Affordability in Practice: Oracle Utilities Opower's Business Intelligence to Meet Low and Moderate Income Need at Eversource." *The Electricity Journal* 33 (2): 106687. doi.org/10.1016/j.tej.2019.106687.

Ma, O., K. Laymon, M. Day, R. Oliveira, J. Weers, and A. Vimont. 2019. *Low-Income Energy Affordability Data (LEAD) Tool Methodology*. Prepared by NREL. Washington, DC: DOE. www.nrel.gov/docs/fy19osti/74249.pdf.

Malcolm, K., and J. Sawani. 2020. "Racial Disparities in the Time of COVID-19." *University of Michigan Health Lab Rounds*, May 4. labblog.uofmhealth.org/rounds/racial-disparities-time-of-covid-19.

Maricopa County Department of Public Health Office of Epidemiology. 2016. *Assessing the Cooling Needs of Homebound Individuals in Maricopa County, 2016*. Phoenix: Maricopa County Department of Public Health. www.maricopa.gov/DocumentCenter/View/53679/Cooling-Needs-of-Homebound-Individuals-Report-PDF

—. 2020. *Heat-Associated Deaths in Maricopa County, AZ: Final Report for 2019*. Phoenix: Maricopa County Department of Public Health. www.maricopa.gov/ArchiveCenter/ViewFile/Item/4959.

Mayors Challenge. 2018. "2018 Champion City—Bringing Housing Stock Up to Scratch with Collaborative Energy Retrofits: Pittsburgh." mayorschallenge.bloomberg.org/ideas/pittsburgh-pa/.

McCarty, M., L. Perl, and K. Jones. 2019. *Overview of Federal Housing Assistance Programs and Policy*. Washington, DC: CRS (Congressional Research Service). crsreports.congress.gov/product/pdf/RL/RL34591.

National Research Council. 2010. *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use*. Washington, DC: National Academies Press. www.ourenergypolicy.org/wp-content/uploads/2012/06/hidden.pdf.

NASCSP (National Association for State Community Service Programs). 2020a. "Couleecap's Weatherization Deferral Program Makes Homes Safer and More Energy Efficient." Accessed July. nascsp.org/success-story/couleecaps-weatherization-deferral-program-makes-homes-safer-and-more-energy-efficient/.

—. 2020b. *Weatherization Assistance Program: Funding Report PY 2018*. Washington, DC: NASCSP. nascsp.org/wp-content/uploads/2020/05/NASCSP-2018-WAP-Funding-Survey_Final_May12.pdf.

New Jersey Legislature. 2020. *An Act Concerning Clean Energy and Energy Efficiency Programs for Overburdened Communities*. S. 2484, May 14. www.njleg.state.nj.us/2020/Bills/S2500/2484_I1.HTM.

New York. 2016. "Governor Cuomo Announces New Energy Affordability Policy to Deliver Relief to Nearly 2 Million Low-Income New Yorkers." May 19. www.governor.ny.gov/news/governor-cuomo-announces-new-energy-affordability-policy-deliver-relief-nearly-2-million-low.

Norton, R., B. Brown, and K. Malomo-Paris. 2017. *Weatherization and Its Impact on Occupant Health Outcomes*. Washington, DC: GHHI (Green & Health Homes Initiative). www.greenandhealthyhomes.org/publication/weatherization-impact-occupant-health-outcomes/.

Nowak, S., M. Kushler, and P. Witte 2019. *The New Leaders of the Pack: ACEEE's Fourth National Review of Exemplary Energy Efficiency Programs*. Washington, DC: ACEEE. aceee.org/research-report/u1901.

NYSERDA (New York State Energy Research & Development Authority). 2018. *Annual Investment Plan and Performance Report through December 31, 2018*. Albany: NYSERDA. nyserda.ny.gov/About/Publications/NYSERDA-Annual-Reports-and-Financial-Statements.

Oregon. 2017. *Executive Order No. 17-20: Accelerating Efficiency in Oregon's Build Environment to Reduce Greenhouse Gas Emissions and Address Climate Change*. Salem: Office of Governor Kate Brown. www.oregon.gov/gov/Documents/executive_orders/eo_17-20.pdf.

Patterson, J., K. Fink, C. Grant, S. Terry, R. Rosenberg, and C. Walker. 2014. *Just Energy Policies: Reducing Pollution and Creating Jobs: A State by State Guide to Energy Efficiency and Renewable Energy Policies*. Baltimore: NAACP (National Association for the Advancement of Colored People). www.naacp.org/wp-content/uploads/2014/03/Just-Energy-Policies-Compendium-EXECUTIVE-SUMMARY_NAACP.pdf.

PEA (Philadelphia Energy Authority). 2020a "Affordable Residential." Accessed July. philaenergy.org/programs-initiatives/residential/.

—. 2020b. *Built to Last: An Initiative to Restore Safe, Healthy, and Affordable Homes*. Philadelphia: PEA. philaenergy.org/wp-content/uploads/2020/07/Built-to-Last-Overview.pdf.

Pennsylvania PUC (Public Utility Commission). 2019a. *Home Energy Affordability for Low-Income Customers in Pennsylvania*. Docket No. M-2017-2587711. Harrisburg: Pennsylvania PUC. www.puc.pa.gov/pcdocs/1602386.pdf.

— 2019b. "PUC Takes Major Steps to Address Energy Affordability for Low-Income Households; Revises Policy on Customer Assistance Programs and Initiates Rulemaking for Universal Service Programs." Press release, September 19. www.puc.state.pa.us/about_puc/press_releases.aspx?ShowPR=4262.

Reames, T. 2016. "A Community-Based Approach to Low-Income Residential Energy Efficiency Participation Barriers." *Local Environment* 21 (12): 1449–66. dx.doi.org/10.1080/13549839.2015.1136995.

Reames, T., M. Reiner, and M. Stacey. 2018. "An Incandescent Truth: Disparities in Energy-Efficient Lighting Availability and Prices in an Urban U.S. County." *Applied Energy* 218: 95–103. doi.org/10.1016/j.apenergy.2018.02.143.

Reames, T., B. Stacey, and M. Zimmerman. 2019. *A Multi-State Analysis of Equity in Utility-Sponsored Energy Efficiency Investments for Residential Electric Customers*. Ann Arbor: University of Michigan. poverty.umich.edu/files/2019/05/Energy_efficiency.pdf.

Rose, E., B. Hawkins, L. Ashcraft, and C. Miller. 2015. *Exploratory Review of Grantee, Subgrantee and Client Experiences with Deferred Services under the Weatherization Assistance Program*. Prepared by Oak Ridge National Laboratory. Washington, DC: DOE. weatherization.ornl.gov/wp-content/uploads/pdf/WAPRecoveryActEvalFinalReports/ORNL_TM-2014_364.pdf.

Ross, L., A. Drehobl, and B. Stickles. 2018. *The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency*. Washington, DC: ACEEE. aceee.org/research-report/u1806.

Ross, L., M. Jarrett, and D. York. 2016. *Reaching More Residents: Opportunities for Increasing Participation in Multifamily Energy Efficiency Programs*. Washington, DC: ACEEE. aceee.org/sites/default/files/publications/researchreports/u1603.pdf.

Rothstein, R. 2017. *The Color of Law: A Forgotten History of How Our Government Segregated America*. New York: Liveright Publishing.

Samarripas, S., and C. de Campos Lopes. 2020. *Taking Stock: Links between Local Policy and Building Energy Use across the United States*. Washington, DC: ACEEE. aceee.org/research-report/2020/04/taking-stock-links-between-local-policy-and-building-energy-use-across.

Samarripas, S., and D. York. 2019. *Closing the Gap in Energy Efficiency Programs for Affordable Multifamily Housing*. Washington, DC: ACEEE. aceee.org/research-report/u1903.

SAMHSA (Substance Abuse and Mental Health Services Administration). 2020. *Double Jeopardy: COVID-19 and Behavior Health Disparities for Black and Latino Communities in the U.S*. Rockville, MD: SAMHSA. www.samhsa.gov/sites/default/files/covid19-behavioral-health-disparities-black-latino-communities.pdf.

Teller-Elsberg, J., B. Sovacool, T. Smith, and E. Laine. 2015. "Fuel Poverty, Excess Winter Deaths, and Energy Cost in Vermont: Burdensome for Whom?" *Energy Policy* 90 (March): 81–91. doi.org/10.1016/j.enpol.2015.12.009.

Tessum, C., J. Apte, A. Goodkind, N. Muller, K. Mullins, D. Paolella, S. Polasky, N. Springer, S. Thakrar, J. Marshall, and J. Hill. 2019. "Inequality in Consumption of Goods and Services Adds to Racial-Ethnic Disparities in Air Pollution Exposure." *Proceedings of the National Academy of Sciences of the United States of America* 116 (13): 6001–6. doi.org/10.1073/pnas.1818859116.

USDN. 2019. *From Community Engagement to Ownership: Tools for the Field with Case Studies of Four Municipal Community-Driven Environmental & Racial Equity Committees.* Prepared by Facilitating Power, Movement Strategy Center, and the National Association of Climate Resilience Planners. Port Washington, WI: USDN (Urban Sustainability Directors Network). www.usdn.org/uploads/cms/documents/community_engagement_to_ownership_-_tools_and_case_studies_final.pdf.

Washington State Department of Commerce. 2020. *CETA: A Brief Overview*. Olympia: Washington State Department of Commerce. www.commerce.wa.gov/wp-content/uploads/2020/02/CETA-Overview.pdf.

Woolf T., C. Neme, M. Kushler, S. Schiller, and T. Eckman. 2017. *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources.* Framingham, MA: NESP (National Efficiency Screening Project). nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf.

