Mapping Household Energy & Transportation Affordability in Connecticut

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CONNECTICUT GREEN BANK SM

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The Connecticut Green Bank's mission is to confront climate change and provide all of society a healthier and more prosperous future by increasing and accelerating the flow of private capital into markets that energize the green economy. We do this with the goal of reducing energy burdens for families and businesses across Connecticut and achieving inclusive prosperity through clean energy.

The mission of Operation Fuel is to ensure equitable access to energy for all by providing year-round energy assistance, promoting energy independence, and advocating for affordable energy. Adding to that, we believe in Environmental Justice. Equal access to transportation, goes back to the Civil Rights movement, launched by Rosa Parks, as she unapologetically refused to give up her seat. In addition to that, government investments in our transportation infrastructure largely focused on moving motor vehicles, not people. We now know that to be problematic for our environment and people. That is the intersectionality that this study achieves.

According to the US Energy Information Administration, energy costs in Connecticut are amongst the highest in the nation, creating a crippling burden on our low- and moderate-income households. Previous studies on energy affordability commissioned by Operation Fuel estimated Connecticut's aggregate energy affordability gap -- the difference between an affordable energy expenditure and actual energy costs -- at $450 million. While over 430,000 households in Connecticut meet the eligibility requirements for energy bill assistance, only 18.7% are served through available funding. We need more comprehensive and sustainable solutions to helping low income families in Connecticut afford their energy costs.

Beyond energy, low income households in Connecticut also face high transportation and housing costs, which, when all combined, can make up over 45% of household income. A comprehensive understanding of these cumulative costs demonstrates the disproportionate burden our low- and moderate-income households face just to meet basic needs.

The Connecticut Green Bank is proud to build on Operation Fuel's critical research by sponsoring this report from VEIC. We hope that this analysis demonstrates the need for collaborative approaches to overcoming the barriers our low-income households face, and the opportunities clean energy solutions present for reducing our state's affordability gap. Together we can solve these complex problems.

Sincerely,

Bryan Garcia
President & CEO
Connecticut Green Bank

Brenda Watson
Executive Director
Operation Fue

Executive Summary

Low- and moderate-income households spend a larger percentage of income on energy than higher income households. Preserving energy affordability is critical to the ability of these households to not only meet basic needs but also build wealth. To understand current patterns in energy affordability in Connecticut, we analyzed spending on building energy (heating and electricity)[1] and transportation[2] across the state. Our analysis of transportation spending includes all transportation-related costs (vehicle ownership, maintenance, fuel, and transit costs), even those beyond energy, since these are the true costs households face to meet their mobility needs. We also considered spending on housing in our analysis because housing and transportation costs are often closely related.

We calculated two metrics of building energy and transportation affordability by U.S. census tract:

1. **Burden**: Spending expressed as percentage of household income. We calculated building energy burden, transportation burden, and a combined burden of energy, transportation, and housing.

2. **Affordability gap**: The difference between an affordable level[3] of spending in a given census tract, and actual levels of spending.

We also calculated a combined affordability gap that included building energy, transportation, and housing costs. We used an affordability threshold of 45% of household income: spending levels above 45% in all three categories combined, were considered unaffordable.

We estimate an aggregate building energy affordability gap of $444 million, statewide. Among households earning less than 60% of state median income, this gap was approximately $1,010 annually. The building energy affordability gap is most acute in the state's urban areas: Hartford, New Haven, Waterbury, and Bridgeport, where the *mean* affordability gap in some census tracts exceeded $1,000 per household per year. In most other areas of the state, building energy spending was within affordable levels (up to 6% of area median income; AMI). **The combination of energy efficiency and solar, such as the CT Green Bank's Solar for All program, can provide enough savings to close the affordability gap entirely for many households: approximately $1,315 in average savings annually**.

[1] Available through the DOE LEAD Tool: https://www.energy.gov/eere/slsc/maps/lead-tool.
[2] Available through the Housing and Transportation Affordability Index developed by the Center for Neighborhood Technology: https://htaindex.cnt.org/.
[3] We used four affordability thresholds to calculate affordability gap(s): 6% building energy burden based on widely used analysis by Fisher Sheehan & Colton: www.homeenergyaffordabilitygap.com ; 15% transportation burden based on the Housing and Transportation Affordability Index; 30% housing burden (inclusive of building energy), see analysis by the US Census Bureau: https://www.census.gov/housing/census/publications/who-can-afford.pdf, and 45% combined building energy, transportation, and housing burden developed by the Center for Neighborhood Technology.

Transportation spending was consistently unaffordable, averaging 20% of household income statewide, above the 15% affordability threshold. Again, this affordability gap was most acute in the state's urban areas where transportation affordability gaps were as high as $7,000 in areas of Bridgeport, New Haven, and Waterbury. Although these areas are among the densest and transit-rich in the state, a vehicle is still needed to maintain a minimum level of mobility, driving transportation costs up. Even within higher income bands, gaps in transportation affordability were present. In more rural areas of the state, even wealthier census tracts exhibited unaffordable transportation burdens (e.g., in Litchfield and New London counties), due primarily to high costs of vehicle ownership and fuel costs for traveling longer distances.

Combined spending levels on energy, housing, and transportation were also unaffordable throughout the state, due to high levels of spending on transportation. Again, the highest affordability gaps clustered in Connecticut's urban areas: New Haven, Bridgeport, and Waterbury, and exceeded $12,000 annually in some areas. In census tracts with median incomes less than 60% of the metropolitan area's median income,[4] combined spending on energy, transportation, and housing, made up 68% of household income, leaving these households less than $1,000 each month to cover all other necessities, such as food, childcare, medical care, and incidental costs.

Our results suggest that a range of policies and programs are needed to maintain affordability for Connecticut's households across energy and transportation sectors. The combination of efficiency and solar can close the building energy affordability gap for most qualifying households in the state that own their dwelling, dramatically reducing annual energy costs. Fewer options are available to renting households, although existing programs, like Energize Connecticut Home Energy Solutions, do substantially reduce building energy burden. The state could consider a program offering for renters modeled off of the Solar for All program: one that combines energy efficiency upgrades with community solar installations, rather than individual rooftop arrays. Addressing Connecticut's high transportation burden is absolutely critical to keeping the state affordable.

Transportation costs were high throughout the state: in urban, suburban, and rural areas, and across income levels. We recommend two strategies to reduce transportation burden for Connecticut's households: minimize reliance on private vehicles through increased access to high quality public transit and electric bikes; and increase adoption of electric vehicles to reduce fuel costs for households that do own vehicles.

Providing Connecticut households mobility without reliance on private vehicles would be a transformative way of reducing transportation burden, especially for low- and moderate- income households, improving the equity of the state's transportation system. In rural and suburban areas, where reliance on private vehicles is unavoidable, access to affordable electric vehicles provides

[4] U.S. Census Metropolitan Statistical Area (MSA).

reliable transportation with lower fuel and maintenance costs relative to gasoline-powered vehicles.

Introduction

Research has consistently shown that low- and moderate-income households spend a larger percentage of income on energy than higher income households.[5, 6, 7] As income inequality grows and real incomes stagnate, energy affordability is a pressing problem across the United States, and within Connecticut. Income inequality in Connecticut is the third highest in the nation, behind only Washington, D.C., and New York, and continues to grow.[8] Preserving energy affordability is critical to the ability of low- and moderate-income households to not only meet basic needs but also build wealth. A 2016 report by the American Council for an Energy Efficient Economy (ACEEE) shows that energy burden is highest among low-income households, and that much of this additional burden could be relieved through increased building efficiency.[9] Energy burden refers to the percentage of household income that is spent on energy.

A 2017 report released by Operation Fuel, Home Energy Affordability in Connecticut, found an energy affordability gap of $450 million among Connecticut's low-income households.[10] The authors defined affordable home energy bills as those that did not exceed 6% of household income (inclusive of electricity and heating fuel) and energy affordability gap as "the dollar difference between actual home energy bills and affordable home energy bills for a specified geographic area." This research estimates that over 320,000 households in Connecticut (approximately 25%) were facing unaffordable energy bills for heating and electricity.

Preserving energy affordability is critical to the ability of low- and moderate-income households to not only meet basic needs but also build wealth.

Our analysis of energy burden and affordability in Connecticut builds on this critical research and expands the study to include transportation. This analysis considers all transportation-related costs since these are the true costs households face to meet their mobility needs. Transportation costs beyond fuel include costs associated with vehicle ownership and maintenance, and public transit.

[5] Fisher Sheehan & Colton. 2013. Home Energy Affordability Gap: www.homeenergyaffordabilitygap.com.
[6] US DOE. 2018. Low-income energy burden varies among states: https://www.energy.gov/sites/prod/files/2019/01/f58/WIP-Energy-Burden_final.pdf
[7] See the Low-income Energy Affordability Tool: https://www.energy.gov/eere/slsc/maps/lead-tool
[8] US Census Bureau, analysis of Gini Index of Income Inequality by state.
[9] ACEEE, 2016. Lifting the High Burden in America's Largest Cities: https://www.aceee.org/research-report/u1602.
[10] https://efficiencyforall.org/wordpress/2019/01/23/home-energy-affordability-in-connecticut-the-affordability-gap-2017/.

In this analysis we build off Operation Fuel's study of building energy costs to include transportation for a number of reasons:

- Transportation energy expenditures are generally more than either heating or electricity spending.
- Total transportation spending (inclusive of transit, fuel, and associated driving costs) are the second highest household expenditure, second only to housing.[11]
- High transportation costs are most crippling for low- and moderate-income households, as some baseline level of household spending will invariably support nondiscretionary energy and transportation costs, regardless of a household's ability to pay.
- The transportation sector is the number one contributor to greenhouse gases in Connecticut and improved efficiency in this sector is crucial to achieving the state's sustainability and clean energy goals.[12]

According to the Bureau of Labor Statistics, nationally, the lowest earning 20% of the population spent nearly 30% of their household income on transportation vs. less than 10% for the highest earning 20% of the population.[13] Our analysis also considers housing costs, in addition to energy and transportation burden, to gain a fuller picture of household spending levels needed to meet basic needs for shelter, heat, and mobility.

Definitions

Energy Burden: Energy spending expressed as a percentage of household income.

Energy Affordability Threshold: Energy burden above which is considered unaffordable.

Energy Affordability Gap: The difference between actual home energy bills and affordable home energy bills for a specified geographic area.

Existing Programs to Relieve Household Energy Burden

A range of programs exist in Connecticut to help households struggling with high energy costs. Direct fuel assistance programs, weatherization to improve homes' efficiency, and the Solar for All program all contribute to reduced home energy burdens for Connecticut's low- and moderate-

[11] Consumer Expenditure Survey, 2018: https://www.bls.gov/news.release/cesan.nr0.htm.
[12] Connecticut Office of Legislative Research, 2019: https://www.cga.ct.gov/2019/rpt/pdf/2019-R-0287.pdf.
[13] BLS: Table 1101. Quintiles of income before taxes: Annual expenditure means, shares, standard errors, and coefficients of variation, Consumer Expenditure Survey, 2017: https://www.bls.gov/cex/2017/combined/quintile.pdf.

income households. Connecticut also provides plug-in electric vehicle (EV) rebates through the CHEAPR program.[14] EVs can reduce transportation energy expenditures. Up-front purchase costs of EVs are generally higher and rebates and incentives, particularly for used EVs and Level 2 chargers, can mitigate these higher costs, somewhat. However, Connecticut does not provide increased EV incentives or EV adoption programs specifically targeted to low- and moderate-income households.

In 2017, Operation Fuel estimated a building energy affordability gap of $450 million among the state's low-income households.[15] Per household, this gap was $1,400 annually. Current funding levels of existing programs suggest that they are not nearly high enough to close this gap for all households that need assistance, meaning that many households in Connecticut are faced with energy costs that exceed affordability thresholds. Low Income Home Energy Assistance Program (LIHEAP) funding in Connecticut totaled $82 million in 2020. Operation Fuel has a budget of about $2.1 million to put towards both direct bill assistance and interventions to reduce energy burdens for low-income households. In 2018, the average per household heating benefit through LIHEAP was $677, covering approximately half of the energy affordability gap for participating households.[16] In sum, not enough families who need it can participate; and families who do, don't get enough assistance. This problem will get worse the longer it is ignored. Some of this energy burden is past arrearage, which increases over time.

At current funding levels, existing programs cannot bridge the affordability gap: many households are faced with energy costs that exceed affordability thresholds.

