

Another Step Forward: Continuing to Build Energy Resiliency Informed by Customer Electric Burden

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ABSTRACT

Weaving together program strategy storytelling with metrics, Entergy Arkansas, LLC (EAL) shares its perspectives on building customer energy resiliency. As defined by the Office of Energy Efficiency & Renewable Energy, energy resilience is the ability of the grid, buildings, and communities to withstand and rapidly recover from power outages and continue operating with electricity, heating, cooling, ventilation, and other energy-dependent services.¹ Through relationship-building in hard-to-reach communities, including partnerships with neighborhood stores and nonprofit organizations, focused outreach efforts for single family, multi-family, and manufactured homes, and inclusion of health and safety measures as part of its low-income offerings, the utility has effectively served vulnerable populations throughout its territory as defined by income, age, and comprehensiveness metrics. This success led to the question: could another metric also help identify and serve customers that can most benefit from energy efficiency improvements? Given the importance of energy burden in understanding energy affordability, and the fact that EAL serves one of the five states with the highest energy burden nationally, as calculated by the U.S. Department of Energy, the company is leading the way for its state in developing and tracking an electric burden metric for each of its low-income customers. Utilizing U.S. Department of Housing and Urban Development (HUD) data overlaid on Geographic Information System mapping of EAL territory and analyzing billing data for each household in a HUD low-income Qualified Census Tract, an average annual electric burden is being developed to inform program outreach efforts and monitor program outcomes. This presentation will overview the utility's program accomplishments through 2023 in serving vulnerable populations, the methodology used to develop the customer electric burden metric, and how program design and delivery strategies are being informed by customer electric burden in the 2024-2026 program cycle.

Introduction

Entergy Arkansas, LLC (EAL) serves low-income customers through multiple programs in its portfolio. To meet the legislative objectives outlined in Arkansas Act 1102 (Act 1102), EAL launched the Low-Income Energy Solutions program in 2020. The program is designed to

¹ [Energy Resilience | Department of Energy](#)

serve low-income residents (i.e., Low-Income Home Energy Assistance Program (LIHEAP)-eligible) and seniors (i.e., 65 and older). As by design, the Low-Income Energy Solutions program fully meets Act 1102 objectives. At the same time, EAL deploys a multi-pronged effort to reach and serve households most in need of energy efficiency improvements. Energy Solutions for Manufactured Homes and Energy Solutions for Multifamily Homes are specifically designed to meet the unique barriers of these customer segments and housing types. Recent evaluation surveys have found that over a quarter of participants in these programs also meet LIHEAP-eligibility criteria. In addition, the upstream component of EAL's Point of Purchase Solutions (POPS) program has focused on serving low-income customers through increasing retailer participation in low-income communities. EAL's success in serving vulnerable populations, as defined in Act 1102, led to the question of other metrics could help EAL identify and serve customer segments that can most benefit from the energy efficiency improvements delivered through its suite of programs.

Energy burden is defined as the percentage of gross household income spent on energy costs. According to the U.S. Department of Energy (DOE), low-income households face a disproportionately higher energy burden. DOE has calculated that the national average energy burden for low-income households is 8.6%, three times higher than for non-low-income households which is estimated at 3%. In some areas, depending on location and income, energy burden can be as high as 30%.² Research conducted by the American Council for an Energy Efficiency Economy (ACEEE) found that low-income, Black, Hispanic, and Native American households face dramatically higher energy burden than the average household. They note that weatherization that can save up to 25% of annual bills should be part of the solution, but segments most in need of weatherization measures are often underserved. In addition to energy savings benefits, ACEEE asserts that non-energy benefits also result from reduced energy burden as they found that high energy burdens are correlated with greater risk for respiratory diseases, increased stress and economic hardship, and difficulty in moving out of poverty. Given these findings, EAL tasked its evaluation, monitoring, and verification (EM&V) contractor, Tetra Tech, with developing an electric burden metric for its low-income customers that could inform future program design, outreach, and delivery in specific geographies in its territory.

First, this paper highlights EAL's key accomplishments through 2023 in reaching and serving vulnerable households through its Multifamily, Manufactured Homes, and POPS program offerings (the Low-Income Energy Solutions Program is a topic of another paper in the 2024 ACEEE Summer Study proceedings). It then discusses the methodology used to calculate energy for a census of low-income households in EAL's territory and the results for this metric. Finally, EAL shares its plans for using the newly developed electric burden metric to inform future program offerings.