# APPENDIX A.
# **Energy Burden Data**

## Appendix A.1–National Energy Burden Data

**A1.** National energy burden data including sample sizes, median energy burdens, median income, median monthly energy bills, and the percentage of households in each group with a high and severe burden

| Subgroups | Sample size | Median energy burden | Median annual income | Median annual energy expenditures | High burden percentage (>6%) | Severe burden percentage (>10%) |
|---|---|---|---|---|---|---|
| All households | 53,539 | 3.1% | $58,000 | $1,800 | 25% | 13% |
| Low-income (≤ 200% FPL) | 16,685 | 8.1% | $18,000 | $1,464 | 67% | 40% |
| Low-income with adult over 65 | 6,018 | 9.3% | $15,000 | $1,440 | 74% | 47% |
| Low-income with child under six | 2,665 | 7.1% | $26,400 | $1,800 | 59% | 33% |
| Low-income with disability | 5,759 | 8.7% | $14,660 | $1,344 | 69% | 43% |
| Non-low-income (> 200% FPL) | 36,854 | 2.3% | $84,005 | $2,040 | 6% | 1% |
| White (non-Hispanic) | 33,219 | 2.9% | $65,000 | $1,920 | 23% | 11% |
| Black | 7,747 | 4.2% | $36,000 | $1,560 | 36% | 21% |
| Hispanic | 8,435 | 3.5% | $47,400 | $1,680 | 28% | 14% |
| Native American | 1,003 | 4.2% | $40,000 | $1,680 | 36% | 19% |
| Older adults (65+ years) | 15,750 | 4.2% | $40,015 | $1,800 | 36% | 19% |
| Renters | 20,455 | 3.4% | $36,000 | $1,320 | 30% | 17% |
| Owners | 33,082 | 3.0% | $75,000 | $2,160 | 22% | 11% |
| Single family | 37,423 | 3.1% | $70,020 | $2,160 | 24% | 12% |
| Multifamily (5+ units) | 9,936 | 2.4% | $35,450 | $960 | 22% | 12% |
| Low-income multifamily (5 + units, ≤ 200% FPL) | 4,563 | 5.6% | $14,300 | $960 | 47% | 26% |
| Small multifamily (2–4 units) | 3,708 | 3.4% | $34,700 | $1,200 | 29% | 17% |
| Manufactured homes | 2,440 | 5.3% | $34,800 | $1,800 | 45% | 25% |
| Buildings built before 1980 | 28,013 | 3.4% | $50,040 | $1,800 | 29% | 15% |
| Buildings built after 1980 | 25,525 | 2.8% | $66,000 | $1,920 | 21% | 11% |

## Appendix A.2–Regional Energy Burden Data

**A2.1.** Regional energy burdens, including sample sizes for each region, median energy burdens, median monthly energy bill, and the percentage with high and severe burdens

| Region | Sample size | Median energy burden | Median annual income | Median annual energy expenditures | Upper-quartile energy burden | High burden percentage (>6%) | Severe burden percentage (>10%) |
|---|---|---|---|---|---|---|---|
| East North Central | 7,422 | 3.6% | $52,500 | $1,920 | 6.8% | 29% | 15% |
| East South Central | 2,177 | 4.4% | $39,400 | $1,800 | 8.5% | 38% | 21% |
| Middle Atlantic | 4,851 | 3.4% | $60,000 | $2,040 | 6.8% | 29% | 16% |
| Mountain | 3,932 | 2.9% | $57,625 | $1,680 | 5.2% | 21% | 11% |
| New England | 2,778 | 3.5% | $71,985 | $2,640 | 6.7% | 29% | 15% |
| Pacific | 11,177 | 2.3% | $69,800 | $1,680 | 4.5% | 18% | 9% |
| South Atlantic | 11,363 | 3.2% | $56,120 | $1,920 | 6.2% | 26% | 14% |
| West North Central | 2,412 | 3.1% | $55,100 | $1,800 | 5.8% | 25% | 12% |
| West South Central | 7,427 | 3.3% | $52,000 | $1,800 | 6.0% | 25% | 13% |
| National | 53,539 | 3.1% | $58,000 | $1,800 | 6.0% | 25% | 13% |

**A2.2.** Regional median energy burdens for income-based groups

| Region | Low-income (≤200% FPL) | Low-income with older adults (65+) | Low-income with child under 6 | Low-income with disability | Low-income multifamily (5+ units, ≤200% FPL) | Non-low-income (>200% FPL) |
|---|---|---|---|---|---|---|
| East North Central | 9.1% | 9.8% | 8.2% | 9.2% | 6.0% | 2.6% |
| East South Central | 9.1% | 10.0% | 8.6% | 9.9% | 6.6% | 2.9% |
| Middle Atlantic | 9.4% | 10.7% | 7.9% | 10.2% | 6.9% | 2.6% |
| Mountain | 6.9% | 8.4% | 5.7% | 7.7% | 4.5% | 2.2% |
| New England | 10.5% | 11.6% | 9.6% | 10.8% | 5.6% | 2.9% |
| Pacific | 6.8% | 7.5% | 5.4% | 6.9% | 5.3% | 1.7% |
| South Atlantic | 8.4% | 9.5% | 7.7% | 8.8% | 5.8% | 2.3% |
| West North Central | 7.9% | 9.1% | 7.1% | 7.9% | 4.7% | 2.5% |
| West South Central | 7.7% | 9.6% | 6.6% | 9.0% | 5.8% | 2.4% |
| National | 8.1% | 9.3% | 7.1% | 8.7% | 5.6% | 2.3% |

**A2.3.** Regional median energy burdens based on race/ethnicity, age, and tenure status

| Region | White (non-Hispanic) | Black | Hispanic | Older adults (65+ years) | Renter | Owner |
|---|---|---|---|---|---|---|
| East North Central | 3.4% | 5.1% | 3.4% | 4.7% | 4.2% | 3.3% |
| East South Central | 4.0% | 6.2% | 5.0% | 5.7% | 5.3% | 4.0% |
| Middle Atlantic | 3.2% | 4.4% | 4.5% | 4.8% | 3.8% | 3.2% |
| Mountain | 2.6% | 3.3% | 3.7% | 3.8% | 3.0% | 2.8% |
| New England | 3.4% | 4.0% | 4.6% | 4.8% | 3.6% | 3.5% |
| Pacific | 2.1% | 3.2% | 3.0% | 3.3% | 2.5% | 2.2% |
| South Atlantic | 2.9% | 4.0% | 3.4% | 4.4% | 3.5% | 3.0% |
| West North Central | 3.0% | 4.6% | 3.3% | 3.9% | 3.9% | 2.9% |
| West South Central | 2.9% | 4.0% | 4.0% | 4.4% | 3.6% | 3.1% |
| National | 2.9% | 4.2% | 3.5% | 4.2% | 3.4% | 3.0% |

**A2.4.** Regional median energy burdens based on building type

| Region | Single family | Multifamily (5+ units) | Low-income multifamily (5+ units, ≤200% FPL) | Built before 1980 | Built after 1980 |
|---|---|---|---|---|---|
| East North Central | 3.6% | 3.0% | 6.0% | 4.0% | 2.9% |
| East South Central | 4.3% | 3.9% | 6.6% | 4.9% | 3.9% |
| Middle Atlantic | 3.5% | 2.5% | 6.9% | 3.6% | 2.9% |
| Mountain | 2.9% | 2.3% | 4.5% | 3.3% | 2.7% |
| New England | 3.6% | 2.4% | 5.6% | 3.7% | 3.1% |
| Pacific | 2.4% | 1.9% | 5.3% | 2.3% | 2.3% |
| South Atlantic | 3.2% | 2.5% | 5.8% | 3.6% | 2.9% |
| West North Central | 3.1% | 2.6% | 4.7% | 3.4% | 2.7% |
| West South Central | 3.3% | 2.6% | 5.8% | 3.9% | 3.0% |
| National | 3.1% | 2.4% | 5.6% | 3.4% | 2.8% |

**A2.5.** Regional upper-quartile energy burdens for income-based groups (25% of households in each group have a burden above the upper-quartile threshold)

| Region | Low-income (≤200% FPL) | Low-income with older adults (65+) | Low-income with child under 6 | Low-income with disability | Low-income multifamily | Non-low-income (>200% FPL) |
|---|---|---|---|---|---|---|
| East North Central | 16.4% | 17.6% | 14.2% | 15.9% | 10.6% | 3.9% |
| East South Central | 15.7% | 15.7% | 18.7% | 17.2% | 12.0% | 4.2% |
| Middle Atlantic | 17.6% | 20.1% | 15.6% | 18.5% | 12.9% | 4.0% |
| Mountain | 12.0% | 15.3% | 9.6% | 13.6% | 8.4% | 3.3% |
| New England | 19.3% | 21.7% | 15.4% | 19.2% | 10.8% | 4.5% |
| Pacific | 12.0% | 13.7% | 10.2% | 12.0% | 9.2% | 2.8% |
| South Atlantic | 14.7% | 15.9% | 12.4% | 15.7% | 10.0% | 3.6% |
| West North Central | 14.1% | 14.5% | 13.7% | 14.6% | 8.7% | 3.6% |
| West South Central | 12.9% | 17.5% | 10.1% | 16.5% | 10.2% | 3.5% |
| National | 14.4% | 16.3% | 12.0% | 15.6% | 10.1% | 3.6% |

**A2.6.** Regional upper-quartile energy burdens based on race/ethnicity, age, and tenure status (25% of households in each group have a burden above the upper-quartile threshold)

| Region | White (non-Hispanic) | Black | Hispanic | Older adults (65+ years) | Renter | Owner |
|---|---|---|---|---|---|---|
| East North Central | 6.4% | 10.0% | 6.1% | 8.4% | 8.4% | 6.1% |
| East South Central | 7.4% | 12.3% | 9.2% | 10.3% | 10.9% | 7.2% |
| Middle Atlantic | 6.2% | 9.8% | 8.6% | 9.3% | 8.0% | 6.1% |
| Mountain | 4.8% | 6.3% | 6.2% | 7.0% | 5.7% | 4.9% |
| New England | 6.3% | 8.1% | 9.3% | 9.5% | 7.8% | 6.0% |
| Pacific | 4.1% | 6.5% | 5.6% | 6.4% | 5.1% | 4.1% |
| South Atlantic | 5.5% | 8.0% | 6.2% | 8.4% | 7.4% | 5.5% |
| West North Central | 5.5% | 9.3% | 6.1% | 7.3% | 7.8% | 5.2% |
| West South Central | 5.1% | 7.6% | 7.1% | 8.6% | 7.3% | 5.4% |
| National | 5.5% | 8.4% | 6.5% | 8.1% | 7.1% | 5.4% |

**A2.7.** Regional upper-quartile energy burdens based on building type (25% of households in each group have a burden above the upper-quartile threshold)

| Region | Single family | Multifamily (5+ units) | Low-income multifamily (≤200% FPL, 5+ units) | Built before 1980 | Built after 1980 |
|---|---|---|---|---|---|
| East North Central | 6.6% | 6.5% | 10.6% | 7.4% | 5.7% |
| East South Central | 7.8% | 8.2% | 12.0% | 9.6% | 7.5% |
| Middle Atlantic | 6.7% | 6.5% | 12.9% | 7.0% | 5.9% |
| Mountain | 5.0% | 4.7% | 8.4% | 5.9% | 4.8% |
| New England | 6.4% | 6.1% | 10.8% | 7.2% | 5.6% |
| Pacific | 4.4% | 4.3% | 9.2% | 4.7% | 4.3% |
| South Atlantic | 6.0% | 5.3% | 10.0% | 7.2% | 5.5% |
| West North Central | 5.7% | 5.5% | 8.7% | 6.4% | 5.1% |
| West South Central | 5.9% | 5.4% | 10.2% | 7.4% | 5.2% |
| National | 5.8% | 5.3% | 10.1% | 6.7% | 5.3% |

