Lighten the Energy Burden: Targeting Energy Efficiency Programs on Underserved and Overburdened Customers

Miles Ingram, Shawn Bodmann, DNV; Kiersten Williams, Eversource; Lisa Skumatz, Skumatz Economic Research Associates; Ralph Prahl, Prahl & Associates

ABSTRACT

As utility rates continue to rise, it becomes increasingly important for energy efficiency programs to help customers manage their energy costs. This applies particularly to low-income households, who must often choose between paying for energy and other basic needs. However, there has been little research into how well programs are succeeding in this critical mission. Historically, limited data has hindered accurate measurements of energy burden (energy costs as a percentage of household income), and programs' effect on burden.

This research leverages newly available account-level customer demographic data to measure energy burden and assess how well programs are serving burdened customers. The team used this data to analyze household burden and the level of arrearages (unpaid utility bills) in Connecticut and combined it with program data to assess how burden and arrearages varied between participating and non-participating households as well as demographic groups.

Results show that ~40% of Connecticut households had non-transportation-related energy expenses exceeding 6% of income (the standard threshold for high energy burden) and that the average amount owed by customers in arrears nearly doubled from 2017 to 2023. There is evidence that energy efficiency programs can help these customers. For instance, among customers in arrears in 2023, those who had previously participated owed 15% less on average than those who had not. Customers who participated before 2023 were also 25% less likely to have high electric energy burden in 2023 than those who had not. These results can guide program efforts to reduce energy bills for burdened customers.

Introduction and Background

Households across the country face growing energy affordability challenges, driven by a confluence of energy market trends and broader economic forces. After years of decline, electric load in many states is increasing, fueled by the expansion of energy-intensive data centers, the growing use of air conditioning, and efforts to electrify transportation and building systems. This rising demand is colliding with an already-constrained electricity supply, placing upward pressure on wholesale energy costs and retail rates. As a result, the share of household income being spent on utility bills is growing, further deepening the energy burdens that many low- and moderate-income households already face. At the same time, current and planned reductions in federal support for critical energy assistance and other safety net programs—including the Low-Income Home Energy Assistance Program—threaten to exacerbate financial stress for the most vulnerable residents.

With increasing energy bills and fewer resources available to cover basic living costs, more households are likely to fall behind on their utility payments, increasing arrearages and creating cascading consequences for customers as well as utility providers. For example, as happened during the COVID-19 pandemic, utilities are likely to see increasing customer arrearages, which may need to be recovered through future rate increases.[1] This self-reinforcing cycle of increasing household financial hardships,

[1]As the Connecticut Office of Consumer Counsel (OCC) explained in September 2024, "the costs of uncollectible outstanding balances for hardship-designated customers in the Public Benefits category are historically significant

unpaid utility bills, and subsequent rate increases poses challenges for utilities seeking to maintain the trust and approval of investors and the public.

Energy affordability has been an acute challenge in Connecticut in recent years, as the state's electricity rates remain among the highest in the nation (Energy Information Administration 2025). According to Operation Fuel (2023), over 400,000 households in Connecticut—about 30% of households—face unaffordable home energy costs, which can exceed 20% of household income for the lowest-income households. Connecticut residents have experienced several recent rate increases—in part for recovering the costs of unpaid utility bills following the COVID-19 pandemic—and are likely to see further increases in the near future to cover costs for storm recovery, mandated grid upgrades, smart-meter installations, and more (Harr 2025).

As these challenges grow, so does the importance of metrics for assessing household energy affordability. Developing meaningful metrics and analytic frameworks to measure levels of energy burden and arrearages—particularly among the most at-risk populations—will be essential for improving the effectiveness of program interventions in addressing affordability challenges. It will also be important for metrics to assess the distributional effects of energy efficiency and other programs, as detailed in guidance from the U.S. Department of Energy (DOE 2024):

> *"[T]raditional benefit-cost analysis is not suited for evaluating energy inequities because it is limited to comparing impacts on all utility customers on average without considering disparate impacts on different groups. Distributional equity analysis focuses on identifying and estimating the distribution of costs and benefits across different customer types. This analysis can inform decision-makers of how some customers will experience costs and benefits differently from other customers."*

In 2020, the Connecticut Department of Energy and Environmental Protection (DEEP) launched the Equitable Energy Efficiency (E3) Proceeding with a goal of defining equity as it relates to the state's Conservation & Load Management (C&LM) energy efficiency programs. The mandate included developing specific metrics to determine which customer groups are underserved by the programs and measure progress toward better serving them. In addition, the Connecticut Energy Efficiency Board (EEB) commissioned a comprehensive customer profiling study of program participants and non-participants to understand participation patterns, savings, and benefits, which in turn can help develop baseline metrics and recommendations for increasing program reach and equitable service. A study team from DNV, under contract with Resource Innovations (RI, formerly Cadeo) and overseen by the Connecticut Evaluation Administrator (EA) team, conducted this research from January 2024 through April 2025, culminating in a final report issued in July 2025.

The study team coordinated with the EEB to help define criteria and calculations used to assess priority populations and to produce quantitative outputs to inform the development of specific key performance indicators related to equity. The study also included an examination of energy burden (electricity and gas costs as a percentage of annual income) among households in Eversource's Connecticut service territory. This analysis was made possible by newly available account-level customer demographic data that included household income, which Eversource collects and integrates with its larger set of customer data. The study also included a review of arrearages (unpaid utility bills) among Connecticut households. Finally, using energy efficiency program tracking and customer billing data from the Connecticut utilities covering 2017-2023, the study attempted to quantify the impact of the C&LM programs in mitigating energy burden and arrearages.

this year, in large part due to the lingering impacts of the COVID pandemic." Eversource's costs for these outstanding balances were approximately $70 million, which were reflected in 2024 rate increases. See CT OCC, *Frequently Asked Questions*, September 4, 2024 at https://portal.ct.gov/-/media/occ/occ-ram-qa-final-09042024.pdf.