Reaching multifamily and manufactured homes

While it is commonly acknowledged that both multifamily and manufactured homes are residential segments with unique barriers to energy efficiency, EAL's offerings are unique in

² [Low-Income Community Energy Solutions | Department of Energy](#)

designing specific programs to reach and serve these segments effectively. EAL's Multifamily Homes program aims to provide cost-effective energy efficiency measures to residents of multifamily buildings with at least five units. EAL's Manufactured Homes program focuses on manufactured home communities, areas with high concentrations of prefabricated, permanent residences that are factory-built and installed on a lot. Participating customers receive no-cost audits, direct installation of energy-efficient measures, and incentives for more in-depth services designed to improve efficiency. In 2023, the programs provided incentives for tune-ups of air conditioners and heat pump systems and for installing air infiltration and duct sealing. Faucet aerators, low-flow showerheads, advanced power strips, and lighting measures were directly installed at no cost. In addition, EAL has promoted the installation of mini splits—ductless heating and cooling systems that deliver concentrated climate control with minimally intrusive retrofits—in prior program years as part of the Manufactured Homes program and found this technology to be especially beneficial to this dwelling type. EAL's EM&V contractor, Tetra Tech, conducted a consumption analysis of participants receiving mini splits and found significant annual savings from these systems in manufactured homes that exceeded the deemed savings estimates found in the Arkansas Technical Reference Manual.

In 2023, the Multifamily Homes program served 2,673 customers, installing 13,470 efficient measures and the Manufactured Homes program served 267 customers, installing 2,627 efficient measures. The 2023 evaluation included customer surveys with program participants to assess customer satisfaction and participant demographics. The evaluation identified the percentage of customers who are eligible for LIHEAP by combining data collected on household size and income. Based on survey responses, at least half of the participants in both the Multifamily Homes and Manufactured Homes programs were LIHEAP-eligible, demonstrating the importance of these programs in serving the low-income community. Finally, the evaluation's net-to-gross research consistently finds 100% net-to-gross ratio for both programs, indicating that the efficiency improvements would not have happened without the programs.

Multifamily Homes Program

The Multifamily Homes program provides cost-effective energy efficiency measures to the multifamily residential and commercial market throughout the EAL service territory. The Multifamily Homes program helps overcome the split incentive barrier by making it easy for property owners to enroll and participate at little or no additional cost. The program continues to offer comprehensive energy-saving incentivized measures such as air conditioner tune-ups, duct sealing, air sealing, and direct install. In addition, the Multifamily Homes program now offers commercial, common area measures such as lighting, pool pumps, and central HVAC replacement. These initiatives continue to improve apartment communities by increasing comfort and reducing maintenance for property staff. By providing a more comprehensive approach to the multifamily market, the program has evolved to provide an all-inclusive experience for

multifamily property owners, making the enrollment process more streamlined.

Manufactured Homes Program

The Manufactured Homes program provides improved energy efficiency that benefits the owners and residents of manufactured homes and parks in the EAL service territory. The program provides much-needed services for a hard-to-serve customer segment, where customers paying the electric bill often do not have the ability to make energy efficiency upgrades. The program overcomes the upfront cost hurdle by making it easy for the occupant to participate at little or no cost, and the program eliminates the split incentive hurdle as described above, where the landlord pays for the energy efficiency upgrade while the tenant benefits from immediate improvement in comfort. The program incentivizes energy saving measures such as air conditioner tune-ups, duct sealing, and air sealing to customers, and direct installs such as LED bulbs, advanced power strips, high efficiency showerheads, and kitchen and bathroom aerators for customers with electric water heating are also offered. In addition, this program educates tenants and owners about the benefits of having these items installed on their property. After the direct install products are put in, the tenants receive personalized tips on improving their homes' efficiency. Direct install participants complete a customer satisfaction survey at the end of the process. Residents are informed of other EAL energy efficiency programs, as well as other programs available to them if they use natural gas energy.