## Appendix A.3—Metro-Level Energy Burden Data

**A3.1.** Metro-level energy burdens, including sample sizes for each city, median energy burdens, median monthly energy bill, and percentage with high burden and severe burden

| Metro area | Sample size | Median energy burden | Median annual income | Median annual energy expenditures | Upper-quartile energy burden | High burden percentage (>6%) | Severe burden percentage (>10%) |
|---|---|---|---|---|---|---|---|
| Atlanta | 1,957 | 3.5% | $60,000 | $2,280 | 6.5% | 28% | 14% |
| Baltimore | 1,741 | 3.0% | $75,100 | $2,280 | 5.5% | 23% | 11% |
| Birmingham | 1,755 | 4.2% | $53,300 | $2,280 | 7.4% | 34% | 18% |
| Boston | 1,728 | 3.1% | $81,925 | $2,640 | 5.8% | 24% | 12% |
| Chicago | 1,788 | 2.7% | $65,350 | $1,800 | 4.8% | 20% | 10% |
| Dallas | 2,472 | 2.9% | $60,000 | $1,920 | 4.9% | 19% | 8% |
| Detroit | 1,917 | 3.8% | $57,000 | $2,160 | 6.9% | 30% | 16% |
| Houston | 2,164 | 3.0% | $60,000 | $1,800 | 5.3% | 21% | 11% |
| Las Vegas | 1,968 | 2.8% | $54,700 | $1,560 | 4.8% | 18% | 10% |
| Los Angeles | 2,351 | 2.2% | $61,900 | $1,440 | 4.4% | 17% | 9% |
| Miami | 1,978 | 3.0% | $48,050 | $1,440 | 5.5% | 23% | 12% |
| Minneapolis | 1,943 | 2.2% | $81,000 | $1,920 | 3.6% | 12% | 5% |
| New York City | 1,510 | 2.9% | $67,500 | $1,920 | 6.0% | 25% | 15% |
| Oklahoma City | 2,111 | 3.3% | $52,000 | $1,800 | 5.8% | 24% | 11% |
| Philadelphia | 1,852 | 3.2% | $66,500 | $2,160 | 6.3% | 26% | 14% |
| Phoenix | 2,000 | 3.0% | $60,000 | $1,800 | 5.2% | 21% | 10% |
| Richmond | 1,933 | 2.6% | $69,000 | $1,920 | 4.7% | 17% | 9% |
| Riverside | 2,070 | 3.6% | $58,750 | $2,160 | 6.7% | 29% | 15% |
| Rochester | 1,807 | 3.8% | $56,000 | $2,160 | 6.7% | 29% | 15% |
| San Antonio | 2,014 | 3.0% | $55,000 | $1,800 | 5.4% | 22% | 11% |
| San Francisco | 1,950 | 1.4% | $100,000 | $1,440 | 2.9% | 10% | 6% |
| San Jose | 2,043 | 1.5% | $109,000 | $1,560 | 2.9% | 11% | 6% |
| Seattle | 2,162 | 1.8% | $79,800 | $1,440 | 3.3% | 11% | 6% |
| Tampa | 1,701 | 2.8% | $52,000 | $1,560 | 5.3% | 21% | 11% |
| Washington, DC | 2,214 | 2.0% | $100,000 | $2,160 | 3.9% | 14% | 7% |
| National | 53,539 | 3.1% | $58,000 | $1,800 | 6.0% | 25% | 13% |

**A3.2.** Metro-level median energy burdens for income-based groups

| Metro area | Low-income (≤200% FPL) | Low-income with older adults (65+) | Low-income with child under 6 | Low-income with disability | Low-income multifamily (5+ units, ≤200% FPL) | Non-low-income (>200% FPL) |
|---|---|---|---|---|---|---|
| Atlanta | 9.7% | 12.6% | 8.1% | 10.4% | 6.6% | 2.7% |
| Baltimore | 10.5% | 11.4% | 7.8% | 10.0% | 7.5% | 2.6% |
| Birmingham | 10.9% | 12.9% | 9.3% | 10.7% | 6.8% | 3.0% |
| Boston | 10.1% | 11.8% | 9.5% | 10.4% | 6.6% | 2.6% |
| Chicago | 8.0% | 9.5% | 5.9% | 8.0% | 6.4% | 2.1% |
| Dallas | 6.7% | 10.0% | 6.0% | 8.1% | 5.0% | 2.4% |
| Detroit | 10.2% | 12.0% | 8.6% | 10.7% | 6.0% | 2.8% |
| Houston | 7.1% | 9.9% | 5.8% | 9.6% | 5.8% | 2.2% |
| Las Vegas | 6.5% | 8.3% | 5.0% | 6.5% | 5.3% | 2.2% |
| Los Angeles | 6.0% | 6.4% | 4.9% | 6.1% | 4.8% | 1.6% |
| Miami | 6.9% | 8.0% | 5.0% | 7.6% | 5.5% | 2.1% |
| Minneapolis | 6.6% | 8.7% | 4.7% | 7.0% | 4.3% | 2.0% |
| New York City | 9.3% | 11.4% | 7.5% | 11.0% | 8.0% | 2.1% |
| Oklahoma City | 7.8% | 9.5% | 6.1% | 8.7% | 6.5% | 2.6% |
| Philadelphia | 9.5% | 10.4% | 8.1% | 10.1% | 6.5% | 2.4% |
| Phoenix | 7.0% | 8.3% | 5.6% | 7.3% | 4.6% | 2.4% |
| Richmond | 8.2% | 10.3% | 6.9% | 8.4% | 5.0% | 2.3% |
| Riverside | 8.7% | 10.6% | 6.7% | 9.6% | 6.1% | 2.7% |
| Rochester | 9.5% | 10.1% | 7.9% | 9.4% | 6.0% | 2.9% |
| San Antonio | 7.4% | 9.5% | 6.0% | 8.6% | 4.8% | 2.4% |
| San Francisco | 6.1% | 7.0% | 4.7% | 6.6% | 4.9% | 1.2% |
| San Jose | 6.5% | 8.1% | 4.4% | 7.6% | 4.7% | 1.2% |
| Seattle | 6.0% | 6.8% | 4.4% | 6.0% | 4.1% | 1.6% |
| Tampa | 7.2% | 8.0% | 5.6% | 8.0% | 4.9% | 2.1% |
| Washington, DC | 7.5% | 9.3% | 5.9% | 8.3% | 5.2% | 1.8% |
| National | 8.1% | 9.3% | 7.1% | 8.7% | 5.6% | 2.3% |

**A3.3.** Metro-level median energy burdens based on race/ethnicity, age, and tenure status

| Metro area | White (non-Hispanic) | Black | Hispanic | Older adults (65+) | Renter | Owner |
|---|---|---|---|---|---|---|
| Atlanta | 3.1% | 4.1% | 4.7% | 5.1% | 3.7% | 3.4% |
| Baltimore | 2.8% | 3.8% | 3.3% | 4.1% | 3.2% | 2.9% |
| Birmingham | 3.8% | 5.6% | 4.8% | 5.8% | 5.2% | 3.9% |
| Boston | 3.0% | 3.7% | 3.6% | 4.4% | 3.2% | 3.0% |
| Chicago | 2.4% | 4.1% | 3.0% | 3.7% | 3.1% | 2.5% |
| Dallas | 2.6% | 3.3% | 3.8% | 3.8% | 2.9% | 3.0% |
| Detroit | 3.5% | 5.3% | 4.5% | 5.2% | 4.6% | 3.6% |
| Houston | 2.5% | 3.5% | 3.4% | 4.1% | 3.3% | 2.7% |
| Las Vegas | 2.7% | 3.2% | 3.0% | 3.4% | 3.0% | 2.7% |
| Los Angeles | 1.8% | 3.6% | 2.6% | 3.2% | 2.4% | 2.1% |
| Miami | 2.5% | 3.4% | 3.1% | 4.2% | 3.1% | 2.8% |
| Minneapolis | 2.2% | 2.6% | 2.7% | 3.0% | 2.3% | 2.2% |
| New York City | 2.6% | 3.6% | 3.8% | 4.2% | 3.3% | 2.7% |
| Oklahoma City | 3.1% | 3.9% | 4.2% | 4.0% | 3.9% | 3.1% |
| Philadelphia | 2.9% | 4.4% | 5.2% | 4.4% | 3.9% | 3.0% |
| Phoenix | 2.8% | 3.2% | 3.6% | 4.0% | 2.8% | 3.1% |
| Richmond | 2.4% | 3.4% | 2.9% | 3.5% | 2.9% | 2.6% |
| Riverside | 3.4% | 3.9% | 3.7% | 5.1% | 4.0% | 3.4% |
| Rochester | 3.6% | 5.1% | 5.4% | 4.8% | 4.3% | 3.6% |
| San Antonio | 2.7% | 3.1% | 3.4% | 4.1% | 3.1% | 3.0% |
| San Francisco | 1.2% | 2.4% | 1.2% | 2.4% | 1.4% | 1.4% |
| San Jose | 1.4% | 1.8% | 1.9% | 2.4% | 1.5% | 1.5% |
| Seattle | 1.8% | 2.3% | 2.0% | 2.4% | 1.8% | 1.8% |
| Tampa | 2.6% | 3.6% | 3.5% | 3.8% | 2.8% | 2.9% |
| Washington, DC | 1.7% | 2.9% | 2.7% | 2.9% | 2.0% | 2.0% |
| National | 2.9% | 4.2% | 3.5% | 4.2% | 3.4% | 3.0% |

**A3.4.** Metro-level median energy burdens based on building type

| Metro area | Single family | Multifamily (5+ units) | Low-income multifamily (5+ units, ≤200% FPL) | Built before 1980 | Built after 1980 |
|---|---|---|---|---|---|
| Atlanta | 3.7% | 2.5% | 6.6% | 4.5% | 3.3% |
| Baltimore | 3.2% | 2.5% | 7.5% | 3.6% | 2.4% |
| Birmingham | 4.1% | 3.5% | 6.8% | 5.1% | 3.6% |
| Boston | 3.1% | 2.2% | 6.6% | 3.2% | 2.6% |
| Chicago | 2.6% | 2.7% | 6.4% | 2.9% | 2.2% |
| Dallas | 3.1% | 2.2% | 5.0% | 3.5% | 2.7% |
| Detroit | 3.8% | 2.5% | 6.0% | 4.3% | 3.0% |
| Houston | 3.0% | 2.5% | 5.8% | 3.4% | 2.7% |
| Las Vegas | 2.8% | 2.4% | 5.3% | 3.6% | 2.7% |
| Los Angeles | 2.3% | 2.1% | 4.8% | 2.3% | 2.1% |
| Miami | 2.9% | 2.9% | 5.5% | 3.3% | 2.6% |
| Minneapolis | 2.3% | 1.8% | 4.3% | 2.5% | 2.0% |
| New York City | 3.0% | 2.4% | 8.0% | 3.0% | 2.4% |
| Oklahoma City | 3.2% | 3.3% | 6.5% | 3.8% | 2.9% |
| Philadelphia | 3.3% | 2.7% | 6.5% | 3.6% | 2.5% |
| Phoenix | 3.1% | 2.1% | 4.6% | 3.6% | 2.8% |
| Richmond | 2.6% | 2.1% | 5.0% | 3.1% | 2.3% |
| Riverside | 3.5% | 3.9% | 6.1% | 4.3% | 3.3% |
| Rochester | 3.7% | 3.2% | 6.0% | 4.0% | 3.4% |
| San Antonio | 3.0% | 2.6% | 4.8% | 3.9% | 2.7% |
| San Francisco | 1.5% | 1.3% | 4.9% | 1.4% | 1.4% |
| San Jose | 1.6% | 1.2% | 4.7% | 1.6% | 1.3% |
| Seattle | 1.9% | 1.5% | 4.1% | 2.0% | 1.7% |
| Tampa | 2.8% | 2.2% | 4.9% | 3.3% | 2.5% |
| Washington, DC | 2.2% | 1.4% | 5.2% | 2.3% | 1.9% |
| National | 3.1% | 2.4% | 5.6% | 3.4% | 2.8% |