Other programs, such as Energize CT's Home Energy Solutions, a utility-run residential efficiency program, provide subsidized weatherization and energy efficiency upgrades. Home Energy Solutions (HES) saves households between $200 and $250 annually.[17] After addressing basic energy efficiency upgrades with the HES program, which is required by the Connecticut Green Bank's Residential Solar Investment Program (RSIP), additional savings can be achieved through participation in the Solar for All program. The Solar For All Program, a combined efficiency and solar program, provides deeper efficiency measures on top of the efficiency measures through

[14] https://portal.ct.gov/DEEP/Air/Mobile-Sources/CHEAPR/CHEAPR---Home.
[15] In the 2017 Operation Fuel report, low-income households are defined as earning less than 200% of federal poverty level.
[16] Public Utility Regulatory Authority Docket No. 17-12-03RE01 – PURA Investigation into System Planning of the Electric Distribution Companies – Energy Affordability, June 2020.
[17] https://www.energizect.com/your-home/solutions-list/home-energy-solutions-core-services.

the HES program and packaged with solar photovoltaics (PV), saving households an estimated $1,315 annually, enough to close the $1,400 affordability gap entirely for many households.[18] The combination of efficiency and solar dramatically improves energy affordability, however only homeowners are eligible to participate in the Solar for All program and landlord approval is required for renters to receive HES services. Additionally, many households with unaffordable energy burdens may not qualify for these programs due to either income requirements or health and safety barriers in the home.

Programs to assist households struggling with high transportation costs are less common, although access to reliable transportation is crucial to households' ability to reach employment and goods and services. Access to public transit, especially in urban and suburban areas can reduce reliance on private vehicles and improve the equity of the transportation system enormously by providing mobility for those who cannot afford a vehicle or are unable to drive. In rural areas, reliance on private vehicles is often unavoidable. Income-eligible EV programs, such as those in California and Oregon, can reduce spending on vehicle fuel and maintenance.

Through this analysis we sought to explore spatial patterns in energy burden in Connecticut and estimate the energy affordability gap for households, inclusive of spending on transportation. This analysis will allow us to identify areas in the greatest need of energy assistance and access to clean energy technologies that can reduce energy burden. Further, estimating the general magnitude of that need can guide programming and policy decisions. In contrast to the 2017 analysis, the scope of this report is all households in Connecticut but includes a special focus on energy affordability among the state's low- and moderate-income households.[19]

Methods

Geography

We examined energy and transportation burden and affordability in Connecticut at two geographic scales: county and U.S. Census tract. **Census tracts** are county subdivisions designated by the U.S. Census; each tract contains between 2,000 and 8,500 people. Connecticut contains 833 tracts. There were 823 tracts for which we had full data (spending on electricity, heating, transportation, housing, and median household income). In addition, we examined building

[18] Connecticut Green Bank Low and Moderate Income Solar Program Savings Analysis. October, 2020, by VEIC with support from the Connecticut Green Bank and funding from Clean Energy States Alliance (CESA) under U.S. Department of Energy Solar Energy (DOE) Technologies Office Award Number DE-EE-0007667.

[19] We define low-income households as those earning less than 80% AMI and moderate-income households as those earning between 80% AMI and 100% AMI.

energy burden and affordability gap statewide to allow for comparison to the 2017 Operation Fuel report noted above. [20]

Household Spending Burden: Building Energy, Transportation, & Housing

We define **burden** as spending expressed as a percentage of household income. We calculated burden for building energy (spending on heating fuel and electricity), transportation, as well as the combined burden of spending on energy, transportation, and housing for each census tract in Connecticut. Our analysis considers housing affordability, although housing is not the focus of this report.

*Burden = (mean household spending) / (median household income) * 100%*

Our estimates of household spending came from two key datasets: the **Low-income Affordability Data (LEAD) Tool**[21] and the **Housing and Transportation Affordability (H&T) Index**.[22] The LEAD Tool was developed by the US Department of Energy and provides estimates of residential spending on electricity, natural gas and other fuels for each county and census tract in the US. Our analysis also examines building energy burden by tenure type (renter vs. owner).

The H&T Index was developed by the Center for Neighborhood Technology and models transportation and housing-related statistics for each census tract in the U.S. H&T models are based primarily on local land use patterns, the density of housing and employment, availability of public transit, and travel and housing survey data.[23] **The H&T Index** provides household-level, tract-specific estimates of vehicle miles traveled, annual number of transit trips and levels of vehicle ownership. The Index also provides comprehensive estimates of spending on household transportation, including spending on public transit, vehicle fuel costs, and costs associated with vehicle ownership, such as insurance, vehicle maintenance, purchase, and financing. The Index estimates total transportation spending that would be required to provide an acceptable level of mobility in a given census tract: mobility to get to work, shopping, recreation, and medical appointments.

[20] https://efficiencyforall.org/wordpress/2019/01/23/home-energy-affordability-in-connecticut-the-affordability-gap-2017/.
[21] https://www.energy.gov/eere/slsc/maps/lead-tool; The LEAD Tool was updated in 2020 using data from the five year 2018 American Community Survey.
[22] https://htaindex.cnt.org/; The H&T Index was updated in 2017 using the five year 2015 American Community Survey and 2014 Longitudinal Employer-Household Dynamics data.
[23] See: https://htaindex.cnt.org/about/

To calculate household **transportation burden**, we used these estimates of total transportation spending from the H&T Index, inclusive of all costs associated with both vehicle operation and ownership and public transit use.[24] (Ride hailing costs are not included in the **H&T Index**).

Our estimates of housing costs also came from the **H&T Index**: for each census tract the Index provides a weighted average of gross housing costs for renters and owners derived from the American Community Survey (ACS).

Household Median Income, the denominator of our burden calculations, came from the 2017 five-year ACS, which combines years 2013-2017 to increase sample size and reduce variability. The ACS is an annual survey conducted by the U.S. Census that covers a range of demographic and housing topics. Unless noted otherwise, all calculations of energy burden and affordability gap rely on tract-level area median income (AMI).[25]

[24] The H&T Affordability Index does not account for EVs in its estimates of fuel costs. EVs currently make up <1% of Connecticut's fleet.

[25] We also report results by AMI band. Each census tract is assigned an income band, which shows how the median income within the tract compares to the median income of the greater Metropolitan Statistical Area (MSA). MSA is a geographic designation of the U.S. Census.

Household Affordability Gaps

As described above, the **building energy affordability gap** is the difference between actual spending on energy bills and affordable home energy bills for a specified geographic area. We calculated affordability gaps by census tract for building energy, transportation, housing, and all three spending categories combined (Table1).

Table 1. Affordability thresholds by spending category

Affordability gap = (Affordability threshold) x (Tract Median Household Income) - (Estimated spending)

Spending Category	What does it include?	Affordability Threshold (% HH income)
Building Energy	Household heating fuel and electricity	6%[26]
Transportation	Vehicle fuel, transit costs, and vehicle ownership costs (including vehicle purchase or lease, insurance, and maintenance)	15%[27]
Housing	Total shelter costs, **inclusive of building energy,** insurance, taxes, and association fees.	30%[28]
Energy, Transportation, & Housing	Total shelter costs (**inclusive of building energy,** insurance, taxes, and association fees) and transportation costs (vehicle fuel, transit, and vehicle ownership costs)	45%[29]

There is not a widely used threshold of transportation affordability. The H&T Index considers combined housing (inclusive of building energy) and transportation costs above 45% of household income to be unaffordable, building on the widely accepted threshold of housing affordability (30% of household income) acknowledging that these housing and transportation costs are often inversely related. In denser, urban areas, housing costs may be more and transportation costs lower due to reduced reliance on private vehicles.[30] According to the Consumer Expenditure Survey, transportation costs are the second highest household

[26] The 6% affordability threshold is and based on the assumption that energy costs should not exceed 20% of total shelter costs and total shelter costs should not exceed 30% of income (20% of 30% is 6%); See: http://www.homeenergyaffordabilitygap.com/ and https://www.aceee.org/sites/default/files/energy-affordability.pdf. The 6% threshold has become widely used within the housing and energy sectors. For instance, in 2016, New York State established an Energy Affordability Policy that set the goal of limiting energy costs for low-income utility customers to an average of no more than 6 percent of income: https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/LMI-Special-Topic-Rpt---Energy-Burden.pdf.

[27] This threshold is derived from the combined energy, transportation, and housing affordability threshold of 45%: using a 30% threshold for total shelter costs (energy and housing) leaves 15% of household income available for transportation-related expenses.

[28] This 30% threshold breaks down as 24% for housing and 6% for building energy costs. A 30% affordability threshold for total shelter costs is broadly used by housing programs nationally. Background on this threshold can be found here: https://www.huduser.gov/portal/pdredge/pdr-edge-featd-article-081417.html and in this commonly cited analysis by the US Census Bureau: https://www.census.gov/housing/census/publications/who-can-afford.pdf.

[29] Combined affordability threshold developed by the H&T Index.

[30] Note that in some Connecticut's urban areas, this pattern does not hold true.

expenditure, after housing, and average 13% of household expenditures nationwide.[31] We used an affordability threshold of 15%, the difference between the combined Energy/Transportation/Housing affordability threshold and the housing threshold.

Affordability threshold and gap were calculated for each census tract. Table 2 provides an illustrative example scenario for a census tract in East Hartford. In this case, the median household income is $32,156. If their spending was at an affordable level for all spending categories, it would not exceed $14,470 annually (45% of household income). We estimate that spending is actually closer to 66% in this case, driven largely by high transportation costs.

Table 2. Example of affordability thresholds and estimated spending for a sample East Hartford census tract.

Spending Category	Affordable Level	Actual Level	Affordability Gap
Building Energy	$1,929	$2,605	$676
Transportation	$4,823	$8,740	$3,917
Housing (total shelter cost inclusive of building energy)	$9,647	$12,684	$3,037
Combined Housing & Transportation	$14,470	$21,424	$6,954

A comprehensive look at housing, energy, and transportation costs in relation to household income provides insight into whether households are able to meet basic needs: shelter, heat, mobility. As noted above some of these costs, such as shelter and transportation, are nondiscretionary. However energy spending can be minimized by operating homes at unhealthy temperatures or not running critical ventilation systems risking the occupants long term well-being. Mapping this affordability gap highlights clusters of census tracts that are most in need of programmatic support.

[31] https://www.bls.gov/news.release/cesan.nr0.htm.

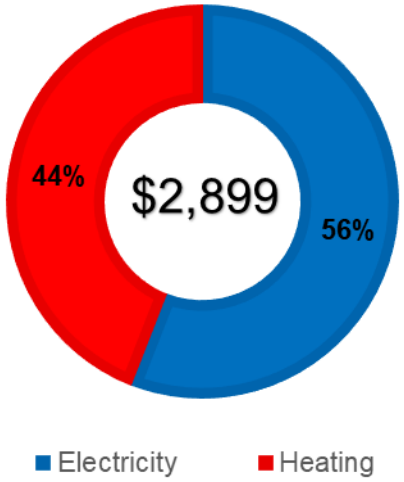
Results

Building Energy

Building Energy Spending and Burden

We estimate that the average household in Connecticut spends a total of $2,899 on building energy and has a mean building energy burden of 4% (Figure 1, Table 3). Across most census tracts, spending on electricity was consistently higher than spending on heating fuel. High spending on electricity is driven in part by the 17% of households statewide that depend on electricity as their primary source of heat. **In twenty percent of Connecticut's census tracts, the mean building energy burden is at or above the affordability threshold of 6%.** A total of 235,670 households live in these tracts. Because we are calculating burden using median household income, we assume that at least 50% of these households have energy costs in excess of 6%.

Figure 1. Connecticut household building energy spending by category.



Heating energy burden varied considerably less than electricity burden across the state. The maximum heating energy burden was 6% in a census tract in Hartford County, and the minimum 0.3% in a tract in New Haven County.[32] By contrast electricity burdens ranged from 1% to 19%. The variability present in electricity burden may again be due to reliance on electricity as a primary heat source highlighting the need for direct assistance programs that alleviate year-round energy

[32] This is not one of the higher earning census tracts (median household income is $69,787), but overall energy costs were estimated to be low in all categories, including transportation, due most likely to high density of housing.

