City of Memphis
TENNESSEE

PATRICE J. ROBINSON
Councilwoman - District 3

CITY COUNCIL

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Energy Efficiency Experts Address City Council on Extreme Energy Burdens in Memphis

ACEEE and EEFA Report on Causes of and Potential Solutions for High Energy Burdens

At the Tuesday, October 18th, meeting of the Memphis City Council's Memphis Light, Gas and Water (MLGW) Committee, the American Council for an Energy Efficient Economy (ACEEE) will present findings from its joint report with Energy Efficiency for All (EEFA), "Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low Income and Underserved Communities," which found that lower-income families in Memphis suffer from the highest energy burdens in the country. Energy burden is the percentage of household income used to pay for utility bills.

The Memphis Branch of the NAACP, along with the Southern Alliance for Clean Energy through the Just Energy Memphis partnership, worked with City Council staff to bring ACEEE to Memphis in order to explain why Memphians have such high-energy burdens.

The ACEEE report identified Memphis as the most energy burdened metropolitan area in our country. On average, Memphians are paying a little more than 6% of their annual income on energy costs, or about 1 percent higher than Birmingham, the next highest metropolitan are,a and almost twice the national average of 3.5 percent. For lower-income families in Memphis, however, these burdens are felt more extremely, averaging 13 percent of annual income – or double that of the average Memphian – with a quarter of low-income families experiencing a burden greater than 25 percent.

"It's unacceptable to me to see our poorest citizens spending upwards of 25% of their paycheck each month just on their utility bill," stated Councilwoman Patrice J. Robinson, who represents District 3 on the Memphis City Council. "As a Memphian who cares deeply for my fellow citizens as well as the Chairwoman of the Council's MLGW Committee, I've been working with my staff and community stakeholders to understand the issue of energy burden and to start moving us towards solutions. I'm excited to have Ariel Drehobl from ACEEE here to present expert testimony before the Council, and I look forward to discussions over the next several months to publicly investigate this issue and move the City of Memphis towards a better future."

"Communities of color, renters, low-income families, and those residing in affordable multifamily housing generally experience higher energy burdens than the average household," said Ariel Drehobl, lead author of the ACEEE energy burden report. "Our study found that these groups all had the highest energy burdens in Memphis. Increasing investments in energy efficiency can help address high energy burdens by lowering household energy bills and improving comfort for these families."

"Many families in Memphis live in older, inefficient housing and lack necessary capital to make home improvements that can reduce high utility bills," said Angela Garrone, Energy Research Attorney for the Southern Alliance for Clean Energy. "We are committed to working with utility staff, city leaders, community groups and national leaders, like ACEEE, to create common sense solutions that can help improve the health and financial stability of our most vulnerable communities."

"As Memphis families with low income or on fixed income struggle to meet their utility expenses, they continue to fall behind in a never ending effort to just keep current on their energy bills," said Madeleine Taylor, Executive Director of the Memphis Branch of the NAACP. "This impacts the health of the families when services are disconnected, their credit worthiness and the likelihood that they can ever be citizens responsible for their survival."

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Lifting the High Energy Burden in America's Largest Cities:

How Energy Efficiency Can Improve Low Income and Underserved Communities

Ariel Drehobl and Lauren Ross

ENERGY EFFICIENCY FOR ALL

ACEEE
American Council for an Energy-Efficient Economy

About the Authors

Ariel Drehobl joined ACEEE in 2015. She conducts research and analysis on local-level energy efficiency policies and initiatives, with an emphasis on low-income energy efficiency. Ariel earned her master of science in environmental science, policy, and management from a joint-degree program at Central European University, Lund University, and the University of Manchester. She earned her bachelor of arts from Northwestern University.

Lauren Ross joined ACEEE in 2014. She manages the local policy team and focuses on the implementation of energy efficiency across low-income communities. Lauren is working on her PhD in urban sociology at Temple University. She earned a master of arts in urban sociology from the George Washington University and a bachelor of arts in political science from the University of Delaware.

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Executive Summary

This report provides a snapshot of energy burdens in cities across the US. We focus on the high home energy burdens faced by select groups in major metropolitan areas.[1] Years of analysis by the firm of Fisher Sheehan & Colton determined that low-income households pay proportionally more than the average household for energy costs.[2] Our analysis builds on this research as we take a closer look at energy burden in specific household groups. In the first half of this report, we analyze data from the US Census Bureau's 2011 and 2013 American Housing Survey to determine energy burden values for 48 of the largest US cities and specific households within each city. In the second half of the report, we discuss strategies for alleviating high energy burdens, with a focus on policies and programs to increase the impact of energy efficiency initiatives in these communities.

Families who face higher energy burdens experience many negative long-term effects on their health and well-being. These families are at greater risk for respiratory diseases and increased stress, and they can experience increased economic hardship and difficulty in moving out of poverty. Our research determined that the overwhelming majority of single-family and multifamily low-income households (those with income at or below 80% of area median income), minority households, low-income households residing in multifamily buildings, and renting households experienced higher energy burdens than the average household in the same city.[3] For example, the median US energy burden across all cities in our sample was 3.5%. The median low-income household's energy burden was more than twice as high at 7.2%, and

three times greater than higher income households (2.3%). Overall, low-income households experienced the highest median energy burden (7.2%), followed by African-American households (5.4%), low-income households living in multifamily buildings (5.0%), Latino households (4.1%), and renting households (4.0%).[4] We also examined the results by region and found that these groups faced the highest average energy burdens in the Southeast and Midwest regions.

Research Results: US Energy Burden Landscape

The efficiency of housing stock is an important factor that influences a household's energy burden. Low-income households, renters, African-American households, and Latino households paid more for utilities per square foot than the average household, indicating that they reside in less efficient housing (see table ES1).

When we compared each group's expenditures on energy per square foot with the median household expenditure, we were able to determine the extent to which home inefficiency contributed to energy burden as compared with lower incomes. We found that for low-income households and for multifamily low-income households, bringing housing stock up to the efficiency of the median household would eliminate 35% of excess energy burden, reducing energy burden from 7.2% to 5.9%. For African-American, Latino, and renting households, 42%, 68%, and 97% of their excess energy burdens, respectively, could be eliminated by raising household efficiency to the median.

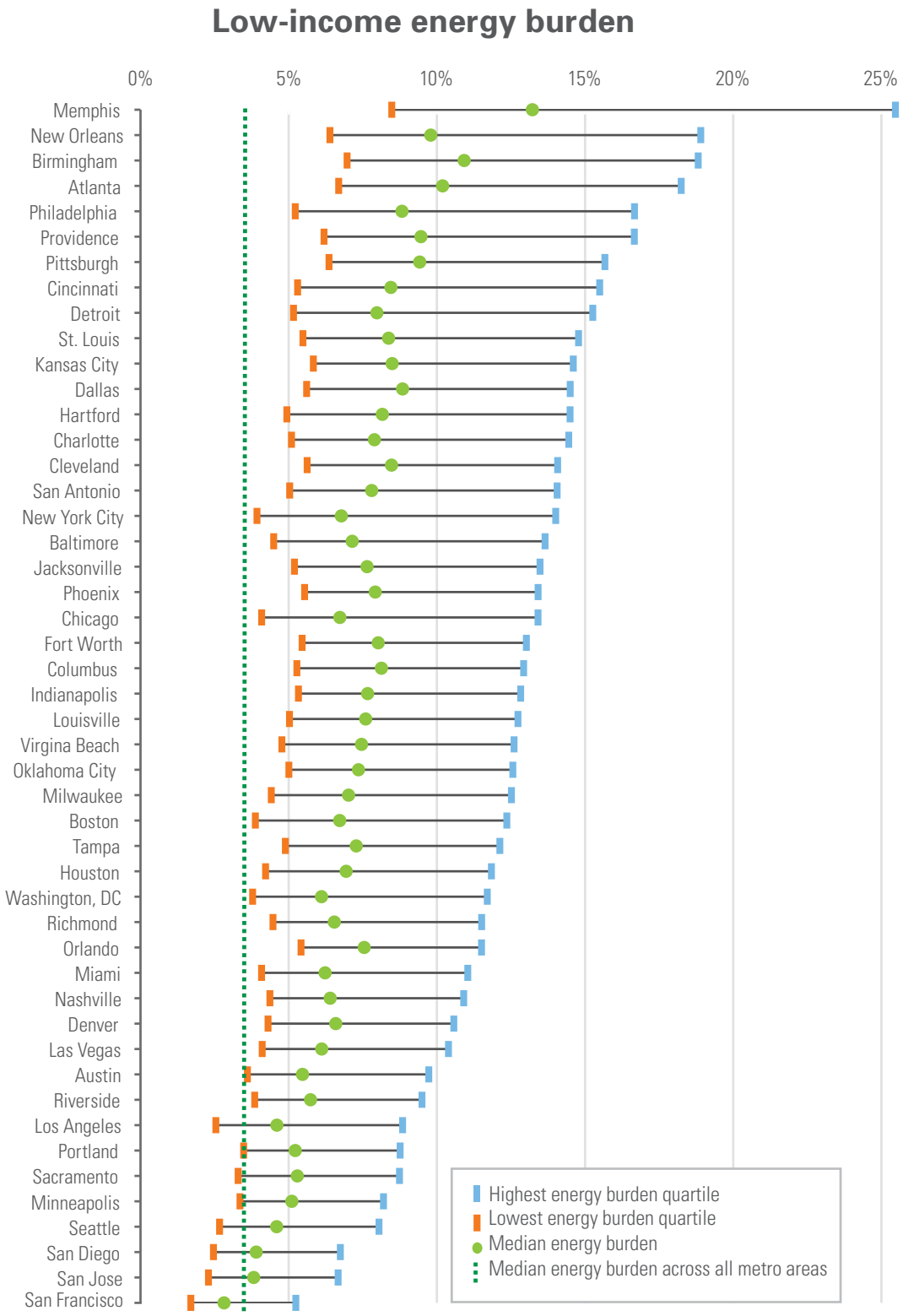
By examining these specific groups within cities, we found that many households experienced energy burdens that greatly exceeded both the overall median of 3.5% and their city medians. Median energy burdens were as high as 13% for some groups.

TABLE ES1. Median income, utility bill, energy burden, and unit size for households based on income type, building type, building ownership, and household race for groups across all metro areas

	Household type	Median annual income	Median size of unit (square feet)	Median annual utility spending	Median annual utility costs per square foot	Median energy burden[1]
Income type	Low-income[2] (≤80% AMI)[3]	$24,998	1,200	$1,692	$1.41	7.2%
	Non-low-income	$90,000	1,800	$2,112	$1.17	2.3%
	Low-income multifamily (≤80% AMI)	$21,996	800	$1,032	$1.29	5.0%
	Non-low-income multifamily	$71,982	950	$1,104	$1.16	1.5%
Building ownership	Renters	$34,972	1,000	$1,404	$1.40	4.0%
	Owners	$68,000	1,850	$2,172	$1.17	3.3%
Head of household race	White	$58,000	1,600	$1,956	$1.22	3.3%
	African-American	$34,494	1,290	$1,920	$1.49	5.4%
	Latino	$39,994	1,200	$1,704	$1.42	4.1%
All households	N/A	$53,988	1,573	$1,932	$1.23	3.5%

[1] Energy burden is the percentage of household income that is spent on energy bills. To calculate median energy burden, we calculated energy burden for all households and then took the median. This value differs from the median energy burden that is calculated using median annual utility spending and income.
[2] Low-income includes both single- and multifamily households. [3] Area median income (AMI) is the median dollar amount that divides the population into two equal parts.
Source: American Housing Survey (Census Bureau 2011 and 2013a).

FIGURE ES1. **Low-income (≤80% AMI) household energy burden for the median, highest energy burden quartile, and lowest energy burden quartile households. The orange bars represent the beginning of the quartile of low-income households with the lowest energy burden. The blue bars represent the beginning of the quartile of low-income households with the highest energy burden. These data include both single- and multifamily low-income households.**



For low-income households, we found that energy burden varied substantially. Figure ES1 presents energy burden data for low-income households in each city at the lowest, median, and highest energy burden quartiles. In 17 cities—which is more than one-third of the cities studied—a quarter of low-income households experienced an energy burden greater than 14%, substantially higher than the 3.5% average for all households.

While energy efficiency programs provide benefits beyond energy savings, we find they are an underutilized strategy that could complement bill assistance and weatherization programs to reduce high energy burdens in low-income communities.

Strategies for Improving Energy Efficiency in Low-Income Communities

Reducing high energy burden on low-income households is a well-established policy objective at the federal, state, and local levels. To help meet this objective, many state utility regulators require that utilities provide bill assistance programs that complement federal programs, such as the Weatherization Assistance Program (WAP) and the Low Income Home Energy Assistance Program (LIHEAP). In addition, many utility regulators require utilities with energy efficiency programs to target low-income customers.

Participants in energy efficiency programs, utilities, and whole communities experience multiple benefits from increased investments in energy efficiency. These benefits include improved health and safety, reduced risk of utility rate increases, reduced costs associated with arrearages and shutoffs, investment in the local economy, and local job creation, among others.[5] While energy efficiency programs provide benefits beyond energy savings, we find they are an underutilized strategy that could complement bill assistance and weatherization programs to reduce high energy burdens in low-income communities.

We propose the following strategies for improving energy efficiency in low-income communities: (1) Improve and expand low-income utility programs. (2) Collect, track, and report demographic data on program participation. (3) Strengthen policy levers and leverage existing programs. (4) Utilize the Clean Power Plan to prioritize investment in low-income energy efficiency.

Improve and Expand Low-Income Utility Programs

To increase program impact in low-income single- and multifamily housing, energy efficiency program managers should design programs to meet the needs of diverse low-income communities, include a range of eligible measures and services, coordinate delivery with other services, align and add on to existing weatherization efforts, address health and safety, and incorporate energy efficiency education into program design.[6]

Low-income programs should also target multifamily customers, who are often underserved by energy efficiency programs. More than two-thirds of the multifamily rental market consists of households that have an annual household income of less than $50,000 (NMHC 2015). Yet residential energy efficiency programs administered by states and utilities have historically focused on single-family, owner-occupied housing. Efficiency measures are far less likely to be installed in multifamily rentals than in any other type of housing, leaving significant energy savings unrealized. Examples of best practices in multifamily programs include integrating direct installation and rebate programs, streamlining rebates and incentives, offering multiple pathways to participation, and incorporating on-bill repayment or low-cost financing, among others.[7]

Access to up-front capital is one of the many barriers to energy efficiency for low-income single- and multifamily households and property owners. Financing programs—provided by several utilities and public and community-based entities—can serve as a complement to energy efficiency programs for low-income customers. With strong consumer protections in place, energy efficiency loans can be beneficial for some households and allow the financing of cost-saving measures. Financing options can also benefit multifamily building owners who lack the up-front capital to invest in energy efficiency retrofits.

Collect, Track, and Report Demographic Data on Program Participation

By collecting and making demographic data on program participation public, utilities can assess the extent to which their programs are serving different segments of the population, especially those customers known to experience high energy burdens. Demographic information can inform program design and marketing and outreach strategies. Examples of demographic data that should be incorporated into program evaluation include income level, renter versus owner, multifamily versus single family, and race/ethnicity.

Strengthen Policy Levers and Leverage Existing Programs

Utility regulators and boards of publicly owned utilities should aid utilities in developing, promoting, and executing strong low-income programs by approving and setting goals and guidelines for spending, savings, cost recovery, and cost-effectiveness testing. Additionally, state and local governments can set policy directives that support low-income energy efficiency, including disclosure and benchmarking policies for multifamily buildings, workforce development initiatives, state-level requirements for utility-delivered energy efficiency that include low-income goals, and other special efforts. Some public utility commissions (PUCs) also set low-income energy savings goals and spending requirements in order to increase investment in low-income energy efficiency. Many community-based organizations, city governments, and local utilities can petition PUCs to advance stronger low-income savings goals.

Few utilities include the nonenergy benefits of energy efficiency in their cost-benefit testing.[8] Both PUCs and local governments can encourage or require that cost-effectiveness testing take into account the multiple benefits of low-income energy efficiency programs.

Utilize the Clean Power Plan to Prioritize Investment in Low-Income Energy Efficiency

The Clean Power Plan—the first rulemaking to set limits on carbon pollution from power plants—offers another incentive for investment in low-income energy efficiency. States have several choices in developing their compliance plans, and they have the opportunity to prioritize low-income energy efficiency programs in this process. States can also opt into the Clean Energy Incentive Program, which offers early credit for energy efficiency projects in low-income communities during the two years before the start of the compliance period. These new regulations can make investment in low-income energy efficiency more attractive at the state and local levels.

Conclusion

We determined that low-income households and other groups experience higher energy burdens than households on average. Low-income families often live in less efficient housing and pay more per square foot on energy costs. Current utility-led energy efficiency programs could better complement bill assistance and weatherization programs to reduce high energy burdens in low-income communities. Our research identified several strategies to ramp up energy efficiency in these communities. While these represent important steps, we still have much work to do to increase energy affordability among vulnerable communities across the country.

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1 Energy burden refers to the percentage of gross household income spent on energy bills.

2 For more information on Fisher Sheehan & Colton's previous work on the Home Energy Affordability Gap, see www.homeenergyaffordabilitygap.com.

3 Area median income (AMI) is the median dollar amount that divides the population into two equal parts. HUD uses AMI to determine eligibility for low-income programs based on metropolitan area and household size.

4 Single-family low-income households experienced the highest average energy burden of 7.8%. We did not specifically analyze these households in this study.

5 For more information, see C. Russell et al., *Recognizing the Value of Energy Efficiency's Multiple Benefits* (Washington, DC: ACEEE, 2015).

6 For a more comprehensive discussion on successful low-income utility programs, see R. Cluett, J. Amann, and S. Ou, *Building Better Energy Efficiency Programs for Low-Income Households* (Washington, DC: ACEEE, 2016).

7 For a more comprehensive discussion of best practices in multifamily energy efficiency programs, see K. Johnson, *Apartment Hunters: Programs Searching for Energy Savings in Multifamily Buildings* (Washington, DC: ACEEE, 2013).

8 See M. Kushler, S. Nowak, and P. Witte, *A National Survey of State Policies and Practices for Evaluation of Ratepayer Funded Energy Efficiency Programs* (Washington, DC: ACEEE, 2012).

Introduction

This report analyzes energy affordability in cities across the United States, focusing on the high home energy burdens faced by select groups in major metropolitan areas. As defined in this study, a household's energy burden is its total annual utility spending (electric, gas, and/or other heating fuel) as a percentage of total annual gross household income. We focus on households in select cities due to the high concentration of poverty in cities, as well as the availability of city-level data.[9] However households in rural areas also suffer from high energy burdens (McCormick 2015). Our focus on cities does not imply that high energy burdens are not a serious issue in rural communities.

Years of analyzing home energy burdens by the firm of Fisher Sheehan & Colton have determined that low-income households pay proportionally more than the average household for energy (Fisher Sheehan & Colton 2013). Our analysis builds on this research as we look more closely at the energy burden of specific household groups. For low-income families, the majority of household income goes toward rent, transportation, and energy, in that order (CNT 2016).[10] In this study, we measure only home energy burden, which includes all spending on a home's energy utility bills. Spending on rent, water, and transportation is outside the scope of this analysis.

Annual energy bills may be affordable for one family but not for another due to differences in income. For example, a low-income family and middle-income family may pay the same $1,800 per year on utilities ($150 monthly average), but for the low-income family, this will be a larger burden on the household.

The data we examine show that the median energy burden for low-income households is more than two times that of the median household (7.2% and 3.5%, respectively), and three times greater than higher income households (2.3%).

This utility bill may represent 8% of annual household income for the low-income family and only 3% for the middle-income family, indicating that the low-income household faces a disproportionate energy burden. The data we examine show that the median energy burden for low-income households is more than two times that of the median household (7.2% and 3.5%, respectively), and three times greater than higher income households (2.3%). Low-income households also pay more per square foot for energy than the average household. These families experience higher energy burdens not only because of lower incomes but also because of inefficiencies in the home. This causes families to face trade-offs between energy and other basic necessities, such as food and medical care.

In the first half of this report, our analysis uses data from the US Census Bureau's *American Housing Survey* (AHS), a national sample of households, to systematically measure energy burdens in metro areas. In the second half of the report, we highlight several policies and programs that can reduce the high energy burden of many households, with a particular focus on programs to improve the energy efficiency of low-income housing. We conclude with an overview of recommended strategies for increasing investments in low-income energy efficiency.