**A3.5.** Metro-level upper-quartile energy burdens for income-based groups (25% of households in each group have a burden above the upper-quartile threshold)

| Metro area | Low-income (≤200% FPL) | Low-income with older adults (65+) | Low-income with child under 6 | Low-income with disability | Low-income multifamily | Non-low-income (>200% FPL) |
|---|---|---|---|---|---|---|
| Atlanta | 16.2% | 19.1% | 12.8% | 17.9% | 11.7% | 4.1% |
| Baltimore | 21.7% | 34.0% | 10.9% | 27.1% | 5.5% | 3.8% |
| Birmingham | 18.3% | 20.0% | 17.1% | 17.7% | 13.9% | 4.6% |
| Boston | 18.6% | 21.8% | 16.0% | 21.4% | 11.7% | 4.2% |
| Chicago | 15.1% | 17.5% | 11.2% | 13.2% | 12.7% | 3.1% |
| Dallas | 11.4% | 17.1% | 8.5% | 15.4% | 7.9% | 3.6% |
| Detroit | 18.8% | 21.2% | 13.6% | 19.8% | 9.6% | 4.3% |
| Houston | 12.2% | 20.2% | 9.0% | 22.0% | 9.8% | 3.2% |
| Las Vegas | 13.8% | 21.8% | 8.0% | 13.7% | 10.9% | 3.2% |
| Los Angeles | 10.4% | 11.4% | 8.4% | 11.2% | 8.7% | 2.6% |
| Miami | 11.2% | 13.3% | 10.0% | 13.0% | 10.0% | 3.0% |
| Minneapolis | 12.2% | 14.8% | 6.9% | 12.6% | 7.7% | 2.9% |
| New York City | 16.8% | 21.8% | 14.1% | 18.6% | 15.0% | 3.4% |
| Oklahoma City | 12.5% | 14.0% | 9.9% | 12.4% | 10.2% | 3.7% |
| Philadelphia | 19.1% | 24.9% | 14.7% | 20.0% | 12.1% | 3.8% |
| Phoenix | 11.9% | 15.3% | 9.2% | 12.7% | 7.3% | 3.5% |
| Richmond | 15.6% | 22.0% | 10.4% | 19.2% | 8.8% | 3.3% |
| Riverside | 15.0% | 16.6% | 10.7% | 16.5% | 9.9% | 3.9% |
| Rochester | 15.9% | 20.0% | 14.0% | 14.7% | 9.9% | 4.3% |
| San Antonio | 13.3% | 16.6% | 9.2% | 16.2% | 9.2% | 3.5% |
| San Francisco | 14.3% | 14.3% | 8.5% | 14.4% | 11.0% | 2.0% |
| San Jose | 12.5% | 14.9% | 7.6% | 14.9% | 8.9% | 2.0% |
| Seattle | 10.9% | 12.0% | 9.2% | 9.9% | 6.8% | 2.4% |
| Tampa | 12.1% | 12.1% | 10.7% | 12.7% | 9.2% | 3.2% |
| Washington, DC | 13.5% | 17.6% | 8.9% | 15.0% | 9.1% | 2.9% |
| National | 14.4% | 16.3% | 12.0% | 15.6% | 10.1% | 3.6% |

**A3.6.** Metro-level upper-quartile energy burdens based on race/ethnicity, age, and tenure status (25% of households in each group have a burden above the upper-quartile threshold)

| Metro area | White (non-Hispanic) | Black | Hispanic | Older adults (65+) | Renter | Owner |
|---|---|---|---|---|---|---|
| Atlanta | 5.4% | 8.1% | 7.4% | 9.8% | 7.2% | 6.2% |
| Baltimore | 5.0% | 8.3% | 4.9% | 8.0% | 6.7% | 5.1% |
| Birmingham | 6.7% | 11.8% | 8.7% | 10.7% | 10.4% | 6.8% |
| Boston | 5.6% | 8.1% | 7.7% | 9.0% | 6.8% | 5.6% |
| Chicago | 4.2% | 8.5% | 4.9% | 7.5% | 6.0% | 4.4% |
| Dallas | 4.3% | 5.8% | 6.0% | 7.0% | 5.1% | 4.8% |
| Detroit | 6.3% | 9.4% | 7.2% | 9.0% | 8.9% | 6.3% |
| Houston | 4.4% | 6.6% | 6.1% | 8.0% | 6.2% | 4.8% |
| Las Vegas | 4.6% | 6.1% | 5.0% | 6.1% | 5.3% | 4.3% |
| Los Angeles | 3.6% | 6.5% | 5.0% | 6.1% | 5.1% | 3.8% |
| Miami | 4.4% | 6.9% | 5.8% | 8.3% | 6.4% | 5.0% |
| Minneapolis | 3.5% | 4.4% | 4.5% | 5.4% | 4.2% | 3.5% |
| New York City | 5.4% | 8.2% | 7.9% | 10.1% | 7.2% | 5.3% |
| Oklahoma City | 5.4% | 7.4% | 6.6% | 7.7% | 6.8% | 5.2% |
| Philadelphia | 5.2% | 10.2% | 9.2% | 8.4% | 7.9% | 5.5% |
| Phoenix | 4.8% | 6.2% | 6.0% | 7.0% | 5.2% | 5.2% |
| Richmond | 4.1% | 7.0% | 5.8% | 6.8% | 5.5% | 4.4% |
| Riverside | 6.7% | 7.3% | 6.9% | 9.2% | 7.2% | 6.4% |
| Rochester | 6.2% | 11.6% | 11.4% | 9.0% | 8.1% | 6.1% |
| San Antonio | 4.6% | 5.2% | 6.4% | 7.9% | 5.5% | 5.3% |
| San Francisco | 2.5% | 5.3% | 3.6% | 4.7% | 3.0% | 2.8% |
| San Jose | 2.8% | 3.7% | 3.4% | 5.0% | 3.1% | 2.8% |
| Seattle | 3.2% | 4.5% | 4.1% | 5.1% | 3.6% | 3.2% |
| Tampa | 5.0% | 7.1% | 6.3% | 6.5% | 5.6% | 5.2% |
| Washington, DC | 3.0% | 5.1% | 5.1% | 6.0% | 4.4% | 3.6% |
| National | 5.5% | 8.4% | 6.5% | 8.1% | 7.1% | 5.4% |

**A3.7.** Metro-level upper-quartile energy burdens based on building type (25% of households in each group have a burden above the upper-quartile threshold)

| Metro area | Single family | Multifamily (5+ units) | Low-income multifamily (≤200% FPL, 5+ units) | Built before 1980 | Built after 1980 |
|---|---|---|---|---|---|
| Atlanta | 6.6% | 5.3% | 11.7% | 8.1% | 5.8% |
| Baltimore | 5.5% | 5.5% | 5.5% | 6.9% | 4.0% |
| Birmingham | 7.3% | 6.5% | 13.9% | 9.7% | 6.3% |
| Boston | 5.6% | 5.6% | 11.7% | 6.2% | 4.9% |
| Chicago | 4.5% | 5.3% | 12.7% | 5.5% | 4.0% |
| Dallas | 5.1% | 4.2% | 7.9% | 6.0% | 4.6% |
| Detroit | 6.8% | 6.0% | 9.6% | 7.5% | 5.7% |
| Houston | 5.1% | 5.1% | 9.8% | 6.1% | 4.8% |
| Las Vegas | 4.7% | 4.7% | 10.9% | 6.7% | 4.4% |
| Los Angeles | 4.4% | 4.4% | 8.7% | 4.5% | 4.1% |
| Miami | 5.2% | 5.5% | 10.0% | 6.2% | 4.8% |
| Minneapolis | 3.6% | 3.3% | 7.7% | 3.9% | 3.3% |
| New York City | 6.3% | 6.6% | 15.0% | 5.9% | 6.4% |
| Oklahoma City | 5.5% | 6.8% | 10.2% | 6.9% | 4.7% |
| Philadelphia | 6.2% | 5.8% | 12.1% | 7.0% | 4.9% |
| Phoenix | 5.1% | 4.2% | 7.3% | 6.0% | 4.6% |
| Richmond | 4.7% | 4.0% | 8.8% | 6.0% | 3.9% |
| Riverside | 6.5% | 6.9% | 9.9% | 7.8% | 5.8% |
| Rochester | 6.5% | 6.3% | 9.9% | 7.1% | 5.9% |
| San Antonio | 5.5% | 4.3% | 9.2% | 7.5% | 4.5% |
| San Francisco | 3.0% | 2.6% | 11.0% | 2.9% | 2.8% |
| San Jose | 3.0% | 2.6% | 8.9% | 3.1% | 2.5% |
| Seattle | 3.2% | 3.2% | 6.8% | 3.6% | 3.1% |
| Tampa | 5.2% | 4.4% | 9.2% | 6.5% | 4.5% |
| Washington, DC | 4.0% | 3.2% | 9.1% | 4.5% | 3.2% |
| National | 5.8% | 5.3% | 10.1% | 6.7% | 5.3% |

# APPENDIX B.
# **High and Severe Energy Burdens**

This section includes 2017 population data from the American Housing Survey (AHS) Table Creator for both national and metropolitan statistical area samples. www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html.