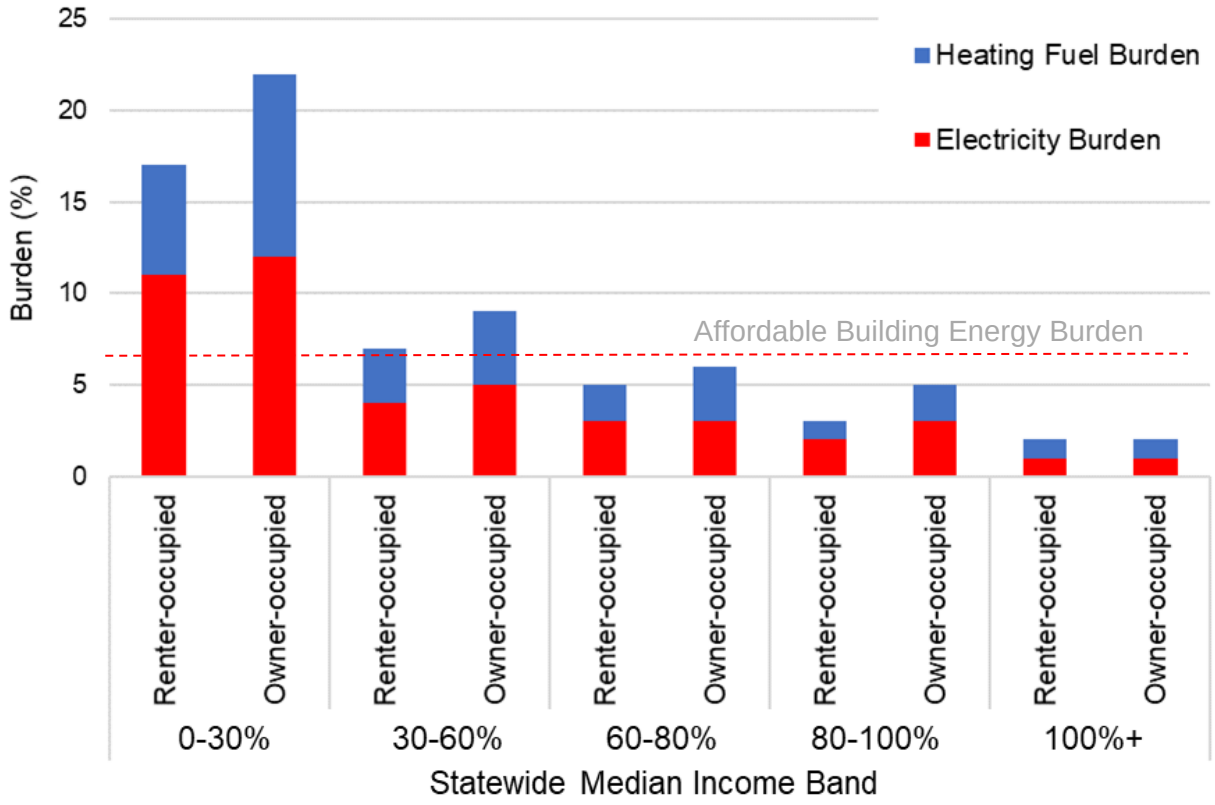
costs rather than just winter heating costs. Heating oil is the most common primary heating fuel in Connecticut, followed by natural gas and electricity. A variety of programs are available to

Connecticut household's facing high heating energy burdens. The Connecticut Energy Assistance Program (CEAP), funded through the federal LIHEAP program, offers bill assistance to offset the cost of heating fuels. Utilities also offer direct assistance in the way of arrearage assistance programs. In addition to direct bill assistance, ratepayer funded programs offered through utilities help improve a home's energy efficiency or add solar energy solutions that reduce long term energy costs.

Table 3. Mean annual spending and building energy burden across all census tracts in Connecticut.

	Annual Spending			**Burden**		
	Mean	Max	Min	Mean	Max	Min
Electricity	$1,621	$2,463	$961	2%	19%	1%
Heating	$1,278	$2,513	$189	2%	6%	<1%
Building Energy Total	$2,899	$4,859	$1,150	4%	22%	1%

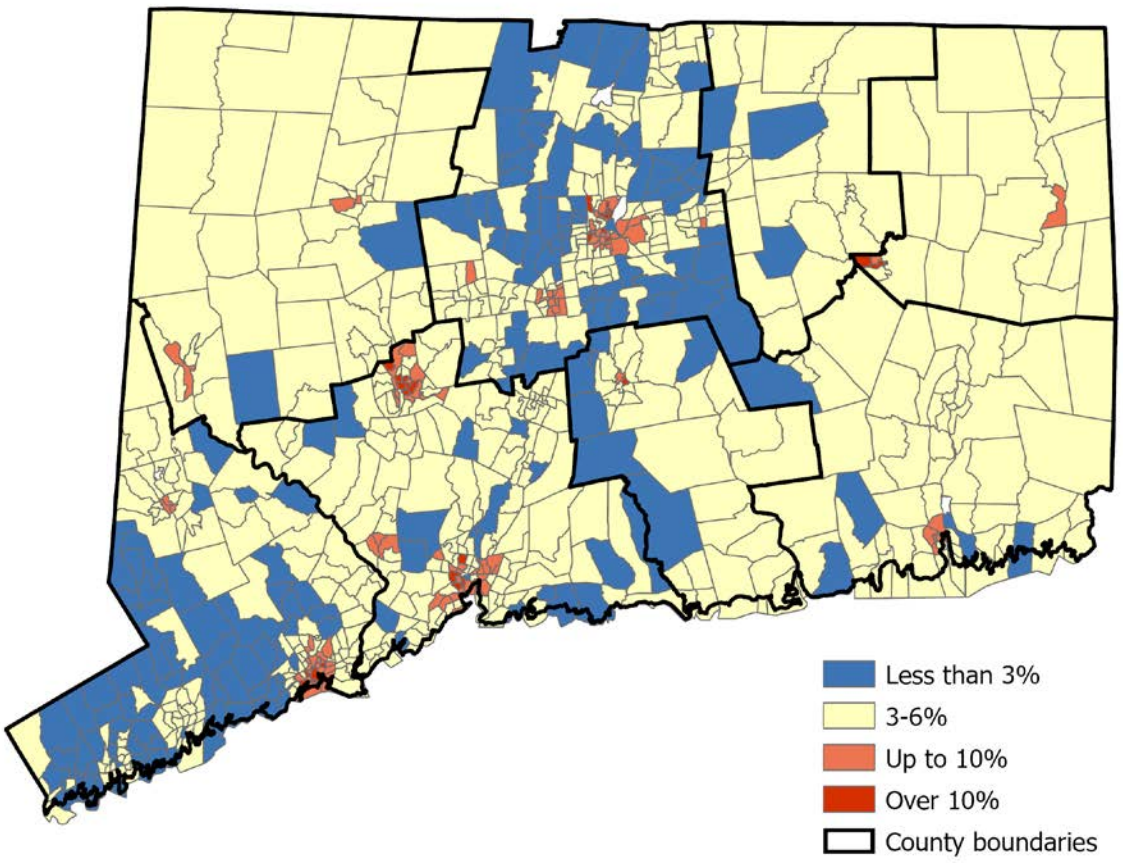
Figure 2. Statewide building energy burden, renters and owners.



Building energy burden was similar for renters and homeowners statewide, approximately 3 - 4%. Homeowners have a slightly higher burden across income all levels, most pronounced within the 0-30% AMI band (Figure 2). **Building energy burden among renters and owners earning <30% of the state median income is six to seven times higher than the statewide mean**. Renters are often faced with a split incentive: building owners may have access to energy efficiency incentives but have little inclination to take advantage of them because it's the renters who pay the energy bill. Split incentives can render low-income renters among the most vulnerable to high energy burdens.

A map of building energy burden by census tract reveals clusters of highly burdened tracts in Hartford, Waterbury, New Haven and Bridgeport (shown in red in Figure 3). Tracts with relatively low building energy burdens (shown in blue) are present in the southeastern portion of the state and Hartford's outer suburbs. Although overall spending was consistently higher than the statewide mean in the blue areas, it comprised a smaller portion of household income than in other areas of the state. Clusters of highly burdened tracts (shown in red) identify where households are struggling most with energy costs and can guide targeted programs to reduce energy burden.

Figure 3. Map of building energy burden by census tract.

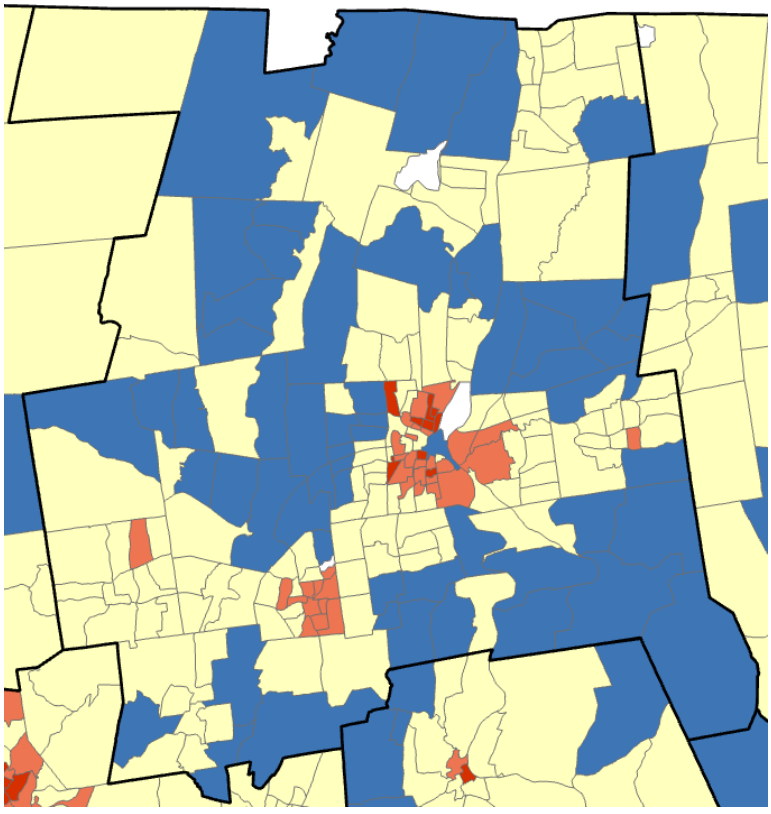


Building energy burden varied widely across the state. However, a county-based analysis revealed that much of this variation occurred within low-income households. Building energy costs for households earning above 80% AMI are not only within affordable levels but have much less variance than low-income households. Among households earning above 80% AMI, building energy burden ranged from about 1% to 5% with a mean burden of 3%. Among low-income households, building energy burden ranged from 2% to over 20% with a mean burden of 6%.

Understanding sources of this variation among low income households will be crucial to improving energy affordability.

A close-up of Hartford County reveals a clearer look at the variation among census tracts: highly burdened tracts (those with building energy burdens greater than 6% and in some cases even 10%) are clustered in the city center, one of the state's most densely populated areas. We identified 26 highly burdened tracts in Hartford County (these tracts are red on Figures 3 and 4). Together these tracts are home to nearly 33,000 households. In 25 of these tracts, median income was below $40,000. There are 64 tracts with building energy burdens less than 3% (blue tracts on Figures 3 and 4). In contrast, nearly all 64 of these tracts have median incomes above the statewide median of $76,348. Consistently, throughout Hartford County and the rest of Connecticut, the highest building energy burdens were present in the most densely populated tracts.

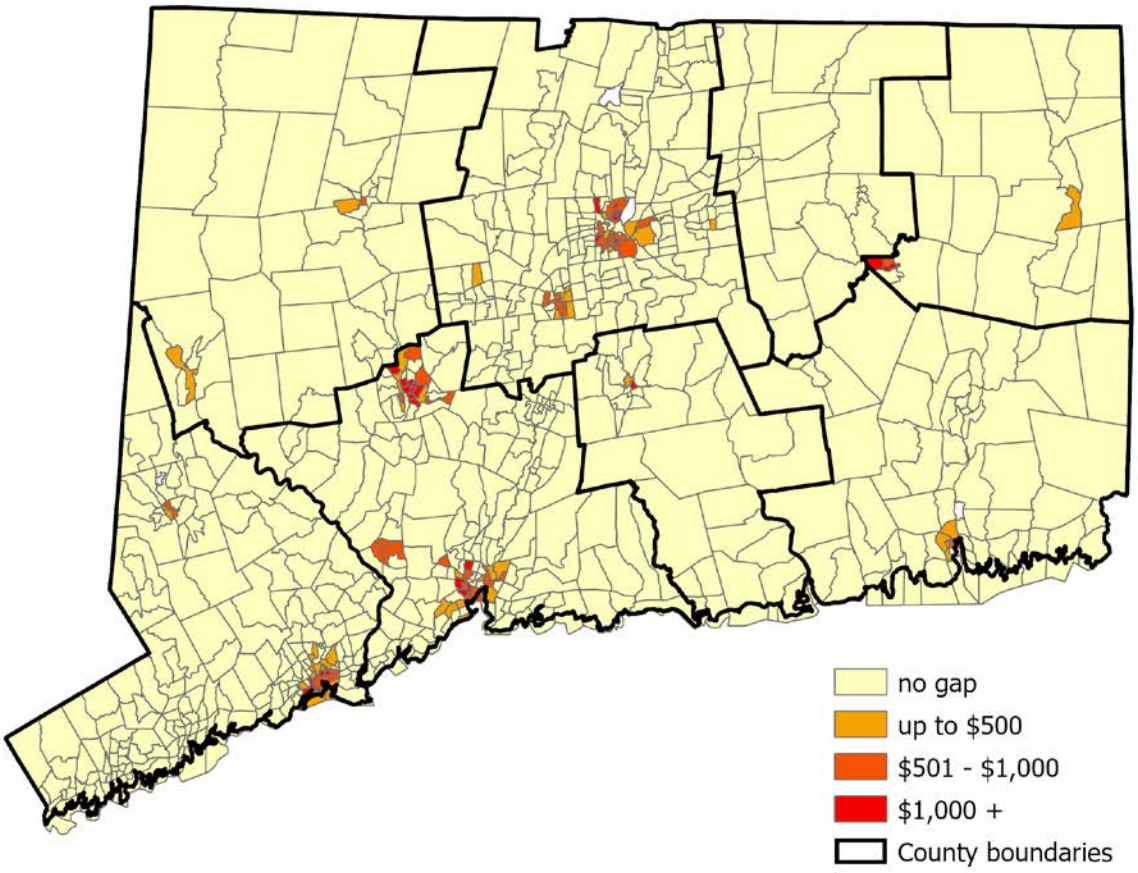
Figure 4. Building energy burden, Hartford County.



