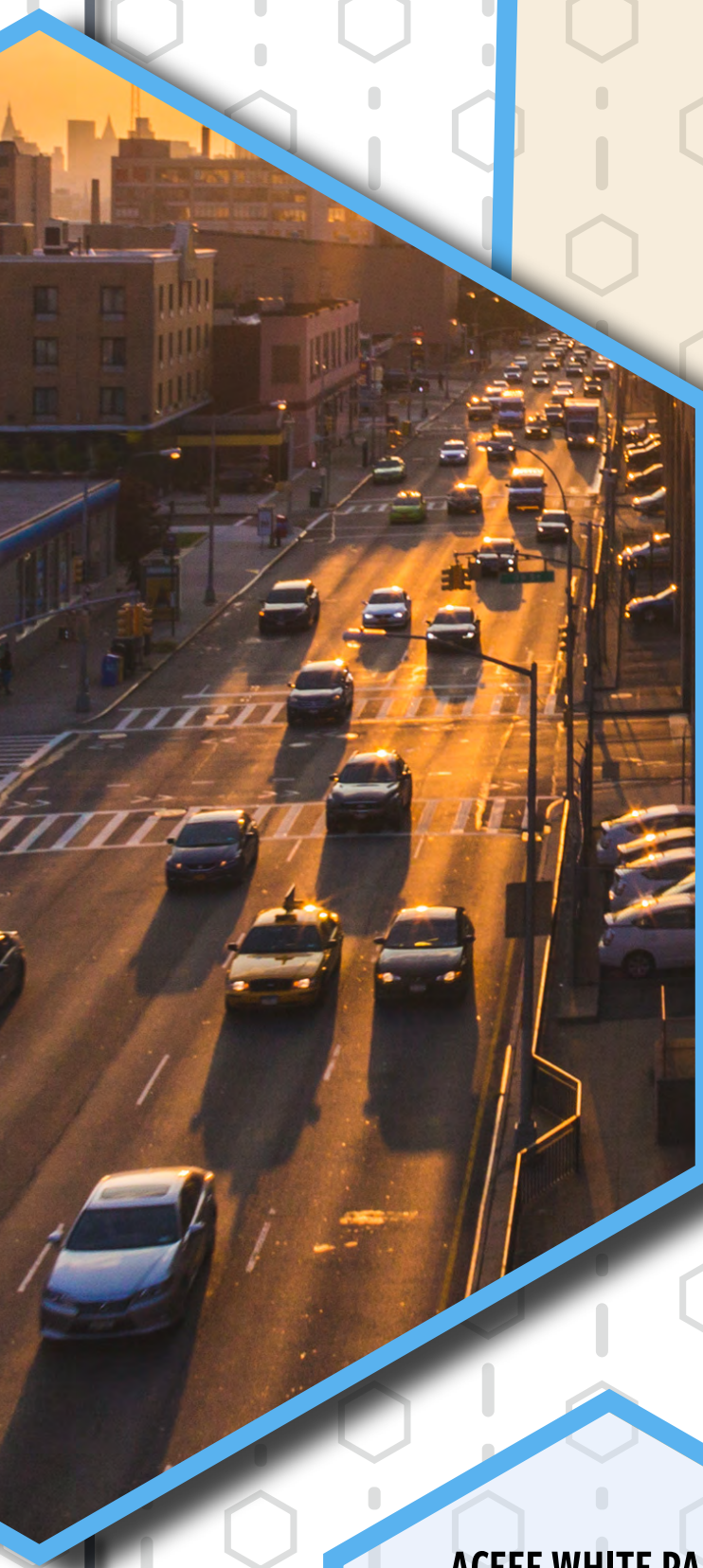

# UNDERSTANDING TRANSPORTATION ENERGY BURDENS

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ACEEE
American Council for an Energy-Efficient Economy

## Contents

## About ACEEE

The **American Council for an Energy-Efficient Economy** (ACEEE), a nonprofit research organization, develops policies to reduce energy waste and combat climate change. Its independent analysis advances investments, programs, and behaviors that use energy more effectively and help build an equitable clean energy future.

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## Abstract

As cities continue to sprawl and jobs move away from urban cores, many low-income and minority communities face two related challenges: They are inadequately served by affordable and efficient transportation options, and they lack local opportunities for work. In households that rely on inefficient personal vehicles or poor public transit as their primary mode of transport, expenses for vehicles, fuel, insurance, and maintenance can be large and unpredictable. Consequently, household transportation costs as a percentage of total income, or transportation burdens, are higher than average for low-income communities and communities of color.

This situation is largely the result of the United States' history of land use planning and uneven transportation investments. Real estate development patterns and highways built through Black and Latino neighborhoods have displaced these households into suburbs or exurbs while transit services remain inadequate. Compounding these obstacles, public transportation funding and service have been ravaged by the COVID-19 pandemic, leaving members of these communities, many of whom hold essential jobs, without affordable transportation options.

While spending on gasoline does not account for all of a household's annual transportation spending, it can make up a significant portion, especially for households that own fuel-inefficient vehicles or those that do not have access to efficient modes of transportation. In this paper, we outline the factors that affect transportation energy burdens—i.e., expenditures on gasoline as a percentage of household income —summarize current knowledge of household spending on gasoline (including results of our own original analysis), and analyze how this spending varies by income group, race, and geography. We conclude with potential policy solutions to address those burdens.