Serving low-income communities through retailer partnerships

The POPS program provides fast, easy, energy efficiency solutions to customers where they shop. Discounts are offered for efficient products and appliances such as room air conditioners, advanced power strips, air purifiers and dehumidifiers, and smart thermostats. Reducing the price at the point-of-sale results in a streamlined participation path with no out-of-pocket cost or application barrier for the customer. In the 2022 and 2023 program years, EAL made a concerted effort to increase retailer partnerships where low-income customers shop, effectively increasing the percentage of low-income customers to more than half of POPS' upstream program savings. In 2023, 61.8% of evaluated gross kWh savings and 58.6% of evaluated gross kW savings achieved through the program were in low-income communities. The strategy to increase low-income participants in POPS' upstream offerings was informed by evaluation research conducted in 2021 that led to increased partnerships with dollar stores and "big box" retailers in low-income communities and community events.

Tetra Tech conducted a study of retailers to assess current shelf stocking practices of efficiency products and a residential general population survey to understand purchasing behavior of customers. The research found that dollar stores are common throughout EAL's territory, including low- to moderate-income neighborhoods. In visiting participating and nonparticipating stores, Tetra Tech found substantial potential to increase efficiency and discounted options in dollar stores. Dollar stores participating in POPS at the time of the stocking study were often found to be completely out of or low on discounted products. In addition, visits to nonparticipating dollar stores found limited efficient options were available. Tetra Tech

recommended expanding offerings in participating stores and gaining the participation of other dollar store chains to increase the efficient products available in these markets. The research also showed that dollar stores represent an opportunity to reach lower-income communities specifically; the general population survey found that low-income households are more likely to buy bulbs at dollar stores than non-low-income households (15% compared to 2%, respectively).

At the same time, the research found that “big box” stores remain the most common place customers plan to purchase equipment and, therefore, need to remain foundational to program strategies to serve low-income customers. The general population survey found that slightly more than one-half of both low-income and non-low-income customers said they are most likely to purchase equipment at a “big box” store, with Lowe’s, Walmart, and Home Depot being the most mentioned locations (42% and 36%, respectively). The shelf-stocking study found these stores have a large selection of products and good signage demonstrating the program incentive. Therefore, the recommendation was to continue these partnerships but with a focus on increasing the participation of retailers with geographic proximity to low-income neighborhoods.

To address the cost and accessibility barriers for residential customers (particularly low-income and rural customers), the POPS program continued a partnership with Feeding America

In Arkansas, 467,550 people are facing hunger and, of them, 134,690 are children.

1 in 6 people face hunger.



1 in 5 children face hunger.



People facing hunger in Arkansas are estimated to report needing \$262,358,000 more per year to meet their food needs.

The average cost of a meal in Arkansas is \$3.18.

SOURCE: Feeding America’s Map the Meal Gap study.

established in 2020. The partnership is designed to bring LED lighting, weatherization, and advanced power strips to those who utilize the food donation services offered by Feeding America partner agencies. Individual pantries and small organizations, such as churches or local development agencies, receive food and other goods from regional food banks that warehouse and distribute to the pantries weekly. In 2023, the program continued to expand the geographic area for donations by reaching out and shipping products directly to food pantries located in rural parts of Arkansas. As an example, this portion of the program donated 990,624 bulbs directly to pantries across the state. This amount is 96%

more than the previous year, since the federal Energy Independence and Security Act (EISA) began banning the inclusion of bulbs after June 30, 2023. This is significant because, according to Feeding America, food insecurity rates are higher in rural areas (i.e., those primarily served by the direct-to-pantry program) than in suburban areas. In fact, 9 out of 10 counties in Arkansas with the highest food insecurity rates are rural. In Arkansas, where according to Feeding America, 467,550 people are facing hunger, 134,690 of them children.

Through these efforts, the POPS program has allowed EAL to gain insight into various avenues by which to reach low-income and rural customers and to ensure these areas are

afforded the same energy efficiency offerings found in more heavily populated areas. The partnerships with the various food pantries and food banks, along with the smaller localized neighborhood stores, have allowed the POPS program to continue to grow its market reach. These efforts further provide weatherization, lighting, and advanced power strip (APS) measures to be placed where they previously had little or no presence to help with the energy burden these customers face.

Developing the electric burden metric

As an electric utility, EAL's metric must focus on electricity use to understand the energy burden of its customers. While the percentage of total energy burden by electricity costs varies by region, home electricity use is the largest contributor to total energy costs, and that percentage is expected to grow given ongoing electrification (RFF).

A three-step approach was used to calculate energy for a census of low-income households in EAL's territory. The first step was to geocode all EAL's residential customers. Using a geocoding computational process, residential addresses were transformed into geographic coordinates to map a home's location.