Building Energy Affordability Gap

We identified 80 census tracts with annual affordability gaps above $500: an average household within these tracts faces energy bills that are $500 above affordable levels. Thirty tracts have affordability gaps greater above $1,000 (Figure 5). These tracts are scattered across the state with the bulk occurring in Hartford, New Haven, and Waterbury.

Figure 5. Building energy affordability gap by census tract.



The **LEAD tool** provides estimate of energy spending and burden by a variety of income levels. To allow comparison with Operation Fuel's 2017 report, which focused on households at and below 200% of federal poverty level (FPL), we also estimated building energy burden and affordability gap statewide (Table 4). We estimate that the statewide aggregate affordability gap

among these households is $398 million, less than the 2017 report, which estimated a gap of $450 among households at or below 200% FPL.[33]

Table 4. Statewide building energy burden and affordability gap by Federal Poverty Level.

% Federal Poverty Level	# Households	Energy Spending	Burden	Household Income	Affordability Gap per Household
0 – 100	128,373	$2,181	26%	$8,388	$1,678
>100 – 150	87,322	$2,344	12%	$19,533	$1,173
>150 – 200	93,217	$2,574	9%	$28,600	$858

An examination of the building energy affordability gap statewide revealed that gaps are primarily present in households earning <60% of the state median income (SMI) and that the burden and affordability gap is more than twice as high for the lowest income earners. (Table 5). Among all households earning less than 60% of SMI, average building energy affordability gap is $1,010 annually. It is worth noting that for many of these households, this affordability gap could effectively be closed by the Solar for All program, which combines deep energy efficiency retrofits and residential solar installations. In 2019, Solar For All achieved an average savings of $1,315 annually per household.[34]

Savings achieved through the Solar for All Program are enough to close the building energy affordability gap among households earning less than 60% AMI.

The statewide aggregate gap of households earning <60% SMI included 439,164 households and totaled $444 million. Calculating the aggregate gap by SMI band, rather than FPL, reduces the estimated gap per household, but increases the number of households included, increasing the statewide aggregate gap from $398 million to $444 million. Statewide, households earning above 60% of SMI, do not have an affordability gap.

[33] There are some key differences between the LEAD tool and the Home Energy Affordability Gap model that formed the basis of the 2017 Operation Fuel report. Both models estimate household-level energy spending and burden. The LEAD tool relies primarily on ACS survey data, including data related to demographics, housing, primary heating fuel type and household energy spending, as well as household usage data available through electric and natural gas utilities. The tool models energy spending and burden for each census tract and county in the U.S. The Home Energy Affordability Gap also relies on ACS data, in addition to DOE's Residential Energy Consumption Survey, and consideration of the number of heating and cooling degree days by county.

[34] Connecticut Green Bank Low and Moderate Income Solar Program Savings Analysis. October, 2020, by VEIC with support from the Connecticut Green Bank and funding from Clean Energy States Alliance (CESA) under U.S. Department of Energy Solar Energy (DOE) Technologies Office Award Number DE-EE-0007667.

Table 5. Statewide building energy burden and affordability gap by income band.

Income Band (% State Median Income)	# Households	Energy Spending	Burden	Household Income	Affordability Gap per Household
0-30	201,146	$2,119	19%	$11,152	$1,450
>30-60	238,018	$2,550	8%	$31,875	$638
>60-80	93,792	$2,753	6%	$45,883	No gap
>80-100	149,272	$2,933	4%	$73,325	No gap

Transportation

Transportation Spending and Burden

Total transportation burden, including vehicle ownership, fuel, and transit costs estimated at the household level for each tract, averaged 20% and ranged from 5% to 147%. Estimated transportation costs do not necessarily reflect actual spending, but rather the average transportation costs within a given census tract required for an acceptable level of mobility and access to employment, shopping, and medical services. Actual transportation burden may be much lower or higher for individual households, depending on factors like the number of vehicles owned and their choice of vehicle.

Even in Connecticut's most densely populated census tracts, households need at least one vehicle to achieve an acceptable level of mobility.

The largest component of transportation burden is costs associated with vehicle ownership, comprising 15% of household income, statewide (Table 6). A move away from reliance on private vehicle ownership would dramatically reduce transportation burden for all households and improve the equity of Connecticut's transportation system. Even in the state's most densely populated tracts, our data source, the **H&T Index**, concluded that households need at least one vehicle to achieve an acceptable level of mobility. These vehicle costs make up the largest proportion of transportation costs overall and prevent even the most urban households from achieving substantial reductions in transportation burden. Vehicle miles traveled (VMT) is lower in urban areas, and transit use is higher, providing households some savings. CT's 4 largest cities (Bridgeport, Hartford, New Haven, Waterbury) all have low rates of car ownership. Zero car households are over 25% of the total households in each city. Though not the focus of this study, it's worth noting the opportunity cost of limited transportation options on individuals' health, economic, social, and other outcomes. Even in low income areas where

transportation spending is not overly burdensome, that may be because people are limiting their own mobility to places they can get to for free. This has larger consequences on CT's economy and opportunity for low income families to acquire wealth.

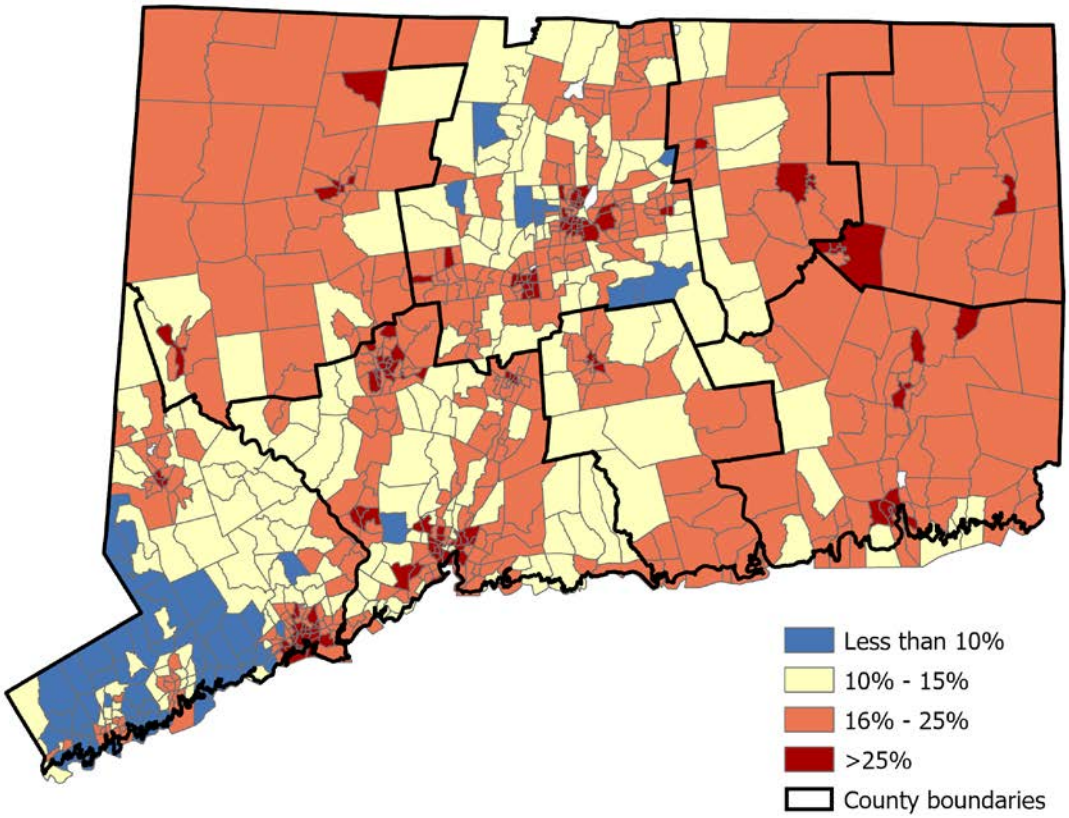
Table 6. Mean annual spending and transportation burden in Connecticut.

	Mean Annual Spending	Mean Burden
Vehicle Ownership	$10,343	15%
Vehicle Fuel	$2,524	4%
Public Transit	$111	<1%
Total	$12,978	20%

Compared to building energy, we identified a far higher number of census tracts where comprehensive spending on transportation exceeded the affordability threshold of 15%. **Three quarters of the state's census tracts have an average transportation burden above affordable levels** (628 tracts out of 823). Large swaths of the state are unaffordable, in both rural and urban areas (Figure 6). In urban areas, where the highest burdens are seen (those exceeding 25%) high burden is driven by relatively low household income. In more rural counties (Litchfield Tolland, Windham, New London), incomes are high relative to the statewide median, but transportation spending is also high. Spending on both fuel and vehicles tended to be higher in the state's rural areas, driving up burden.

The southeastern portion of the state in Fairfield County is one of the few clusters of affordable and even below affordable levels of transportation spending. These census tracts fall within the commuter-shed of New York City and the combination of high household income, average transportation spending and high transit use results in consistently low transportation burdens.

Figure 6. Transportation burden by census tract.



Transportation Affordability Gap

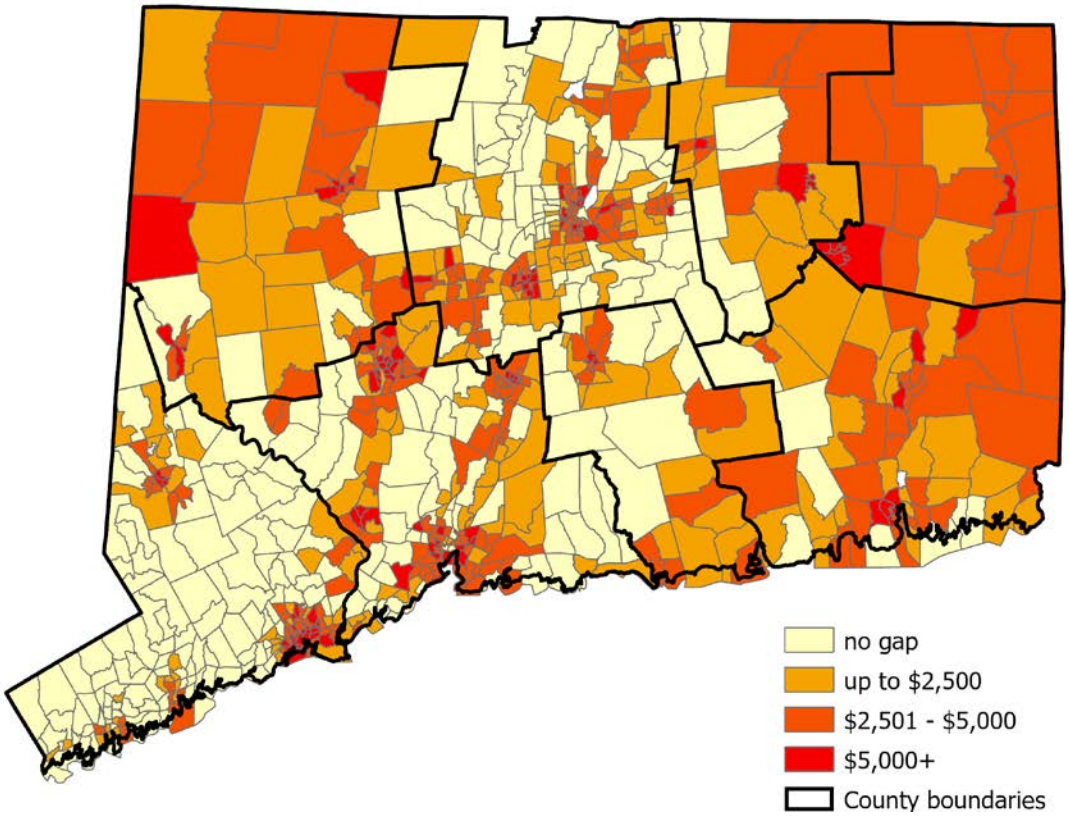
Sizable affordability gaps in transportation spending were present in nearly every AMI band, even those census tracts exceeding 100% AMI (Table 7). The gap was generally most acute (over $5,000 annually) in urban areas characterized by low household income (e.g. Waterbury and Bridgeport; Figure 7). Again, even in these urban areas, modeling by the H&T Index indicated that households would need at least at least one vehicle to meet their mobility needs, driving up transportation costs. Transportation affordability gaps are pervasive in rural and suburban Connecticut, although smaller, less than $5,000 in most cases.

Table 7. Transportation affordability gap by census tract AMI band[35]

Census Tract AMI Band	Mean Household Transportation Affordability Gap
<60% AMI	$5,097
60-80% AMI	$3,464
80-100% AMI	$2,050
100-120% AMI	$1,067
>120% AMI	No gap

[35] Income bands are based on Census Metropolitan Statistical Area (MSA).