While high energy costs are an important social and economic issue, few have systematically analyzed how energy burdens vary across the country and among specific groups. By developing a clearer understanding of the intersection of energy costs and household demographics, stakeholders can better target investments in energy efficiency to create more economically viable and healthy communities.

9 According to the Brookings Institute's 2013 study, poverty is concentrated in metropolitan areas. Of the families at or below the federal poverty level, 7.3 million live in rural areas as compared to 13.4 million in large cities and a growing 16.4 million in suburbs (Ross 2013).

10 See the Center for Neighborhood Technology's Housing + Transportation Index for more information on housing and transportation affordability: www.cnt.org/tools/housing-and-transportation-affordability-index.

Causes and Effects of High Home Energy Burden

What Is a High Home Energy Burden, and Why Is It Important?

There is no widely accepted value or threshold that establishes whether a household faces a high or unaffordable energy burden. Some researchers suggest home energy bills are unaffordable when they represent more than 6% of a household's annual gross income; others suggest a threshold of at least 10 or 11% of a household's annual gross income (Fisher Sheehan & Colton 2015; Heindl 2015; Hernández and Bird 2010).[11] Fisher Sheehan & Colton recommends using an affordability standard of 6% of gross household income based on the idea that a household can afford to spend about 30% of income on shelter costs and that about 20% of shelter costs are used for energy bills. Meanwhile, the Applied Public Policy Research Institute for Study and Evaluation (APPRISE) uses a model that identifies a severe shelter burden as 50% or more of income, and energy costs as about 22% of shelter costs.[12] Using this approach, APPRISE suggests that analysts use 11% of income as an indicator of high energy burden (APPRISE 2007). Other researchers and policymakers use the area median energy burden as the threshold for affordable energy. For example, the Nevada Percentage of Income program indicates that low-income home energy burden should be no higher than that of a median-income household (Nevada 2013). Others suggest that high energy burden should be defined as twice the median (Liddell et al. 2012; Moor 2012). When we discuss high energy burden in this report, we refer to households with an energy burden greater than the city's median energy burden.

As in the case of housing and transportation costs, low-income households spend a greater proportion of their income on energy costs compared with the average household.

The families who are the worst off—such as those with extremely low incomes or who face sudden economic

hardship—often suffer from high rates of arrearages and potential utility shutoffs due to unpaid energy bills. These families often live in older, less efficient housing stock, which means that their homes require more energy for heating and cooling than newer, more efficient housing (Penney and Kloer 2015). Due to lack of savings, disposable income, and access to credit, low-income households also have fewer choices in regard to housing options, with many low-income families living in units with structural deficiencies that can make energy retrofits not viable. These families also experience greater barriers to upgrading housing stock with traditional efficiency measures, especially in multifamily buildings where the majority of low-income residents are renters (EPC 2013a).

The families who are the worst off—such as those with extremely low incomes or who face sudden economic hardship—often suffer from high rates of arrearages and potential utility shutoffs due to unpaid energy bills.

Causes of High Home Energy Burden

Numerous factors contribute to a high household energy burden. Commonly reported causes of high utility expenses are inefficiencies in housing, such as poor insulation or air leaks; inefficient heating systems and appliances; lack of control over systems and appliances (e.g., in rental households); lack of access to or information about relevant energy efficiency programs; and lack of knowledge about energy conservation measures. High energy burden can also be caused by income reductions, such as loss of employment or support, or an increase in utility bills, such as with additional children or adult household members. In table 1, we list a range of possible physical, economic, policy, and behavioral factors that cause high energy burden.

Even though they spend a larger proportion of their income on energy than the average home, low-income households typically spend less on energy overall. According to the US Energy Information Administration's 2009 *Residential Energy Consumption Survey*, low-income households spend on average $1,690 annually on energy bills, while the average non-low-income household spends $2,134 per year (EIA 2009).[13] However low-income utility bills are lower not because low-income households are more efficient, but often because they live in smaller spaces.

At the same time, low-income households spend much more per square foot on utilities, with an average cost of $1.23 per square foot for low-income households

TABLE 1. Drivers of household energy burden

Type of driver	Examples
Physical	Inefficient and/or poorly maintained HVAC systems
	Heating system and fuel type
	Poor insulation, leaky roofs, and inadequate air sealing
	Inefficient large-scale appliances (e.g., refrigerators, dishwashers) and lighting sources
	Weather extremes that raise the need for heating and cooling
Economic	Chronic economic hardship due to persistent low income (see text box "Income Inequality and Energy Affordability")
	Sudden economic hardship (e.g., severe health event or unemployment)
	Inability or difficulty affording the up-front costs of energy efficiency investments
Policy	Insufficient or inaccessible policies and programs for bill assistance, weatherization, and energy efficiency for low-income households
	Certain utility rate design practices, such as high customer fixed charges, that limit the ability of customers to respond to high bills through energy efficiency or conservation
Behavioral	Lack of access to information about bill assistance or energy efficiency programs
	Lack of knowledge about energy conservation measures
	Increased energy use due to age or disability

versus $0.98 for non-low-income households (EIA 2009). The higher energy cost per square foot in low-income households appears to be, at least in part, a function of energy use, household/appliance efficiency, and unit size. Low-income households make up the majority of multifamily rentals, and families who rent tend to use more energy on average than owner-occupied homes, due in part to the difficulties renters face in regard to energy efficiency investments (Carliner 2013). In addition, the structure and appliances are less efficient in low-income housing (Penney and Kloer 2015). For example, low-income households are more likely to have older and less efficient appliances such as refrigerators and washing machines (EIA 2013). Finally, energy consumption is typically spread over a smaller area in low-income households, which are on average smaller than the average home (Census Bureau 2013a).

Investing in energy efficiency upgrades is often more challenging for low-income households than for higher-income households. For renters, of which the majority are low-income, landlords who do not pay for utilities may not be motivated to invest in efficiency upgrades, and renters may not want to invest, unsure if their tenure will be sufficient to recoup the investment. In many cases, low-income home and building owners are not able to afford the up-front investment needed to upgrade housing stock and equipment. The type of heating system installed in a building will also influence energy burden, as certain heating technologies are more expensive than others. Later in this report, we discuss strategies for overcoming the up-front barriers to energy efficiency investments for low-income households.

Therefore, customers' inability to meet monthly utility payments may lead to higher costs for the utility, which can lead to even higher home energy burdens for all households.

Customers who have difficulty paying their bills may ultimately contribute to additional utility costs that can increase utility bills for all customers. For example, the utility's costs for covering arrearages, bill payment accommodations, and shutoffs are distributed to all ratepayers. Therefore, customers' inability to meet monthly utility payments may lead to higher costs for the utility, which can lead to even higher home energy burdens for all households.

A recent trend toward raising fixed monthly charges on customer utility bills also threatens energy affordability, especially for low-income customers (Kind 2015). Fixed charges are generally applied to all bills equally, or based on peak demand, and are not related to the volume of energy usage. Shifting costs to fixed charges and away from the amount of energy use itself acts as a disincentive for energy efficiency and reduces the ability of the customer to save money by conserving energy (Whited, Woolf, and Daniel 2016). Increases in energy bills due to higher fixed charges pose a real threat to already overburdened households, negating their efforts to avoid high energy bills by reducing consumption. Strategies aimed at improving energy affordability must also address the issue of rising fixed charges and their impacts on low-income customers.

INCOME INEQUALITY AND ENERGY AFFORDABILITY

If income does not increase for all households on par with changes in energy costs, household energy burden for low-income and disadvantaged households will increase in future years. In the largest US cities, income inequality continues to rise and consistently remains higher than the national average (Stone et al. 2015). Between 1979 and 2007, the average income of the bottom 99% of households grew by 18.9%, while the average income of the top 1% of households grew by 200.5% (Sommeiller and Price 2015; Desilver 2015). According to a 2016 Brookings report, declining incomes are an influential factor in present-day inequality, as most households in cities experience growing income inequality between the top 5% and bottom 20% of households (Berube and Holmes 2015). Slow income growth—or even real income decline at the lowest levels—can lead to more extensive economic hardship and unaffordable energy costs. From 2004 to 2014, average US residential electricity prices increased from 9 cents/kWh to 12.5 cents/kWh, an increase of 39% (EIA 2016a). In contrast, average adjusted income grew from $29,900 in 2004 to $30,180 in 2014, an increase of 0.9% (Census Bureau 2014). If energy prices continue to increase more rapidly than income, energy burden will continue to grow for vulnerable households.

Families suffering from high energy burdens also tend to experience stress from living in constant fear of losing necessary electricity and gas service due to inability to pay their bills.

Effects of High Energy Burden

Addressing energy affordability can help to break the cycle of poverty and improve economic development, educational achievement, and public health. High energy burden can cause very real mental and physical health problems for household members due to thermal discomfort, inadequate lighting, unsafe housing conditions, and constant financial and social stress. Individuals who experience high energy burdens may cut back on necessary energy use and inadequately heat, cool, and light their homes, which can result in many negative health consequences.

Studies have found that living in homes that are not properly heated or cooled increases cases of asthma, respiratory problems, heart disease, arthritis, and rheumatism (Heyman 2011; Hernández and Bird 2010; Liddell and Morris 2010; Wright 2004). Children and the elderly are more susceptible to these health impacts. Families suffering from high energy burdens also tend to experience stress from living in constant fear of losing necessary electricity and gas service due to inability to pay their bills.

For many low-income families, this compounds with other stresses, such as difficulty accessing health care, fear of losing their housing, and living in potentially unsafe buildings and neighborhoods. These constant stresses cause serious health problems.

Researchers have also found that high energy burdens affect mental health by creating more stressful environments, increasing social isolation, and negatively impacting educational achievement and emotional resiliency (Li et al. 2014; Dear and McMichael 2011; Liddell and Morris 2010). Families that have trouble paying their energy bills may sacrifice nutrition, medicine, and other necessities in order to avoid shutoffs. These effects are especially detrimental to the physical and mental development of children. Living in underheated homes puts adolescents at double the risk of respiratory problems and five times the risk of mental health problems (Dear and McMichael 2011). Families may also cope with high energy burdens by heating fewer rooms in their home and reducing lighting use (Bruner Spitzer, and Christanell 2012). These stresses can hinder the ability of adolescents to study and complete school assignments, which negatively affects their academic success.

High energy burdens can also cause societal problems extending well beyond the household. For example, 5.5% of low-income customers in California experienced disconnections for nonpayment in 2011 as compared with 2.9% of non-low-income customers. Half of the disconnected households owed less than $315, and 6% of those disconnected did not reconnect within the year. Because of the disconnections, some of these families improvised hazardous methods to light and heat their homes (Watts-Zagha 2011). Additionally, researchers conducted studies in northern Kentucky, St. Paul, and Philadelphia and found utility shutoffs to be one of the primary factors that led to homelessness (Vick and Norton 2008).

Ultimately, the drivers and effects of high energy burden create a negative feedback loop that can become a trap that is hard to escape. Various factors associated with low income contribute to a high energy burden. In turn, higher utility bills require more of a family's income and make them more likely to remain in poverty.

The troubling reality is that many households resort to high-cost payday lending in order to pay their utility bills, which can further exacerbate the cycle of poverty. A 2012 study found that paying utility bills was the most common reason why individuals took out a payday loan (Levy and Sledge 2012). These loans are small, short-term loans with high interest rates that can make repayment difficult and costly. By addressing energy affordability, policymakers can help to break the cycle of poverty and increase economic development, educational achievement, and public health.

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11 For more information on defining the energy affordability gap, see Fisher Sheehan & Colton's Home Energy Affordability Gap research at www.homeenergyaffordabilitygap.com. They provide a model that calculates the monetary gap between actual and affordable home energy bills at the county level for segments of the low-income population. Their model includes factors left out of this research, such as household size, fuel mix, and heating and cooling degree days.

12 In this context, shelter costs include all expenses relating to housing, such as rent or mortgage payments, condominium fees, utilities, and property taxes.

13 In 2009, the US Energy Information Administration's Residential Energy Consumption Survey defined "low-income" as less than or equal to 150% of the federal poverty line (FPL). This survey compiles data from a household survey and energy supplier survey and uses estimates of consumption and expenditures.

The US Home Energy Burden Landscape

We took a snapshot of energy burdens across the largest US metropolitan areas, with a focus on select groups. These data have helped us understand the disproportionate impact of energy burden on vulnerable households and the extent to which this experience varies regionally.

Methodology

Research shows that low-income households, especially renters and minority households, face disproportionate energy cost burdens (Hernández 2015). As part of this analysis, we focus on the energy burdens experienced by four groups of households:

- *Low-income households*: those who report an annual gross household income at or below 80% of the area median income, including both single- and multifamily households[14]
    - *Low-income multifamily households*: those who report an annual gross household income at or below 80% of the area median income and reside in a building with five or more units
- *Minority households*: African-American and Latino families[15]
- *Renting households*

We analyzed data from the US Census Bureau and US Department of Housing and Urban Development's (HUD) *American Housing Survey* (AHS) in 2011 and 2013. This survey samples households across the US to gather information on housing stock characteristics, housing and energy costs, occupant characteristics, and other related information (Census Bureau 2011 and 2013a). The survey is conducted every two years in 25 to 30 metro areas; the 2011 and 2013 surveys contain the most recent city data available. The survey's unit of analysis is the household, and interviewees self-report

TABLE 2. Metropolitan statistical areas (MSAs) included in analysis, by region

Northeast	Southeast	Midwest	South Central	Southwest	Northwest	California
Baltimore	Atlanta	Chicago	Austin	Denver	Portland	Los Angeles
Boston	Birmingham	Cincinnati	Dallas	Las Vegas	Seattle	Riverside
Hartford	Charlotte	Cleveland	Fort Worth	Phoenix		Sacramento
New York City	Jacksonville	Columbus	Houston			San Diego
Philadelphia	Louisville	Detroit	Oklahoma City			San Francisco
Pittsburgh	Memphis	Indianapolis	San Antonio			San Jose
Providence	Miami	Kansas City				
Washington, DC	Nashville	Milwaukee				
	New Orleans	Minneapolis				
	Orlando	St. Louis				
	Richmond					
	Tampa					
	Virginia Beach					

all collected information. For this study, we analyzed individual household-level data to measure energy burden in 48 of the largest US metropolitan statistical areas (MSAs), as detailed in table 2.[16]

Data Limitations

We experienced a few limitations in our analysis that should be considered when examining the results. While city samples are representative, these data represent only a snapshot in time (2011 and 2013). Therefore, the results may not reflect future energy burdens. Volatile gas or oil prices, stagnant wages, and rising electricity prices in past and future years could also significantly impact home energy burden. We did not adjust energy bills to reflect the difference in energy prices between 2011 and 2013 (EIA 2016b).

These data are also self-reported. Every household in the sample provided self-reported estimates of average monthly electricity and heating fuel bills, as well as estimated household income and household size. Even so, our findings are comparable to EIA's 2009 *Residential Energy Consumption Survey* (EIA 2009). EIA found that the average household spent $2,134 and low-income household spent $1,690 annually on energy bills, which is similar to our findings of $1,932 and $1,692 median annual bills for the average household and low-income household.

We also limited our sample to include only those households that reported positive income, paid their electricity bill directly, and also directly paid for their main heating fuel (electricity, gas, fuel oil, wood, coal, kerosene, or other).[17] Due to a lack of data necessary to calculate energy burden, our analysis necessarily excludes two categories of low-income homes that often have a high energy burden: households without any reported income and households in master-metered apartment buildings where energy costs are paid by the landlord and incorporated into monthly rent. Before we limited the sample sizes, the average city sample size was 4,190 households. This was reduced to 2,700 households after controlling for the above factors.

Measuring Home Energy Burden

We calculated energy burden as follows:

$$\text{HOME ENERGY BURDEN} = \frac{\text{TOTAL ENERGY UTILITY SPENDING}^{18}}{\text{TOTAL GROSS HOUSEHOLD INCOME}}$$

We first determined the energy burden for each household in our data set, and then calculated the median burden for each of the four household groups in each metro area (see Appendix B).[19]

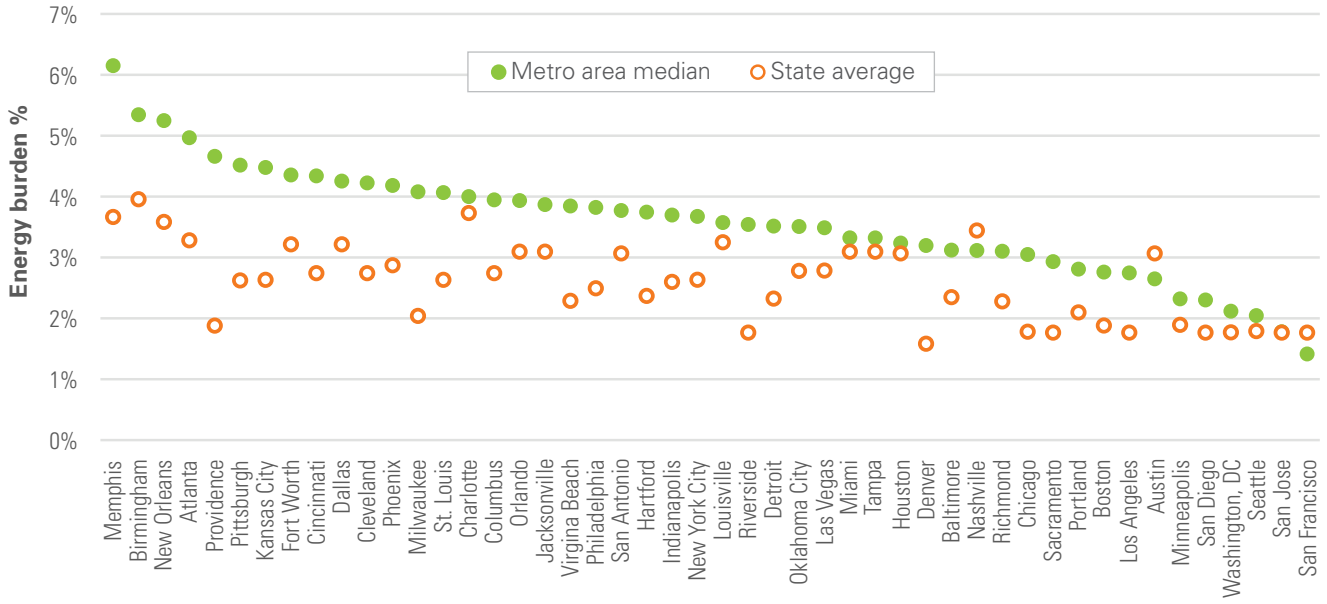
We also examined the households at the highest energy burden quartile in each group. (Simply put, 25% of households have an energy burden equal to or greater than the highest energy burden quartile value.) Appendix C shows the highest energy burden quartile value alongside the median. This additional analysis of the highest quartile gives a better sense of the burden placed on the most vulnerable households in each metro area, without the median burden masking the extremes.

Because different cities have different median energy burdens, comparing vulnerable groups between cities becomes difficult and potentially misleading. To provide a way to compare groups between cities, we created a metric that measures the proportion of each group that experiences an energy burden greater than or equal to twice the metropolitan area's median energy burden. We report these results in Appendix D.

Results: Energy Burdens in US Cities

Figure 1 compares the median energy burden in each metro area with the average for its state. Because we could not calculate state energy burdens using the AHS data set, we used EIA and US Census Bureau data to make these calculations. Most cities have higher energy burdens than the state average.[20] The five cities with the greatest difference between the city and state energy burden were Providence, Memphis, Milwaukee, Pittsburgh, and Kansas City. In these cities, the median metro-area energy burden ranged from 1.9 to 2.8 percentage points greater than the overall burden for the state.

FIGURE 1. Median energy burden for metro area and average energy burden for state households. Metro areas are ranked by their median energy burden. We used American Housing Survey (AHS) data from 2011 and 2013 to calculate the median energy burden for the metro areas (Census Bureau 2011 and 2013a). We also used data from the 2011 and 2013 US Energy Information Administration (Annual Electric Power Industry Report, EIA-861) and average historical income from 2011 and 2013 (Census Bureau 2013b) to calculate the average energy burden for the states.



Metro areas also varied by their median energy burden, ranging from more than 6% to less than 1.5%. The cities with the highest median energy burdens were Memphis (6.2%), Birmingham (5.3%), New Orleans (5.3%), Atlanta (5.0%), and Providence (4.7%). These metro areas—and others with higher median energy burdens—differ from one another in terms of typical energy costs. Overall, metro areas in the Southeast and Midwest regions faced the highest median energy burdens.