Methodology

This research was based primarily on C&LM program tracking and customer billing data covering 2017-2023 from Eversource and Avangrid, along with several other sources of data, as detailed below. The full study also leveraged findings from recent customer profiling studies in Massachusetts and Rhode Island to corroborate findings and compare Connecticut's results with neighboring states. Table 1 below details the datasets the team used for this analysis. Note that the customer demographic data used to analyze energy burden—in particular household income—was available only from Eversource and only for 2023. Other data, including on arrearages, was available from both companies for 2017-2023.

Table 1. Primary data sources

Data	Description	Source
Program tracking data	Description and vintage: Energy efficiency program tracking records, 2017-2023 Data fields and granularity: Measure-level datasets, with key fields including program, electric and gas savings, program incentives, project address, and participant account numbers.	Eversource and Avangrid
Customer billing data	Description and vintage: Electric and gas consumption and billing data for all customers, 2017-2023 Data fields and granularity: Annual account-level data, with key fields including amount of consumption, billed amount, hardship rates, date, service address. Also includes data on arrearages.	Eversource and Avangrid
Customer demographic data	Description and vintage: Residential demographic data for all Eversource customers, 2023 only Data fields and granularity: Account-level data with key demographic fields for household income, number of people per household, dwelling type, and ownership	Eversource only
Environmental Justice Community (EJC) data	Description and vintage: List as of 2023 of (1) distressed municipalities as designated by the CT Department of Economic and Community Development and (2) defined Census block groups where 30% of the population is living below 200% of the federal poverty level Data fields and granularity: Municipality name; Census block group ID	CT Department of Energy and Environmental Protection (DEEP)

Database development

The team merged tracking, billing, and third-party datasets into a combined database, allowing specific subsets of data to be queried consistently to quickly answer research questions at the population, segment, subsegment, and individual customer levels. This framework accommodates the large volume of data required for the project's scope and enables the efficient re-running of analyses as data is added or updated. It thus provides a long-term solution for managing the Connecticut datasets that can be expanded for future research. The high-level process included the following:

1. Loaded over 900 tracking, billing, and third-party datasets into a relational database
2. Mapped common fields such as account number and energy savings
3. Executed data transformations to make sure all common fields are the same units
4. Merged billing and tracking data
5. Merged third-party data
6. Geocoded all records based on address

7. Executed data quality checks

The full published report provides additional detail on the database development process (Connecticut Energy Efficiency Board 2025).

Definitions

Energy burden. This study considered households with non-transportation related energy expenses exceeding 6% of household income to have high energy burden. This definition uses a commonly applied threshold of 6% based on affordability thresholds of (1) utility costs not exceeding 20% of housing costs and (2) housing costs not exceeding 30% of income (Colton 2011 and Brown 2019). The 6% threshold is widely recognized in the literature and used in EPA's LEAD tool and other sources (EPA 2024).

Because total burden accounts for electric and non-electric household energy costs, and the team did not have delivered fuel cost data for the large share of Connecticut households that heat with oil or propane, the team calculated burden separately by fuel for electricity and gas. A household was considered electric burdened if its electric costs were 3% or more of its annual household income, and gas burdened if its gas costs were 3% or more of its annual household income.[2] Note that using the 3% per-fuel threshold, homes with electric heating will be somewhat overcounted as electric burdened, because their electric costs include heating.

Arrearages. For purposes of our analysis, customers with arrearages are those who had unpaid, overdue electric or gas bills as of December of a given year (from 2017-2023). Our analysis presents both the rate of arrearages (the percentage of accounts in arrears) and the average amount owed for those in arrears. Unlike energy burden data, arrearage data were available from both Connecticut utilities for the full study period of 2017-2023.

Low-income households. This study defined low-income households as those with household incomes below the 40th percentile of the area median.

Environmental Justice Communities (EJCs). The research examined how program participation and other benefits are distributed among residences located in EJCs. As detailed in Table 1 above, the team based these analyses on the most recently available (2023) EJC data from DEEP. These data include both (1) distressed municipalities and (2) defined Census block groups (in any municipality) where 30% of the population is living below 200% of the federal poverty level.[3] The Distressed Municipalities list identifies the state's most fiscally and economically distressed municipalities, based on statistical indicators measuring the fiscal capacity of each municipality based on (1) tax base, (2) personal income of residents, and (3) the residents' need for public services (Connecticut Department of Energy & Environmental Protection 2025). Figure 1 shows where the 2023 EJCs are located across the state.

[2] The 3% per-fuel threshold is also supported by data from EPA's LEAD tool, which presents energy burdens by AMI quintiles, and breaks them down by electric cost, gas cost, and delivered fuel costs. The two lowest quintiles had total energy burdens exceeding 6%, and individual electric and gas energy burdens exceeding 3% each.

[3] EJCs are designated based on Connecticut's statutory definition, and state agencies use the list of EJCs to target funds for needs including housing, brownfield remediation and economic development programs, among others.