This allowed Tetra Tech to utilize U.S. Department of Housing and Urban Development (HUD) data for the second step in the methodology, which was to identify all residential dwellings within low-income housing tax-credit-qualified census tracts through the use of Geographic Information System (GIS) information. Census tracts represent the smallest territorial unit for which population data are available. More specifically, they are "designed to be relatively homogeneous units with respect to population characteristics, economic status, and living conditions."³ HUD has designed its own Low-Income Housing Tax Credit Qualified Census Tracts (Qualified Census Tracts) by estimating median family income annually based on data from the American Community Survey, table B19113. At least 50% of households within these tracts must have incomes below 60% of the area median gross income. The average household income of the Qualified Census Tracts serves as the denominator of the electric burden equation.

The third step utilizes EAL billing data for each household in a Qualified Census Tract to calculate annual electricity costs. Tetra Tech conducted a sensitivity analysis to assess if an average based on multiple past years (2020-2022) or the past 12 months was the best estimate of average annual electricity costs for a household. After determining the best electricity cost annual estimate, this became the numerator in the electricity burden equation.

Methodology

As an initial step, all EAL residential customers were geocoded to allow for identification of their census tract. Once the latitudes and longitudes were appended to the working data set, each customer was placed into their respective census tract to allow for the merging of median household income data from HUD. Lastly, monthly electric billing amounts were appended to

³ Huduser.gov

the data file for each residential customer. 2022 data was used for both the estimated median household income and billing records.

Expectedly, not all residential accounts had complete data for all 12 months in 2022. To examine the possibilities and implications of imputing or removing accounts, the project team compared electric bill statistics in 2022 for three distinct groups:

- Customers with electric use in every month of 2022.
- Customers with at least nine months of electric use in 2022.
- Customers with at least six months of electric use in 2022.

The results of the comparison, provided in Table 1, show minimal differences between monthly usage fees regardless of the data filtering method. It was decided to limit eligible accounts to those with at least nine months of consumption and billing data in 2022.

Table 1. Comparison of monthly electric bills by filtering method

	12 months	9+ months	6+ months
Monthly records	5,219,163	5,774,631	5,975,904
Mean bill	\$138.49	\$136.61	\$135.77
Median bill	\$118.77	\$117.06	\$116.30

Monthly billing records were annualized by summing electric bills in each month of 2022. Among accounts with less than 12 months of data, the average of the available monthly data was applied to the months with missing electric usage data, allowing each valid customer’s average monthly electric cost to be scaled to the annual level for comparison with income. Table 2 summarizes the number of customer records dropped and retained for the analysis, including an explanation for removal. We removed accounts without billing data, as this information is required for the energy burden calculation. These accounts represent closed accounts, move-outs, etc., that previously received electricity from EAL but did not during our period of interest. Lastly, we removed accounts with less than nine months of billing data in 2022 to maintain the integrity of the billing data.

Table 2. Summary of accounts used in analysis

Reason for drop	Accounts removed	Remaining accounts
Initial geocoded participant data	-	752,789
Merge with 2022 census tract median income data	0	752,789
Merge with 2022 EAL residential billing account data	198,200	554,589
Retain accounts with 9+ months of energy use	72,190	482,399

The median income of a census tract was applied to all customers within that tract. Lastly, the energy burden for each census tract (t) was calculated using this formula, with an example of the resulting energy burden statistics in Table 3:

$$\text{Energy Burden}_t = \frac{\text{Median Annual Electric Charges}_t}{\text{Median Household Income}_t}$$

Table 3. Example energy burdens by census tract

Census tract ID	Accounts in tract	Qualified census tract	Median income	Median annual electric cost	Electric burden
FIPS05107480400	460	Yes	\$14,363	\$1,216	8.5%
FIPS05077470300	1,315	Yes	\$17,806	\$1,448	8.1%
FIPS05119004500	598	Yes	\$17,130	\$1,326	7.7%
FIPS05103950600	1,426	Yes	\$17,168	\$1,301	7.6%
FIPS05051010800	742	Yes	\$20,120	\$1,390	6.9%

Insight from the Electric Burden Metric

Residents of Arkansas enjoy dependable and relatively low-cost electrical service statewide. The state provides residential customers electricity at a significantly lower rate than the national average of 14.94 cents per kWh. Ranking 12th lowest in the price of electrical service in 2022, Arkansas delivered power to residential ratepayers at an average of 11.35 cents per kWh (EIA2).