It is noteworthy that many of the metro areas in the Southeast—a region with relatively low electricity prices and lower average incomes—faced the highest energy burdens compared with cities nationally. As we describe further in the text box "The Relationship between Energy Burden and Energy Prices," low electricity prices do not equate to low bills. Figure 2 provides a visual

FIGURE 2. Median metro-area energy burden for all households

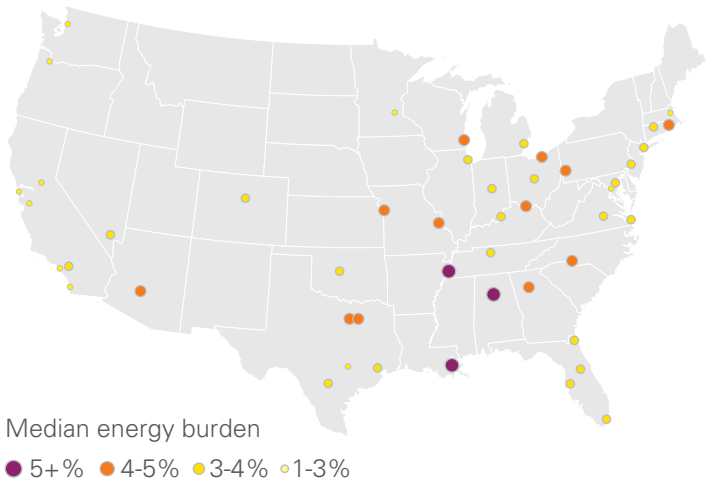


TABLE 3. Median income, utility bill, energy burden, and unit size for households based on income type, building type, building ownership, and household race for groups across all metro areas

	Household type	Median annual income	Median size of unit (square feet)	Median annual utility spending	Median annual utility costs per square foot	Median energy burden[1]
Income type	Low-income[2] (≤80% AMI[3])	$24,998	1,200	$1,692	$1.41	7.2%
	Non-low-income	$90,000	1,800	$2,112	$1.17	2.3%
	Low-income multifamily (≤80% AMI)	$21,996	800	$1,032	$1.29	5.0%
	Non-low-income multifamily	$71,982	950	$1,104	$1.16	1.5%
Building ownership	Renters	$34,972	1,000	$1,404	$1.40	4.0%
	Owners	$68,000	1,850	$2,172	$1.17	3.3%
Head-of-household race	White	$58,000	1,600	$1,956	$1.22	3.3%
	African-American	$34,494	1,290	$1,920	$1.49	5.4%
	Latino	$39,994	1,200	$1,704	$1.42	4.1%
All households	N/A	$53,988	1,573	$1,932	$1.23	3.5%

[1] Energy burden is the percentage of household income that is spent on energy bills. To calculate median energy burden, we calculated energy burden for each household, then took the median. This value differs from the median energy burden that is calculated using median annual utility spending and income.
[2] Low-income includes both single- and multifamily households.
[3] Area median income (AMI) is the median dollar amount that divides the population into two equal parts.
Source: American Housing Survey (Census Bureau 2011 and 2013a).

representation of the median energy burdens in metro regions across the country. See Appendix B for the median energy burden values for each city.

The five cities with the lowest median energy burdens were San Francisco (1.4%), San Jose (1.8%), Seattle (2.1%), Washington, DC (2.1%), and San Diego (2.3%). In these cities, households spent less of their overall income on utility bills, which could be due to a combination of lower energy bills and higher household income throughout the metro areas, and/or more efficient buildings and energy use.

Currently, we cannot make causal arguments about why a city has either a high or low energy burden. Factors such as the efficiency of housing stock and the effectiveness and reach of energy efficiency investments, among other factors, may play a role. More research is needed to understand the drivers of energy burdens in specific geographical areas.

Results: Energy Burden Trends by Household Group

We compared various household groups in our sample to identify overall energy burden trends. Table 3 includes median income, housing unit size, annual utility bills, annual utility spending per square foot, and energy burden for these groups across all metro areas.

Median energy burdens in low-income households were more than three times higher than in non-low-income households (7.2% and 2.3%, respectively). Higher energy burdens result in part from lower income. The data also show these households have higher energy cost per square foot than the average household, which could indicate lower efficiency of the housing unit itself. We discuss this point in greater detail below. The situation for multifamily households was similar. The median low-income multifamily household experienced an energy burden more than three times higher than that of the median non-low-income multifamily household (5.0% and 1.5%, respectively) and had higher utility cost per square foot.[21] Renters were also disproportionately impacted. The median renter experienced an energy burden greater than that of the median owner (4.0% and 3.3%, respectively).

We also found that energy burdens were related to the race of householders. On average, African-American and white households paid similar utility bills, but African-American households experienced a median energy burden 64% greater than white households (5.4% and 3.3%, respectively). Latino households paid lower utility bills, on average, than African-American and white households did, yet they experienced a median energy burden 24% greater than white households (4.1% and 3.3%, respectively).

Looking at how inefficient housing contributes to this issue, we calculated what the energy burdens for various categories would be if their housing stock were as efficient as the median— i.e., if their energy expenditures per square foot were the same as the median for all households. Then, for each category, we calculated the proportion of the excess energy burden (the difference between category median burdens and the all-household median burden) that would be eliminated if their housing stock were brought up to the efficiency standard of the all-household median.

THE RELATIONSHIP BETWEEN ENERGY BURDEN AND ENERGY PRICES

Many people confuse their high energy bills with high electricity and gas prices. However our findings show that low prices do not necessarily mean low bills. Consider that, in 2014, three of the five states with the highest average monthly utility bills for households—Alabama, South Carolina, and Mississippi—were states with average (not high) electricity prices and a wide range of gas prices. Our study found that the Southeast and Midwest regions, while having among the lowest average prices, also had the highest average metropolitan energy burdens. In 2014, New Orleans and Memphis were among the five cities in our sample with the lowest average electricity prices (both $0.10/kWh) and average gas prices ($10.9 and $10.1/1,000 ft^3). Even with these low prices, these two cities are in the top three for highest average energy burden for all households, at 5.27% and 6.18%, respectively. Therefore, it is important to recognize that factors beyond prices—such as lower incomes and inefficient housing stock—contribute to high energy bills.

We found that for all low-income households and for multifamily low-income households, bringing their housing stock up to the efficiency level of the median household would eliminate 35% of their excess energy burden. As one might expect, the energy burdens of low-income households are driven in large part by their low-income status. However more than one-third of their excess energy burden was caused by inefficient housing stock. Bringing their homes up to median efficiency would lower their energy burden from 7.2% to 5.9%. For African-American and Latino households, 42% and 68% of the excess energy burden, respectively, was due to inefficient homes. For renters that number was 97%, meaning that almost all of their excess energy burden could be eliminated by making their homes as efficient as the median.

Far from being an intractable problem related to persistent income disparity, the excess energy burdens they face are directly related to the inefficiency of their homes. This is important not only for understanding how best to address the problem for various populations, but also to correct any misconceptions that the energy burden problem is a driven purely by income, a perception that might be reinforced by the stark differences in incomes shown in table 3.

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Results: Energy Burdens by City and Household Groups

When we examined specific demographic groups across different cities, we found that many of these groups experienced energy burdens greatly exceeding

TABLE 4. Energy burdens for demographic groups in the 10 cities with the highest energy burdens

	All households	Low-income households*	Low-income multifamily households	African-American households	Latino households	Renting households
1	Memphis (6.2%)	Memphis (13.2%)	Memphis (10.9%)	Memphis (9.7%)	Memphis (8.3%)	Memphis (8.6%)
2	Birmingham (5.3%)	Birmingham (10.9%)	Birmingham (8.7%)	Pittsburgh (8.3%)	Providence (7.3%)	Birmingham (7.3%)
3	New Orleans (5.3%)	Atlanta (10.2%)	Atlanta (8.3%)	New Orleans (8.1%)	Philadelphia (7.3%)	Atlanta (6.8%)
4	Atlanta (5.0%)	New Orleans (9.8%)	Providence (7.1%)	Kansas City (7.9%)	Kansas City (6.6%)	New Orleans (6.3%)
5	Providence (4.7%)	Providence (9.5%)	Pittsburgh (7.1%)	Birmingham (7.7%)	Atlanta (6.6%)	Providence (6.2%)
6	Pittsburgh (4.5%)	Pittsburgh (9.4%)	New Orleans (6.9%)	Milwaukee (7.4%)	Birmingham (6.6%)	Kansas City (6.1%)
7	Kansas City (4.5%)	Dallas (8.8%)	Columbus (6.5%)	St. Louis (7.4%)	Phoenix (6.0%)	Pittsburgh (6.0%)
8	Fort Worth (4.4%)	Philadelphia (8.8%)	Dallas (6.5%)	Cleveland (7.0%)	Dallas (6.0%)	Cincinnati (6.0%)
9	Cincinnati (4.3%)	Kansas City (8.5%)	Indianapolis (6.5%)	Cincinnati (6.9%)	Fort Worth (5.7%)	St. Louis (5.9%)
10	Dallas (4.3%)	Cleveland (8.5%)	Kansas City (6.3%)	Atlanta (6.6%)	Detroit (5.7%)	Cleveland (5.5%)

* Low-income includes both single- and multifamily households.

the city median, ranging as high as 13% for some groups (see Appendix B). Table 4 gives details for the 10 cities with the highest overall median energy burdens, as per figure 1. For example, low-income households face the greatest energy burden in Memphis (13.2%), Birmingham (10.9%), and Atlanta (10.2%), and African-American households face the greatest energy burden in Memphis (9.7%), Pittsburgh (8.3%), and New Orleans (8.1%).

Results by Energy Burden Quartile

We also calculated energy burden for the highest energy burden quartile households in each group (see Appendix C). Simply looking at the median does not provide insight into the distribution across the group and does not properly represent the range of experiences of those who are the worst off within these groups. We can better understand this by comparing the energy burden of the household at the median and the highest quartile of energy burdens.

For example, the median low-income energy burden in Atlanta was 10.2%, meaning that half of the city's low-income households experienced an energy burden greater than 10.2%. Looking at the highest energy burden quartile in Atlanta, we can see that 25% of the low-income population experienced an energy burden greater than or equal to 18.2%. This is more than three times the city median of 5.0%. Results for the 10 cities with the highest energy burdens are detailed in table 5.

In Atlanta, we can see that 25% of the low-income population experienced an energy burden greater than or equal to 18.2%. This is more than three times the city median of 5.0%.

TABLE 5. Highest energy burden quartiles in the 10 cities with the highest energy burdens

	All households	Low-income households*	Low-income multifamily households	African-American households	Latino households	Renting households
1	Memphis (12.8%)	Memphis (25.5%)	Memphis (21.8%)	Memphis (19.4%)	Memphis (15.9%)	Memphis (18.5%)
2	Birmingham (10.8%)	New Orleans (18.9%)	Birmingham (16.2%)	New Orleans (16.4%)	Philadelphia (15.7%)	Birmingham (15.1%)
3	New Orleans (10.0%)	Birmingham (18.8%)	Atlanta (15.7%)	Kansas City (16.2%)	Pittsburgh (12.4%)	Atlanta (13.3%)
4	Atlanta (9.7%)	Atlanta (18.2%)	Pittsburgh (15.7%)	Pittsburgh (16.1%)	Kansas City (12.0%)	St. Louis (12.9%)
5	Providence (8.7%)	Philadelphia (16.7%)	Chicago (14.6%)	Cincinnati (15.6%)	Providence (11.7%)	New Orleans (12.6%)
6	Pittsburgh (8.6%)	Providence (16.7%)	Cincinnati (13.0%)	Milwaukee (15.5%)	Atlanta (11.5%)	Cincinnati (12.1%)
7	Cincinnati (8.5%)	Pittsburgh (15.7%)	St. Louis (12.9%)	Birmingham (15.4%)	Hartford (11.1%)	Cleveland (11.9%)
8	Kansas City (8.4%)	Cincinnati (15.5%)	Cleveland (12.3%)	Chicago (15.3%)	Phoenix (10.7%)	Pittsburgh (11.9%)
9	Philadelphia (8.3%)	Detroit (15.3%)	Hartford (11.8%)	Detroit (14.8%)	Birmingham (10.4%)	Providence (11.7%)
10	Dallas (8.2%)	St. Louis (14.8%)	Fort Worth (11.4%)	St. Louis (14.4%)	Detroit (10.2%)	Kansas City (11.7%)

* Low-income includes both single- and multifamily households.

FIGURE 4. **Low-income (≤80% AMI) household energy burdens for the median, highest energy burden quartile, and lowest energy burden quartile households for each metro area. The orange bars represent the beginning of the quartile of low-income households with the lowest energy burden. The blue bars represent the beginning of the quartile of low-income households with the highest energy burden. These data include both single- and multifamily low-income households.**

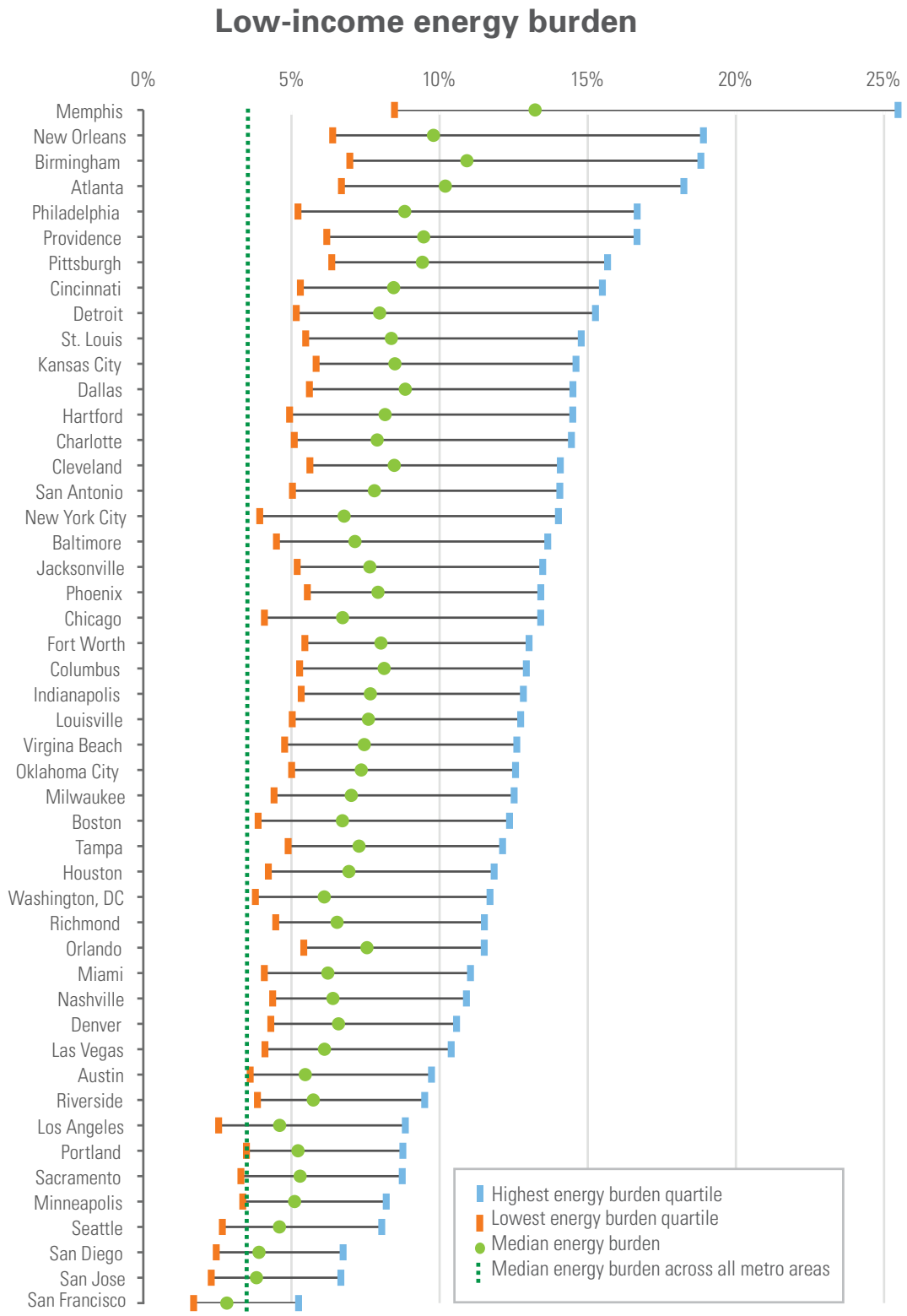


Figure 4 provides a more detailed representation of the energy burden faced by low-income households in each metro area. Across the metro areas in our sample, based on our definition of "low-income" (≤80% of AMI), low-income households made up 44% of all households included in our analysis (see Appendix A). Figure 4 highlights the household energy burdens for the highest and lowest quartiles, as well as the median energy burden for all low-income households. For comparison, the figure also includes a line indicating the median energy burden for all households across all metro areas in the sample.

For low-income households, the range of energy burdens varies greatly across and within cities. For example, one-fourth of low-income households in Nashville had an energy burden below 4.4%, one-fourth had an energy burden between 4.4% and the median of 6.4%, one-fourth had an energy burden between 6.4% and 10.9%, and one-fourth had a burden greater than 10.9%. The data, presented in this way, are useful for understanding the depth of the low-income energy burden in cities. In 17 cities, a quarter of low-income households experienced an energy burden greater than 14%.

In 17 cities, a quarter of low-income households experienced an energy burden greater than 14%.

Additionally, we assessed the energy burden for certain households and examined the proportion of residents that experienced an energy burden greater than or equal to twice the city median. We include this analysis in Appendix D. For all the cities in the sample, at least 38% of low-income households experienced an energy burden that was twice the city median.

Results: Regional Energy Burden Trends

In this section, we examine regional energy burden data for our select groups in more detail. Figure 5 shows the regional median energy burden for each group and for all households. In Appendix E, we include similar graphs for each region.

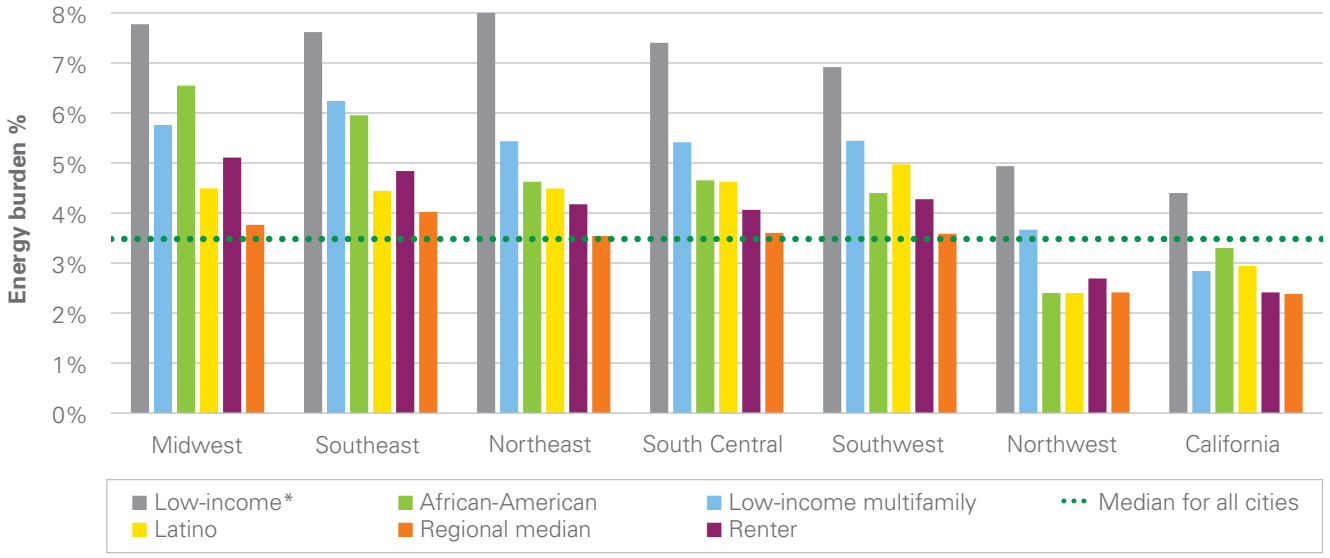
Metro areas in the Midwest and Southeast had the highest median energy burdens across all groups, with African-American and low-income multifamily households the worst-off in these regions.