## Appendix B.1–National High and Severe Energy Burdens

**B1.1.** Total national households in each subgroup, and each subgroup's total households with a high energy burden (≥6%) and total households with severe energy burden (≥10%)

| Category | Subgroup | Total households | Percentage highly burdened (≥6%) | Total highly burdened households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened households (≥10%) |
|---|---|---|---|---|---|---|
| Income | All households | 121,560,000 | 25% | 30,585,830 | 13% | 15,861,674 |
| | Low-income (≤200% FPL) | 38,551,000 | 67% | 25,776,144 | 40% | 15,383,432 |
| | Non-low-income (>200% FPL) | 83,009,000 | 6% | 5,214,246 | 1% | 738,779 |
| Race/ ethnicity | Black | 16,552,000 | 36% | 5,995,213 | 21% | 3,469,788 |
| | Native American | 1,483,000 | 36% | 541,155 | 19% | 283,884 |
| | Hispanic | 16,496,000 | 28% | 4,572,335 | 14% | 2,250,966 |
| | White (non-Hispanic) | 80,550,000 | 23% | 21,924,520 | 11% | 10,485,640 |
| Age | Older adults (65+) | 34,929,000 | 36% | 12,487,949 | 19% | 6,701,933 |
| Tenure | Renters | 43,993,000 | 30% | 13,218,332 | 17% | 7,290,945 |
| | Owners | 77,567,000 | 22% | 17,174,847 | 11% | 8,431,501 |
| Housing type | Low-income multifamily (5+ units) and low-income (≤200% FPL) | 9,345,000 | 47% | 4,413,429 | 26% | 2,408,442 |
| | Small multifamily (2–4 units) | 8,363,000 | 47% | 3,949,653 | 26% | 2,155,356 |
| | Manufactured homes | 6,727,000 | 45% | 2,999,580 | 25% | 1,709,320 |
| | Built before 1980 | 55,723,000 | 29% | 15,911,480 | 15% | 8,392,366 |
| | Single family | 85,791,000 | 24% | 20,831,649 | 12% | 10,476,575 |
| | Multifamily (5+ units) | 20,605,000 | 22% | 4,572,668 | 12% | 2,449,125 |
| | Built after 1980 | 65,838,000 | 21% | 14,114,223 | 11% | 7,137,071 |

## Appendix B.2–Regional High and Severe Energy Burdens

**B2.1.** Total households in each region, and each region's total households with a high energy burden (≥6%) and total households with severe energy burden (≥10%)

| Region | Total households in region | Percentage highly burdened (≥6%) | Total highly burdened households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened households (≥10%) |
|---|---|---|---|---|---|
| East North Central | 18,522,000 | 29% | 5,371,380 | 15% | 2,778,300 |
| East South Central | 7,417,000 | 38% | 2,818,460 | 21% | 1,557,570 |
| Middle Atlantic | 16,019,000 | 29% | 4,645,510 | 16% | 2,563,040 |
| Mountain | 8,916,000 | 21% | 1,872,360 | 11% | 980,760 |
| New England | 5,809,000 | 29% | 1,684,610 | 15% | 871,350 |
| Pacific | 18,305,000 | 18% | 3,294,900 | 9% | 1,647,450 |
| South Atlantic | 23,974,000 | 26% | 6,233,240 | 14% | 3,356,360 |
| West North Central | 8,527,000 | 25% | 2,131,750 | 12% | 1,023,240 |
| West South Central | 14,070,000 | 25% | 3,517,500 | 13% | 1,829,100 |
| National | 121,560,000 | 25% | 30,585,830 | 13% | 15,861,674 |

**B2.2.** Total low-income households in each region, and each region's total low-income households with a high energy burden (≥6%) and total low-income households with severe energy burden (≥10%)

| Region | Total low-income households in region | Percentage highly burdened (≥6%) | Total highly burdened low-income households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened low-income households (≥10%) |
|---|---|---|---|---|---|
| East North Central | 5,979,000 | 74% | 4,424,460 | 45% | 2,690,550 |
| East South Central | 2,976,000 | 74% | 2,202,240 | 46% | 1,368,960 |
| Middle Atlantic | 4,827,000 | 72% | 3,475,440 | 48% | 2,316,960 |
| Mountain | 2,719,000 | 58% | 1,577,020 | 33% | 897,270 |
| New England | 1,621,000 | 75% | 1,215,750 | 52% | 842,920 |
| Pacific | 5,064,000 | 57% | 2,886,480 | 33% | 1,671,120 |
| South Atlantic | 8,042,000 | 69% | 5,548,980 | 41% | 3,297,220 |
| West North Central | 2,297,000 | 66% | 1,516,020 | 39% | 895,830 |
| West South Central | 5,026,000 | 66% | 3,317,160 | 36% | 1,809,360 |
| National | 38,551,000 | 67% | 25,776,144 | 40% | 15,383,432 |

**B2.3.** Total Black households in each region, and each region's total Black households with a high energy burden (≥6%) and total Black households with severe energy burden (≥10%)

| Region | Total Black households in region | Percentage highly burdened (≥6%) | Total highly burdened Black households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened Black households (≥10%) |
|---|---|---|---|---|---|
| East North Central | 2,336,000 | 43% | 1,004,480 | 25% | 584,000 |
| East South Central | 1,595,000 | 51% | 813,450 | 31% | 494,450 |
| Middle Atlantic | 2,437,000 | 38% | 926,060 | 25% | 609,250 |
| Mountain | 359,000 | 27% | 96,930 | 13% | 46,670 |
| New England | 401,000 | 33% | 132,330 | 17% | 68,170 |
| Pacific | 1,077,000 | 26% | 280,020 | 15% | 161,550 |
| South Atlantic | 5,485,000 | 35% | 1,919,750 | 20% | 1,097,000 |
| West North Central | 585,000 | 40% | 234,000 | 24% | 140,400 |
| West South Central | 2,277,000 | 34% | 774,180 | 19% | 432,630 |
| National | 16,552,000 | 36% | 5,995,213 | 21% | 3,469,788 |

**B2.4.** Total Hispanic households in each region, and each region's total Hispanic households with a high energy burden (≥6%) and total Hispanic households with severe energy burden (≥10%)

| Region | Total Hispanic households in region | Percentage highly burdened (≥6%) | Total highly burdened Hispanic households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened Hispanic households (≥10%) |
|---|---|---|---|---|---|
| East North Central | 1,083,000 | 26% | 281,580 | 12% | 129,960 |
| East South Central | 197,000 | 38% | 74,860 | 23% | 45,310 |
| Middle Atlantic | 2,052,000 | 38% | 779,760 | 22% | 451,440 |
| Mountain | 1,721,000 | 27% | 464,670 | 13% | 223,730 |
| New England | 563,000 | 40% | 225,200 | 23% | 129,490 |
| Pacific | 4,466,000 | 23% | 1,027,180 | 11% | 491,260 |
| South Atlantic | 2,695,000 | 26% | 700,700 | 12% | 323,400 |
| West North Central | 360,000 | 26% | 93,600 | 15% | 54,000 |
| West South Central | 3,359,000 | 31% | 1,041,290 | 15% | 503,850 |
| National | 16,496,000 | 28% | 4,572,335 | 14% | 2,250,966 |

**B2.5.** Total older adult (65+) households in each region, and each region's total older adult (65+) households with a high energy burden (≥6%) and total older adult (65+) households with severe energy burden (≥10%)

| Region | Total older adult (65+) households in MSA | Percentage highly burdened (≥6%) | Total highly burdened older adult households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened older adult households (≥10%) |
|---|---|---|---|---|---|
| East North Central | 4,711,000 | 39% | 1,837,290 | 20% | 942,200 |
| East South Central | 1,902,000 | 49% | 931,980 | 26% | 494,520 |
| Middle Atlantic | 4,228,000 | 41% | 1,733,480 | 23% | 972,440 |
| Mountain | 2,258,000 | 30% | 677,400 | 15% | 338,700 |
| New England | 1,578,000 | 41% | 646,980 | 24% | 378,720 |
| Pacific | 4,328,000 | 27% | 1,168,560 | 14% | 605,920 |
| South Atlantic | 6,402,000 | 37% | 2,368,740 | 21% | 1,344,420 |
| West North Central | 2,202,000 | 32% | 704,640 | 17% | 374,340 |
| West South Central | 3,058,000 | 37% | 1,131,460 | 21% | 642,180 |
| National | 34,929,000 | 36% | 12,487,949 | 19% | 6,701,933 |

**B2.6.** Total renting households in each region, and each region's total renting households with a high energy burden (≥6%) and total renting households with severe energy burden (≥10%)

| Region | Total renting households in region | Percentage highly burdened (≥6%) | Total highly burdened renting households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened renting households (≥10%) |
|---|---|---|---|---|---|
| East North Central | 5,945,000 | 37% | 2,199,650 | 21% | 1,248,450 |
| East South Central | 2,458,000 | 46% | 1,130,680 | 28% | 688,240 |
| Middle Atlantic | 6,279,000 | 34% | 2,134,860 | 21% | 1,318,590 |
| Mountain | 3,091,000 | 24% | 741,840 | 12% | 370,920 |
| New England | 2,092,000 | 34% | 711,280 | 19% | 397,480 |
| Pacific | 7,910,000 | 21% | 1,661,100 | 11% | 870,100 |
| South Atlantic | 8,395,000 | 31% | 2,602,450 | 17% | 1,427,150 |
| West North Central | 2,616,000 | 34% | 889,440 | 19% | 497,040 |
| West South Central | 5,207,000 | 31% | 1,614,170 | 17% | 885,190 |
| National | 43,993,000 | 30% | 13,218,332 | 17% | 7,290,945 |

# Appendix B.3–Metro Area High and Severe Energy Burdens

**B3.1.** Total households in each MSA, and each MSA's total households with a high energy burden (≥6%) and total households with severe energy burden (≥10%)

| Metro area | Total households in MSA | Percentage highly burdened (≥6%) | Total highly burdened households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened households (≥10%) |
|---|---|---|---|---|---|
| Atlanta | 2,108,800 | 28% | 589,430 | 14% | 287,711 |
| Baltimore | 1,047,600 | 23% | 237,681 | 11% | 120,345 |
| Birmingham | 447,000 | 34% | 153,330 | 18% | 80,995 |
| Boston | 1,853,800 | 24% | 447,358 | 12% | 230,652 |
| Chicago | 3,526,500 | 20% | 704,117 | 10% | 362,906 |
| Dallas | 2,564,700 | 19% | 483,475 | 8% | 216,838 |
| Detroit | 1,723,300 | 30% | 518,698 | 16% | 269,687 |
| Houston | 2,329,000 | 21% | 499,379 | 11% | 249,689 |
| Las Vegas | 798,600 | 18% | 145,680 | 10% | 80,347 |
| Los Angeles | 4,395,700 | 17% | 768,453 | 9% | 390,770 |
| Miami | 2,090,600 | 23% | 476,674 | 12% | 249,435 |
| Minneapolis | 1,379,600 | 12% | 159,048 | 5% | 71,714 |
| New York City | 7,428,000 | 25% | 1,859,460 | 15% | 1,111,740 |
| Oklahoma City | 515,900 | 24% | 124,637 | 11% | 57,920 |
| Philadelphia | 2,308,400 | 26% | 609,507 | 14% | 332,798 |
| Phoenix | 1,685,600 | 21% | 351,448 | 10% | 165,189 |
| Richmond | 489,500 | 17% | 85,086 | 9% | 46,342 |
| Riverside | 1,314,500 | 29% | 382,285 | 15% | 197,493 |
| Rochester | 439,700 | 29% | 127,262 | 15% | 64,726 |
| San Antonio | 805,700 | 22% | 176,022 | 11% | 88,011 |
| San Francisco | 1,706,200 | 10% | 170,620 | 6% | 100,622 |
| San Jose | 657,700 | 11% | 71,468 | 6% | 38,953 |
| Seattle | 1,485,700 | 11% | 170,423 | 6% | 83,837 |
| Tampa | 1,182,800 | 21% | 248,937 | 11% | 127,945 |
| Washington, DC | 2,178,800 | 14% | 299,167 | 7% | 149,583 |
| National | 120,062,818 | 25% | 30,585,830 | 13% | 15,861,674 |