Figure 7. Transportation spending affordability gap by census tract.



Housing Affordability Gap

Median housing costs exceeded the 30% affordability threshold in 307 census tracts.[36] These tracts are scattered across the state, with concentrations in Hartford, New Haven, and Bridgeport (Figure 8). There were four census tracts with housing affordability gaps over $10,000: two in Fairfield County and two in New Haven County.

As noted, estimates of housing costs came from the **H&T Index** and are full shelter costs, inclusive of building energy. Housing costs by county, exclusive of building energy are presented in Table 8. Spending on building energy comprised the smallest portion of total shelter costs in Fairfield County, where housing costs are by far the highest (over $25,000 annually). On average, building energy comprised 14% of total shelter costs, statewide, below the widely used 20% threshold established by Fisher et al.[37] but a sizable portion nonetheless. **Further reducing building energy costs and thus total shelter costs, is one means of improving housing affordability.**

[36] The 30% affordability threshold includes all shelter cost: mortgage/rent, utility costs, building energy, insurance, condo association fees, and taxes.

[37] Fisher Sheehan & Colton. 2013. Home Energy Affordability Gap: www.homeenergyaffordabilitygap.com

Figure 8. Housing affordability gap by census tract.

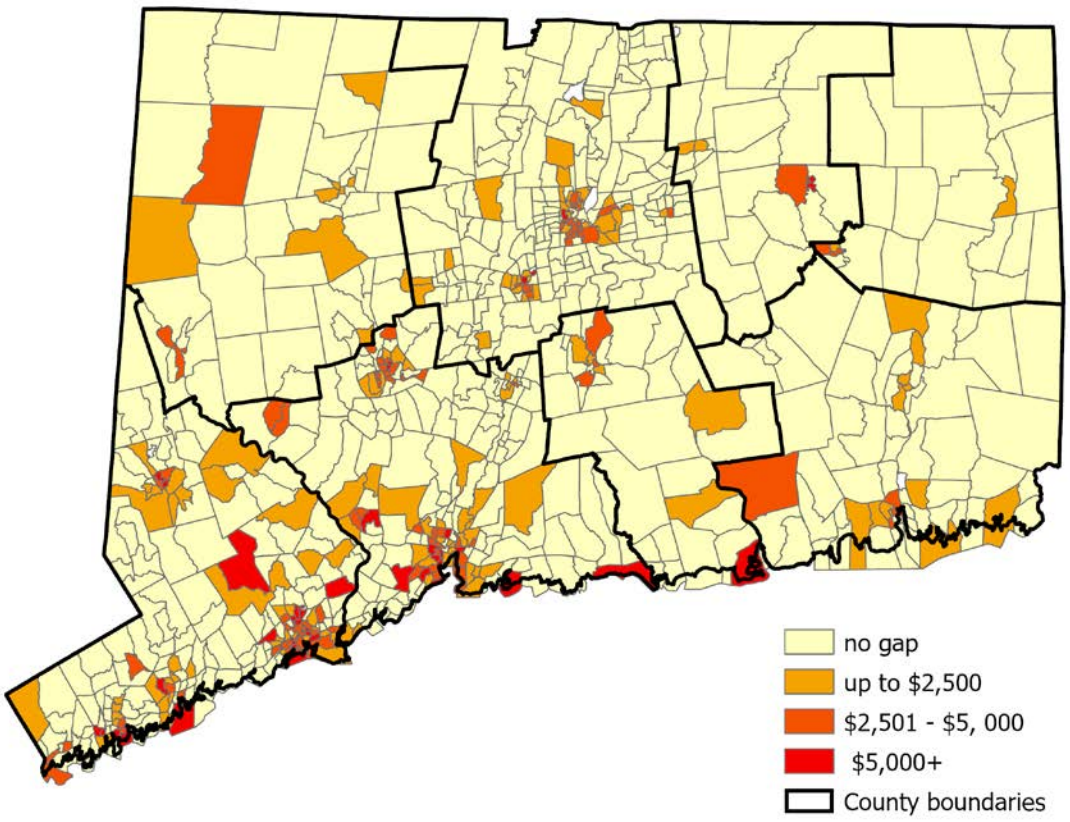


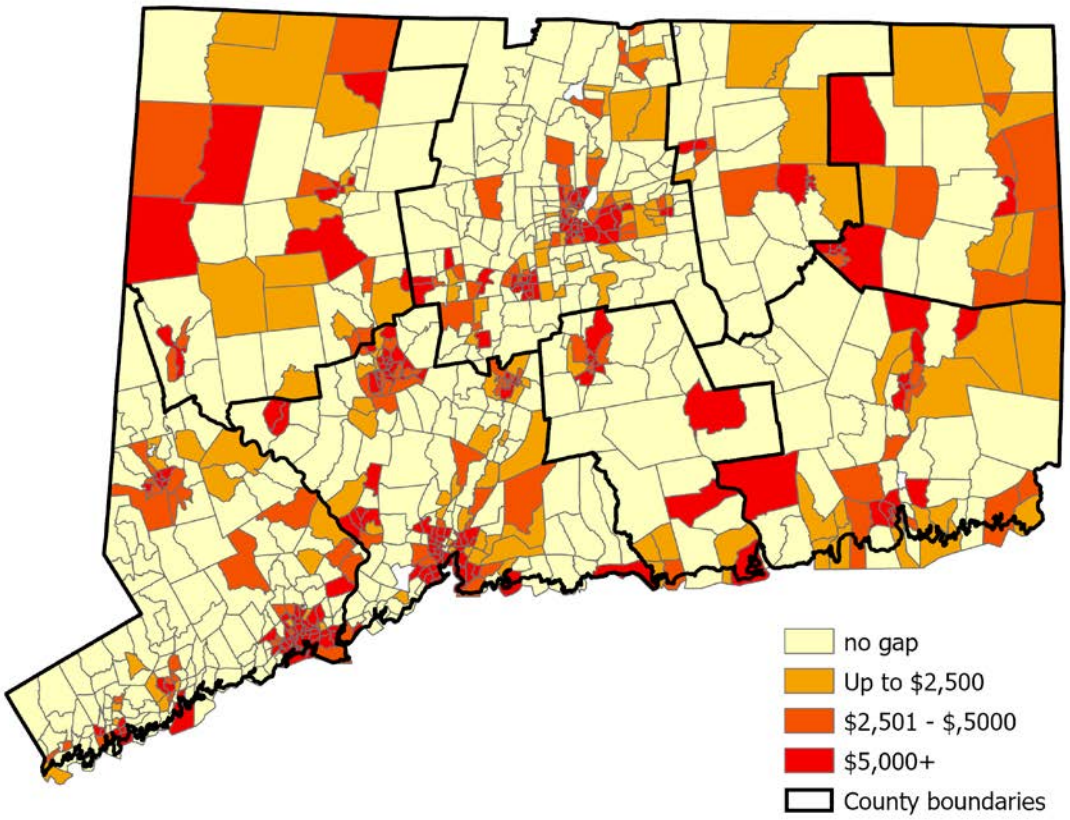
Table 8. Annual housing and building energy costs by county.

County	Average Building Energy Spending	Average Spending on Housing, Exclusive of Building Energy
Fairfield	$3,283	$25,770
Hartford	$2,671	$16,619
Litchfield	$2,993	$18,047
Middlesex	$2,847	$18,666
New Haven	$2,806	$17,162
New London	$2,694	$16,713
Tolland	$2,832	$18,000
Windham	$2,894	$14,616

Energy, Transportation, and Housing Affordability Gap

On average, for households earning 100% of tract-level AMI, combined housing and transportation costs exceed affordable levels in Connecticut. Combined mean burden for spending on energy, transportation, and housing is 49% statewide, slightly above the 45% threshold for affordability. In more than half of census tracts, combined spending on building energy, transportation, and housing exceeded 45% of median household income. These census tracts are scattered throughout the state, in rural and urban areas. A primary driver of these results is transportation costs: housing costs were generally estimated to be at or below 30% of AMI in most of the state's census tracts while the mean transportation cost burden was 20%, above the threshold of affordability.

Figure 9. Combined energy, transportation, and housing affordability gap by census tract.

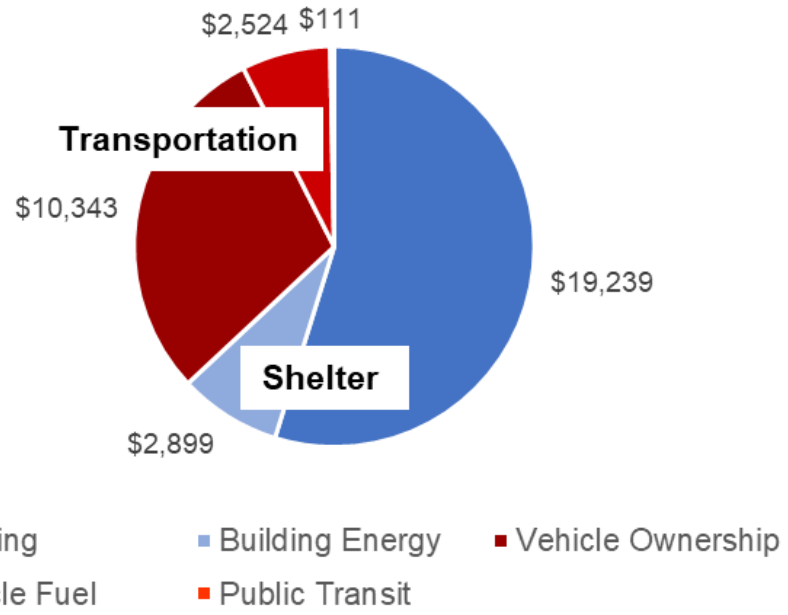


In nearly 200 tracts out of 823, the average building energy/transportation/housing affordability gap was greater than $5,000. These tracts are most concentrated in the state's urban areas: Hartford, New Haven, Bridgeport, and Waterbury (Figure 9). Although these tracts skewed towards households with median incomes between 60-80% of the regional AMI,[38] they also included tracts in the 80-100% regional AMI income band in Hartford and New Haven, suggesting

[38] Census Metropolitan Statistical Area (MSA).

that **even households above traditional low-income thresholds struggle with the combined affordability of building energy, transportation, and housing.** As more than 700,000 residents filed for unemployment in 2020, we see this problem is dramatically worse in the wake of COVID.[39] We estimate that, on average, households earning 100% of tract-level AMI would need to spend about $35,000 each year to secure housing, adequate space heating and cooling, and mobility (Figure 10).

Figure 10. Total household spending on shelter and transportation in Connecticut

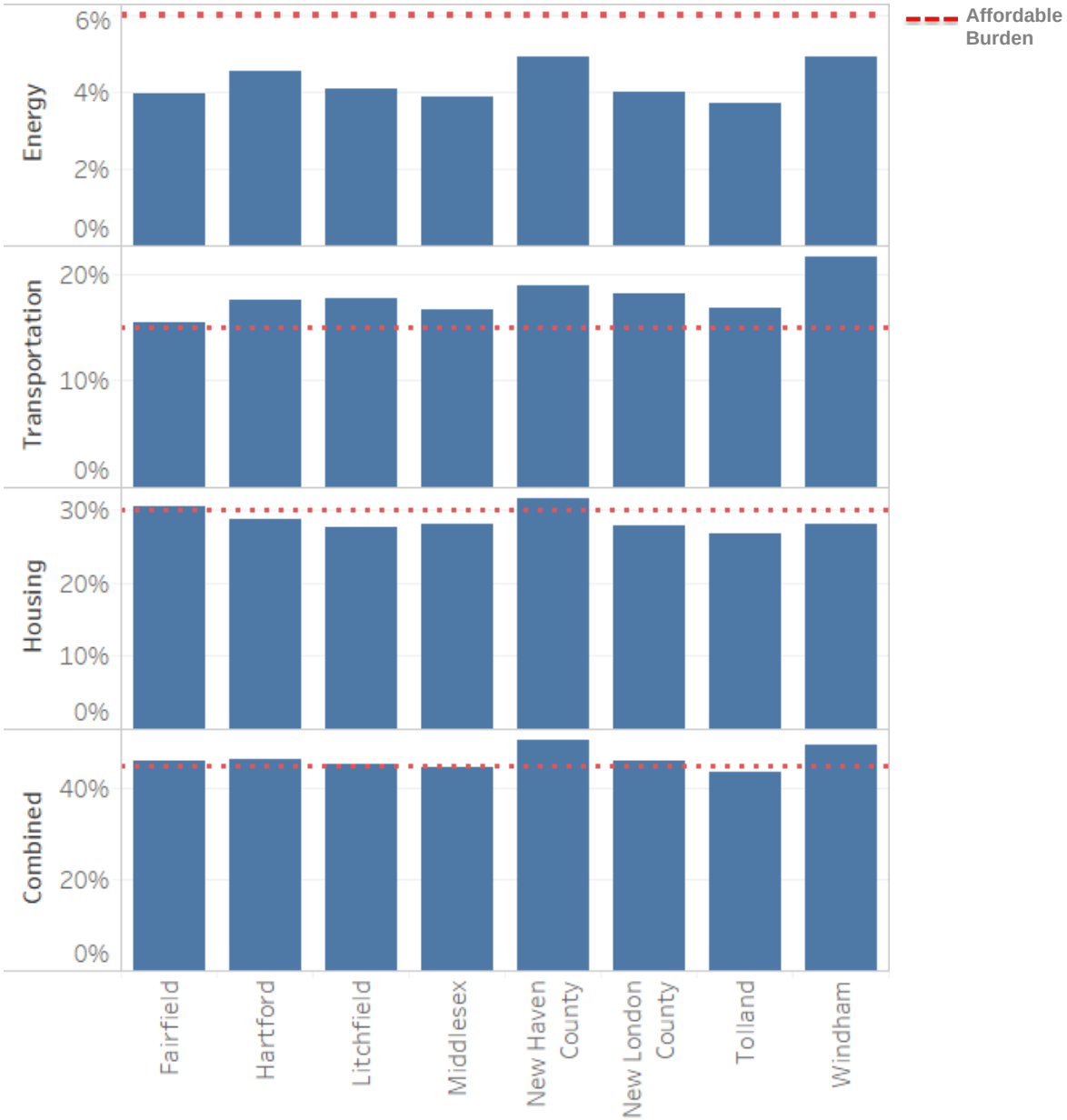


[39] https://www.courant.com/business/hc-biz-unemployment-extension-20200804-drpbilkzyzfmxkt5zgt2om66pa-story.html

County-level Affordability

To provide a picture of affordability and cost burden at a broader level we also looked at spending by county in Connecticut across all income levels. For building energy, no counties have a mean cost burden above the 6% threshold, but many are above the 15% affordable threshold for transportation, and most are right on the edge of housing affordability (Figure 11).