Low-income households—including both single- and multifamily—had the highest energy burden in each region and were the worst-off across Northeastern metro areas. While we cannot attribute with certainty

REGIONAL TRENDS IN UTILITY ENERGY EFFICIENCY INVESTMENTS

We found that many cities with little to no investment in utility energy efficiency programs also experienced higher average energy burdens. Programs that help households save energy are often administered by the local utility. Utilities taking the lead on energy efficiency provide an array of programs for commercial and residential customers. Some localities and states will adopt energy savings targets or requirements to encourage and guide utility program spending and design. According to the rankings in *The 2015 City Energy Efficiency Scorecard* issued by ACEEE, the utilities with the least spending on energy efficiency programs were those serving southeastern cities. All of the southeastern cities in the *Scorecard* fell within the bottom 40% of the ranking (Ribeiro et al. 2015b). The cities with the most energy efficiency investment in 2015 were Boston, Minneapolis, Portland (Oregon), Chicago, and San Francisco. However, even when cities do have strong utility programs, there is no guarantee that low-income households will benefit. Information on what types of households are currently being served by energy efficiency programs is crucial to ensuring that these programs reach a diverse set of households.

FIGURE 5. Energy burden of select groups by region, ordered from highest to lowest based on the average of the median energy burdens across all groups.



* Low-income includes both single- and multifamily households.

the drivers of high energy burden within specific regions and cities, we know that numerous factors are at play. Southeastern households have the lowest median incomes in the country, which likely contributes to higher energy burdens. In terms of energy prices, the Southeast, Midwest, and Northwest regions have the lowest average electricity prices, but at the same time, they also have the highest average energy burdens. This indicates that low electricity and gas prices do not necessarily lead to low bills or affordable energy (see earlier text box "The Relationship between Energy Burden and Energy Prices"). Although we do not know the relative efficiency of housing stock in the Southeast, we do know that the southeastern utilities serving major cities currently have the lowest investment in energy efficiency programs as compared with other regions (see text box "Regional Trends in Utility Energy Efficiency Investments"). Low energy prices therefore do not compensate for the lack of energy efficiency investment or low incomes.

Metro areas in the Midwest and Southeast had the highest median energy burdens across all groups, with African-American and low-income multifamily households the worst-off in these regions.

14 Area median income (AMI) is the median dollar amount that divides the population into two equal parts. HUD uses AMI to determine eligibility for low-income programs based on metropolitan area and household size.

15 Sample sizes in some cities for Latino households (Birmingham, Cincinnati, Detroit, Louisville, Pittsburgh, and St. Louis) and African-American households (Portland) were small. See Appendix A for sample sizes for each group by city.

16 A metropolitan statistical area (MSA) is a geographical region typically made up of several counties, with a core urban area having a population of 50,000 or more. MSAs, therefore, include a central city and surrounding suburbs. Raleigh and Salt Lake City, two of the top 50 MSAs, were not included in the AHS 2011 and 2013 and therefore were not included in this analysis. See Appendix A for the corresponding year of data for each MSA—either 2011 or 2013.

17 See Appendix A for sample sizes for each group studied after filtering for these variables.

18 Total utility spending includes average annual spending on electricity and heating fuels, as reported. Total gross household income includes all annual income reported by all household members, including all government assistance.

19 By using medians for both income and energy costs, we were able to arrive at a truer median, as the data distributions for income and energy costs differed greatly.

20 We should note that we are comparing a median energy burden in metro areas with an average energy burden statewide. By using an average, the data may be skewed toward higher values because there is a zero lower bound on energy burden and no upper bound.

21 Single-family low-income households experienced the highest average energy burden of 7.8%. We did not specifically analyze these households in this study.

Policies and Programs to Address High Energy Burdens

In the following sections of this report, we discuss policies and programs that address high energy burdens, with a focus on energy efficiency. Reducing the impact of high energy burden has been a long-standing policy goal at the local, state, and national levels. Policy has focused on three main intervention programs: bill payment assistance, weatherization, and utility-funded efficiency programs (see table 6).

These efforts aim to address the two factors that impact energy burden: low income and high energy bills. Federal, state, local, and utility funding supports these programs as well as other, related programs that focus on health and safety, behavior, and education.[22]

Policymakers and program administrators design these programs to address high utility bills, inefficiencies in housing units, and lack of awareness in regard to energy efficiency programs and actions that customers can take.

TABLE 6. Policies and programs for addressing high energy burden

Program type	Program	Funding source
Bill assistance	Low Income Home Energy Assistance Program (LIHEAP)	Federal and state taxpayers
	Other low-income bill assistance programs	Utility ratepayers; private contributions
	Modified rate design, rate discounts or waivers, and modified billing methods	Utility ratepayers
Weatherization	Weatherization Assistance Program (WAP)	Federal and state taxpayers
Energy efficiency	Low-income energy efficiency programs[1]	Utility ratepayers[2]

[1] Customer benefit surcharges are collected through customer utility bills. Public utility commissions or city councils set these charges, and the utility uses this money to fund energy efficiency and energy education programs. [2] Non-utility entities can also fund low-income energy efficiency programs, such as the Regional Greenhouse Gas Initiative (RGGI), Qualified Energy Conservation Bonds (QECBs), state treasury funding, and general obligation bonds (EPC 2013b; RGGI 2015; Brown 2008).

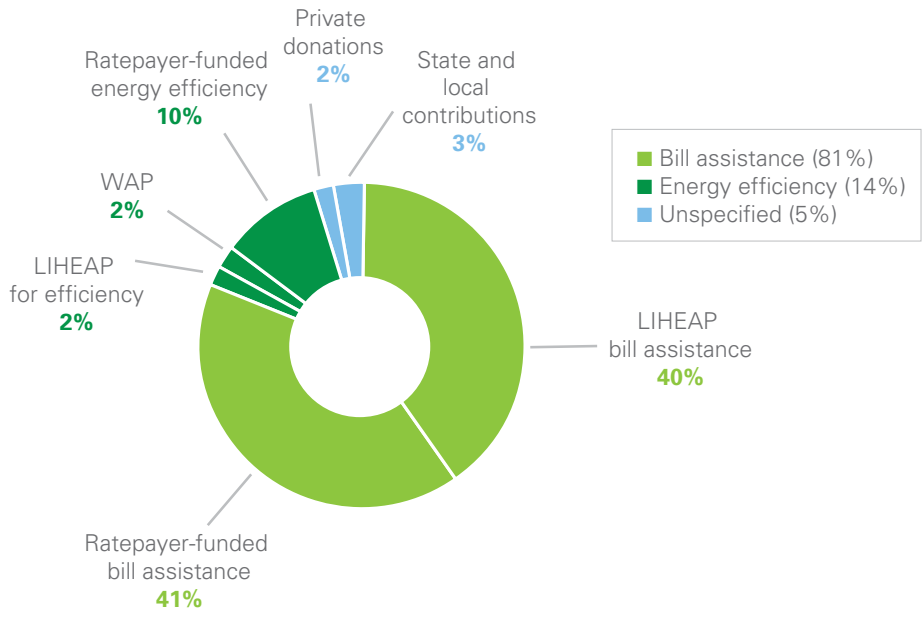
Funding for low-income programs varies by program type. Figure 6 illustrates the allocation of funding from ratepayer-funded bill assistance and energy efficiency programs, the Weatherization Assistance Program (WAP), and the Low Income Home Energy Assistance Program (LIHEAP). As indicated in the chart, the overwhelming majority of program support—about 81%, or $6.31 billion—goes toward helping customers pay their utility bills. Energy efficiency programs receive about 14% of program support ($1.17 billion), and the remaining 5% of program support ($38 million) is unspecified (LIHEAP Clearinghouse 2016). While bill assistance programs provide important, immediate relief to distressed households, energy efficiency investment appears to be an underutilized strategy for addressing energy affordability. Increased investment, expanded reach, and improved design of energy efficiency programs could better complement bill assistance and weatherization programs.

Increased investment, expanded reach, and improved design of energy efficiency programs could better complement bill assistance and weatherization programs.

Bill Assistance Programs

Bill assistance programs provide financial assistance to help families pay their immediate home energy bills. The federally funded Low Income Home Energy Assistance Program (LIHEAP) is the primary vehicle for bill assistance. LIHEAP provides funding to states, based on a formula, and then states allocate this funding to qualified households according to established federal parameters. Funds can take the form of direct bill assistance, crisis assistance, support for weatherization programs, or other aid to reduce household energy needs (Perl 2012). The bulk of funding, however, goes toward energy bill assistance and ends up with utilities. States typically determine household eligibility for bill assistance as between 150% and 110% of the federal poverty line, or 60% of the state median income.

FIGURE 6. Support for low-income energy needs. Data on ratepayer-funded bill assistance, ratepayer-funded energy efficiency, WAP, and LIHEAP assistance are from 2013. LIHEAP spending on efficiency is approximated based on 6% of LIHEAP funds spent on efficiency in 2006. Data on state and local contributions and private donations are from 2010. Data collected from the LIHEAP Clearinghouse in 2016. *Source:* Cluett, Amann, and Ou 2016.



LIHEAP serves between 20 and 25% of eligible households, about 7.6 million in 2009 and 8.3 million in 2010 (Jackson 2011). Other bill assistance programs help to meet the overwhelming need, such as voluntary utility customer contributions to cold weather funds and other forms of bill assistance, programs supported by charitable groups, and, in some cases, structured payment programs offered by utilities. Agencies that provide weatherization services may also deliver LIHEAP assistance. In these cases, LIHEAP eligibility can act as a gateway for weatherization and low-income energy efficiency programs. Bill assistance programs remain critical for alleviating the *immediate* energy burden that many households face, but they could be better coordinated with weatherization and other energy efficiency programs to provide upgrades that can reduce energy burden over the long term.

Weatherization Programs

Weatherization programs address the longer-term energy needs of households by making home repairs that reduce high energy bills. By upgrading the efficiency of homes, programs can then reach more customers who need immediate assistance with more persistent intervention. Weatherization programs consist of energy efficiency measures aimed at improving the building envelope, such as weather-stripping doors and windows, air sealing, and installing insulation. In some cases, weatherization includes upgrades or repairs to heating and cooling systems and the reduction of electric baseload consumption through energy efficiency measures such as lighting and appliances, but these measures are less common among typical weatherization programs.

The federal government, state governments, and utilities all fund and sponsor weatherization programs. The US Department of Energy's Weatherization Assistance Program (WAP) historically has been the largest funder of these programs. Because states can choose to allocate funding from LIHEAP toward weatherization programs, LIHEAP funding (as well as state and local funding) supplements WAP in many states. Households with income up to 200% of the federal poverty line qualify for WAP funding. WAP estimates that 38 million households qualify for the program and that of these, approximately 15 million are good candidates for cost-effective weatherization (WAPTAC 2016). Over the history of the program, WAP has served about 7 million households (Benefits.gov 2015). Numerous factors limit the reach of the federal program, such as funding, capacity of implementing agencies, and the necessity of making health and safety improvements before weatherization can begin.[23]

The most effective weatherization programs address the largest household energy uses with the longest sustained savings (e.g., heating and cooling systems), which often have the greatest impact on reducing energy burdens. Low-income housing units can also require substantial structural improvements before energy efficiency measures can be implemented; these can be costly and require large up-front investment. However many researchers have proved these programs to be cost effective in the long run. The Department of Energy determined that, on average, the value of efficiency upgrades is 2.2 times greater than their cost (DOE 2015). This value does not come from energy savings alone, as WAP also aims to improve health, safety, and security for participating households. When program evaluators include all of these multiple benefits into cost–benefit analyses, WAP proves to be a cost-effective solution to improving energy affordability.

Utility Energy Efficiency Programs

Many utilities provide energy efficiency programs that target low-income households. These programs are funded through customers (or "ratepayers"). Such programs generally have a very good record of delivering cost-effective energy savings as a resource to the entire utility system. Unlike bill assistance and most weatherization programs, utility energy efficiency programs can include a variety of program strategies.[24] Some utility energy efficiency programs operate in tandem with local or statewide weatherization efforts, using similar channels to reach customers.

When program evaluators include all of these multiple benefits into cost–benefit analyses, WAP proves to be a cost-effective solution to improving energy affordability.

Typical low-income programs focus on single-family whole-house retrofits (Cluett, Amann, and Ou 2016; Hoffman et al. 2015). These programs can mirror other residential energy efficiency programs offered by utilities or weatherization implementers; they often focus on specific measures and provide higher incentives. The most common low-income energy efficiency approaches are of two types: comprehensive weatherization, and the direct installation of low-cost energy efficiency measures (e.g., efficient lighting, high-efficiency showerheads and faucet aerators, and air infiltration reductions). Some utilities operate direct-install programs targeting multifamily rental buildings as part of their low-income program offerings. Other, less common low-income programs include conservation kits, product rebates, appliance recycling, and programs that promote behavioral change or provide information on home energy use (Cluett, Amann, and Ou 2016).

Low-income households in multifamily buildings can also be reached through whole-building programs that target these buildings and typically require the participation of only the building owner. In most cases, energy efficiency retrofits and measures provide energy bill reduction for both owner and residents. There are three types of program models that utilities typically use to serve their multifamily customers: direct install services, equipment and product rebates, and comprehensive energy retrofits for existing buildings and new construction (Johnson and Mackres 2013). In some cases, these programs are adapted to meet the needs of properties that house low-income residents by offering higher incentives or additional measures.

Despite the existence of such programs, low-income households remain a hard-to-reach group with many barriers to participation.

Despite the existence of such programs, low-income households remain a hard-to-reach group with many barriers to participation. Most utilities have found that their energy efficiency program strategies do not adequately reach these households (Rasmussen et al. 2014). Low-income households and owners of multifamily buildings that provide affordable housing may find it challenging to participate in residential low-income energy efficiency programs that require a copay. These households may also lack the time, resources, and up-front capital to register and participate. As a result, many low-income programs offer free or discounted direct-install measures, such as efficient lighting, low-flow showerheads, smart thermostats, and/or smart power strips in order to facilitate program participation.

22 At times, low-income programs that address health and safety issues are implemented in conjunction with weatherization programs to provide the most comprehensive offering. These programs make sure the house is fit from a health and safety perspective before it undergoes weatherization (Wilson and Katz 2010). Behavior and education programs can also supplement low-income assistance and energy efficiency programs. These programs typically provide educational material on energy saving behaviors, feedback on customer energy use, or games and other interactive measures to encourage energy savings (Mazur-Stommen and Farley 2013).

23 Spending on WAP is historically low. However, as a part of the American Recovery and Reinvestment Act of 2009, WAP received $5 billion over the course of 2009, 2010, and 2011, which is about 25 times the funding the program has received in each year since (LIHEAP Clearinghouse 2016).

24 For more information on best practices for low-income utility programs, see Cluett, Amann, and Ou 2016.

Benefits of Investing in Energy Efficiency in Low-Income Communities

Low-income energy efficiency programs provide benefits that go beyond reduced utility bills and beyond benefits experienced by direct participants. In table 7, we categorize these benefits as those received by participating low-income households, by utilities and ratepayers, and by the wider community. These values can justify policy decisions to increase such investments.

Low-income households participating in energy efficiency programs report direct benefits that improve their quality of life. For example, energy efficiency investments lower energy bills, which reduces energy burden, eases economic and social stresses, and provides families with more disposable income that can be spent on other necessities beyond energy (e.g., medicine, food, transportation) (Tonn et al. 2014). Building efficiency upgrades also increase property value and the reliability of appliances and HVAC equipment, which reduces maintenance costs and stress (Cluett and Amann 2015). Multiple case studies by the New York State Energy Research and Development Authority (NYSERDA) found that energy efficiency programs also increase tenant comfort and provide tenants with more control over their surroundings (NYSERDA 2013a; NYSERDA 2013b). These benefits occur as a result of both single- and multifamily energy efficiency projects, though some benefits—such as increased property value—accrue only to the building owner in cases where the household rents the unit (Russell et al. 2015).

In affordable multifamily housing, the cost of energy is typically the highest controllable operating expense. Reducing operating expenses allows affordable housing providers to maintain reasonable rents, invest in resident services, and make necessary building improvements. Energy efficiency can also help low-income households manage bills in the event of utility

TABLE 7. Energy efficiency benefits for low-income households, utilities, and communities

Benefit recipient	Energy efficiency outcome	Resulting benefit
Low-income program participants	Lower monthly utility bills	Lower household energy burden and greater disposable income
		Reduced stress and fewer trade-offs between energy and other necessities
		Reduced exposure to risk from utility rate increases
	Improvements in the efficiency of the housing stock	Improved health and safety and greater household comfort
		Increased property value, more reliable equipment, and lower maintenance costs
		Greater satisfaction with the building/unit and improved household and neighborhood stability
Utilities and ratepayers	Demand-side management (both gas and electric)	Avoided excess costs of increased generation, capacity, and transmission investments
		Contribution toward compliance with energy efficiency portfolio standards and other environmental legislation
	Cost savings to utilities and ratepayers	Reduced arrearages and cost of shutoffs, which lowers utility operating costs
		Improved customer service
Communities	Lower electric and gas demand	Reduced environmental pollutants and improved public health
	Lower monthly utility bills due to avoided utility costs	More money spent in the local economy due to greater household disposable income, with higher local multiplier effect
		Poverty alleviation and increased standard of living
	Improvements in the efficiency of the housing stock	Local job creation through weatherization programs and energy efficiency providers and trade allies
		Improved quality of life
		Increased property values and preservation of housing stock

price increases and variable seasons. In 2014, residential electricity prices rose to the highest level in six years, with average electric price increasing by 3.1% annually between 2008 and 2014 (EIA 2015). By improving household efficiency, individuals and communities can be more resilient in times of price increases.

Utilities operate energy efficiency programs because of the benefits that accrue not only to customers but also to the utility system. Investing in low-income energy efficiency can mean avoiding the excess costs of increased energy generation, capacity, and transmission due to reduced demand. The reduction in energy production due to efficiency also reduces environmental pollutants, which helps utilities comply with environmental legislation that limits emissions (Baatz 2015; Brockway, Kallay, and Malone 2014). Energy efficiency investments in low-income communities also reduce the risk of arrearages and the costs of shutoffs for families who have difficulty paying their bills. By lowering these costs, utilities can reduce overall tariffs and charges for their entire ratepayer base.

By improving household efficiency, individuals and communities can be more resilient in times of price increases.

Although not all low-income customers have the opportunity to participate in their utility's energy efficiency programs, research shows that energy efficiency benefits

the whole community and can be used as a core strategy for increasing energy affordability and community resilience (Ribeiro et al. 2015a). Energy efficiency programs benefit the entire population by reducing environmental pollutants, which tend to impact low-income communities disproportionately (NAACP 2015; EPA 2012. Investments in energy efficiency also stimulate the local economy by providing individuals and families with greater disposable income, alleviating poverty, increasing purchasing power, and creating more local jobs (Bell 2014; IEA 2014).

Last, investing in energy efficiency allows communities to increase their percentage of renewable energy sources. Numerous state and local governments have invested in solar energy projects for low-income multifamily households; these include the Colorado Energy Office, the District of Columbia Department of Energy and Environment, and the Baltimore Office of Sustainability (Collins 2015; Shahan 2015). By using energy efficiency to lower a building's energy demand, utilities and local governments can maximize the percentage of a building's energy needs that can be met by renewables. Also, because energy efficiency is relatively inexpensive, it can help reduce the total cost per kWh of a combined renewable energy and energy efficiency project. As more states and local governments seek to advance renewable projects in low-income communities—and especially in multifamily housing—energy efficiency can and should play a crucial role in these efforts.

Energy efficiency programs benefit the entire population by reducing environmental pollutants, which tend to impact low-income communities disproportionately.

Strategies for Improving Energy Efficiency in Low-Income Communities

When developing energy efficiency policies and programs, policymakers and other stakeholders must consider the extent to which these investments will reach the target populations, especially those experiencing persistent and high energy burdens. Individuals or families experiencing high energy burdens vary in important ways relevant to program design: by ownership, income, building type, race/ethnicity, energy use per square foot, and languages spoken (Berelson 2014). Therefore, programs and policies should be designed, targeted, and implemented with the goal of reaching a wide variety of households facing high energy burdens.