**B3.2.** Total low-income households in each MSA, and each MSA's total low-income households with a high energy burden (≥6%) and total low-income households with severe energy burden (≥10%)

| Metro area | Total low-income households in MSA | Percentage highly burdened (≥6%) | Total highly burdened low-income households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened low-income households (≥10%) |
|---|---|---|---|---|---|
| Atlanta | 589,900 | 79% | 466,021 | 48% | 283,152 |
| Baltimore | 241,200 | 77% | 185,724 | 52% | 125,424 |
| Birmingham | 156,000 | 82% | 127,920 | 54% | 84,240 |
| Boston | 412,700 | 74% | 305,398 | 51% | 210,477 |
| Chicago | 1,025,400 | 68% | 697,272 | 39% | 399,906 |
| Dallas | 692,500 | 49% | 339,325 | 31% | 214,675 |
| Detroit | 551,700 | 80% | 441,360 | 51% | 281,367 |
| Houston | 731,100 | 61% | 445,971 | 34% | 248,574 |
| Las Vegas | 253,700 | 55% | 139,535 | 33% | 83,721 |
| Los Angeles | 1,371,300 | 50% | 685,650 | 27% | 370,251 |
| Miami | 820,900 | 57% | 467,913 | 31% | 254,479 |
| Minneapolis | 256,900 | 57% | 146,433 | 32% | 82,208 |
| New York City | 2,248,400 | 70% | 1,573,880 | 48% | 1,079,232 |
| Oklahoma City | 155,400 | 68% | 105,672 | 37% | 57,498 |
| Philadelphia | 652,300 | 74% | 482,702 | 48% | 313,104 |
| Phoenix | 507,800 | 59% | 299,602 | 32% | 162,496 |
| Richmond | 122,100 | 64% | 78,144 | 40% | 48,840 |
| Riverside | 453,700 | 71% | 322,127 | 44% | 199,628 |
| Rochester | 137,400 | 73% | 100,302 | 46% | 63,204 |
| San Antonio | 260,800 | 62% | 161,696 | 35% | 91,280 |
| San Francisco | 326,600 | 51% | 166,566 | 32% | 104,512 |
| San Jose | 121,500 | 54% | 65,610 | 32% | 38,880 |
| Seattle | 290,000 | 50% | 145,000 | 28% | 81,200 |
| Tampa | 377,900 | 61% | 230,519 | 36% | 136,044 |
| Washington, DC | 399,200 | 60% | 239,520 | 36% | 143,712 |
| National | 38,551,000 | 67% | 25,776,144 | 40% | 15,383,432 |

**B3.3.** Total Black households in each MSA, and each MSA's total Black households with a high energy burden (≥6%) and total Black households with severe energy burden (≥10%)

| Metro area | Total Black households in MSA | Percentage highly burdened (≥6%) | Total highly burdened Black households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened Black households (≥10%) |
|---|---|---|---|---|---|
| Atlanta | 789,500 | 36% | 284,220 | 21% | 165,795 |
| Baltimore | 324,100 | 34% | 110,194 | 20% | 64,820 |
| Birmingham | 137,000 | 47% | 64,390 | 30% | 41,100 |
| Boston | 157,900 | 32% | 50,528 | 16% | 25,264 |
| Chicago | 682,800 | 37% | 252,636 | 21% | 143,388 |
| Dallas | 466,000 | 25% | 116,500 | 14% | 65,240 |
| Detroit | 427,900 | 43% | 183,997 | 23% | 98,417 |
| Houston | 482,400 | 29% | 139,896 | 15% | 72,360 |
| Las Vegas | 112,600 | 26% | 29,276 | 18% | 20,268 |
| Los Angeles | 372,200 | 27% | 100,494 | 15% | 55,830 |
| Miami | 459,500 | 29% | 133,255 | 18% | 82,710 |
| Minneapolis | 113,000 | 15% | 16,950 | 7% | 7,910 |
| New York City | 1,459,600 | 32% | 467,072 | 21% | 306,516 |
| Oklahoma City | 61,000 | 32% | 19,520 | 17% | 10,370 |
| Philadelphia | 542,900 | 39% | 211,731 | 25% | 135,725 |
| Phoenix | 107,200 | 26% | 27,872 | 15% | 16,080 |
| Richmond | 153,500 | 28% | 42,980 | 15% | 23,025 |
| Riverside | 129,300 | 30% | 38,790 | 17% | 21,981 |
| Rochester | 48,000 | 44% | 21,120 | 29% | 13,920 |
| San Antonio | 61,500 | 20% | 12,300 | 11% | 6,765 |
| San Francisco | 157,900 | 24% | 37,896 | 15% | 23,685 |
| San Jose | 20,600 | 14% | 2,884 | 11% | 2,266 |
| Seattle | 94,100 | 14% | 13,174 | 6% | 5,646 |
| Tampa | 144,500 | 28% | 40,460 | 18% | 26,010 |
| Washington, DC | 631,200 | 21% | 132,552 | 10% | 63,120 |
| National | 16,552,000 | 36% | 5,995,213 | 21% | 3,469,788 |

**B3.4.** Total Hispanic households in each MSA, and each MSA's total Hispanic households with a high energy burden (≥6%) and total Hispanic households with severe energy burden (≥10%)

| Metro area | Total Hispanic households in MSA | Percentage highly burdened (≥6%) | Total highly burdened Hispanic households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened Hispanic households (≥10%) |
|---|---|---|---|---|---|
| Atlanta | 168,100 | 35% | 58,835 | 14% | 23,534 |
| Baltimore | 42,800 | 21% | 8,988 | 8% | 3,424 |
| Birmingham | 14,400 | 40% | 5,760 | 18% | 2,592 |
| Boston | 184,900 | 30% | 55,470 | 17% | 31,433 |
| Chicago | 561,600 | 19% | 106,704 | 9% | 50,544 |
| Dallas | 592,600 | 25% | 148,150 | 10% | 59,260 |
| Detroit | 55,200 | 38% | 20,976 | 15% | 8,280 |
| Houston | 706,000 | 25% | 176,500 | 11% | 77,660 |
| Las Vegas | 186,600 | 18% | 33,588 | 10% | 18,660 |
| Los Angeles | 1,589,200 | 20% | 317,840 | 10% | 158,920 |
| Miami | 884,800 | 24% | 212,352 | 12% | 106,176 |
| Minneapolis | 60,500 | 16% | 9,680 | 10% | 6,050 |
| New York City | 1,544,500 | 33% | 509,685 | 19% | 293,455 |
| Oklahoma City | 52,300 | 29% | 15,167 | 16% | 8,368 |
| Philadelphia | 154,100 | 45% | 69,345 | 24% | 36,984 |
| Phoenix | 378,300 | 25% | 94,575 | 11% | 41,613 |
| Richmond | 25,100 | 24% | 6,024 | 11% | 2,761 |
| Riverside | 579,000 | 31% | 179,490 | 15% | 86,850 |
| Rochester | 25,500 | 44% | 11,220 | 26% | 6,630 |
| San Antonio | 400,900 | 27% | 108,243 | 14% | 56,126 |
| San Francisco | 284,300 | 12% | 34,116 | 8% | 22,744 |
| San Jose | 139,200 | 13% | 18,096 | 7% | 9,744 |
| Seattle | 109,600 | 15% | 16,440 | 7% | 7,672 |
| Tampa | 188,300 | 27% | 50,841 | 16% | 30,128 |
| Washington, DC | 252,700 | 19% | 48,013 | 6% | 15,162 |
| National | 16,496,000 | 28% | 4,572,335 | 14% | 2,250,966 |

**B3.5.** Total older adult (65+) households in each MSA, and each MSA's total older adult (65+) households with a high energy burden (≥6%) and total older adult (65+) households with severe energy burden (≥10%)

| Metro area | Total older adult (65+) households in MSA | Percentage highly burdened (≥6%) | Total highly burdened older adult households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened older adult households (≥10%) |
|---|---|---|---|---|---|
| Atlanta | 490,700 | 44% | 215,908 | 24% | 117,768 |
| Baltimore | 107,700 | 34% | 36,618 | 18% | 19,386 |
| Birmingham | 127,800 | 48% | 61,344 | 27% | 34,506 |
| Boston | 516,400 | 38% | 196,232 | 22% | 113,608 |
| Chicago | 976,800 | 31% | 302,808 | 16% | 156,288 |
| Dallas | 540,500 | 29% | 156,745 | 17% | 91,885 |
| Detroit | 493,400 | 41% | 202,294 | 22% | 108,548 |
| Houston | 503,200 | 34% | 171,088 | 20% | 100,640 |
| Las Vegas | 204,400 | 26% | 53,144 | 15% | 30,660 |
| Los Angeles | 1,184,600 | 26% | 307,996 | 14% | 165,844 |
| Miami | 712,800 | 35% | 249,480 | 20% | 142,560 |
| Minneapolis | 339,300 | 22% | 74,646 | 10% | 33,930 |
| New York City | 2,162,800 | 39% | 843,492 | 26% | 562,328 |
| Oklahoma City | 123,800 | 35% | 43,330 | 17% | 21,046 |
| Philadelphia | 674,400 | 37% | 249,528 | 21% | 141,624 |
| Phoenix | 502,700 | 30% | 150,810 | 14% | 70,378 |
| Richmond | 131,100 | 29% | 38,019 | 15% | 19,665 |
| Riverside | 368,300 | 42% | 154,686 | 24% | 88,392 |
| Rochester | 133,600 | 39% | 52,104 | 20% | 26,720 |
| San Antonio | 188,100 | 35% | 65,835 | 18% | 33,858 |
| San Francisco | 498,900 | 18% | 89,802 | 10% | 49,890 |
| San Jose | 171,000 | 20% | 34,200 | 11% | 18,810 |
| Seattle | 361,100 | 19% | 68,609 | 9% | 32,499 |
| Tampa | 402,500 | 30% | 120,750 | 14% | 56,350 |
| Washington, DC | 546,800 | 25% | 136,700 | 14% | 76,552 |
| National | 34,929,000 | 36% | 12,487,949 | 19% | 6,701,933 |