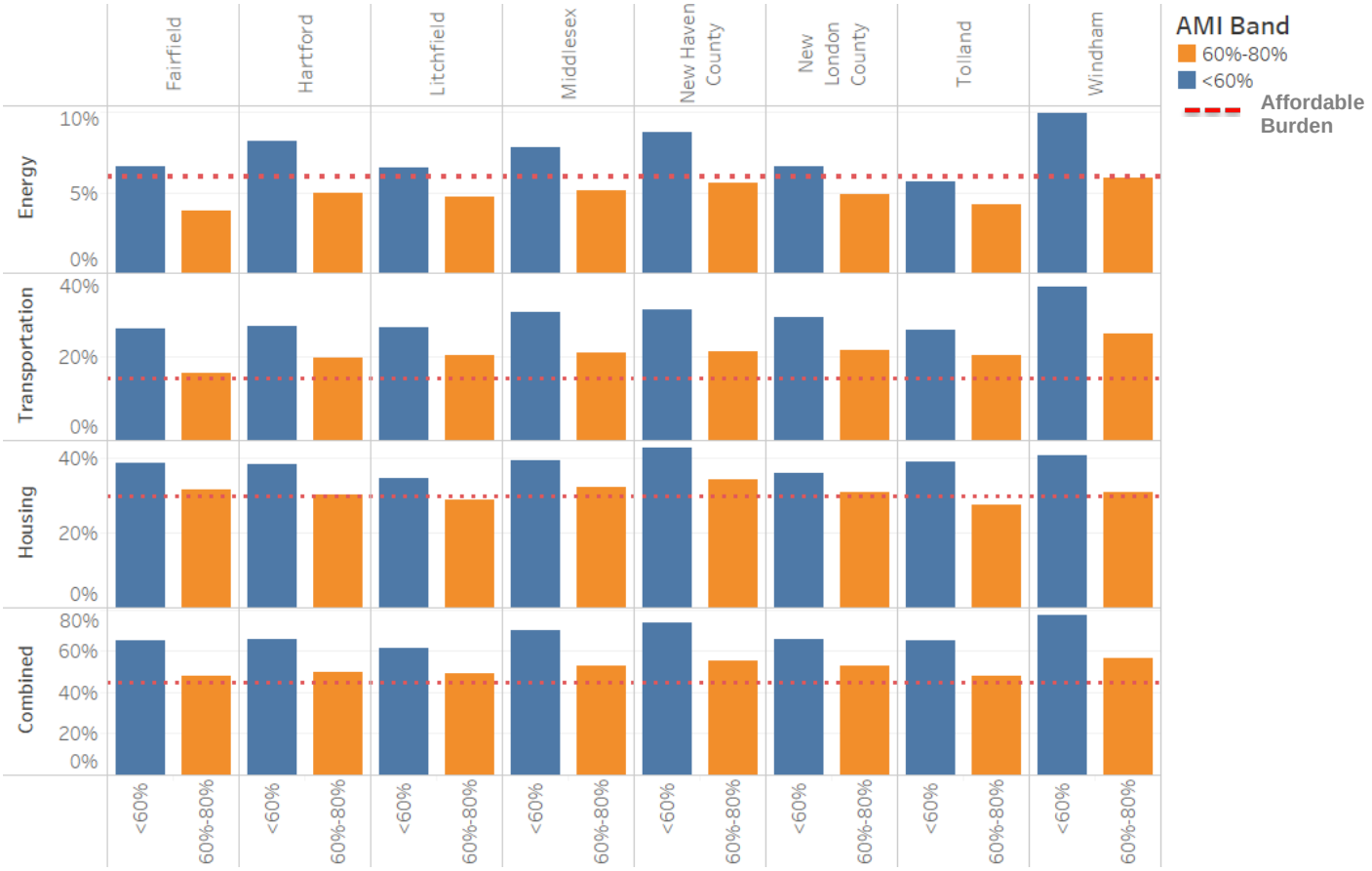
Figure 11. Mean spending burden by county: building energy, transportation, housing, and all spending categories combined.



Considering only low-income households (census tracts below 80% AMI), mean cost burden was well above affordable levels for transportation, housing and combined spending on energy,

transportation, and housing (Figure 12). Splitting the data out by Metropolitan Statistical AMI bands sharpens the picture of cost burden by median income level: in all cases, cost burdens are reduced as median incomes rise.[40] **Building energy burdens are significantly higher for lower income populations, even though the highest income population is spending roughly one-third more for building energy and transportation and twice as much for housing than the lowest income population.**

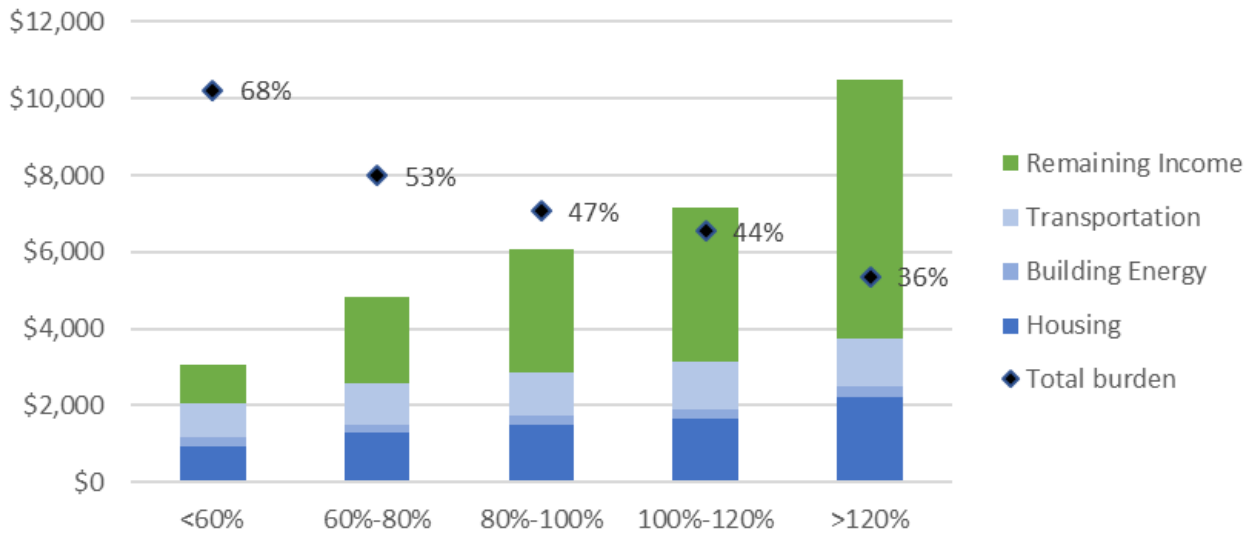
Figure 12. Average low-income building energy, transportation, and housing burden by county.



[40] Each census tract is assigned an income band based on the incomes in their local Metropolitan Statistical Area (MSA). MSA is a geographic designation of the U.S. Census.

Comparing estimated spending among the highest earning and lowest earning census tracts in the state reveals starkly different conditions. Figure 13 illustrates average monthly expenditures and remaining income for all households that fall below 60% AMI and above 120% AMI. For households below 60% AMI, housing, energy and transportation costs account for 68% of total monthly income compared to 36% of monthly income for those households earning more than 120% AMI.

Figure 13. Combined monthly spending on energy, transportation, and housing and remaining income for Connecticut census tracts by AMI band.



Discussion & Solutions

Combined spending on energy, transportation, and housing in Connecticut exceeded affordable levels in census tracts throughout the state. Urban areas were characterized by low household incomes, such as New Haven, Hartford, and Bridgeport, had clusters of highly burdened census tracts, as expected. Less expected, was the emergence of wealthier census tracts with unaffordable transportation burdens (e.g., in Litchfield and New London counties). Our results show that a range of policies and programs are needed to maintain affordability for Connecticut's households across energy and transportation sectors. The combination of efficiency and solar can help close the building energy affordability gap for most households in the state that own their dwelling, dramatically reducing annual energy costs. Fewer options are available to renting households, although existing programs, like Energize CT's Home Energy Solutions do substantially reduce building energy burden. Addressing Connecticut's high transportation burden is absolutely critical to keeping the state affordable. Transportation costs were high throughout the state: in urban,

suburban, and rural areas, and across income levels. Programs to both reduce reliance on private vehicles and vehicle fuel costs are needed.

Building Energy Burden and Affordability Gap

While Connecticut has multiple programs available to low income customers to help them better afford their utility bills, individual programs are insufficient to support all customers on their own. The Connecticut Energy Assistance Program ("CEAP) is primarily funded through the federal Low Income Home Energy Assistance Program ("LIHEAP") and provides direct bill assistance to households earning <60% of state median income. **The CEAP program budget is approximately $88 million, which is only sufficient to serve roughly 20% of the 430,825 eligible households in the state.**[41, 42] **Both of the state's investor-owned utilities also offer matching payment and arrearage forgiveness programs. In 2019 these programs served nearly 19,000 customers but only 58% successfully completed the program.** Further exacerbating the insufficiency of these resources is the fact that, while bill assistance programs are critical to supporting low income households and their ability to afford their energy costs, they do not offer a solution that permanently reduces a household's energy burden.

The savings achieved through the combination of efficiency and solar is enough to close the building energy affordability gap entirely for many of the state's low income households.

The combination of energy efficiency and solar has the potential to close the building energy affordability gap. An analysis by the CT Green Bank in partnership with VEIC found an average combined savings from energy efficiency and solar PV of close to $600 for participants of the Residential Solar Incentive Program (RSIP) and just over $1,300 for participants in the Solar for All program. The building energy affordability gap for households earning less than 60% AMI is $1,010. This is evidence that programs designed to provide both energy efficiency upgrades and solar energy are well poised to fill the building energy gap at all income levels and across all census tracts.[43] However, most of the state's solar programs, including Solar For All, are only open

[41] https://liheappm.acf.hhs.gov/sites/default/files/private/congress/profiles/2018/FY2018_CT_grantee_prof_final.pdf
[42] Docket No. 17-12-03RE01 – PURA Investigation into System Planning of the Electric Distribution Companies – Energy Affordability, PRO Final Report June 3, 2020
[43] Connecticut Green Bank Low and Moderate Income Solar Program Savings Analysis. October, 2020, by VEIC with support from the Connecticut Green Bank and funding from Clean Energy States Alliance (CESA) under U.S. Department of Energy Solar Energy (DOE) Technologies Office Award Number DE-EE-0007667.

to owner-occupied homes, not rentals. Further efforts are needed to ensure these types of programs benefit both homeowners and renters.

Table 9 provides a high-level overview of currently available programs and the impact they can have on reducing energy burdens. Due to varying eligibility requirements, these programs do not demonstrate a cumulative approach to relieving building energy burden. The state residential solar incentive program, Residential Solar Investment Program (RSIP), is available to all owner-occupied single-family homes, pending their individual solar feasibility, and offers a higher incentive level for customers that are low-and-moderate income. The state's energy assistance program (CEAP) also has an income threshold, serving customers below 60% state median income. Energy efficiency programs can serve both homeowners and renters who obtain landlord approval but can often be deferred if health and safety issues such as lead or asbestos exist. Despite inconsistent eligibility requirements, many programs exist to address various aspects of energy burdens.