Based on research, experience, and findings in other reports, we suggest the following strategies for improving energy efficiency in low-income communities:

- Improve and expand low-income utility programs
- Collect, track, and report demographic data on program participation
- Strengthen policy levers and more effectively leverage existing programs
- Utilize the Clean Power Plan to prioritize investment in low-income energy efficiency

Utilities and state and local governments can utilize these strategies to create more effective low-income energy efficiency programs. These strategies should be used in combination, and they should be prioritized according to the needs of the community.

Improve and Expand Low-Income Utility Programs

Take advantage of best practices in low-income energy efficiency program design and delivery

Utilities and other program administrators can increase the impact of their low-income programs by taking advantage of best practices in low-income energy efficiency program design and delivery. In doing so, they must recognize the diversity of the low-income housing stock, including renter- and owner-occupied housing as well as single- and multifamily units.

In regard to single-family housing, successful low-income energy efficiency programs have been found to

- offer a range of measures and services
- coordinate delivery with other organizations
- align and add on to existing weatherization efforts
- address health and safety issues when implementing efficiency measures
- incorporate strategies for customer energy efficiency education

Some programs may also coordinate efficiency with bill assistance programs and develop dual-fuel and fuel-blind programs to make program delivery seamless. Examples of utilities and other program administrators that run strong low-income energy efficiency programs include Southern California Edison, Efficiency Vermont, National Grid, and Pacific Power. For a more comprehensive discussion of successful low-income utility programs, see ACEEE's 2016 report *Building Better Energy Efficiency Programs for Low-Income Households* (Cluett, Amann, and Ou 2016).

To achieve greater savings within this sector, utilities can offer more comprehensive programs that meet the needs of a diverse low-income customer base. These programs could include direct-install and weatherization measures, as well as appliance, equipment, and electronics upgrades. Currently, the majority of low-income energy efficiency programs offered by utilities focus on the weatherization model and direct-install measures, with the most common ones including insulation, air sealing, and heating and cooling measures (Cluett, Amann, Ou 2016). Some utility programs go beyond weatherization and incorporate additional offerings, such as energy efficiency equipment upgrades and initiatives that encourage behavioral change.

Utilities are well positioned to serve low-income customers with energy efficiency programs. They already have built-in communication channels and relationships with households and building owners who receive their energy bills. Some utilities have also built strong partnerships with trusted community organizations to disseminate information and run programs. For example, utilities can expand low-income energy efficiency programs alongside WAP implementation in order to best leverage delivery channels and program strengths and resources (Cluett, Amann, and Ou 2016). In order to better inform the design and delivery of low-income energy efficiency programs, state and local governments can partner with utilities and local organizations that already work on outreach to low-income communities. Local governments can also assist with joint delivery of energy efficiency programs with other low-income services in order to streamline program delivery and maximize participation.

Develop Programs Targeted to Affordable Multifamily Housing

In many states the majority of low-income households are renters. Yet residential energy efficiency programs administered by states and utilities have historically focused on single-family, owner-occupied housing. Efficiency measures are far less likely to be installed in multifamily rentals than in any other type of housing, leaving significant unrealized energy savings (Pivo 2014). A recent study issued by Energy Efficiency for All estimates that energy efficiency in multifamily affordable housing could realistically cut the sector's electricity usage by as much as 26%, based on data from a sample of states (Mosenthal and Socks 2015).

Utilities and other program administrators should develop programs to target multifamily customers. In 2013, ACEEE completed a review of leading multifamily programs and identified 10 best practices among these programs (Johnson 2013):

- provide a one-stop shop for program services
- incorporate on-bill repayment or low-cost financing
- integrate direct installation and rebate programs
- streamline rebates and incentivize in-unit measures to overcome split incentives
- coordinate programs across electric, natural gas, and water utilities
- provide escalating incentives for achieving greater savings levels
- serve both low-income and market-rate multifamily households
- align utility and housing finance programs
- partner with the local multifamily housing industry
- offer multiple pathways for participation to reach more buildings

Program administrators designed these programs specifically to serve multifamily customers, often targeting building owners who have a budget for repairs and improvements. As a result, these programs often address the specific needs identified for this market.

Work with Utility Regulators and Utilities to Document and Recognize the Nonenergy Benefits of Low-Income Energy Efficiency Programs

Program administrators do not often include nonenergy benefits in their pre- and post-program cost–benefit analyses, even though programs often have purposes beyond energy savings, such as addressing health and safety measures and increasing energy affordability (Cluett, Amann, and Ou 2016). A 2012 ACEEE study found that less than one-third of sampled utilities included the multiple and nonenergy benefits of energy efficiency in their cost–benefit testing, although three-fourths did include all participant costs. Of the utilities that included multiple benefits, few included comprehensive nonenergy benefits, with utilities in Massachusetts and Rhode Island performing best in this regard (Kushler, Nowak, and Witte 2012).

Both public utility commissions and local governments can encourage or require cost-effectiveness screening and testing to take into account the multiple benefits of low-income energy efficiency programs.

When program administrators include the nonenergy benefits of energy efficiency alongside energy savings, the benefit–cost ratio can improve to up to 1.5 times the initial investment for single-family households and up to 3.5 times for multifamily households (Russell et al. 2015; Mosenthal and Socks 2015). Program managers and researchers have not yet come to an agreement on values for nonenergy benefits of energy efficiency, but studies show that these benefits, especially health-related ones, greatly increase the benefit-cost ratio (Skumatz 2014; Oppenheim and MacGregor 2014). Some utilities have found ways to account for these benefits, such as by using an adder in the cost–benefit calculation. An adder is a factor that adjusts the calculated benefit of an energy efficiency measure on the basis of its perceived value, including nonenergy benefits. In other words, while certain benefits may be difficult to measure, it is more accurate to use an approximation than to use zero.

When program administrators include the nonenergy benefits of energy efficiency alongside energy savings, the benefit–cost ratio can improve to up to 1.5 times the initial investment for single-family households and up to 3.5 times for multifamily households.

By including costs and excluding some benefits, the evaluation of low-income programs might not reflect their full value. If tests measure only energy-related benefits, then costs not associated with energy—such as health- and safety-related home repairs and job training—should not be included. In order to produce more accurate results, benefit–cost tests should include only costs and benefits related to energy savings or include all energy and nonenergy costs and benefits.

Some states—including Connecticut, California, and New Hampshire—acknowledge that low-income programs provide benefits beyond energy savings (Berelson 2014; Woolf et al. 2013). These states do not apply the same cost-effectiveness standards to low-income programs that they apply to the other energy efficiency programs throughout the state. They recognize difficult-to-measure nonenergy benefits, as well as the fact that the portfolio must include programs that reach low-income households even if those particular programs incur higher costs. Program administrators may set a lower cost-effectiveness threshold for low-income programs, or they may use adders to account for the non-monetized benefits (Cluett and Amann 2015). For example, cost–benefit testing of low-income programs in Colorado assumes an increase in benefits of 25%, and Vermont similarly increases benefits by 15% for low-income programs (Malmgren and Skumatz 2014).

Provide Financing Options to Households and Building Owners

Access to up-front capital is one of the many barriers to energy efficiency for low-income households and low-income multifamily property owners. Several utilities and public and community-based entities have developed financing programs to help these customers access credit to make cost-effective energy efficiency improvements. These programs have the potential to serve as a complement to energy efficiency programs for low-income customers. In the Southeast, electric cooperative utilities are increasingly offering financing

programs that enable households to pay for energy efficiency upgrades via their utility bills. The bill reductions due to energy savings help cover the cost of upgrades (Marsh-Robinson 2016; Lundin 2016). While these programs are typically open to all customers, many low-income households participate.

On-bill financing programs, like most loan products, should include program terms with strong consumer protections. They should also strive to achieve bill neutrality, which means that energy savings from efficiency investments cover the monthly loan payments so the post-investment bill does not exceed the pre-investment amount.[25] With strong consumer protections in place, energy efficiency loans can prove beneficial for some households by providing a way to finance efficient and cost-saving measures.

Financing can also be critical to furthering energy efficiency investments in multifamily housing. Multifamily building owners, especially low-income housing providers, face increasing operational costs as their buildings age. Maintenance and improvement priorities often compete with energy efficiency upgrades for limited financial capital, and as a result, building owners often lack the up-front capital needed for energy efficiency retrofits. Low-interest financing or on-bill financing can limit or eliminate up-front costs, allowing building owners to undertake more substantial energy efficiency projects and repay loans with a portion of the energy savings.

Additionally, state housing finance agencies can support energy efficiency in both new and existing affordable multifamily buildings. Their financing programs can require energy efficiency standards in all new construction and rehabilitation that they support in this sector. They can also work with utilities that provide ratepayer-funded programs for multifamily building owners. Utility incentives can be applied to refinance or redevelopment loans to buy down some up-front costs and yield deeper, more comprehensive energy efficiency improvements throughout the affordable building stock.[26]

Collect, Track, and Report Demographic Data on Program Participation

By collecting demographic data on program participation, utilities can assess the extent to which their programs are serving different segments of the population, especially those customers known to experience high energy burdens. For example, many utilities do not track the percentage of multifamily customers that they serve relative to the eligible customer base, leaving themselves unaware of the extent to which they are adequately serving these customers. Utilities can rely on this information to inform program design and marketing and outreach strategies. Our research indicates that some of the household demographics that should be incorporated into program evaluation for these purposes include: income level, renter versus owner, multifamily versus single family, and race/ethnicity. These data points and/or evaluations should also be made available to the public for stakeholder review (Kallay et al. 2015).

Even though some utilities do collect demographic data on program participation, few utilities use this information during program evaluation. In a sample of California utility programs, the majority did collect demographic data and published these data in their evaluation reports, but only half of these utilities used the data to make program design recommendations, and even fewer used the data in the analysis of program impact (Frank and Nowak 2016 forthcoming). According to this study, utility program managers most commonly collected data on income and education, with data on home ownership, age, language spoken, and race/ethnicity collected less often.

While some utilities use segmentation to identify customers for specific programs using factors such as geography, income, and energy use per square foot to determine who should be targeted for certain programs, the majority of programs do not use demographic information for evaluation purposes. For many, collecting these data would be a first step toward better program design and measurement. To ensure that energy efficiency programs reach all types of households—especially those experiencing high energy burdens—program administrators should examine demographically identifiable participation gaps in past programs, adjust their program design to target these populations, and continue to collect and analyze these data to measure program success.

Strengthen Policy Levers and Leverage Existing Programs

Utility regulators and boards of publicly owned utilities should help utilities develop, promote, and execute strong low-income programs by approving and

setting goals and guidelines for spending, savings, cost recovery, and cost-effectiveness testing. For municipally owned utilities, city boards and councils can require strong goals and targets for low-income energy efficiency savings and also incorporate cost-effectiveness testing into program evaluation. Even though public utility commissions (PUCs) set goals for investor-owned utilities (IOUs), state and local governments can still encourage PUCs to set low-income program goals and evaluation criteria and can advocate for improved program design and implementation.

Additionally, state and local governments can set policy directives that support low-income energy efficiency, disclosure and benchmarking policies for multifamily buildings, workforce development initiatives, state-level requirements for utility-delivered energy efficiency (e.g., energy efficiency resource standards [EERSs]), and other, related efforts.[27]

States can also set EERSs that include targets for the low-income sector. Currently, 25 states have an EERS in place, and some of these also have low-income energy-saving goals. Utilities in states that do not have an EERS could also create quantifiable performance indicators (QPIs) that include low-income efficiency programs as a measurement of success.[28] For example, Efficiency Vermont includes a minimum acceptable threshold for low-income household participation in programs as one of its QPIs, aiming for $7.5 million in spending on low-income single- and multifamily programs (Efficiency Vermont 2013). Local governments can support the development of low-income goals and performance indicators by advocating to their PUC, petitioning the utility itself for QPIs, or establishing targets for municipally owned utilities.

Some PUCs also set low-income energy savings goals and spending requirements. For example, the Maine Public Utilities Commission allocates 10% of energy efficiency funds to support low-income programs. Some stakeholders advocate for PUCs to adopt more-stringent goals. Massachusetts's Green Communities Act requires that energy efficiency program funds be allocated in proportion to the customer class from which the funds are contributed but also stipulates that at least 10% for electric and 20% for gas energy efficiency programs be spent on comprehensive low-income programs (Commonwealth of Massachusetts 2008). In Pennsylvania, many community-based organizations, city governments, and local utilities petitioned the PUC to raise its low-income goal. In June 2015, their efforts succeeded: the PUC increased its low-income target from 4.5% to 5.5% of energy efficiency savings by 2021 (Pennsylvania Public Utility Commission 2016).

Use the Clean Power Plan to Prioritize Investment in Low-Income Energy Efficiency

The Clean Power Plan, announced by President Obama on August 3, 2015, sets the first-ever limits on carbon pollution from power plants—the nation's largest source of the pollution driving dangerous climate

State and local governments can set policy directives that support low-income energy efficiency, disclosure and benchmarking policies for multifamily buildings, workforce development initiatives, state-level requirements for utility-delivered energy efficiency.

change. The US Environmental Protection Agency (EPA) projects that by 2030, the Clean Power Plan will cut the electric sector's carbon pollution by 32% nationally, relative to 2005 levels (EPA 2016). Under the Clean Power Plan, states have the opportunity to develop state plans that apply emissions limits to their power plants. They face several choices in developing these plans, and they can, if they wish, prioritize low-income energy efficiency programs in this process.

To do so, states would first choose a plan approach that incentivizes low-income energy efficiency programs. One way to do this would be to adopt a mass-based plan, which limits the total amount of carbon pollution from the state's power plants. Under this system, the state issues a permit—called an allowance—for each ton of carbon pollution that its power plants are allowed to emit. These allowances have an economic value because they represent the right to emit one ton of a capped pollutant.

Next, states would distribute these allowances in a manner that allowed their value to be captured for public policy purposes, including low-income energy efficiency programs. There are three main ways states can do this. First, they can auction allowances and take in revenue, and then use some of this revenue to fund low-income energy efficiency programs. This is the approach used in the northeastern and mid-Atlantic states in the Regional Greenhouse Gas Initiative, which invested $1 billion of allowance auction revenue in energy efficiency programs between 2008 and 2013 (RGGI 2015). Second, in states where distribution utilities operate separately from power plant owners (known as deregulated states), allowances can be distributed to the distribution utility, which operates under public utility commission oversight. The distribution utility then sells these allowances and uses the revenue for regulator-approved activities, such as funding low-income energy efficiency programs. Third, states can allocate allowances directly to low-income energy efficiency programs, which can then sell them to generate revenue. All three strategies can be used to fund programs.

States can also opt in to the Clean Energy Incentive Program, which offers early credit for energy efficiency projects in low-income communities during the two years prior to the start of the compliance period. Without this program, projects could not receive credit until the start of the compliance period, currently slated for 2022. For each megawatt-hour of electricity that programs save in 2020 and 2021, eligible low-income energy efficiency programs will get two emission rate credits, or an equivalent number of allowances. Project developers can sell credits to power plant owners, gaining revenue to offset program costs.

Low-income energy efficiency providers should engage with state air agencies to help shape state plans. The Clean Power Plan provides a unique opportunity to drive investment in low-income energy efficiency programs and gives states additional incentive to act.

25 For more information on consumer protections for on-bill financing programs, particularly for low-income households, see Burcat and Power 2013.

26 For properties financed through Low Income Housing Tax Credits (LIHTC), recapitalization windows present approximately every 15 years.

27 Disclosure and benchmarking policies refer to local laws that require owners of commercial and multifamily residential buildings to annually disclose their buildings' energy use and benchmark it relative to other buildings. An energy efficiency resource standard (EERS) establishes specific, long-term targets for energy savings that utilities or non-utility program administrators must meet through customer energy efficiency programs. For more information on EERSs, see aceee.org/topics/energy-efficiency-resource-standard-eers.

28 Quantifiable performance indicator (QPI) targets are set by the utility in order to measure how well its performance meets planned strategic goals and objectives. Low-income participation can be included as a QPI in order to make sure that attention to low-income households remains a priority for the utility.

Conclusion

Based on our analysis results, we determined that certain households—namely low-income, low-income multifamily, African-American, Latino, and renters—devote a disproportionate share of their income to energy expenses. Low-income households typically live in less efficient housing and are often more difficult to reach with information about energy efficiency programs.

Many of these households, due to lack of disposable income to invest in energy efficiency measures, have less ability to participate in their utility's energy efficiency programs. In order to overcome the barriers to participation that low-income customers face, governments and utilities should enhance their low-income program offerings, improve program design and implementation for low-income households, and better utilize existing channels and programs that target low-income households. Programs that address high energy burden also help alleviate poverty and provide other benefits to society beyond energy savings, such as economic development, employment, education, and public health.

Utility-led energy efficiency is an underutilized strategy that could complement bill assistance and weatherization programs to alleviate high household energy burdens in low-income communities. Energy efficiency programs in low-income communities need improved design and targeting in order to address long-term energy affordability needs. Local governments and utilities can work together to improve energy efficiency in these communities. We identified several strategies to ramp up energy efficiency, including improving current low-income program offerings, incorporating demographic data into program goals and evaluation, exploring financing options, and using additional policy levers.

This report has focused on improving low-income energy efficiency as a strategy for addressing high energy burdens. While this is an important strategy for reducing household energy use, it will not break cycles of poverty or completely eradicate high utility costs for all households. We estimate that energy efficiency investments (i.e., whole-home retrofits) for low-income households can make homes 25% more efficient than the average home, which means these investments have the potential to reduce the energy burden of a low-income household by nearly 30%.[29] Energy efficiency is a big part of the solution, but we still have a long way to go to ensure an equitable distribution of energy costs for all American families.

Due to changing regulatory policies, cities and states have additional urgency to ramp up efforts to increase low-income energy efficiency. In addition to the Clean Power Plan, the EPA has numerous potential rulemakings to limit the emissions of nitrogen oxides, sulfur dioxide, and carbon dioxide, which will increase states' obligations to reduce emissions. Energy efficiency remains a least-cost strategy for states to reduce multipollutant emissions. Under this approach, greater investment in low-income energy efficiency can cut emissions while improving energy affordability for those most in need.

Next Steps and Future Research

We encourage cities and other stakeholder groups to use this report's energy burden data and principles in their efforts to design and deliver energy efficiency policies and programs targeted toward the alleviation of high energy burdens. Cities can compare their median energy burden with the burdens of the groups in the study (Appendix B) and determine how their city or metro area stacks up regionally and nationally for each group studied (Appendix E). The energy burden data in this report is a snapshot of the current energy burden landscape, and stakeholders should use the data as a baseline for improvement.

While this report focuses on energy burdens in cities, rural communities experience acute energy burdens as well, and the severity of these burdens may differ from those experienced in cities. Although the strategies presented in this report can be applied to rural communities, future research should explore the landscape of rural energy burden and determine the specific policy needs of rural families that experience high energy burdens.

We hope that this report's findings and recommendations will act as conversation starters for cities and states that want to consider new energy affordability measures and determine how best to help their citizens obtain affordable and equitable access to energy. We have found that high energy bills, low household income, inefficient housing stock, and lack of access to efficiency programs contribute to energy burden. Cities and states should explore these drivers to determine why energy burden is higher in some regions and communities than in others.

We estimate that energy efficiency investments (i.e., whole-home retrofits) for low-income households can make homes 25% more efficient than the average home, which means these investments have the potential to reduce the energy burden of a low-income household by nearly 30%.

29 We assume 25% savings from energy efficiency upgrades based on the US Department of Energy's estimate (DOE 2014), and use the values in table 3 to calculate the 30% energy savings. A 30% savings for low-income households would reduce energy costs per square foot to $1.06, which reduces annual utility spending to $1,269 and energy burden to 5.1%. This is a reduction of 29.2% from the original energy burden of 7.2%. This savings estimate does not include the net costs for energy efficiency improvements.

References

APPRISE (Applied Public Policy Research Institute for Study and Evaluation). 2007. *Ratepayer-Funded Low-Income Energy Programs: Performance and Possibilities*. Princeton: APPRISE. www.appriseinc.org/reports/NLIEC%20Multi-Sponsor%20Study.pdf.

Baatz, B. 2015. *Everyone Benefits: Practices and Recommendations for Utility System Benefits of Energy Efficiency*. Washington, DC: American Council for an Energy-Efficient Economy. aceee.org/everyone-benefits-practices-and-recommendations.

Bell, C. 2014. "Understanding the True Benefits of Both Energy Efficiency and Job Creation." *Community Development Investment Review* 10 (1): 109–16. www.frbsf.org/community-development/publications/community-development-investment-review/2014/march/benefits-energy-efficiency-job-creation/.