**B3.6.** Total renting households in each MSA, and each MSA's total renting households with a high energy burden (≥6%) and total renting households with severe energy burden (≥10%)

| Metro area | Total renting households in MSA | Percentage highly burdened (≥6%) | Total highly burdened renting households (≥6%) | Percentage severely burdened (≥10%) | Total severely burdened renting households (≥10%) |
|---|---|---|---|---|---|
| Atlanta | 794,400 | 31% | 246,264 | 16% | 127,104 |
| Baltimore | 369,100 | 30% | 110,730 | 16% | 59,056 |
| Birmingham | 141,700 | 47% | 66,599 | 28% | 39,676 |
| Boston | 715,000 | 28% | 200,200 | 15% | 107,250 |
| Chicago | 1,238,200 | 26% | 321,932 | 14% | 173,348 |
| Dallas | 1,060,200 | 20% | 212,040 | 10% | 106,020 |
| Detroit | 527,300 | 40% | 210,920 | 21% | 110,733 |
| Houston | 896,000 | 27% | 241,920 | 14% | 125,440 |
| Las Vegas | 400,900 | 21% | 84,189 | 12% | 48,108 |
| Los Angeles | 2,280,900 | 21% | 478,989 | 11% | 250,899 |
| Miami | 853,900 | 27% | 230,553 | 15% | 128,085 |
| Minneapolis | 407,700 | 14% | 57,078 | 7% | 28,539 |
| New York City | 3,643,800 | 29% | 1,056,702 | 19% | 692,322 |
| Oklahoma City | 169,200 | 30% | 50,760 | 15% | 25,380 |
| Philadelphia | 614,800 | 35% | 215,180 | 19% | 116,812 |
| Phoenix | 593,300 | 21% | 124,593 | 10% | 59,330 |
| Richmond | 174,500 | 23% | 40,135 | 13% | 22,685 |
| Riverside | 479,300 | 33% | 158,169 | 16% | 76,688 |
| Rochester | 144,300 | 36% | 51,948 | 20% | 28,860 |
| San Antonio | 305,300 | 22% | 67,166 | 11% | 33,583 |
| San Francisco | 375,100 | 13% | 48,763 | 8% | 30,008 |
| San Jose | 272,200 | 12% | 32,664 | 7% | 19,054 |
| Seattle | 613,600 | 13% | 79,768 | 7% | 42,952 |
| Tampa | 418,000 | 23% | 96,140 | 13% | 54,340 |
| Washington, DC | 801,800 | 17% | 136,306 | 8% | 64,144 |
| National | 43,993,000 | 30% | 13,218,332 | 17% | 7,290,945 |

# APPENDIX C.
# City- and State-Led Actions to Address High Energy Burdens

**C1.** City-led actions to reduce high energy burdens

| Metro area | Strategy/action | Year enacted | Description | Data source |
|---|---|---|---|---|
| **Atlanta** | Plan with energy burden strategy | 2017 | The Clean Energy plan includes energy burden as a key strategy for achieving the city's clean energy future. | City of Atlanta 2019 |
| | Plan with energy burden goal | 2017 | The Resilience Strategy includes action to lift energy burden on 10% of Atlanta households. | City of Atlanta 2017 |
| **Cincinnati** | Plan with energy burden goal | 2018 | The Green Cincinnati Plan set a goal to reduce household energy burdened by 10% compared to current levels. | City of Cincinnati 2018 |
| | City-led program to reduce energy burdens | 2020 | The city partnered with Duke Energy Ohio to address the high energy burdens by launching a low-income multifamily energy efficiency pilot program called Warm Up Cincy. | City of Cincinnati 2020 |
| **Houston** | Plan with energy burden strategy | 2018 | The Climate Action Plan includes a goal to promote weatherization programs to reduce residential energy consumption and focus on reducing energy burdens of low-income populations. | City of Houston 2020 |
| **Minneapolis** | Plan with energy burden goal | 2013 | The Climate Action Plan states that the city will prioritize neighborhoods with high energy burdens for strategy implementation. | City of Minneapolis 2013 |
| | Equity indicator | 2013 | Climate Action Plan reporting should also include equity indicators to measure whether energy burden reductions are equitable. | |
| **New Orleans** | Plan with energy burden goal | 2017 | The Climate Action Plan includes two strategies to reduce the high energy burdens of the city's residents. | City of New Orleans 2017 |
| **Oakland** | Equity indicator | 2018 | Oakland includes energy cost burden as a metric in its 2018 Equity Indicators report. | City of Oakland 2018 |
| **Philadelphia** | Plan with energy burden goal | 2018 | The Clean Energy Vision Plan set a goal to eliminate the energy burden for 33% of Philadelphians. | City of Philadelphia 2018 |
| **Pittsburgh** | City-led program to reduce energy burdens | 2019 | As part of the Bloomberg Mayor's Challenge, the city created Switch PGH to address high burdens through a civic engagement tool. | City of Pittsburgh 2019 |
| **Saint Paul** | Plan with energy burden goal | 2017 | The city set a goal to reduce resident energy burden within 10 years so that no household spends more than 4% of its income on energy bills. | City of Saint Paul 2017 |

See Appendix for data sources

**C2.** State-led actions to reduce high energy burden

| State | Strategy/action | Year enacted | Description | Data source |
|---|---|---|---|---|
| **Colorado** | Demonstration project/pilot program | 2018 | The Energy Office awarded GRID Alternatives a $1.2 million grant to launch a project to reduce the energy burden of 300 low-income households through renewable energy and energy efficiency investments. | Cook and Shah 2018 |
| **New Jersey** | State legislation | 2020 | The NJ Clean Energy Equity Act (S. 2484) aims to use solar, storage, and energy efficiency to bring low-income households and environmental justice communities within or below the state's average energy burden. | New Jersey Legislature 2020 |
| **New York** | Governor-led executive order | 2016 | Governor Andrew M. Cuomo issued the Energy Affordability policy to work toward a goal of no New Yorker spending more than 6% of their household income on energy. | New York 2016 |
| **Oregon** | Governor-led executive order | 2018 | In response to Governor Kate Brown's Executive Order 17-20, the Oregon Department of Energy, the Oregon Public Utility Commission, and the Oregon Housing and Community Services Department conducted an assessment and created a 10-year plan to reduce energy burdens in Oregon affordable housing. | OR DOE, OR PUC, and OHCS 2018 |
| **Pennsylvania** | Public Utility Commission study | 2019 | The Pennsylvania PUC released a report that assessed home energy affordability for low-income customers in the state. | Pennsylvania Public Utility Commission 2019 |
| | Public Utility Commission policy | 2020 | The Pennsylvania PUC set a new policy to direct utilities to ensure that low-income customers spend no more than 10% (6% for lowest-income customers) of their income on energy bills. | Pennsylvania Public Utility Commission 2019 |
| **Washington** | Governor-led executive order | 2019 | As part of Governor Jay Inslee's Clean Energy Transformation Act, the Washington Department of Commerce assessed the energy burdens for low-income households and the energy assistance offered by electric utilities. | Washington State Department of Commerce 2020 |

# APPENDIX D.
# Low-Income Energy Efficiency Program Best Practices

This section contains short descriptions of some best practices for low-income energy efficiency programs: coordination, collaboration, and segmentation; funding and financing; effective measures and targeting; evaluation and quality control; and coordination of energy efficiency and renewable energy investments.

## Coordination, collaboration, and segmentation

**Community engagement and participatory planning** can ensure that programs are designed to meet community needs and build trust. By involving the community in the planning process, energy efficiency programs create outcomes that best meet community needs, leverage community networks to achieve higher program participation, and improve visibility and support within the community for program implementers (e.g., a utility or local government). Participatory planning requires effort from program planners, who can follow a set of best practices for optimal success.[21] For example, Professor Tony Reames conducted a community engagement study of Kansas City, Missouri, to understand barriers that low-income households face in participating in weatherization. This stakeholder engagement led to the development of innovative strategies to overcome barriers, such as hiring an all-African American staff to help build trust within the local community.[22]

**Statewide coordination models** enable consistent low-income program delivery across utilities, WAP implementers, and local jurisdictions. Some states have one implementer for the state's low-income programs who ensures that similar program offerings are available to all customers in the state. States such as California, New Jersey, New York, Colorado, and Massachusetts offer statewide low-income program models that aim to coordinate resources from multiple sources through a single program. For example, California's Energy Saving Assistance Program is offered by all regulated investor-owned utilities across the state. Massachusetts is served by the Low-Income Energy Affordability Network (LEAN), which includes community action agencies, public and private housing owners, government organizations, and public utilities that all work together to provide low-income efficiency solutions in the state.

**One-stop-shop program models** minimize barriers and allow low-income households to access all available resources in one place. The models provide a single point of contact, universal intake applications, comprehensive technical assistance, and streamlined access to program resources.[23] One-stop-shop models should be replicated in various locations and combine each location's available offerings. Through its Energize Delaware program model, for example, the nonprofit Delaware Sustainable Energy Utility (DESEU) offers a one-stop-shop resource that focuses on a whole-building approach and consolidates available resources directed at both low-income customers and owners of affordable multifamily buildings.

**Market segmentation** designs programs to meet the specific needs of subsets of highly burdened households, such as people living in affordable multifamily buildings or manufactured housing. Low-income customers are a diverse segment with diverse energy needs. By segmenting customers by key demographic categories, program designers can then work to identify a specific customer segment's energy usage characteristics and program needs. This can lead to more impactful outreach, relationship building, program design, and results. For instance, Eversource partnered with Oracle Utilities–Opower to develop a first-of-kind approach to digitally characterizing and targeting customers that require assistance. This analytical approach can guide utilities in creating programs that are specific to a resident subset or area.[24]

**Fuel-neutral programs** allow energy efficiency measures to be completed simultaneously in a home regardless of the electric and/or natural gas utilities that service it. This is critical for addressing the high costs associated with delivered fuels (oil, propane) and for coordinating across electric and natural gas utilities. For example, New York's Clean Energy Fund, designed to deliver on the state's Reforming the Energy Vision (REV) commitments, implements energy efficiency initiatives on a fuel-neutral basis. By taking a fuel-neutral approach, New York State can increase energy efficiency at the lowest cost, enable greater greenhouse gas reductions, and stimulate local economic development.[25]

[21] Calvert, K., I. McVey, and A. Kantamneni. 2017. "Placing the 'Community' in Community Energy Planning. Prepared for *Guelph's Community Energy Initiative Task Force* by the Community Energy Knowledge-Action Partnership. DOI: 10.13140/RG.2.2.22817.30562. www.researchgate.net/publication/319141113_Placing_the_'Community'_in_Community_Energy_Planning.

[22] Reames, T. 2016. "A Community-Based Approach to Low-Income Residential Energy Efficiency Participation Barriers." *The International Journal of Justice and Sustainability* Vol 21. www.tandfonline.com/doi/abs/10.1080/13549839.2015.1136995.

[23] Energy Efficiency for All, *One-Stop Shops for the Multifamily Sector*. assets.ctfassets.net/ntcn17ss1ow9/30B8LUDt8GTegjPE8clalF/8c5e68405c9692afb9f11fe898b8653e/EEFA_OneStopShop_Fact_Sheet__2_.pdf.

[24] Lin, J., K.M. Rodgers, S. Kabaca, M. Frades, and D. Ware. 2020. "Energy Affordability in Practice: Oracle Utilities Opower's Business Intelligence to Meet Low and Moderate Income Need at Eversource." *The Electricity Journal*. 33 (9): 1–11. doi.org/10.1016/j.tej.2019.106687.