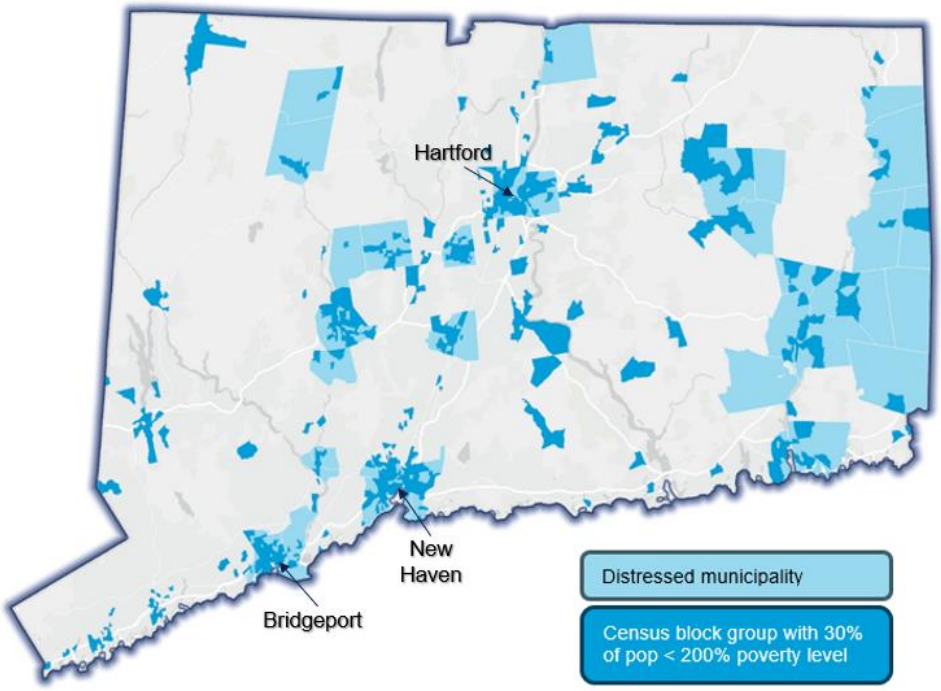

Figure 1. Connecticut EJCs

Results

Energy Burden

Based on available data for 2023, approximately 40% of households in Eversource territory meet the standard definition of having high energy burden. When considered separately, approximately 30% of homes (about 264,000 homes) are electricity-burdened, and 25% of homes (about 43,000 homes) are gas-burdened, as shown for electric accounts in Figure 2. (The results for gas households show a similar pattern as electric households, but the gas figure is not included in this paper due to space constraints.).

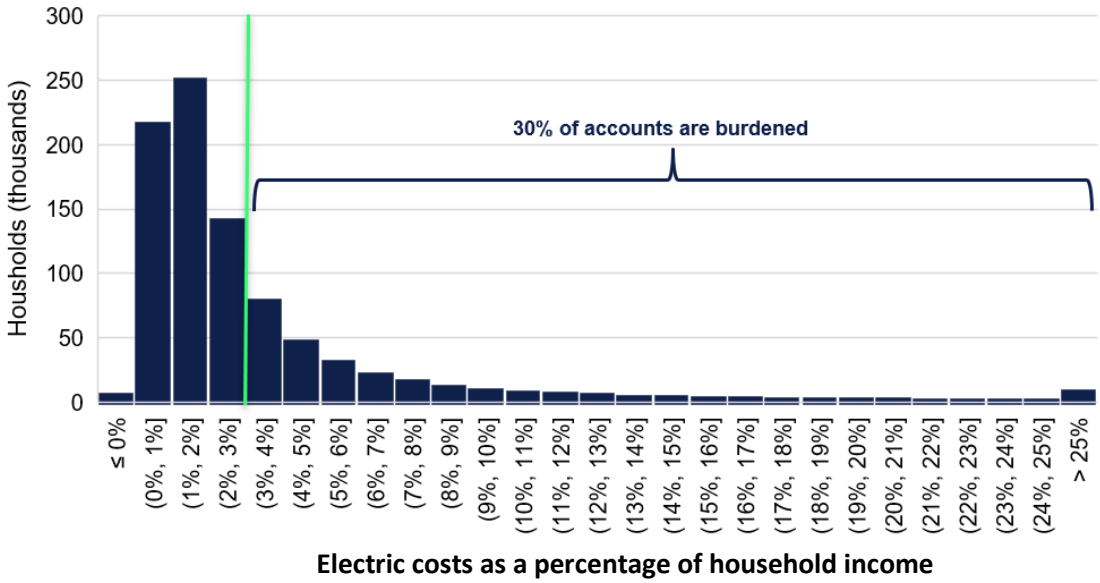

Figure 2. Electric energy burden, Eversource only, 2023

It is important to note that electrically-heated homes are reflected in these results, because there was not reliable account-level data on these homes the team could use to exclude them. Many of these homes will appear as burdened in these results when they may not be burdened, because the 3% threshold used to define burden assumes fossil fuel heating. As such, these results overstate the extent of electric burden to some extent. According to the most recent residential saturation study in Connecticut, 11% of Connecticut homes use electricity for primary heating.

Residents of large and small multifamily buildings, as well as renters, experience higher levels of energy burden than single-family households and homeowners, as shown in Figure 3 and Figure 4. While the rate of burden (% of households above burden thresholds) and the average level of burden (% of household income spent on energy) are shown below only for electric, gas burden trends (not shown) are the same. Residents of multifamily buildings and renters also tend to use less energy than other households, due to smaller living spaces, fewer appliances, and other factors. Therefore, their higher energy burden is likely driven by lower household income rather than higher energy use.