Benefits.gov. 2015. "Weatherization Assistance Program for Low-Income Persons." Accessed December 4. www.benefits.gov/benefits/benefit-details/580.

Berelson, S. 2014. "Myths of Low-Income Energy Efficiency Programs: Implications for Outreach." In *Proceedings of the ACEEE 2014 Summer Study on Energy Efficiency in Buildings* 7: 32-43. Washington, DC: ACEEE. aceee.org/files/proceedings/2014/data/papers/7-287.pdf.

Berube, A., and H. Holmes. 2015. *Some Cities Are Still More Unequal than Others—An Update*. Washington, DC: Brookings Institution. www.brookings.edu/research/reports2/2015/03/city-inequality-berube-holmes.

Brockway, N., J. Kallay, and E. Malone. 2014. *Low-Income Assistance Strategy Review: Options for the Design and Implementation of Ratepayer-Funded Assistance Programs for Low-Income Electricity Customers.* Cambridge, MA: Synapse Energy Economics, Inc. www.synapse-energy.com/sites/default/files/Low-Income-Assistance-Strategy-Review-14-111.pdf.

Brown, M. 2008. *State Energy Efficiency Policies: Options and Lessons Learned.* Washington, DC: Alliance to Save Energy. www.ase.org/sites/ase.org/files/file_Brief_1v3.pdf.

Bruner, K., M. Spitzer, and A. Christanell. 2012. "Experiencing Fuel Poverty: Coping Strategies of Low-Income Households in Vienna/Austria." *Energy Policy* 49: 53–59.

Burcat, L., and M. Power. 2013. *On-Bill Repayment for Home Energy Efficiency: The Benefits and the Risks.* Washington, DC: Economic Opportunity Studies. cleanenergycoops.org/downloads/OBR_Final_Report.pdf.

Carliner, M. 2013. *Reducing Energy Costs in Rental Housing: The Need and the Potential*. Cambridge, MA: Center for Housing Studies of Harvard University. www.jchs.harvard.edu/sites/jchs.harvard.edu/files/carliner_research_brief_0.pdf.

Census Bureau. 2011. "American Housing Survey 2011 Public Use File." Accessed November 2015. www.census.gov/programs-surveys/ahs/data/2011/ahs-national-and-metropolitan-puf-microdata.html.

———. 2013a. "American Housing Survey 2013 Metropolitan Public Use File." Accessed November 2015. www.census.gov/programs-surveys/ahs/data/2013/ahs-2013-public-use-file--puf-/2013-ahs-metropolitan-puf-microdata.html.

———. 2013b. "Table H-8B: Historical Income Tables: Households." www.census.gov/hhes/www/income/data/historical/household/.

———. 2014. "Table P-1: Total CPS Population and Per Capita Income: All Races." www.census.gov/hhes/www/income/data/historical/people/.

Cluett, R., and J. Amann. 2015. *Multiple Benefits of Multifamily Energy Efficiency for Cost-Effectiveness Screening.* Washington, DC: ACEEE. aceee.org/multiple-benefits-multifamily-energy-efficiency.

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

CNT (Center for Neighborhood Technology). 2016. "Transportation and Community Development." Accessed January 26. www.cnt.org/transportation-and-community-development.

Collins, M. 2015. "Pilot Project Provides C.A.R.E. Community with Solar Electric Systems." *The Baltimore Sun*, June 22. www.baltimoresun.com/news/maryland/baltimore-city/bs-md-ci-solar-power-20150622-story.html.

Commonwealth of Massachusetts. 2008. *An Act Relative to Green Communities.* Chapter 169. malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter169.

Dear, K., and A. McMichael. 2011. "The Health Impacts of Cold Homes and Fuel Poverty." *BMJ* 342. dx.doi.org/10.1136/bmj.d2807

DeSilver, D. 2015. "The Many Ways to Measure Economic Inequality." *Fact Tank* blog, September 22. www.pewresearch.org/fact-tank/2015/09/22/the-many-ways-to-measure-economic-inequality/.

DOE (Department of Energy). 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.

———. 2015. "What is Weatherization." Accessed December 4. energy.gov/eere/wipo/what-weatherization.

Efficiency Vermont. 2013. *Annual Report 2012.* Burlington: Efficiency Vermont. www.efficiencyvermont.com/docs/about_efficiency_vermont/annual_reports/Efficiency-Vermont-Annual-Report-2012.pdf.

EIA (Energy Information Administration). 2009. "Residential Energy Consumption Survey." Accessed November 2015. www.eia.gov/consumption/residential/index.cfm.

———. 2013. "Heating and Cooling No Longer Majority of US Home Energy Use." *Today in Energy*, March 7. www.eia.gov/todayinenergy/detail.cfm?id=10271&src=‹ Consumption Residential Energy Consumption Survey (RECS)-b1.

———. 2015. "Growth in Residential Electricity Prices Highest in 6 Years, but Expected to Slow in 2015." *Today in Energy*, March 16. www.eia.gov/todayinenergy/detail.cfm?id=20372.

———. 2016a. *Short-Term Energy Outlook February 2016.* Washington, DC: EIA. www.eia.gov/forecasts/steo/archives/Feb16.pdf.

———. 2016b. "Average Price of Electricity to Ultimate Customers, Table 5.3." *Electric Power Monthly.* Accessed February 10. www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_3.

EPA (Environmental Protection Agency). 2012. *President's Task Force on Environmental Health Risks and Safety Risks to Children: Coordinated Federal Action Plan to Reduce Racial and Ethnic Asthma Disparities.* Washington, DC: EPA. www.epa.gov/sites/production/files/2014-08/documents/federal_asthma_disparities_action_plan.pdf.

———. 2016. *Overview of the Clean Power Plan: Cutting Carbon Pollution from Power Plants*. Washington, DC: EPA. www.epa.gov/sites/production/files/2015-08/documents/fs-cpp-overview.pdf.

EPC (Energy Programs Consortium). 2013a. *Multifamily Energy: What We Know and What's Next.* Washington, DC: Energy Programs Consortium. www.naseo.org/data/sites/1/documents/publications/EPC-Report-Multi-Family-Housing.pdf.

———. 2013b. *Qualified Energy Conservation Bonds (QECBs).* Washington, DC: Energy Programs Consortium. energy.gov/sites/prod/files/2014/06/f16/QECB_memo_12-13-13.pdf.

Fisher Sheehan & Colton. 2013. "Home Energy Affordability Gap." www.homeenergyaffordabilitygap.com/.

Frank, M., and S. Nowak. 2016 (forthcoming). "Mining Participant Demographics to Yield New Opportunities from Old Measures." In *Proceedings of the ACEEE 2016 Summer Study on Energy Efficiency in Buildings*. Washington, DC: ACEEE.

Heindl, P. 2015. "Dynamic Properties of Energy Affordability Measures." *Energy Policy* 86: 123–32.

Hernández, D. 2015. "Sacrifice Along the Energy Continuum: A Call for Energy Justice." *Environmental Justice* 8 (4): 151–6.

Hernández, D., and S. Bird. 2010. "Energy Burden and the Need for Integrated Low-Income Housing and Energy Policy." *Poverty and Public Policy* 2 (4): 5–25.

Heyman, B., B. Harrington, and A. Heyman. 2011. "A Randomized Controlled Trial of an Energy Efficiency Intervention for Families Living in Fuel Poverty." *Housing Studies* 26 (1): 117–32.

Hoffman, I., G. Rybka, G. Leventis, C. Goldman, L. Schwartz, M. Billingsley, and S. Schiller. 2015. *The Total Cost of Saving Electricity through Utility Customer-Funded Energy Efficiency Programs: Estimates at the National, State, Sector, and Program Level*. Berkeley: Lawrence Berkeley National Laboratory. emp.lbl.gov/sites/all/files/total-cost-of-saved-energy_0.pdf.

IEA (International Energy Agency). 2014. *Capturing the Multiple Benefits of Energy Efficiency*. Paris: IEA. www.iea.org/publications/freepublications/publication/Captur_the_MultiplBenef_ofEnergyEficiency.pdf.

Jackson, A. 2011. *Fact Sheet: The Low Income Home Energy Assistance Program: A Critical Resource for Low-Income Households*. Washington, DC: AARP (American Association of Retired Persons) Public Policy Institute. assets.aarp.org/rgcenter/consume/fs138_liheap.pdf.

Johnson, K. 2013. *Apartment Hunters: Programs Searching for Energy Savings in Multifamily Buildings*. Washington, DC: ACEEE. aceee.org/research-report/e13n.

Johnson, K., and E. Mackres. 2013. *Scaling up Multifamily Energy Efficiency Programs: A Metropolitan Area Assessment*. Washington, DC: ACEEE. aceee.org/research-report/e135.

Kallay, J., K. Takahashi, A. Napoleon, and T. Woolf. 2015. *Fair, Abundant, and Low Cost: A Handbook for Using Energy Efficiency in Clean Power Plan Compliance.* Cambridge, MA: Synapse Energy Economics, Inc. synapse-energy.com/sites/default/files/EE-Handbook.pdf.

Kind, P. 2015. *Pathway to a 21st Century Electric Utility.* Boston: Ceres. www.ceres.org/resources/reports/pathway-to-a-21st-century-electric-utility/view.

Kushler, M., S. Nowak, and P. Witte. 2012. *A National Survey of State Policies and Practices for Evaluation of Ratepayer Funded Energy Efficiency Programs*. Washington, DC: ACEEE. aceee.org/research-report/u122.

Levy, R., and J. Sledge. 2012. *A Complex Portrait: An Examination of Small-Dollar Credit Consumers*. Chicago: Center for Financial Services Innovation. www.fdic.gov/news/conferences/consumersymposium/2012/A%20Complex%20Portrait.pdf.

Li, K., B. Lloyd, X-J. Liang, and Y-M Wei. 2014. "Energy Poor or Fuel Poor: What Are the Differences?" *Energy Policy* 68: 476–81.

Liddell, C., and C. Morris. 2010. "Fuel Poverty and Human Health: A Review of Recent Evidence." *Energy Policy* 38 (6): 2987–97.

Liddell, C., C. Morris, S. McKenzie, and G. Rae. 2012. "Measuring and Monitoring Fuel Poverty in the UK: National and Regional Perspectives." *Energy Policy* 49: 27–32.

LIHEAP Clearinghouse 2016. "Low-Income Energy Programs Funding History 1977–2015." Accessed February 2. www.liheapch.acf.hhs.gov/Funding/lhemhist.htm.

Lundin, B. 2016. "Tariff Really PAYS for Arkansas Co-ops." *Smart Grid News*, February 16. www.smartgridnews.com/story/tariff-really-pays-arkansas-co-ops/2016-02-16.

Malmgren, I., and L. Skumatz. 2014. "Lessons from the Field: Practical Applications for Incorporating Non-Energy Benefits into Cost-Effectiveness Screening." In *Proceedings of the ACEEE 2014 Summer Study on Energy Efficiency in Buildings,* 8: 186–200. Washington, DC: ACEEE. aceee.org/files/proceedings/2014/data/papers/8-357.pdf.

Marsh-Robinson, M. 2016. "Rural Electric Cooperatives Improve Energy Efficiency with On-Bill Financing." *The Environmental Defense Fund* blog, March 9. blogs.edf.org/energyexchange/2016/03/09/rural-electric-cooperatives-improve-energy-efficiency-with-on-bill-financing/.

Mazur-Stommen, S., and K. Farley. 2013. *ACEEE Field Guide to Utility-Run Behavior Programs*. Washington, DC: ACEEE. aceee.org/research-report/b132.

McCormick, K. 2015. *Bridging the Clean Energy Divide: Affordable Clean Energy Solutions for Today and Tomorrow*. New York: Natural Resources Defense Council. www.nrdc.org/energy/files/clean-energy-benefits-vulnerable-comms-report.pdf.

Moor, R. 2012. "Definitions of Fuel Poverty: Implications for Policy." *Energy Policy* 49: 19–26.

Mosenthal, P., and M. Socks. 2015. *The Potential for Energy Savings in Affordable Multifamily Housing*. Hinesburg, VT: Optimal Energy. www.energyefficiencyforall.org/sites/default/files/EEFA%20Potential%20Study%20EXECSUM.pdf.

NAACP (National Association for the Advancement of Colored People). 2015. "NAACP Statement on President Obama's Clean Power Plan." August 4. www.naacp.org/press/entry/naacp-statement-on-president-obamas-clean-power-plan.

Nevada. 2013. *Nevada Fund for Energy Assistance and Conservation State Plan FY 2013*. Carson City: State of Nevada.

NMHC (National Multifamily Housing Council). 2015. "Apartment Household Incomes in the Previous Year." nmhc.org/Content.aspx?id=4708.

NYSERDA (New York State Energy Research and Development Authority). 2013a. *Aging Systems Open the Door for Major Energy Savings: Carnegie House, Manhattan*. Albany: NYSERDA. www.nyserda.ny.gov/-/media/Files/Publications/Case-Studies/MEPP/carnegie-building-cs.pdf.

——. 2013b. *A Dramatic Turnaround—and Major Energy Savings to Go with It: Rose May Manor Apartments, Pulaski, NY*. Albany: NYSERDA. www.nyserda.ny.gov/-/media/Files/Publications/Case-Studies/MEPP/rose-may-manor-cs.pdf.

Oppenheim, J., and T. MacGregor. 2014. "Accounting for Health Benefits." In *Proceedings of the 2014 International Energy Policy and Programmes Evaluation Conference, Berlin*. democracyandregulation.com/attachments/146/Accounting_for_Health_Benefits..pdf.

Penney, B., and P. Kloer. 2015. *Shelter Report 2015—Less Is More: Transforming Low-Income Communities Through Energy Efficiency.* Atlanta: Habitat for Humanity. www.habitat.org/sites/default/files/2015-habitat-for-humanity-shelter-report.pdf.

Pennsylvania Public Utility Commission. 2016. "Energy Efficiency and Conservation (EE&C) Program." No. M-2012-2289411. Accessed March 27. www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/energy_efficiency_and_conservation_ee_c_program.aspx.

Perl, L. 2012. *The LIHEAP Formula: Legislative History and Current Law*. Washington, DC: Congressional Research Service. neada.org/wp-content/uploads/2013/03/RL332751.pdf.

Pivo, G. 2014. "Unequal Access to Energy Efficiency in US Multifamily Rental Housing: Opportunities to Improve." *Building Research & Information* 42 (5): 551–73.

Rasmussen, T., C. Edwards, B. Getting, M. O'Drain, and A. Tran. 2014. "Understanding the Needs of Low Income Customers: Comprehensive, Robust Results form a Needs Assessment Study." In *Proceedings of the ACEEE 2014 Summer Study on Energy Efficiency in Buildings* 2: 293–304. Washington, DC: ACEEE. aceee.org/files/proceedings/2014/data/papers/2-1088.pdf.

RGGI (Regional Greenhouse Gas Initiative). 2015. *Investment of RGGI Proceeds through 2013*. New York: RGGI. www.rggi.org/docs/ProceedsReport/Investment-RGGI-Proceeds-Through-2013.pdf.

Ribeiro, D., E. Mackres, B. Battz, R. Cluett, M. Jarrett, M. Kelly, and S. Vaidyanathan. 2015a. *Enhancing Community Resilience through Energy Efficiency*. Washington, DC: ACEEE. aceee.org/research-report/u1508.

Ribeiro, D., V. Hewitt, E. Mackres, R. Cluett, L. Ross, S. Vaidyanathan, and S. Zerbonne. 2015b. *The 2015 City Energy Efficiency Scorecard*. Washington, DC: ACEEE. aceee.org/research-report/u1502.

Ross, T. 2013. "Addressing Urban Poverty in American Must Remain a Priority." June 5. www.americanprogress.org/issues/poverty/news/2013/06/05/65268/addressing-urban-poverty-in-america-must-remain-a-priority/.

Russell, C., B. Baatz, R. Cluett, and J. Amann. 2015. *Recognizing the Value of Energy Efficiency's Multiple Benefits.* Washington, DC: ACEEE. aceee.org/research-report/ie1502.

Shahan, Z. 2015. "Solar Power for Low- & Moderate-Income Americans—Obama's New Solar Initiative." *Clean Technica*, July 11. cleantechnica.com/2015/07/11/solar-power-for-low-moderate-income-americans-obamas-new-solar-initiative/.

Skumatz, L. 2014. *Non-Energy Benefits/Non-Energy Impacts (NEBs/NEIs) and their Role & Values in Cost-Effectiveness Tests: State of Maryland.* Superior, CO: Skumatz Economic Research Associates, Inc. energyefficiencyforall.org/sites/default/files/2014_%20NEBs%20report%20for%20Maryland.pdf.

Sommeiller, E., and M. Price. 2015. *The Increasingly Unequal States of America: Income Inequality by State, 1917 to 2012*. Washington, DC: Economic Policy Institute. www.epi.org/files/2014/IncreasinglyUnequalStatesofAmerica1917to2012.pdf.

Stone, C., D. Trisi, A. Sherman, and B. Debot. 2015. *A Guide to Statistics on Historical Trends in Income Inequality*. Washington, DC: Center on Budget and Policy Priorities. www.cbpp.org/sites/default/files/atoms/files/11-28-11pov_0.pdf.

Tonn, B., Rose, E., Hawkins, B., and Conlon, B. 2014. *Health and Household-Related Benefits Attributable to the Weatherization Assistance Program*. Oak Ridge, TN: Oak Ridge National Laboratory. weatherization.ornl.gov/Retrospectivepdfs/ORNL_TM-2014_345.pdf.

Vick, J., and C. Norton. 2008. *State of Metropolitan Housing Report 2008*. Louisville, KY: Metropolitan Housing Coalition. www.metropolitanhousing.org/wp-content/uploads/member_docs/2008_State_of_Metropolitan_Housing_Report.pdf.

WAPTAC (Weatherization Assistance Program Technical Assistance Center). 2016. "Questions and Answers: Frequently Asked Questions." Accessed March 23. http://www.waptac.org/WAP-Basics/Briefing-Book.aspx.

Watts-Zagha, C. 2011. *Status of Energy Utility Service Disconnections in California*. San Francisco: California Public Utilities Commission, Division of Ratepayer Advocates. www.dra.ca.gov/WorkArea/DownloadAsset.aspx?id=634.

Whited, M., T. Woolf, and J. Daniel. 2016. *Caught in a Fix: The Problem with Fixed Charges for Electricity*. Cambridge, MA: Synapse Energy Economics, Inc. www.synapse-energy.com/sites/default/files/Caught-in-a-Fix.pdf.

Wilson, J., and A. Katz. 2010. *Integrating Energy Efficiency and Healthy Housing*. Washington, DC: National Center for Healthy Housing and Advanced Energy. www.nchh.org/Portals/0/Contents/Coalition_briefing_paper_energy.pdf.

Woolf, T., E. Malone, J. Kallay, and K. Takahashi. 2013. *Energy Efficiency Cost-Effectiveness Screening in the Northeast and Mid-Atlantic States*. Cambridge, MA: Synapse Energy Economics, Inc. www.neep.org/sites/default/files/resources/EMV_Forum_C-E-Testing_Report_Synapse_2013%2010%2002%20Final.pdf.

Wright, F. 2004. "Old and Cold: Older People and Policies Failing to Address Fuel Poverty." *Social Policy & Administration* 38 (5): 488–503.