Table 9. Programmatic solutions to high building energy burden.

	Program	Average Savings per Household	Total Eligible Customers/Customers Served
Direct Bill Assistance			
	Connecticut Energy Assistance Program (LIHEAP)	$677 - $1,180 (delivered fuel bill assistance)[44]	- 430,825 eligible - 80,467 served
Energy Efficiency			
	Weatherization (WAP)	$3,435 lifetime savings[45]	- 430,825 eligible - 286 served in 2018
	Home Energy Solutions (HES)	$200 - $250[46]	- 1,367,374 occupied housing units eligible[47] - 164,378 served since 2007[48]
Solar Programs[49]			
	Residential Solar Investment Program (RSIP)	$349	- 857,796 owner occupied 1-4 unit households eligible[50] - 41,805 projects approved

[44] Docket No. 17-12-03RE01 – PURA Investigation into System Planning of the Electric Distribution Companies – Energy Affordability, PRO Final Report June 3, 2020.
[45] https://liheappm.acf.hhs.gov/sites/default/files/private/congress/profiles/2018/FY2018_CT_grantee_prof_final.pdf.
[46] See https://www.energizect.com/your-home/solutions-list/home-energy-solutions-core-services.
[47] 2018 ACS
[48] Data provided by Eversource.
[49] Solar program savings available in: Connecticut Green Bank Low and Moderate Income Solar Program Savings Analysis. October, 2020, by VEIC with support from the Connecticut Green Bank and funding from Clean Energy States Alliance (CESA) under U.S. Department of Energy Solar Energy (DOE) Technologies Office Award Number DE-EE-0007667.
[50] 2018 ACS

	Program	Average Savings per Household	Total Eligible Customers/Customers Served
Solar Programs[51]			
	RSIP Low-and-Moderate Income Incentive	$679	- 295,750 owner occupied 1-4 unit households in <100% AMI band census tract eligible[52] - 1,669 projects approved
	Solar for All (solar PV and energy efficiency)	$1,315	3,049 LMI and non-LMI customers served
	Shared Clean Energy Facilities	$208 estimated annual bill credit[53]	

Transportation Costs

Transportation costs were consistently above affordable levels; most of these costs were associated with private vehicle ownership (vehicle purchase, maintenance, and fuel). These costs were modeled, rather than based on actual spending levels, and although rigorously reviewed, these were the least reliable estimates in our datasets. Transportation data is notoriously difficult to collect, especially for low-and moderate-income households that are traditionally under-represented in survey data. However, these estimates do provide some insight into what expected spending levels are, given local land use patterns and a minimum level of mobility (access to reliable transportation to reach employment, medical appointments, goods and services).

If rather than spending 15% of household income on vehicle ownership, households could spend 5% or even 10% on public transit, their household wealth would grow.

In even the state's most densely populated urban areas, the H&T Index deemed a car necessary to achieve this minimum level of mobility. Granted, actual rates of auto ownership may be considerably lower than those used in the model, meaning households are spending less; however, if they are depending solely on public transportation, biking and walking they presumably have reduced mobility and may be spending an excessive amount of time traveling to destinations.

[51] Solar program savings available in: Connecticut Green Bank Low and Moderate Income Solar Program Savings Analysis. October, 2020, by VEIC with support from the Connecticut Green Bank and funding from Clean Energy States Alliance (CESA) under U.S. Department of Energy Solar Energy (DOE) Technologies Office Award Number DE-EE-0007667.
[52] Ibid.
[53] $0.025/kWh bill credit applied to an assumed 8,311kWh annual load, based on Eversource average residential customer load profile in 2017.

Previous research has shown that private vehicle ownership can be a key avenue out of poverty. [54, 55, 56] Despite their crippling costs, for those who can afford to purchase and maintain them, cars provide reliable access to employment, a level of access that can only be rivaled in the most transit-dense areas of the U.S., like Manhattan.

Our analysis suggests that changing this narrative and making prosperity possible without a vehicle is perhaps the clearest way to improve the financial stability of low-and moderate-income households in Connecticut. Our dependence on private vehicles hits these households the hardest. If rather than spending 15% of household income on vehicle ownership (and another 4% on vehicle fuel), households could spend 5 or even 10% on public transit, their household wealth would grow, even more so among low- and moderate-income households which spend proportionately more on transportation. For households that cannot afford a vehicle, a high level of transit service (high frequency of service, night and weekend service, service to major employment centers) provides affordable mobility. For households that do own vehicle(s), often at unaffordable cost as this analysis showed, a high level of transit can allow them to reduce their reliance on vehicles by driving less and owning fewer cars.

We suggest two solutions to Connecticut's high household transportation burden: 1) minimize the need for private vehicles through increased access to other modes of travel, and 2) for households that do own vehicles, lower fuel costs through electric vehicle adoption.

1. Minimizing the need for and use of private vehicles:

   a. Increase access to, and use of, public transit: In Connecticut's densest urban areas facing the highest transportation burdens, a high level of transit service is the clearest way to provide mobility without taking on the cost burden of vehicle ownership. Users with highest need should be centered in public transit planning process, from vehicles, to prices, to routes, to frequency, and other service considerations. Further, people must be able to safely access public transit stops by foot or wheels; this will increase value, safety, and ridership.

   b. Electric bike adoption: E-bikes have enormous potential to provide much of the convenience of private vehicles at a fraction of the cost and environmental impact. In China, e-bike owners already outnumber car owners. For some, although not all households, e-bike adoption can dramatically improve mobility. For urban and suburban households, e-bikes can provide a first mile/last mile link to transit. A 2019 study of e-bike owners in Vermont reported an average of 1,400 miles ridden annually (important to

[54] The Urban Institute. 2014: https://www.urban.org/sites/default/files/publication/22461/413078-Driving-to-Opportunity-Understanding-the-Links-among-Transportation-Access-Residential-Outcomes-and-Economic-Opportunity-for-Housing-Voucher-Recipients.PDF

[55] Smart and Klein. 2018. Disentangling the role of cars and transit in employment and labor earnings.

[56] King et al. 2019. The Poverty of the Carless: Toward Universal Auto Access. Journal of Planning and Education.

note that winter mileage was very low). One of the most common uses of e-bikes among survey participants was commuting.[57] To reach low-and-moderate income households, a generous incentive program (inclusive of helmets, bike locks, and technical assistance) would be necessary. Secure bike storage facilities on job sites and other destinations is also important.

2. Electric vehicle adoption: In rural and suburban areas, dependence on private vehicles is often unavoidable. Electric vehicles offer clear fuel savings over gasoline-powered vehicles (often over 50% for fully electric vehicles). However, fuel savings are not always enough to overcome higher upfront costs, especially for low-and-moderate income households for whom upfront cost is a key barrier. Generous income-eligible EV incentives can help households overcome this barrier. Similarly, the MileageSmart Program, in Vermont, provides incentives to low income households for vehicles that achieve a minimum of 40 miles per gallon.[58] A 50% reduction in vehicle fuel spending would reduce transportation energy burden from 4% to 2%.

Although transportation burden in Connecticut is higher than the national average (20% vs. 13%), reliance on private vehicles is high throughout the U.S. Most transportation projects are designed with these vehicles in mind and most funding at state, federal, and local levels, goes towards accommodating these vehicles, rather than upgrades to local transit systems or bicycle and pedestrian networks.[59] In 2014, research by the Pew Charitable Trust confirmed that funding for highways far exceeds funding for public transit at all three levels of government.[60] Building a more equitable transportation system will require systemic solutions and new funding mechanisms. The suggestions above have the potential to provide meaningful reductions in transportation burden for many of Connecticut's most highly burdened households. Our hope is that these suggestions above can guide further study and implementation efforts.

[57] Electric Bikes: Survey and Efficiency Analysis: https://www.efficiencyvermont.com/Media/Default/docs/white-papers/efficiency-vermont-electric-bike-white-paper.pdf

[58] https://capstonevt.org/transportation/mileagesmart

[59] Although it's challenging to get an accurate accounting, funding for public transit comprises about 20-25% of the federal highway budget. Bike and pedestrian infrastructure comprises less than 2%. See: Congressional Research Service: https://fas.org/sgp/crs/misc/R42706.pdf; Congressional Budget Office, 2020: https://www.cbo.gov/system/files/2020-01/56006-CBO-presentation.pdf; U.S. DOT 2018 Transportation Statistics Annual Report: https://www.bts.dot.gov/sites/bts.dot.gov/files/docs/browse-statistical-products-and-data/transportation-statistics-annual-reports/Preliminary-TSAR-Full-2018-a.pdf; U.S. DOT 2015 Status of the Nation's Highways, Bridges, and Transit: https://www.fhwa.dot.gov/policy/2015cpr/chap11.cfm;

[60] https://www.pewtrusts.org/-/media/assets/2014/09/ff-transportation-report-horizontal-graphics_v3_123114.pdf

Appendix

Spending Burden by County

Figure 1A. Mean burden by county and AMI band.

Figure 2A. Mean spending burden by municipality for Fairfield County: building energy, transportation, housing, and all spending categories combined.

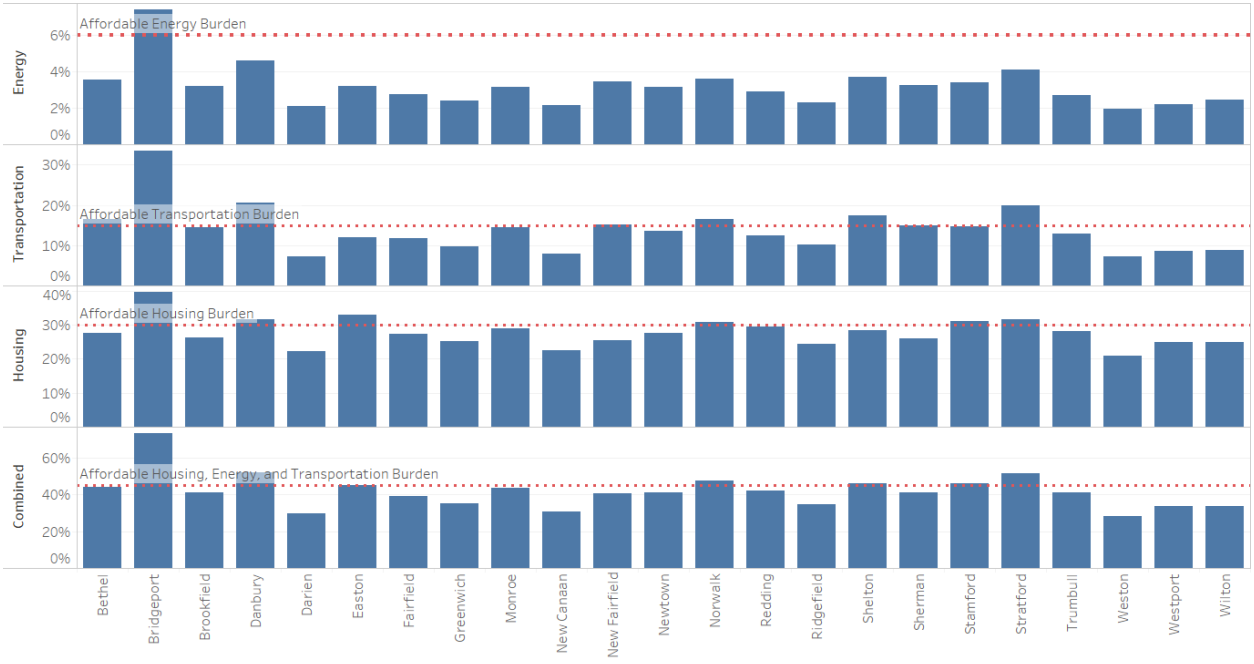


Figure 3A. Mean spending burden by municipality for Hartford County: building energy, transportation, housing, and all spending categories combined.

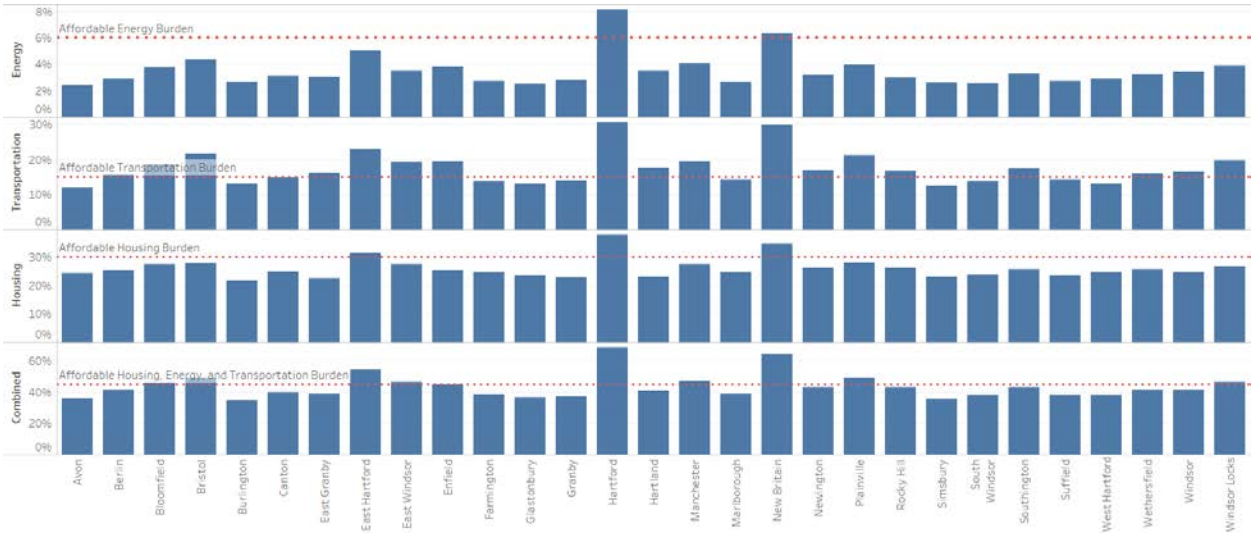


Figure 4A. Mean spending burden by municipality for Litchfield County: building energy, transportation, housing, and all spending categories combined.