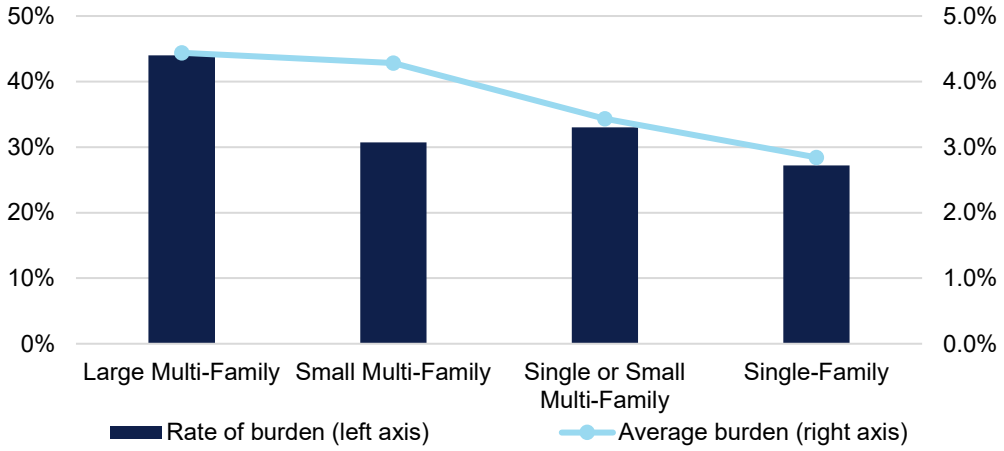

Figure 3. Electric energy burden by dwelling type, Eversource only, 2023

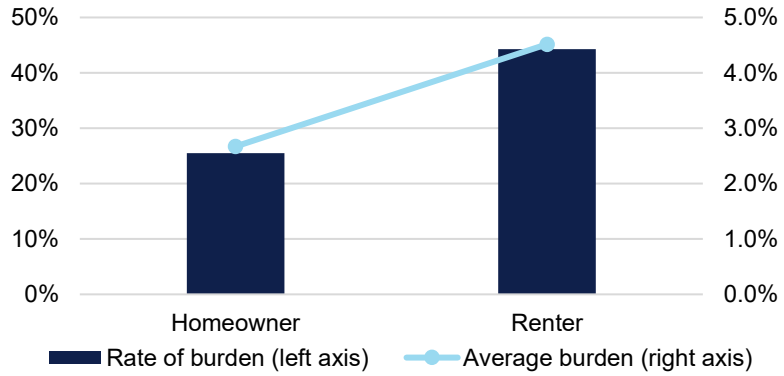

Figure 4. Electric energy burden by ownership status, single-family only, Eversource only, 2023

Levels of burden among households in EJCs, shown in Figure 5 below, mirror the levels of burden among multifamily and renter households shown above. This result is expected, as the study team separately found that there is significant overlap between EJCs and areas with high concentrations of multifamily and renter-occupied households (Connecticut Energy Efficiency Board 2025).[4]

[4] For key characteristics analyzed such as renters and multifamily households, over 60% of block groups with high concentrations of one characteristic also have a high share of the other characteristics or are in an EJC.

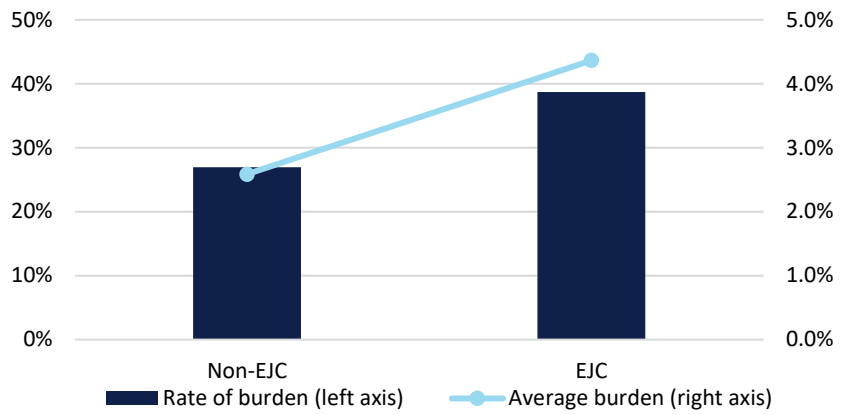

Figure 5. Electric energy burden by EJC, Eversource only, 2023

Energy burden is much greater for low-income customers, while program participation is lower—meaning that households with the most need receive less program support. As shown below, the team found a steady trend of increasing burden and decreasing participation at lower levels of household income, both among electric (Figure 6) and gas households. (The results for gas households show the same pattern as electric households. The gas figure is not included in this paper due to space constraints.) As shown, most households have incomes of >80% of area median, but the over 400,000 homes with lower incomes see far higher rates of burden and decreasing rates of participation. For the lowest income quintile, the rate of electric burden approached 100% and the rate of gas burden (not shown) exceeded 80% in 2023, while rates of 2017-2022 cumulative participation rates were 7% (electric) and 5% (gas, not shown). This pattern also underscores that income levels, more than energy use, are often the primary driver of energy burden. Specifically, lower-income households—and particularly multifamily occupants and renters—tend to use less energy, yet often have higher energy burdens, as even modest energy expenses can represent a large share of their limited income.