[25] NYSERDA. Reforming the Energy Vision: Clean Energy Fund, Frequently Asked Questions. www.nyserda.ny.gov/-/media/Files/About/Clean-Energy-Fund/clean-energy-fund-qa.pdf.

## Funding and financing

**Leveraging diverse funding sources** allows programs to address health and safety issues and include greater investment and available measures. Funding for low-income energy efficiency programs often comes from electric and natural gas utility ratepayer dollars, federal WAP and LIHEAP funds, state and local funds, nonprofit resources, and other private funding sources. Leveraging funding from various sources can give program implementers greater flexibility, as some federal and utility funding sources limit the types of measures they fund. Leveraging diverse funding sources can lead to a more comprehensive program outcome that has the flexibility to address health and safety issues and incorporate more complex sets of energy efficiency investments.

**Inclusive financing models,** such as no-interest loans, loan guarantees, and the elimination of credit requirements, are designed to help low-income households overcome up-front cost barriers to accessing traditional private financing options. Inclusive financing options include Pay As You Save (PAYS) programs and on-bill tariff models, which allow low-income households to install energy efficiency investments that are paid off over time on the customer's bill.[26] In the low-income multifamily sector, limiting or eliminating up-front costs to building owners can help them undertake more substantial energy efficiency projects and overcome barriers related to the competition for scarce funding for capital projects. Low-interest financing and on-bill repayment can help owners spread out their energy efficiency project costs over time.

**Align utility and housing finance programs** to encourage energy efficiency upgrades in low-income multifamily buildings. Incorporating utility-customer funding in the current climate of affordable housing refinance and redevelopment can yield deeper, more comprehensive energy efficiency improvements. These extensive renovations may involve replacing outdated building systems, and utility-customer funds can be used to help cover the incremental cost of installing more-efficient equipment than would otherwise be required. For example, the Connecticut Green Bank coordinates closely with the state's energy efficiency initiatives led by the state agencies and local utilities to align incentives for affordable financing for both energy efficiency upgrades and rooftop solar installations. The Connecticut Green Bank's financing opportunities complement the available funding for energy efficiency upgrades from the Connecticut Housing Finance Authority and the Connecticut Department of Housing.[27]

## Effective measures, messaging, and targeting

**Include health and safety measures and healthier building materials** to reduce deferral rates and improve indoor air quality, comfort, and long-term health outcomes for program participants. Programs often address health and safety concerns through leveraged funds. However, rather than disqualifying households due to building health and safety issues such as structural problems, mold, or asbestos, utilities and program implementers can combine funding streams to provide health and safety services. For example, the Bronx Healthy Buildings Program aims to reduce asthma-related hospital visits and address the social determinants of health through education, organizing, workforce development, and building upgrades. Energy audits, building inspections, and tenant organizing aim to identify needed repairs and opportunities for energy efficiency improvements.[28]

**Prioritize deep energy-saving measures** through a single program and/or engagement to achieve high levels of energy savings. Using trusted contractor networks to deliver programs that include savings-based incentives lets contractors focus on deep savings rather than limiting projects to simple direct-install measures. For example, Oncor's Targeted Weatherization Low-Income program first prioritizes deep energy-saving measures such as building-shell weatherization and air sealing, and then focuses on additional measures such as air-conditioning, refrigeration, and lighting.[29]

**Integrate direct-installation and rebate programs** to encourage more extensive improvements. For low-income single and multifamily projects, direct-installation programs that offer no-cost energy efficiency measures can provide an opportunity to connect with building owners, complete an on-site energy assessment, and encourage owners to take advantage of rebates for more extensive improvements such as HVAC upgrades, weatherization, common-area lighting retrofits, and other building-shell improvements.

**Targeting high energy users and vulnerable households** to generate the greatest energy savings and impact. By using utility data to identify households with the highest energy use, energy efficiency providers can achieve the greatest energy savings. Even so, energy use should be looked at in combination with other factors

[26] For more information on inclusive financing options, see SEE Action, 2017. *Energy Efficiency Financing for Low- and Moderate Income Households: Current State of the Market, Issues, and Opportunities.* emp.lbl.gov/sites/default/files/news/lmi-final0811.pdf.

[27] See ACEEE's 2018 report, *Our Powers Combined: Energy Efficiency and Solar in Affordable Multifamily Buildings*. aceee.org/research-report/u1804.

[28] buildhealthchallenge.org/communities/awardee-bronx-nyc/.

[29] Gilleo, A., S. Nowak, and A. Drehobl. 2017. *Making a Difference: Strategies for Successful Low-Income Energy Efficiency Programs.* Washington, DC: ACEEE. aceee.org/sites/default/files/publications/researchreports/u1713.pdf.

that lead to household energy vulnerability. Although high energy use can lead to high savings, households with lower energy use can still experience high energy burdens. Efficiency Vermont, for example, changed its program qualification to focus on low-income households with high energy burden rather than low-income households with high energy use. This let the program qualify more customers and target needs to the most vulnerable households.[30]

**Incorporate new and emerging technologies in low-income programs**. Expanding the technology scope of low-income energy efficiency programs to technologies they do not traditionally incorporate—such as solar PV, smart meters, energy storage, and electric vehicles—can significantly improve energy affordability and equitable access to these technologies for low-income households.[31] Unless we ensure that new technologies are available to low-income and underinvested communities, inequities in access to these technologies will continue to grow. Programs that incorporate these emerging technologies can address access barriers for low-income communities and ensure more equitable distribution of their benefits.

**Effectively message programs in ways that provide clear value and actionable guidance.** Effective messaging helps achieve high program participation and builds trust and understanding of program benefits. Investing in energy efficiency often takes time and resources for both single and multifamily building owners. Although programs typically focus on energy savings and energy cost reductions benefits, programs must also market the many nonenergy benefits that result from energy efficiency improvements. Further, they should include actionable guidance—that is, clear steps that residents and building owners can take to learn more about program services and enroll in the program.

## Evaluation and quality control

**Collect and share metrics** on program outcomes, equity impacts, and other tracked data to hold implementers accountable to program requirements and goals. These metrics can include factors such as race and/or ethnicity, income status, property ownership, energy burden, and energy vulnerability. Often, program implementers publish demand-side management reports that include metrics on low-income program savings, spending, and customers served. Implementers can report additional equity factors such as energy burden data, demographic data, and participation distribution. For example, VEIC published the *State of Equity Measurement: A Review of Practices in the Clean Energy Industry*, a guide that offers an overview of energy industry metrics for measuring program equity.[32] These include metrics to define target populations, determine disparate impacts, and include representative voices in program design, implementation, evaluation, and oversight.

**Conduct robust research and evaluation** to assess achieved reductions in energy usage. Such evaluations help document and clarify program performance. Impact evaluations measure the direct and indirect benefits from programs, while process evaluations provide systematic assessments of how programs operate. By completing robust evaluations, program planners can determine how to best improve their programs for greater impact and efficiency, and better meet the needs of the target community.

**Include quality control** as a core element of the services to ensure that energy efficiency services are effective, and homes are left in a safe condition. Many program implementers incorporate ongoing training for contractors and quality control professionals, viewing this as critical to program success and devoting project funding to regular trainings. Some program administrators also include strict quality control requirements for all projects rather than for a sample, which helps incentivize contractors to perform high-quality work. For example, Ouachita Electric Cooperative's HELP PAY program, a tariff-based residential energy efficiency financing program, evaluates every project after completion and facilitates trainings for its contractors in quality control techniques to ensure that all contractors understand the assessment methodologies.[33]

**Incorporate nonenergy benefits** into testing. Without monetizing nonenergy benefits, utility-operated low-income energy efficiency programs cost more to implement per household—and are less cost effective by traditional measures—than utility-operated energy efficiency programs serving higher income groups. However, low-income energy programs deliver benefits beyond energy savings to low-income households that are not typically incorporated into traditional cost-effectiveness testing methods. The *National Standard Practice Manual* discusses how low-income program benefits can be considered at the societal level.[34] States can decide to adjust cost-effectiveness tests for

[30] Efficiency Vermont. 2020. *Targeted Communities Program Update*. www.efficiencyvermont.com/trade-partners/targeted-communities-program-update.

[31] Brown, M., A. Soni, M. Lapsa, and K. Southworth. 2020. *Low-Income Energy Affordability: Conclusions from a Literature Review*. ORNL/TM-2019/1150. info.ornl.gov/sites/publications/Files/Pub124723.pdf.

[32] Levin, E., E. Palchak, and R. Stephenson. 2019. *The State of Equity Measurement: A Review of Practices in the Clean Energy Industry*. Winooski, VT: VEIC. www.veic.org/Media/default/documents/resources/reports/equity_measurement_clean_energy_industry.pdf.

[33] Gilleo, A., S. Nowak, and A. Drehobl. 2017. *Making a Difference: Strategies for Successful Low-Income Energy Efficiency Programs*. Washington, DC: ACEEE. aceee.org/sites/default/files/publications/researchreports/u1713.pdf.

[34] National Efficiency Screening Project. 2017. *National Standard Practice Manual*. nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf. Page 58: Societal Low-Income Impacts.

low-income programs to incorporate these additional benefits. For example, Vermont uses the societal cost test as its primary test and incorporates a 15% adder for nonenergy benefits for low-income customers in its cost-effectiveness screening tool. Similarly, Colorado uses the total resource cost test and includes a 50% adder to account for the benefits from low-income programs.

### Renewables and workforce

**Integrate energy efficiency and solar** program offerings to maximize participant benefits. To do this, combined renewable and energy efficiency programs should first invest in energy efficiency to reduce the home's overall energy needs, and then invest in renewable energy so that individual households can install the right size solar system or many households can access community solar options. For example, the Connecticut Green Bank collaborates with PosiGen, a private company, to deliver both solar and energy efficiency to low-income customers. The Green Bank helps PosiGen generate capital to provide 20-year solar leases combined with energy efficiency upgrades to program participants, leading to the most cost-effective investment.[35]

**Support the development of a diverse and strong energy efficiency workforce** that represents the local community. Ensure that training opportunities are linked to high-quality, well-paid, and stable careers in the energy efficiency and clean energy workforce sector. States and local governments, utilities, and other program implementers can focus on diversifying suppliers, increasing the worker pipeline by offering training for both contracting firms and students, and partnering with skills-training providers and state agencies—all while working to overcome barriers faced by historically excluded community members. Implementers can also co-deliver training for energy efficiency and renewable energy technologies. For example, the Chicago-based nonprofit Elevate Energy coordinates a Clean Energy Jobs Accelerator that trains individuals from economically excluded communities for careers in solar and energy efficiency.

[35] EDF (Environmental Defense Fund) and APPRISE (Applied Public Policy Research Institute for Study and Evaluation). 2018. Low-Income Energy Efficiency. New York. www.edf.org/sites/default/files/documents/liee_national_summary.pdf.

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