Appendix A. Sample Sizes

Table A1. Sample sizes used in energy burden calculations

City	Data year	All households	Low-income households	Low-income multifamily households	African-American households	Latino households	Renting households
Atlanta	2011	2,564	1,170	291	878	202	835
Austin	2013	2,794	1,178	326	206	692	1,145
Baltimore	2013	2,786	1,084	213	742	126	756
Birmingham	2011	2,876	1,397	212	809	91	717
Boston	2013	2,373	829	183	199	172	732
Charlotte	2011	2,816	1,326	263	716	214	888
Chicago	2013	766	388	128	176	128	288
Cincinnati	2011	2,401	1,141	246	271	66	683
Cleveland	2011	2,708	1,204	168	485	132	679
Columbus	2011	3,009	1,317	243	431	105	1,030
Dallas	2011	2,887	1,280	353	491	669	1,064
Denver	2011	2,714	1,171	354	144	482	884
Detroit	2013	2,530	1,063	186	445	77	628
Fort Worth	2011	3,095	1,435	309	426	671	1,052
Hartford	2013	2,817	1,105	210	252	303	659
Houston	2013	2,527	1,096	319	471	705	910
Indianapolis	2011	3,013	1,314	246	429	176	900
Jacksonville	2013	2,996	1,358	208	606	175	972
Kansas City	2011	2,974	1,430	216	356	164	876
Las Vegas	2013	2,496	1,186	294	284	564	1,112
Los Angeles	2011	3,001	1,773	635	290	1,161	1,591
Louisville	2013	2,916	1,218	204	370	98	822
Memphis	2011	2,870	1,348	220	1,280	119	900
Miami	2013	2,351	1,154	444	445	971	865
Milwaukee	2011	1,911	1,005	309	284	137	785
Minneapolis	2013	2,624	914	170	118	100	517
Nashville	2013	2,919	1,233	238	416	155	921
New Orleans	2011	2,800	1,407	191	901	210	911
New York City	2013	677	353	155	147	131	333
Oklahoma City	2013	3,304	1,310	214	354	319	1,034
Orlando	2013	3,031	1,284	276	444	719	1,101
Philadelphia	2013	2,893	1,322	163	602	215	730
Phoenix	2011	2,569	1,137	264	147	555	873
Pittsburgh	2011	2,758	1,203	128	210	50	642
Portland	2011	2,916	1,256	347	60	209	1,022
Providence	2011	2,666	1,143	110	105	195	672
Richmond	2013	2,916	1,193	189	791	134	868
Riverside	2011	2,816	1,400	216	232	1,105	1,063
Sacramento	2011	2,954	1,422	334	219	472	1,154
San Antonio	2013	3,357	1,499	273	212	1,659	1,142
San Diego	2011	3,123	1,497	498	169	732	1,404
San Francisco	2011	2,878	1,220	469	115	410	1,343
San Jose	2011	3,292	1,374	392	113	658	1,337
Seattle	2013	2,765	1,017	361	142	179	976
St. Louis	2011	2,663	1,224	201	541	71	748
Tampa	2013	2,225	883	211	234	293	680
Virginia Beach	2011	3,018	1,335	278	873	136	1,002
Washington, DC	2013	2,307	670	207	556	226	611
Total	N/A	129,662	57,266	12,665	19,187	17,333	42,857

Appendix B. City Median Energy Burdens

Table B1. Median gross household income and energy burdens for the median household in each group

City	Data year	Median household	Median low-income household	Median low-income multifamily	Median African-American household	Median Latino household	Median renter household
Atlanta	2011	4.97%	10.19%	8.31%	6.60%	6.60%	6.75%
Austin	2013	2.65%	5.47%	4.09%	3.47%	3.72%	3.14%
Baltimore	2013	3.12%	7.14%	4.80%	4.41%	3.29%	3.64%
Birmingham	2011	5.34%	10.92%	8.71%	7.68%	6.55%	7.30%
Boston	2013	2.76%	6.72%	4.40%	3.89%	3.28%	2.86%
Charlotte	2011	4.00%	7.89%	5.50%	5.14%	4.91%	4.78%
Chicago	2013	3.05%	6.73%	5.57%	6.56%	3.64%	4.12%
Cincinnati	2011	4.34%	8.45%	6.19%	6.86%	3.87%	5.96%
Cleveland	2011	4.22%	8.47%	5.36%	7.00%	4.64%	5.47%
Columbus	2011	3.95%	8.13%	6.52%	6.19%	5.00%	5.17%
Dallas	2011	4.25%	8.84%	6.51%	5.45%	5.97%	4.73%
Denver	2011	3.20%	6.59%	5.43%	4.81%	4.54%	4.18%
Detroit	2013	3.52%	7.98%	5.26%	5.78%	5.72%	4.56%
Fort Worth	2011	4.36%	8.02%	6.12%	5.24%	5.72%	5.04%
Hartford	2013	3.74%	8.16%	5.90%	6.03%	5.20%	4.92%
Houston	2013	3.24%	6.94%	5.22%	3.96%	3.81%	3.49%
Indianapolis	2011	3.70%	7.66%	6.51%	5.40%	4.13%	5.00%
Jacksonville	2013	3.87%	7.64%	5.56%	5.30%	4.33%	4.41%
Kansas City	2011	4.48%	8.49%	6.36%	7.91%	6.64%	6.11%
Las Vegas	2013	3.49%	6.11%	4.51%	4.08%	4.42%	3.71%
Los Angeles	2011	2.75%	4.60%	3.48%	3.72%	3.27%	2.73%
Louisville	2013	3.57%	7.60%	6.10%	4.66%	4.16%	4.77%
Memphis	2011	6.15%	13.22%	10.88%	9.65%	8.26%	8.64%
Miami	2013	3.32%	6.23%	4.80%	4.10%	3.73%	3.80%
Milwaukee	2011	4.08%	7.02%	5.54%	7.40%	4.46%	4.93%
Minneapolis	2013	2.32%	5.11%	3.05%	4.14%	3.14%	2.57%
Nashville	2013	3.11%	6.40%	5.18%	4.21%	4.45%	3.76%
New Orleans	2011	5.25%	9.79%	6.93%	8.06%	5.07%	6.31%
New York City	2013	3.67%	6.78%	5.68%	4.37%	4.87%	3.75%
Oklahoma City	2013	3.51%	7.36%	5.21%	4.98%	4.26%	4.27%
Orlando	2013	3.93%	7.55%	6.24%	5.27%	4.85%	4.14%
Philadelphia	2013	3.82%	8.82%	5.12%	6.46%	7.30%	4.70%
Phoenix	2011	4.18%	7.92%	6.09%	4.93%	6.00%	5.30%
Pittsburgh	2011	4.52%	9.42%	7.08%	8.31%	4.95%	6.00%
Portland	2011	2.81%	5.22%	4.16%	3.99%	3.53%	3.34%
Providence	2011	4.66%	9.46%	7.10%	6.03%	7.33%	6.18%
Richmond	2013	3.10%	6.54%	5.17%	4.24%	3.49%	3.97%
Riverside	2011	3.54%	5.74%	4.22%	3.81%	3.77%	4.14%
Sacramento	2011	2.93%	5.29%	3.60%	4.49%	3.45%	3.41%
San Antonio	2013	3.77%	7.80%	5.00%	3.99%	4.50%	3.95%
San Diego	2011	2.30%	3.90%	2.66%	2.24%	2.54%	2.27%
San Francisco	2011	1.41%	2.82%	1.89%	2.27%	1.83%	1.27%
San Jose	2011	1.78%	3.82%	2.28%	1.86%	2.35%	1.73%
Seattle	2013	2.05%	4.59%	3.08%	2.84%	2.22%	2.18%
St. Louis	2011	4.07%	8.37%	6.25%	7.40%	4.21%	5.90%
Tampa	2013	3.32%	7.28%	5.95%	3.97%	3.91%	3.64%
Virginia Beach	2011	3.85%	7.46%	5.39%	4.98%	3.75%	4.54%
Washington, DC	2013	2.12%	6.11%	4.28%	2.88%	2.67%	2.44%

Appendix C. Energy Burdens at the Median and Highest Energy Burden Quartile, by City

Table C1. Energy burdens for low-income and multifamily low-income households

City	Data year	Median household	Median low-income household	Highest energy burden quartile for low-income households	Median low-income multifamily household	Highest energy burden quartile for low-income multifamily households
Atlanta	2011	4.97%	10.19%	18.24%	8.31%	15.72%
Austin	2013	2.65%	5.47%	9.73%	4.09%	7.29%
Baltimore	2013	3.12%	7.14%	13.65%	4.80%	9.54%
Birmingham	2011	5.34%	10.92%	18.82%	8.71%	16.17%
Boston	2013	2.76%	6.72%	12.36%	4.40%	8.94%
Charlotte	2011	4.00%	7.89%	14.45%	5.50%	10.22%
Chicago	2013	3.05%	6.73%	13.41%	5.57%	14.59%
Cincinnati	2011	4.34%	8.45%	15.49%	6.19%	12.95%
Cleveland	2011	4.22%	8.47%	14.07%	5.36%	12.31%
Columbus	2011	3.95%	8.13%	12.93%	6.52%	11.17%
Dallas	2011	4.25%	8.84%	14.50%	6.51%	11.28%
Denver	2011	3.20%	6.59%	10.57%	5.43%	8.79%
Detroit	2013	3.52%	7.98%	15.26%	5.26%	9.76%
Fort Worth	2011	4.36%	8.02%	13.02%	6.12%	11.35%
Hartford	2013	3.74%	8.16%	14.49%	5.90%	11.75%
Houston	2013	3.24%	6.94%	11.84%	5.22%	9.18%
Indianapolis	2011	3.70%	7.66%	12.83%	6.51%	9.91%
Jacksonville	2013	3.87%	7.64%	13.48%	5.56%	9.06%
Kansas City	2011	4.48%	8.49%	14.60%	6.36%	11.08%
Las Vegas	2013	3.49%	6.11%	10.39%	4.51%	7.55%
Los Angeles	2011	2.75%	4.60%	8.84%	3.48%	6.67%
Louisville	2013	3.57%	7.60%	12.74%	6.10%	10.42%
Memphis	2011	6.15%	13.22%	25.47%	10.88%	21.73%
Miami	2013	3.32%	6.23%	11.04%	4.80%	7.99%
Milwaukee	2011	4.08%	7.02%	12.52%	5.54%	9.65%
Minneapolis	2013	2.32%	5.11%	8.20%	3.05%	5.77%
Nashville	2013	3.11%	6.40%	10.91%	5.18%	9.40%
New Orleans	2011	5.25%	9.79%	18.90%	6.93%	10.43%
New York City	2013	3.67%	6.78%	14.01%	5.68%	9.97%
Oklahoma City	2013	3.51%	7.36%	12.56%	5.21%	9.03%
Orlando	2013	3.93%	7.55%	11.51%	6.24%	9.39%
Philadelphia	2013	3.82%	8.82%	16.67%	5.12%	9.07%
Phoenix	2011	4.18%	7.92%	13.42%	6.09%	9.79%
Pittsburgh	2011	4.52%	9.42%	15.67%	7.08%	15.72%
Portland	2011	2.81%	5.22%	8.76%	4.16%	6.53%
Providence	2011	4.66%	9.46%	16.66%	7.10%	11.07%
Richmond	2013	3.10%	6.54%	11.51%	5.17%	9.26%
Riverside	2011	3.54%	5.74%	9.50%	4.22%	7.19%
Sacramento	2011	2.93%	5.29%	8.74%	3.60%	6.35%
San Antonio	2013	3.77%	7.80%	14.06%	5.00%	9.16%
San Diego	2011	2.30%	3.90%	6.74%	2.66%	4.80%
San Francisco	2011	1.41%	2.82%	5.24%	1.89%	3.26%
San Jose	2011	1.78%	3.82%	6.67%	2.28%	4.05%
Seattle	2013	2.05%	4.59%	8.05%	3.08%	5.61%
St. Louis	2011	4.07%	8.37%	14.78%	6.25%	12.87%
Tampa	2013	3.32%	7.28%	12.13%	5.95%	9.54%
Virginia Beach	2011	3.85%	7.46%	12.61%	5.39%	9.67%
Washington, DC	2013	2.12%	6.11%	11.70%	4.28%	7.68%

Table C2. Energy burdens for African-American and Latino households

City	Data year	Median household	Median African-American household	Highest energy burden quartile for African-American households	Median Latino household	Highest energy burden quartile for Latino households
Atlanta	2011	4.97%	6.60%	12.32%	6.60%	11.53%
Austin	2013	2.65%	3.47%	6.11%	3.72%	6.75%
Baltimore	2013	3.12%	4.41%	8.92%	3.29%	5.66%
Birmingham	2011	5.34%	7.68%	15.44%	6.55%	10.44%
Boston	2013	2.76%	3.89%	6.38%	3.28%	6.22%
Charlotte	2011	4.00%	5.14%	10.85%	4.91%	8.90%
Chicago	2013	3.05%	6.56%	15.27%	3.64%	7.14%
Cincinnati	2011	4.34%	6.86%	15.64%	3.87%	7.26%
Cleveland	2011	4.22%	7.00%	13.14%	4.64%	9.77%
Columbus	2011	3.95%	6.19%	10.93%	5.00%	9.56%
Dallas	2011	4.25%	5.45%	10.61%	5.97%	10.06%
Denver	2011	3.20%	4.81%	9.39%	4.54%	8.70%
Detroit	2013	3.52%	5.78%	14.78%	5.72%	10.19%
Fort Worth	2011	4.36%	5.24%	10.27%	5.72%	9.07%
Hartford	2013	3.74%	6.03%	12.47%	5.20%	11.10%
Houston	2013	3.24%	3.96%	8.56%	3.81%	6.87%
Indianapolis	2011	3.70%	5.40%	10.07%	4.13%	7.57%
Jacksonville	2013	3.87%	5.30%	10.06%	4.33%	6.68%
Kansas City	2011	4.48%	7.91%	16.22%	6.64%	11.96%
Las Vegas	2013	3.49%	4.08%	8.04%	4.42%	7.09%
Los Angeles	2011	2.75%	3.72%	9.47%	3.27%	6.38%
Louisville	2013	3.57%	4.66%	8.59%	4.16%	9.10%
Memphis	2011	6.15%	9.65%	19.36%	8.26%	15.93%
Miami	2013	3.32%	4.10%	8.63%	3.73%	6.36%
Milwaukee	2011	4.08%	7.40%	15.48%	4.46%	7.92%
Minneapolis	2013	2.32%	4.14%	7.90%	3.14%	6.10%
Nashville	2013	3.11%	4.21%	9.21%	4.45%	7.81%
New Orleans	2011	5.25%	8.06%	16.38%	5.07%	8.23%
New York City	2013	3.67%	4.37%	9.00%	4.87%	8.90%
Oklahoma City	2013	3.51%	4.98%	9.14%	4.26%	7.40%
Orlando	2013	3.93%	5.27%	8.53%	4.85%	7.55%
Philadelphia	2013	3.82%	6.46%	14.23%	7.30%	15.74%
Phoenix	2011	4.18%	4.93%	8.61%	6.00%	10.74%
Pittsburgh	2011	4.52%	8.31%	16.14%	4.95%	12.44%
Portland	2011	2.81%	3.99%	10.61%	3.53%	6.87%
Providence	2011	4.66%	6.03%	12.90%	7.33%	11.66%
Richmond	2013	3.10%	4.24%	7.99%	3.49%	6.28%
Riverside	2011	3.54%	3.81%	7.30%	3.77%	6.01%
Sacramento	2011	2.93%	4.49%	8.14%	3.45%	5.98%
San Antonio	2013	3.77%	3.99%	7.96%	4.50%	8.60%
San Diego	2011	2.30%	2.24%	4.29%	2.54%	4.40%
San Francisco	2011	1.41%	2.27%	4.22%	1.83%	3.33%
San Jose	2011	1.78%	1.86%	3.93%	2.35%	4.33%
Seattle	2013	2.05%	2.84%	6.08%	2.22%	4.65%
St. Louis	2011	4.07%	7.40%	14.41%	4.21%	7.32%
Tampa	2013	3.32%	3.97%	8.05%	3.91%	6.44%
Virginia Beach	2011	3.85%	4.98%	9.64%	3.75%	6.08%
Washington, DC	2013	2.12%	2.88%	5.78%	2.67%	4.57%

Table C3. Energy burdens for renting households

City	Data year	Median household	Median renting household	Highest energy burden quartile for renting households
Atlanta	2011	4.97%	6.75%	13.25%
Austin	2013	2.65%	3.14%	5.65%
Baltimore	2013	3.12%	3.64%	7.41%
Birmingham	2011	5.34%	7.30%	15.06%
Boston	2013	2.76%	2.86%	5.76%
Charlotte	2011	4.00%	4.78%	9.65%
Chicago	2013	3.05%	4.12%	10.01%
Cincinnati	2011	4.34%	5.96%	12.12%
Cleveland	2011	4.22%	5.47%	11.93%
Columbus	2011	3.95%	5.17%	9.82%
Dallas	2011	4.25%	4.73%	9.07%
Denver	2011	3.20%	4.18%	7.77%
Detroit	2013	3.52%	4.56%	10.20%
Fort Worth	2011	4.36%	5.04%	8.70%
Hartford	2013	3.74%	4.92%	10.24%
Houston	2013	3.24%	3.49%	6.83%
Indianapolis	2011	3.70%	5.00%	9.43%
Jacksonville	2013	3.87%	4.41%	8.21%
Kansas City	2011	4.48%	6.11%	11.68%
Las Vegas	2013	3.49%	3.71%	6.82%
Los Angeles	2011	2.75%	2.73%	5.97%
Louisville	2013	3.57%	4.77%	9.25%
Memphis	2011	6.15%	8.64%	18.48%
Miami	2013	3.32%	3.80%	6.62%
Milwaukee	2011	4.08%	4.93%	9.85%
Minneapolis	2013	2.32%	2.57%	5.52%
Nashville	2013	3.11%	3.76%	6.99%
New Orleans	2011	5.25%	6.31%	12.61%
New York City	2013	3.67%	3.75%	7.19%
Oklahoma City	2013	3.51%	4.27%	7.97%
Orlando	2013	3.93%	4.14%	7.90%
Philadelphia	2013	3.82%	4.70%	11.18%
Phoenix	2011	4.18%	5.30%	9.11%
Pittsburgh	2011	4.52%	6.00%	11.87%
Portland	2011	2.81%	3.34%	5.85%
Providence	2011	4.66%	6.18%	11.74%
Richmond	2013	3.10%	3.97%	7.03%
Riverside	2011	3.54%	4.14%	7.30%
Sacramento	2011	2.93%	3.41%	6.39%
San Antonio	2013	3.77%	3.95%	7.52%
San Diego	2011	2.30%	2.27%	4.03%
San Francisco	2011	1.41%	1.27%	2.50%
San Jose	2011	1.78%	1.73%	3.45%
Seattle	2013	2.05%	2.18%	4.25%
St. Louis	2011	4.07%	5.90%	12.93%
Tampa	2013	3.32%	3.64%	6.77%
Virginia Beach	2011	3.85%	4.54%	8.52%
Washington, DC	2013	2.12%	2.44%	5.22%

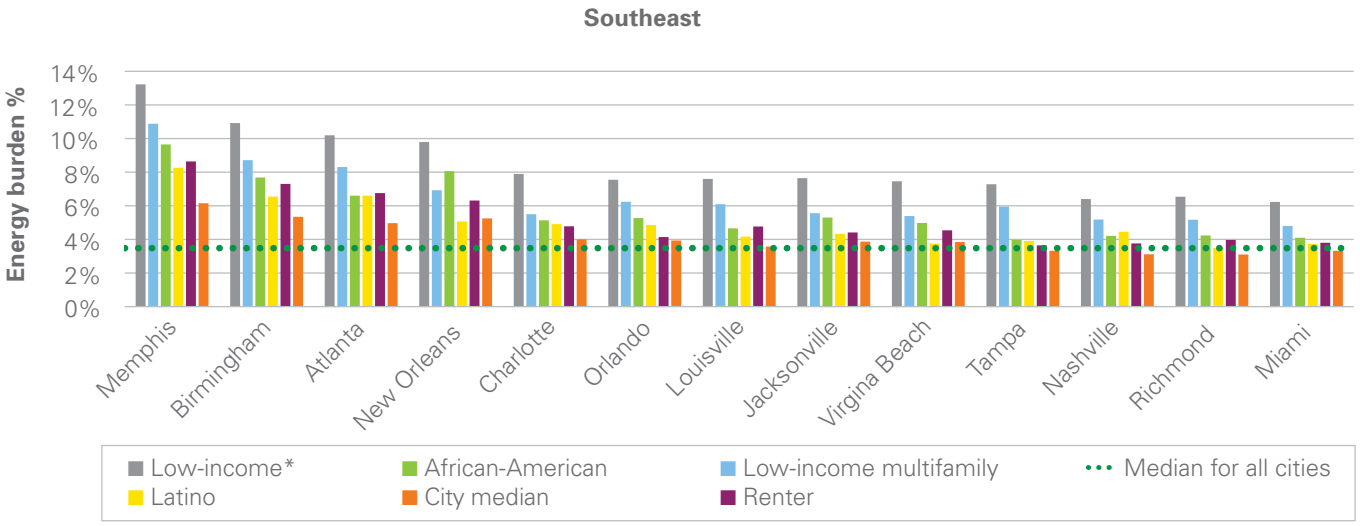
Appendix D. Households with Energy Burden At Least Twice the City Median