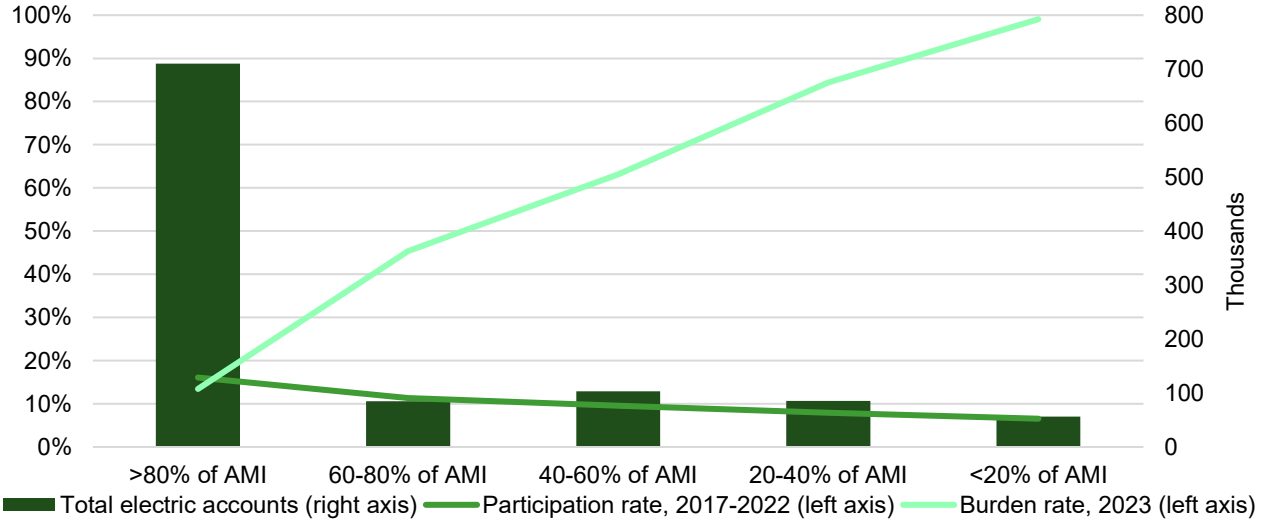

Figure 6. Rates of electric energy burden and participation, by income quintile, Eversource only. Note: Participation includes the four comprehensive residential retrofit programs in Connecticut: Home Energy Solutions (HES), HES-Income Eligible (IE), Multifamily, and Multifamily-IE programs.

Energy efficiency programs appear to reduce energy burden, but further research is needed to definitively establish causation. As shown in Figure 8, households that participated at least once in 2017-

2022 had lower rates of electric and gas burden in 2023 than non-participating households. Electric burden in particular was about 25% lower for participants than non-participants. However, it is possible that the causal effects flow in multiple directions. For example, less burdened households have more disposable income and may therefore be more likely to participate in programs than more burdened households. Testing this hypothesis requires further data and analysis beyond the current research.

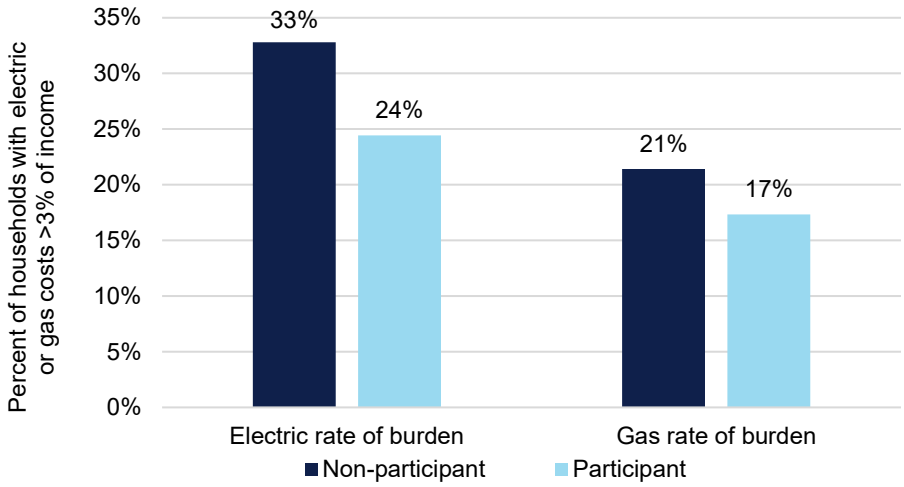

Figure 8. Rate of 2023 burden by participation in 2017-2022, Eversource only. Note: Participation includes the four comprehensive residential retrofit programs in Connecticut: Home Energy Solutions (HES), HES-Income Eligible (IE), Multifamily, and Multifamily-IE programs.

In addition, when controlling for income, rates of gas burden show the opposite pattern as overall rates of burden shown above. Specifically, low-income participants—defined as households with incomes below the 40th percentile of the area median—had a higher rate of 2023 gas burden than non-participating low-income households (Figure 9).

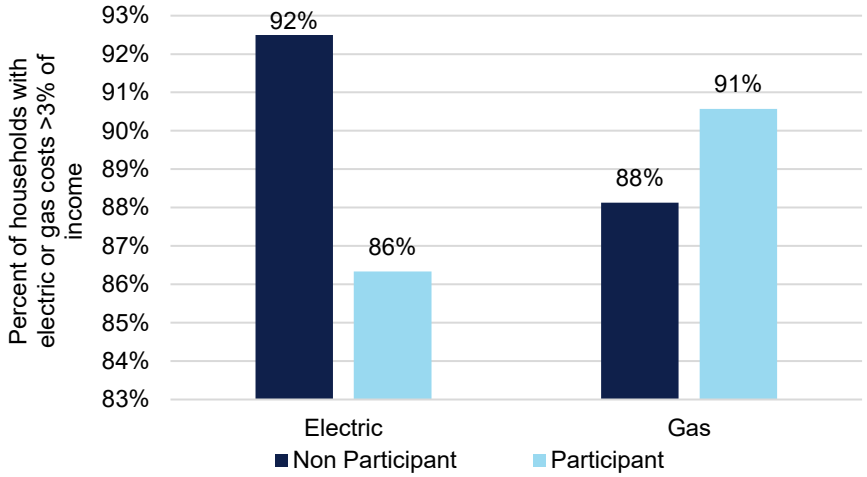

Figure 9. Rate of 2023 burden by participation in 2017-2022, low-income households, Eversource only. Participation includes the four comprehensive residential retrofit programs in Connecticut: Home Energy Solutions (HES), HES-Income Eligible (IE), Multifamily, and Multifamily-IE programs.

Low-income households facing higher gas burdens are more likely to participate than their households with lower burden, as shown in Figure 10. This result helps explain the higher levels of burden among low-income gas participants shown above. It also shows that the utilities are relatively effective in reaching low-income gas-burdened customers and is an exception to the otherwise consistent finding that burdened households are generally less likely to participate than non-burdened households. Specifically,

as shown in Figure 10 and Figure 11, lower participation rates among burdened households can be seen among (1) low-income electric, (2) non-low-income electric and (3) non-low-income gas-served households. This trend is also consistent with findings in the full report showing lower participation rates among households with lower incomes and other characteristics associated with lower incomes such as renters or small multifamily buildings.