In 2022, the average electric bill among residential customers in EAL’s territory was \$136.61 per month, essentially matching the national average of \$137 (EIA1), a fact that supports the need for energy efficiency programs across the state. However, monthly expenditures on electricity disproportionately affect lower-income households, as a higher percentage of their monthly income must go to paying for electric service. Splitting residential customers into two groups—those located in income-qualified census tracts and those located in non-income-qualified census tracts—allows for a comparison of the overall electric burden experienced by customers across the income spectrum in EAL territory.

Examining the overall energy burden of these two groups, the project team identifies that residential customers in income-qualified census tracts allocate an average of five percent of their annual household income to electric bills, while customers living in non-income-qualified census tracts only allocate about three percent. Figure 1 provides the distribution of energy burdens among census tracts, showing that most qualified census tracts have higher energy burdens than non-qualified tracts.

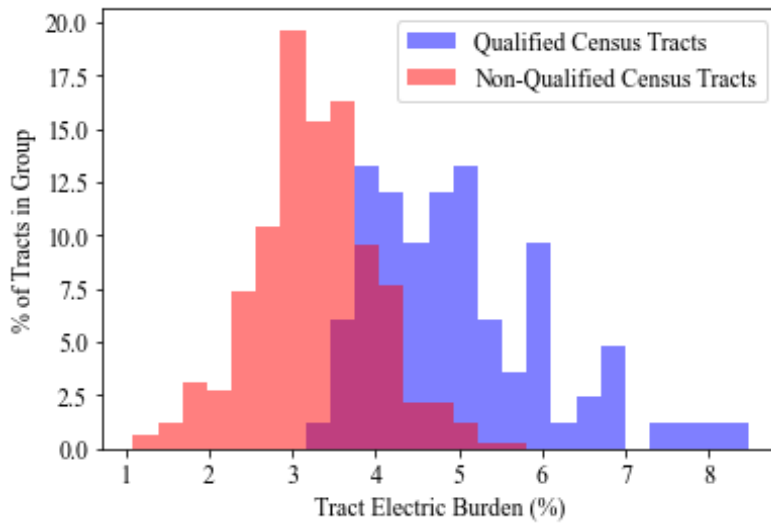


Figure 1. Electric burden among qualified and non-qualified census tracts.

Comparing the two groups, the median household income level of non-qualified census tracts is approximately 60% higher than that of households located in qualified census tracts. The corresponding metric for electric bills shows a much smaller relative difference between the two groups, with residential customers in non-qualified census tracts spending approximately 11% more per year on electricity than households in qualified census tracts, as detailed in Table 4.

Table 4. Comparison of overall electric burden statistics by qualified tract status

Statistic	Qualified Census Tract	Non-Qualified Census Tract
Number of accounts	83	326
Median household income (2022)	\$29,774	\$47,173
Median annual electric bill	\$1,390	\$1,548
Mean electric burden	5.0%	3.3%
Mean annual electric bill	\$1,420	\$1,553
Minimum electric burden	3.3%	1.1%
Maximum electric burden	8.5%	5.7%
Standard deviation	1.1%	0.7%

Conclusion

As research continues for the possibility of a new metric for energy burden, using the median household income levels and the census tracts, it evokes the question: can other metrics identify populations of low-income customers that could benefit from a reduced energy burden? Further, as this new population of energy burden customers is identified, what are the best

strategies to reach them? Energy efficiency professionals across the globe have the challenge of including more of this population in future program design and delivery. EAL will incorporate this crucial discussion across all of its energy efficiency programs. Building trust and educating customers on energy efficiency is one of EAL’s main goals, and educating customers on the importance of this work is key to the long-term success of energy efficiency programs. Knowledge can be passed on to future generations and to whole communities, which in turn helps people continue to save energy and money, long after the work has been done in their homes, which builds energy resiliency. “Tomorrow’s homes, buildings, and factories will use less energy and put less strain on the electric grid when demand is at its peak. DOE’s Office of Energy Efficiency and Renewable Energy funds research and development that accelerates process toward smarter, more energy efficient, and flexible buildings and industrial processes to enhance grid resilience.”⁴

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⁴ [Energy Resilience | Department of Energy](#)