Table D1. Percentage of households in each group with energy burdens over two times the city median energy burden

City	Data year	All households	Low-income households	Low-income multifamily households	African-American households	Latino households	Renting households
Atlanta	2011	24.18%	51.45%	41.24%	32.57%	34.65%	33.77%
Austin	2013	23.55%	53.14%	36.81%	33.01%	34.68%	28.82%
Baltimore	2013	23.80%	56.83%	37.09%	36.12%	19.84%	28.84%
Birmingham	2011	25.31%	51.32%	41.51%	38.32%	23.08%	36.82%
Boston	2013	23.98%	50.54%	42.62%	30.65%	26.16%	25.82%
Charlotte	2011	23.76%	49.47%	32.70%	32.40%	29.44%	30.41%
Chicago	2013	29.11%	56.44%	48.44%	52.84%	28.13%	37.85%
Cincinnati	2011	24.32%	48.29%	36.99%	41.70%	22.73%	35.43%
Cleveland	2011	22.97%	50.08%	34.52%	41.03%	28.79%	36.38%
Columbus	2011	23.20%	51.40%	39.51%	40.37%	30.48%	32.43%
Dallas	2011	23.93%	52.19%	39.38%	33.60%	33.18%	27.16%
Denver	2011	23.25%	51.84%	40.40%	40.28%	35.27%	32.13%
Detroit	2013	25.26%	57.10%	36.02%	44.49%	38.96%	34.71%
Fort Worth	2011	21.55%	45.30%	33.33%	30.75%	27.57%	24.90%
Hartford	2013	22.97%	54.30%	38.57%	40.48%	37.29%	34.90%
Houston	2013	24.10%	53.28%	38.87%	34.39%	26.24%	26.37%
Indianapolis	2011	23.76%	52.82%	41.46%	34.97%	26.70%	34.00%
Jacksonville	2013	22.53%	48.97%	30.29%	33.50%	20.57%	26.54%
Kansas City	2011	22.66%	46.50%	34.72%	44.66%	34.15%	33.79%
Las Vegas	2013	20.95%	42.50%	27.89%	30.99%	25.71%	24.64%
Los Angeles	2011	26.22%	42.92%	32.44%	40.34%	30.15%	27.72%
Louisville	2013	22.98%	53.28%	41.67%	31.89%	30.61%	33.33%
Memphis	2011	26.10%	54.15%	43.64%	40.00%	32.77%	37.67%
Miami	2013	23.05%	46.10%	31.08%	32.36%	22.76%	24.74%
Milwaukee	2011	23.81%	43.08%	30.74%	46.13%	24.09%	30.19%
Minneapolis	2013	20.54%	56.46%	31.76%	46.61%	34.00%	29.01%
Nashville	2013	22.82%	52.23%	41.18%	34.38%	34.84%	29.21%
New Orleans	2011	23.71%	45.84%	24.08%	39.62%	17.14%	29.20%
New York City	2013	27.03%	47.03%	36.13%	29.25%	28.24%	24.62%
Oklahoma City	2013	22.19%	52.90%	36.92%	33.62%	26.96%	29.21%
Orlando	2013	20.59%	47.12%	34.42%	29.28%	22.95%	25.25%
Philadelphia	2013	27.03%	56.88%	31.29%	43.52%	47.44%	35.07%
Phoenix	2011	21.37%	46.53%	31.82%	25.85%	34.77%	28.29%
Pittsburgh	2011	23.57%	52.45%	40.63%	45.24%	34.00%	33.18%
Portland	2011	20.71%	45.86%	32.28%	40.00%	31.58%	26.91%
Providence	2011	22.66%	50.83%	34.55%	30.48%	38.46%	33.04%
Richmond	2013	22.53%	53.39%	39.68%	32.24%	25.37%	29.84%
Riverside	2011	20.10%	38.57%	25.93%	25.86%	20.45%	26.06%
Sacramento	2011	22.58%	43.74%	28.74%	36.53%	26.06%	29.12%
San Antonio	2013	24.13%	51.97%	31.14%	26.42%	29.42%	24.78%
San Diego	2011	21.07%	40.88%	26.10%	21.89%	23.91%	20.73%
San Francisco	2011	23.45%	49.92%	30.70%	40.00%	29.27%	21.67%
San Jose	2011	24.30%	53.78%	31.38%	28.32%	32.67%	24.61%
Seattle	2013	23.33%	55.36%	38.23%	38.03%	28.49%	26.33%
St. Louis	2011	24.30%	51.80%	38.81%	46.03%	19.72%	38.77%
Tampa	2013	22.47%	54.47%	41.23%	29.06%	23.55%	25.44%
Virginia Beach	2011	22.27%	48.39%	32.73%	32.42%	19.85%	28.34%
Washington, DC	2013	22.71%	68.06%	50.24%	32.91%	28.32%	29.30%

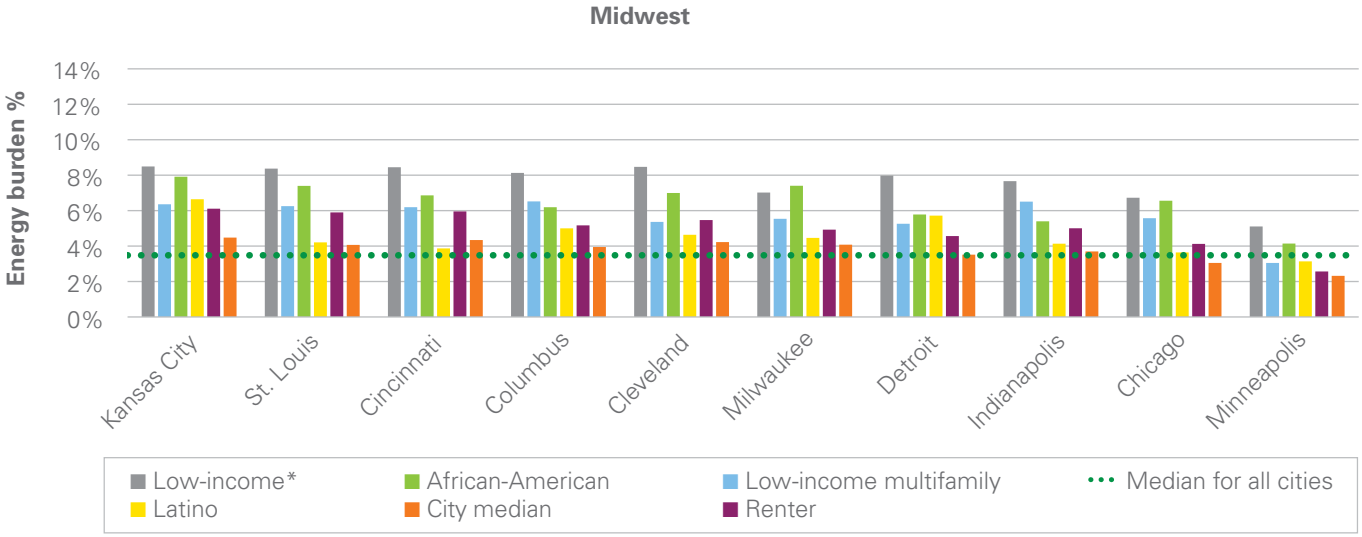
Appendix E. Regional Energy Burden

FIGURE E1. **Energy burden for median household from select groups in Southeast cities, ordered from highest to lowest based on the average of the median energy burdens across all groups.**



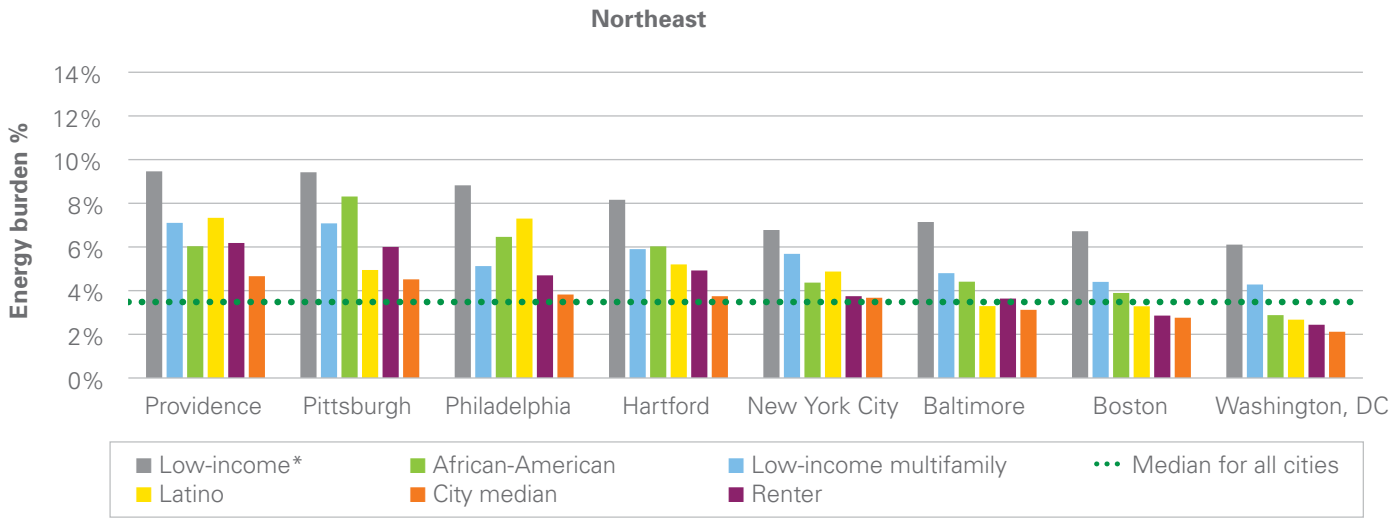
* Low-income includes both single- and multifamily households.

Figure E2. **Energy burden for median household from select groups in Midwest cities, ordered from highest to lowest based on the average of the median energy burdens across all groups.**



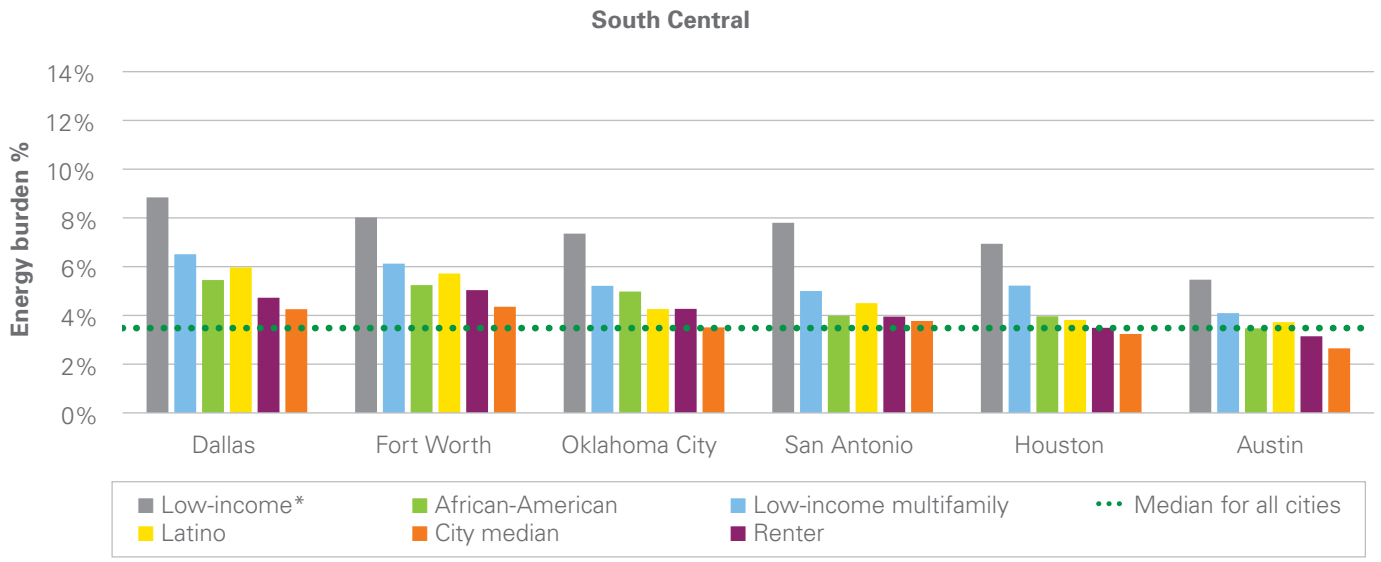
* Low-income includes both single- and multifamily households.

FIGURE E3. **Energy burden for median household from select groups in Northeast cities, ordered from highest to lowest based on the average of the median energy burdens across all groups.**



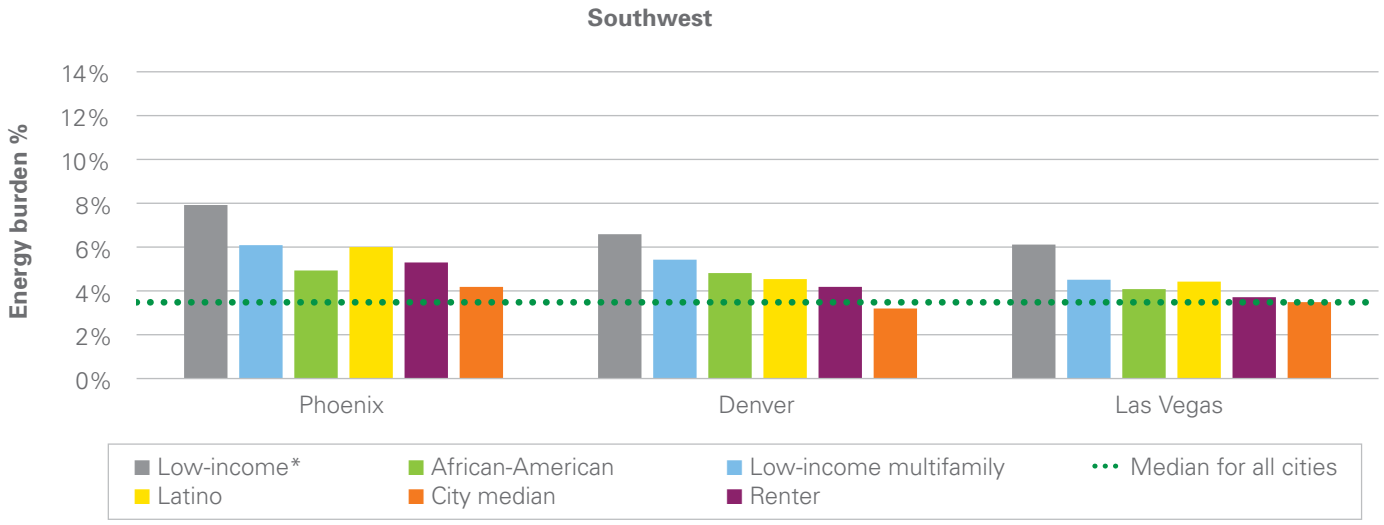
* Low-income includes both single- and multifamily households.

Figure E4. **Energy burden for median household from select groups in South Central cities, ordered from highest to lowest based on the average of the median energy burdens across all groups.**



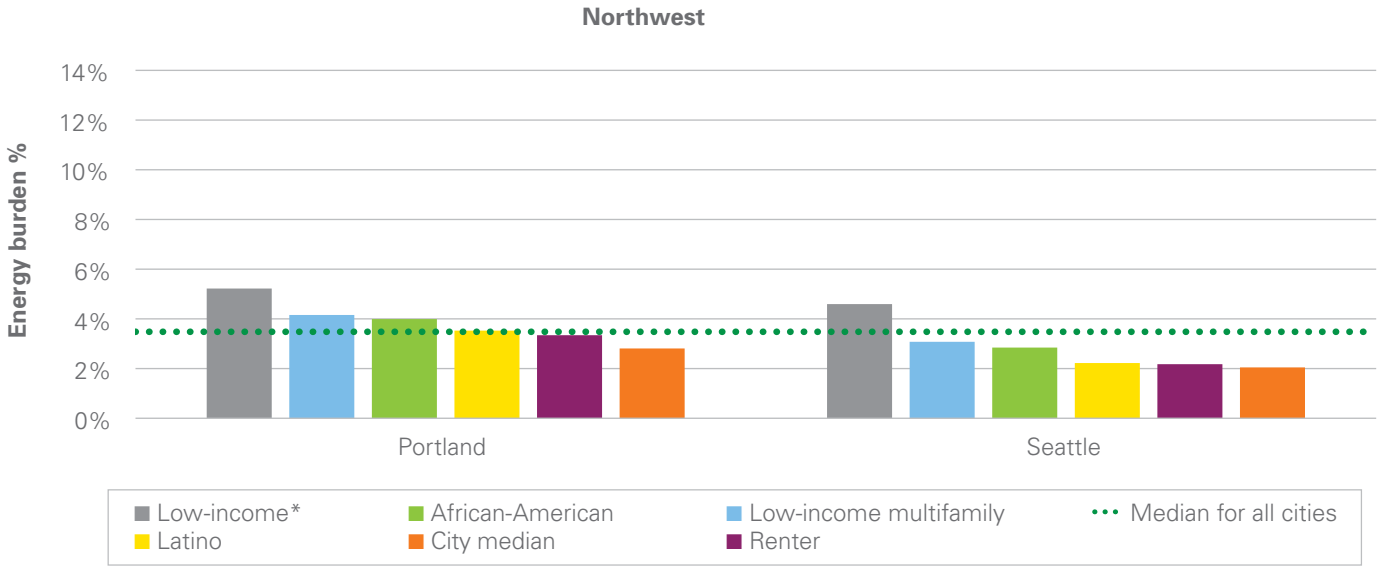
* Low-income includes both single- and multifamily households.

FIGURE E5. Energy burden for median household from select groups in Southwest cities, ordered from highest to lowest based on the average of the median energy burdens across all groups.



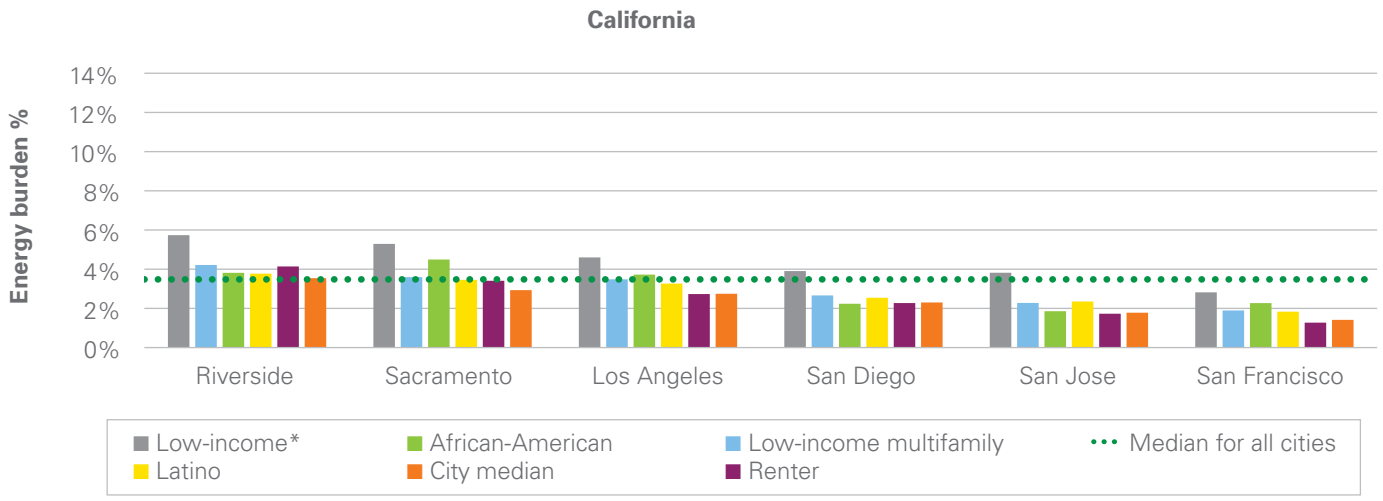
* Low-income includes both single- and multifamily households.

FIGURE E6. Energy burden for median household from select groups in Northwest cities, ordered from highest to lowest based on the average of the median energy burdens across all groups.



* Low-income includes both single- and multifamily households.

FIGURE E7. **Energy burden for median household from select groups in California cities, ordered from highest to lowest based on the average of the median energy burdens across all groups.**



* Low-income includes both single- and multifamily households.

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