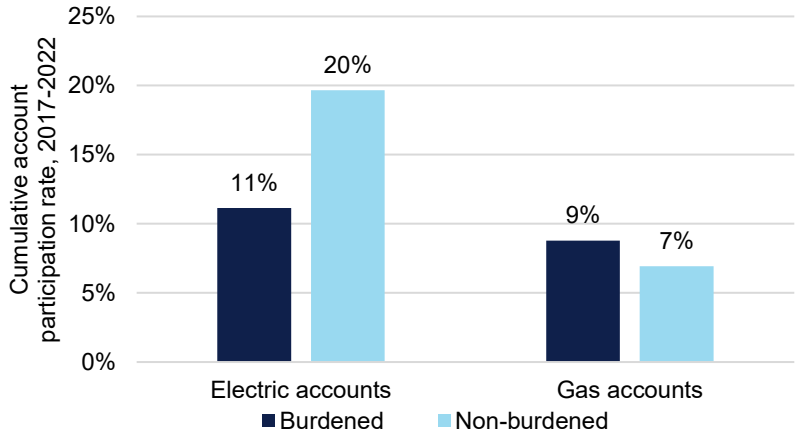

Figure 10. 2017-2022 participation rate by 2023 burden status, low-income households, Eversource only. Participation includes the four comprehensive residential retrofit programs in Connecticut: Home Energy Solutions (HES), HES-Income Eligible (IE), Multifamily, and Multifamily-IE programs.

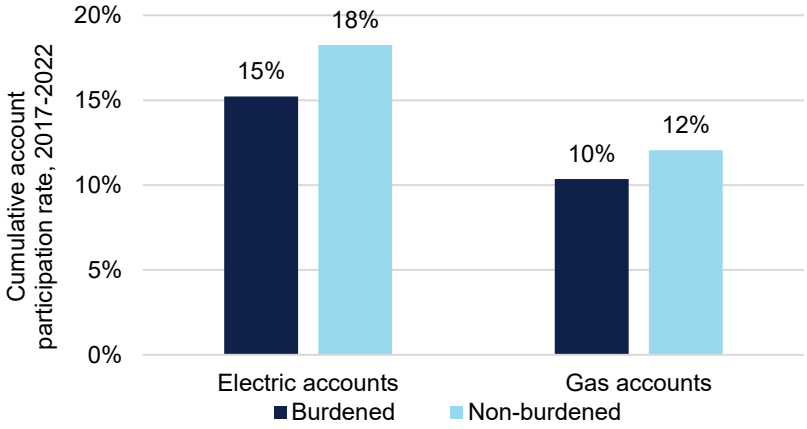

Figure 11. 2017-2022 participation rate by 2023 burden status, non-low-income households, Eversource only. Participation includes the four comprehensive residential retrofit programs in Connecticut: Home Energy Solutions (HES), HES-Income Eligible (IE), Multifamily, and Multifamily-IE programs.

Additional years of household income data could be used to definitively establish a causal relationship between participation and energy burden, including among low-income gas households. The findings above suggest that energy efficiency programs help reduce energy burden—particularly among electric households—but since household income data (and therefore energy burden analysis) was limited to 2023 only, the team could not definitively establish causality. With multiple years of household income data, more robust analysis that provides stronger evidence of a causal relationship would be possible in the future.

Arrearages

The average amount of arrearages (unpaid bills) has been steadily increasing since 2017, although the rate of households in arrears is relatively stable, as shown in Figure 12. The average amount

owed among by customers in arrears has almost doubled over the 7-year evaluation window. This rate of increase is much faster than the percentage increase in the per-kWh cost of electricity over the same period (47%, based on EIA data).

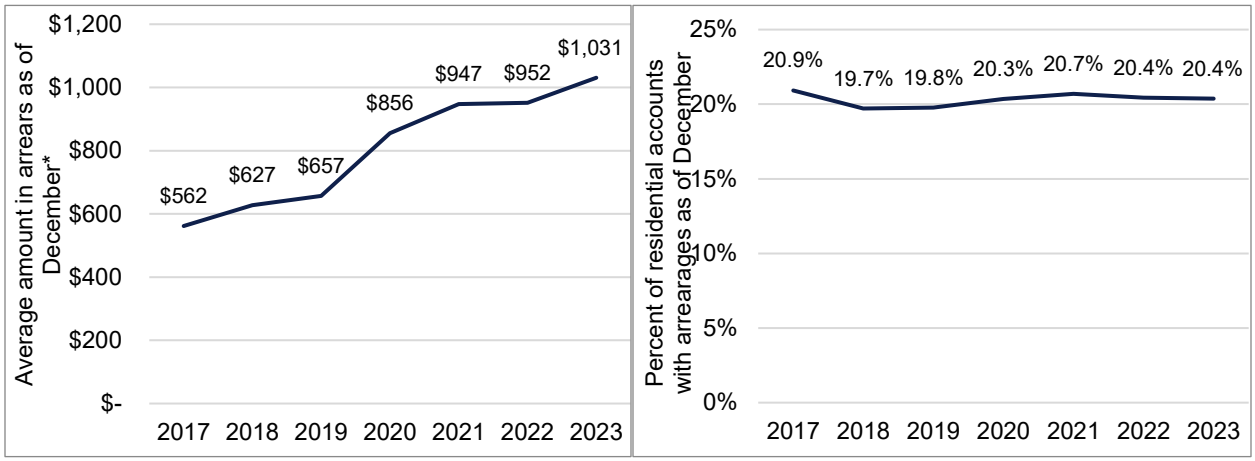

Figure 12. Rate of arrearages and average amount owed, statewide, 2017-2023. Average includes only those customers in arrears.

Arrearages are more prevalent for customers in EJCs. Unsurprisingly, customers in EJCs are much more likely to be in arrears, and this rate is slightly increasing. Meanwhile, non-EJC areas are experiencing a slightly decreasing rate of arrears, as shown in Figure 13. In addition, EJC customers in arrears have higher unpaid bills than customers in non-EJC areas.