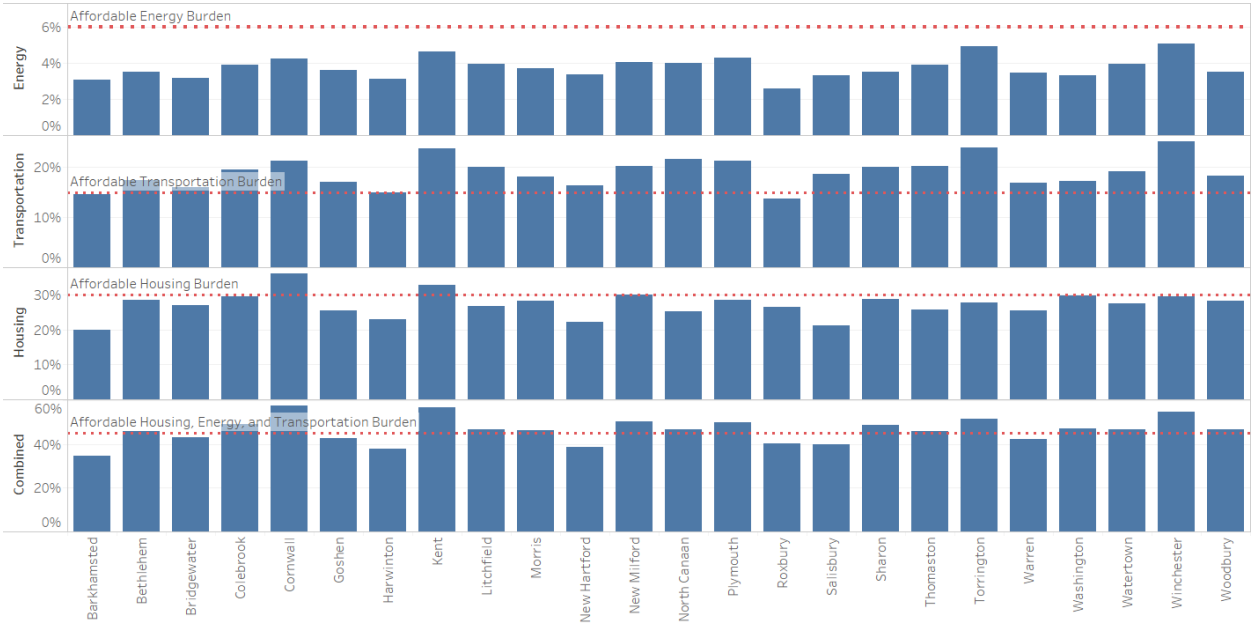


Figure 5A. Mean spending burden by municipality for Middlesex County: building energy, transportation, housing, and all spending categories combined.

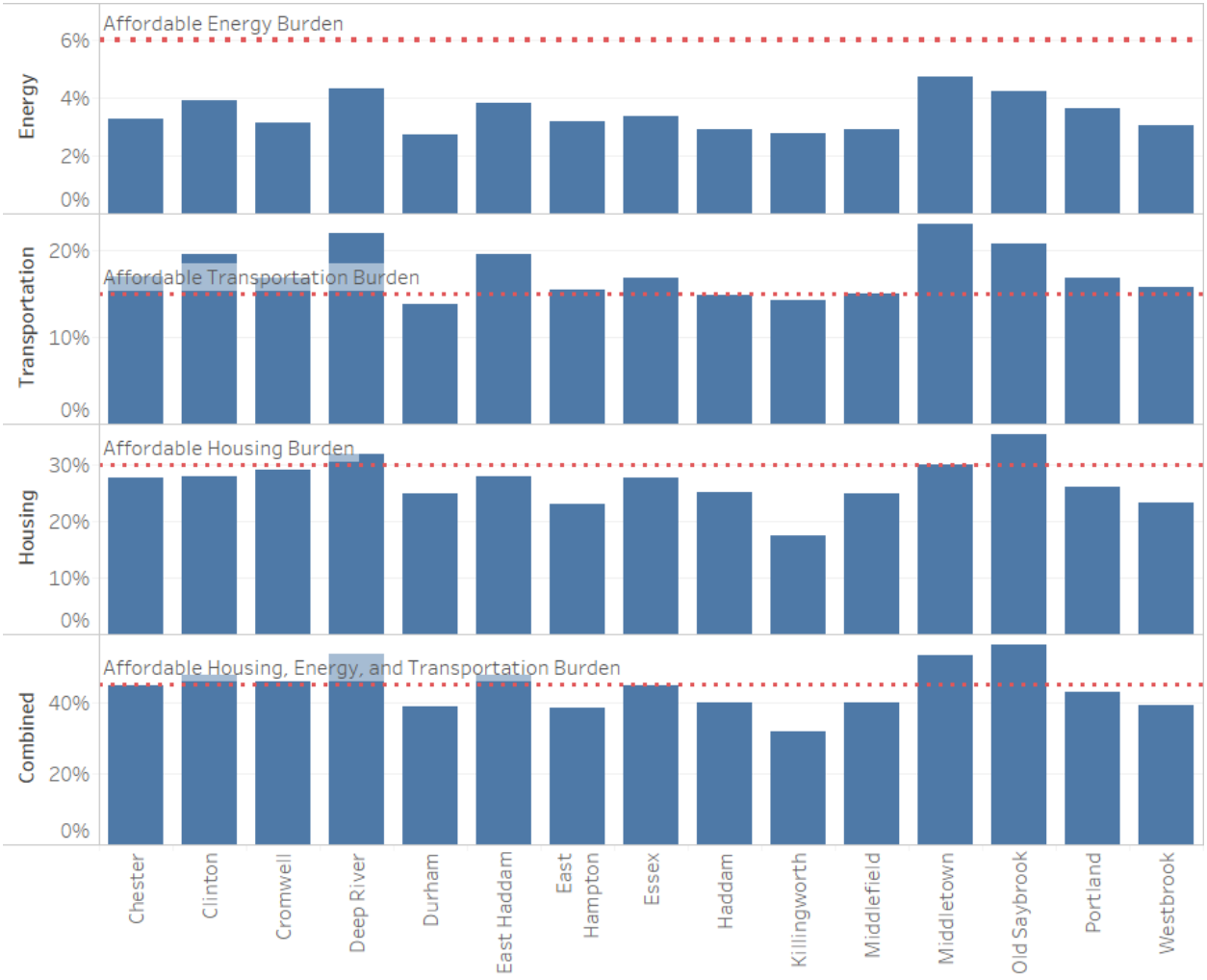


Figure 6 A. Mean spending burden by municipality for New Haven County: building energy, transportation, housing, and all spending categories combined.

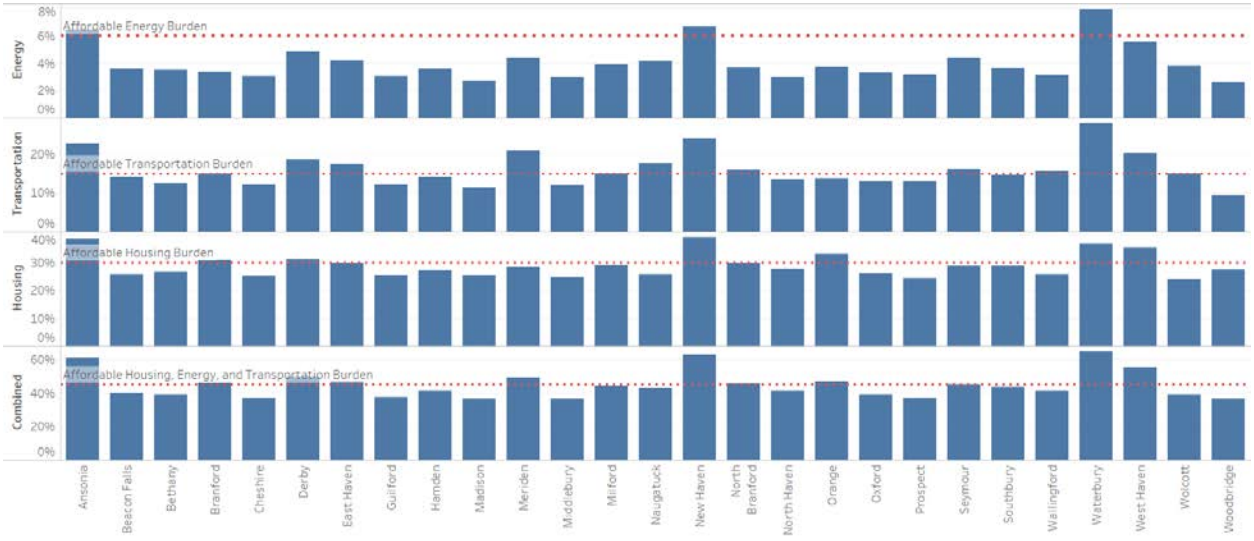


Figure 7A. Mean spending burden by municipality for New London County: building energy, transportation, housing, and all spending categories combined.

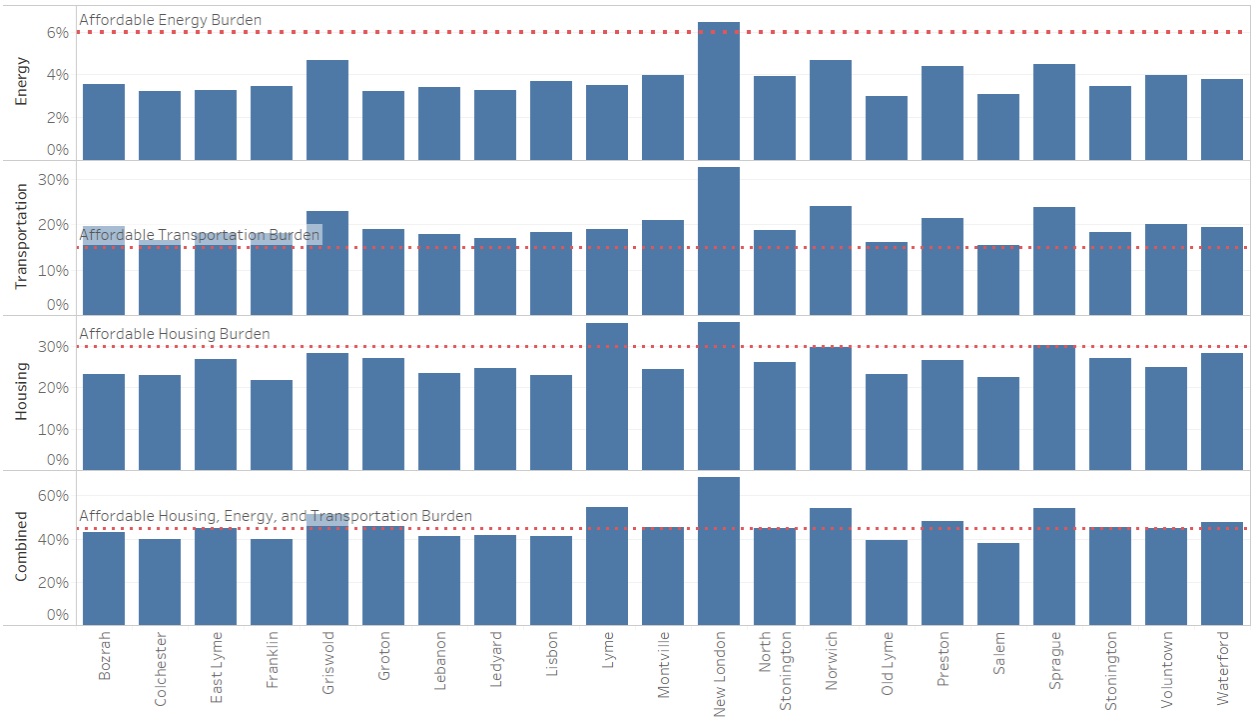


Figure 8A. Mean spending burden by municipality for Tolland County: building energy, transportation, housing, and all spending categories combined.

Figure 9A. Mean spending burden by municipality for Windham County: building energy, transportation, housing, and all spending categories combined.