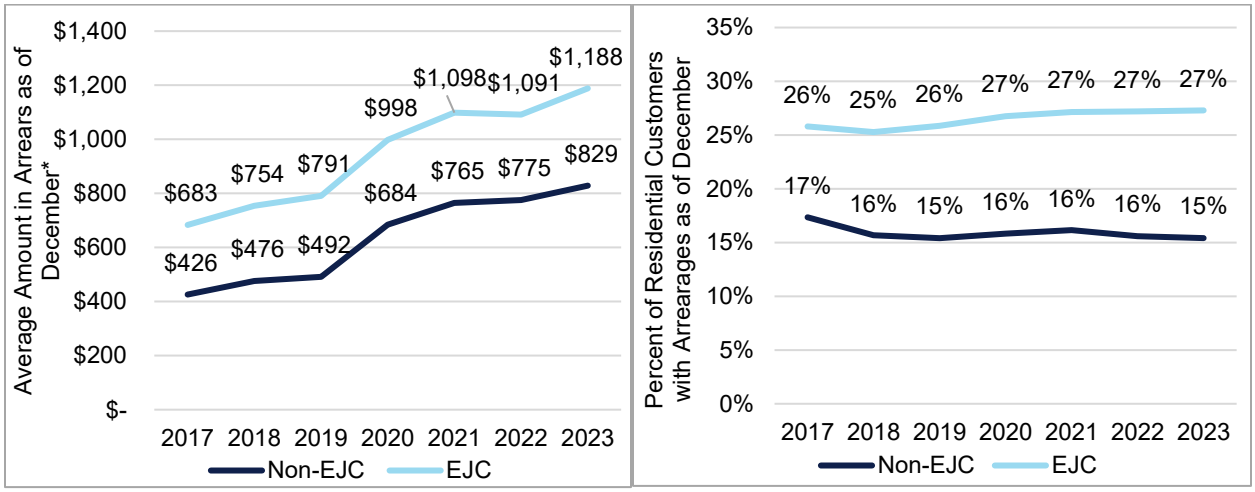

Figure 13. Arrearages by EJC status

The programs have had some success in serving customers with arrearages and helping reduce the amount they owe. As shown in Figure 14 below, customers with arrearages during the evaluation period[5]—particularly those in EJCs—participated at higher rates than those without arrearages. This may be due in part to programs leveraging customer touchpoints—such as notices and communications about unpaid bills—as an opportunity for program recruitment and enrollment.

[5] Customers with arrearages are those that had positive amounts due as of December of one or more years from 2017-2023.

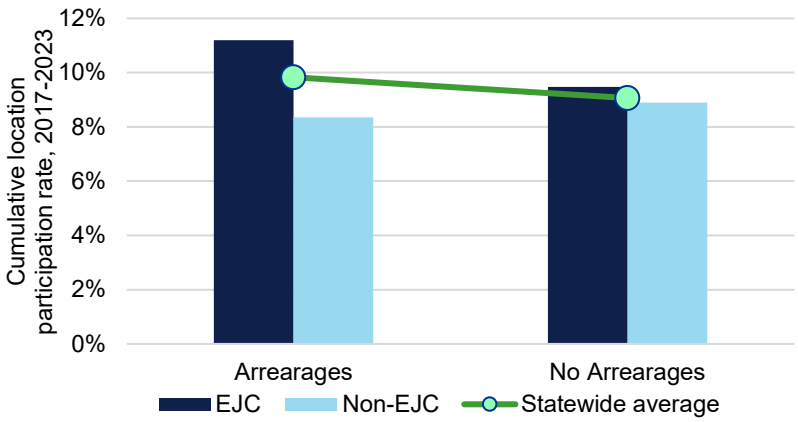

Figure 14. Participation rate by arrearages and EJC status. Note: Participation includes the four comprehensive residential retrofit programs in Connecticut: Home Energy Solutions (HES), HES-Income Eligible (IE), Multifamily, and Multifamily-IE programs. Customers with arrearages are those who had positive amounts due as of December of one or more years from 2017-2023.

In addition, there is evidence that participating in energy efficiency programs can help lower amounts in arrears. When observing customers who were in arrears at the end of 2022, the study team found that those who participated in HES/HES-IE in the following year were less likely to still be in arrears at the end of 2023 than those who did not participate. Specifically, among those with arrearages at the end of 2022, 53% of 2023 program participants remained in arrears at the end of the year, whereas 58% of 2023 non-participants remained in arrears at the end of the year. This equates to a relative difference of 10% decreased frequency of arrearages among those who participated. In addition, as shown in Figure 15, among customers who remained in arrears at the end of 2023, those who participated had on average a 15% larger reduction in their amount owed than those who did not participate (NMR 2022).[6]

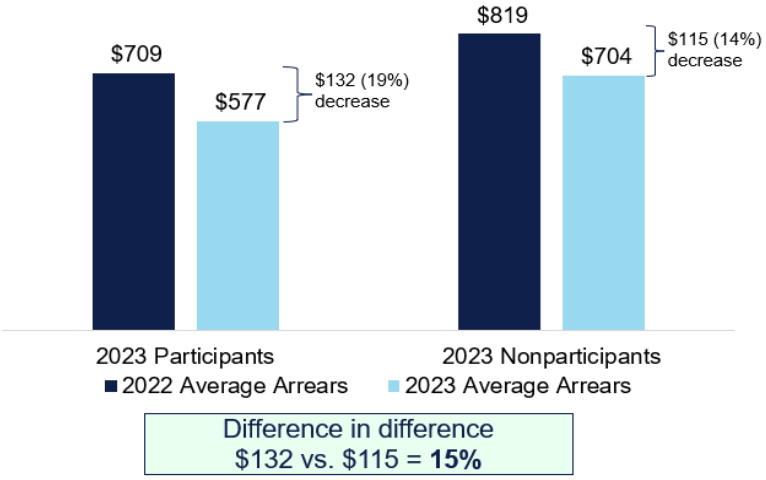

Figure 15. Change in arrearages during 2023, for those previously in arrears. Note: Participation includes the four comprehensive residential retrofit programs in Connecticut: Home Energy Solutions (HES), HES-Income Eligible (IE), Multifamily, and Multifamily-IE programs.

Conclusions

Customers in Connecticut are experiencing increasing arrearages and a significant share are energy burdened. Approximately 20% of customers overall were in arrears as of the end of 2023, and the

[6] A similar effect was found in the CT X1942 Non-Energy Impacts evaluation.

rate of arrears in EJCs (27%) is almost twice as high as the rate in non-EJCs (15%). In addition, the average amount owned by customers in arrears has almost doubled since 2017. This trend will likely accelerate, given expected rate increases and decreasing federal low-income energy assistance (see below). Based on available data from Eversource, approximately 40% of households in its territory met the standard definition of experiencing high energy burdens in 2023.

There is evidence that participating in energy efficiency programs helps struggling customers pay their energy bills. For instance, customers that remain in arrears after participation shave about 15% more off the amounts they owe than non-participants, on average. In addition, analysis of 2023 Eversource data found that low-income customers who participated prior to 2023 were 25% less likely to have high electric energy burdens in 2023 than those who had not participated. However, customers who are energy-burdened or are on hardship rates participate at lower rates than customers without those challenges.[7]

As the study team was completing this research, the federal government announced significant cuts to energy assistance programs, including the Low Income Home Energy Assistance Program (LIHEAP) and other incentives that help low-income households manage energy costs. As federal aid for low-income households ramps down, customer hardship will increase and customers will increasingly struggle to pay their utility bills. As such, programs' ability to mitigate customer energy burden and arrearages makes them an important source of support for customers facing growing financial hardships. Programs can also help avoid the kind of rapid build-up of arrearages that occurred during the COVID-19 pandemic and that contributed to future rate increases. This dynamic threatens to create a self-reinforcing cycle of increasing household financial hardships, unpaid utility bills, and subsequent rate increases that threaten investor trust and public approval of utilities.

Energy burden is a product of energy use as well as other factors beyond the control of utilities and programs, such as broader socioeconomic hardships. These other factors limit the impact that energy efficiency programs can have on addressing burden. However, program administrators can take steps to increase the reach and improve the targeting of programs to better serve burdened customers. The full report includes several recommendations for programs to identify and target households struggling to pay energy bills, such as coupling energy efficiency programs with customer touchpoints enrolling them in discounted hardship utility rate programs or notifying them of unpaid bills. Programs could also utilize account-level data on energy burden to identify customers for marketing offerings designed for low-income households. The full report also recommended establishing program performance metrics to better measure and analyze levels of burden and assess program performance in mitigating burden (DNV and Cadeo 2025).

Acknowledgments

The authors would like to thank the following individuals for their contributions to the underlying research for this paper: Bogdan Olaru, Jordan Gropper, and Ryan Barry at DNV; and Doug Bruchs at Resource Innovation.

References

Brown, M., A. Soni, M.V. Lapsa, K. Southworth, and M. Cox 2019. "Low-Income Energy Affordability in an Era of U.S. Energy Abundance." *Progress in Energy 012002*. https://doi.org/10.1088/2516-1083/ab250b

[7] Hardship rates are discounted electricity or gas service rates provided by utilities to qualifying low-income households. The full report includes findings showing lower participation rates among households on hardship rates as well as those with lower incomes more generally.

Colton, Roger D. 2011. “Home Energy Affordability in New York: The Affordability Gap (2008-2012).” New York State Energy Research Development Authority. https://www-nyserdany-gov.webpkgcache.com/doc/-/s/www.nyserda.ny.gov/-/media/Project/Nyserda/Files/EDPPP/LIFE/Resources/2008-2010-affordability-gap.pdf

Connecticut Department of Environmental Protection 2025. “Learn More About Environmental Justice Communities.” CT.gov. https://portal.ct.gov/deep/environmental-justice/05-learn-more-about-environmental-justice-communities

DNV and Cadeo 2025. “CT X2208/2235 Residential Customer Profile Study.” Connecticut Energy Efficiency Board, June 30, 2025. https://energizect.com/sites/default/files/documents/CT_X2208_Residential_Participant_Non-Participant_Report_FINAL_06302025.pdf

Energy Information Administration. “Table 5.6.A Average Price of Electricity to Ultimate Customers.” *Electric Power Monthly*, April 2025 and 2024. https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a

Haar, Dan 2025. “Eversource warns Connecticut lawmakers it may seek $3.2 billion electric rate hike.” *CT Insider,* April 2, 2025. https://www.ctinsider.com/news/article/eversource-electric-rate-hikes-20249384.php

NMR 2022. “X1942A Cross-cutting NEI Study–Utility NEI and Arrearage Data Analysis Results.” June 2022, https://energizect.com/media/11426

Sears, Justine and Leslie Badger 2023. “Mapping Household Cost Burdens: A study of energy, transportation, water, and housing affordability in Connecticut.” Operation Fuel, May 2023.https://operationfuel.org/wp-content/uploads/2023/11/VEIC-affordability-study-May-2023.pdf

US Department of Energy 2024. “Distributional Equity Analysis for Energy Efficiency and Other Distributed Energy Resources: A Practical Guide.” https://eta-publications.lbl.gov/sites/default/files/bto-distributed-equity-analysis-guide_may2024.pdf.

US Department of Energy 2024. Low-Income Energy Affordability Data (LEAD) tool. https://www.energy.gov/scep/low-income-energy-affordability-data-lead-tool-and-community-energy-solutions