Results from our analysis show that American households have an average gasoline burden of about 7.0% of total income, which is substantially higher than the 3.7–4.6% identified in current literature. Gasoline burdens for low-income households that earn less than 200% of the federal poverty level range from 13.8% to 14.1%. Additional key insights include the following:

- Gasoline cost burdens for low-income households are more than **three times larger** than burdens for higher-income households.
- Among low-income households, these burdens are higher for **Black, Hispanic, and American Indian households** than for white and Asian households.
- Metropolitan areas in the **Northeast** have some of the United States' lowest average burdens, while those in the **Sunbelt** have some of the highest.
- Households **outside key metropolitan** areas have gasoline cost burdens that are 25% higher than those borne by households located within metro regions.
- Burdens are higher for households living in **apartments and mobile homes.**

# Introduction

## *DEFINING TRANSPORTATION ENERGY BURDENS*

Transportation costs are the second-largest expense for households in the United States after housing-related expenditures. The average household in the United States spends approximately 13% of its total income on expenses for vehicles, fuel, insurance, and maintenance (known as transportation burdens). For low-income households, this average burden can be as high as 30% (ITDP 2018). High transportation burdens have the potential to inflict direct and indirect stresses on households. These can range from limits placed on a household's purchasing power to impacts on property values.

As cities continue to sprawl and jobs move away from urban cores, many low-income and minority communities face two related challenges: They are inadequately served by affordable and efficient transportation options, and they lack local opportunities for work. In households that rely on inefficient personal vehicles or poor public transit as their primary mode of transport, expenses for vehicles, fuel, insurance, and maintenance can be large and unpredictable. Consequently, household transportation costs as a percentage of total income are higher than average for low-income communities and communities of color (Pew Charitable Trusts 2016).

The Center for Neighborhood Technology (CNT) tracks the combined costs of housing and transportation across the country. According to its H+T Index, transportation costs should account for no more than 15% of annual household income (CNT 2021). However, more than two-thirds of households within certain highly populated metropolitan areas (such as Atlanta, Dallas, Detroit, and Houston) that receive housing assistance from the U.S. Department of Housing and Urban Development (HUD) spend more than 15% of their annual household incomes on transportation (Schmitt 2016).

Households of color, in particular, shoulder some of the heaviest transportation costs while also bearing the disproportionate impact of transportation emissions. This situation is largely the result of the United States' history of land use planning and uneven transportation investments (Creger et al. 2018). Real estate development patterns and highways built through Black and Latino neighborhoods have displaced these households into far-flung suburbs while transit services for these communities are often inadequate (Valentine 2020; Fulton et al. 2020). Compounding these obstacles, public transportation funding and service have been ravaged by the COVID-19 pandemic, leaving members of these communities, many of whom hold essential jobs, without affordable transportation options (Tan et al. 2020).

Rural communities have their own location-specific transportation challenges. Given the lack of density necessary for comprehensive public transit services and networks, rural residents generally do not have a wide range of mobility options and are often forced to rely on personal transportation (SUMC 2020).

While spending on gasoline does not account for all of a household's annual transportation spending, it can make up a significant portion, especially for households that own fuel-inefficient vehicles or those that do not have access to efficient modes of transportation. In

fact, as a percentage of income, lower-income households spend about twice as much on gas as do middle-income households (CFA 2018). Efficient transportation policies can, therefore, mitigate the heavy burdens that these households bear.

To create the most effective policies and invest in the most impactful programs, policymakers need to understand the transportation energy–related burdens that American households experience. For the purposes of this report, we define transportation energy burdens as the amount spent on gasoline as a percentage of total household income. Other analyses also categorize parking, vehicle maintenance and repair, vehicle charging, and transit costs as transportation energy expenses. However, we believe gasoline costs are the simplest way to estimate energy burdens in transportation and are a good proxy by which to understand such factors as the location efficiency of homes, the energy efficiency of vehicles, and household access to mobility options besides personal vehicles.

To date, there has been little research or analysis regarding the magnitude of transportation energy burdens. This paper attempts to fill the gap by elucidating how this burden varies among different income groups, how it varies geographically, and how it affects total energy burdens.

A recent ACEEE analysis found that, nationally, 60% of low-income households face severe energy burdens, meaning that these households spend more than 10% of their annual incomes on household energy bills. It also found that that Black, Hispanic, and Native American households have disproportionately high energy burdens relative to the national median household. On average, the percentage of income that low-income households pay on their home energy bills is more than three times what their higher-income counterparts pay (Drehobl, Ross, and Ayala 2020). The analysis in that report was limited to utility expenditures, however, and did not include transportation-related energy costs, the addition of which would provide a more accurate picture of total energy-related burdens.

This white paper outlines the factors that affect transportation energy burdens, summarizes our understanding of the magnitude of household spending on gasoline, and shows how this spending varies among income groups. We also conduct our own analysis of energy burdens, using data on household gasoline expenditures from HUD's American Housing Survey (currently available only for 2013). The American Housing Survey provides self-reported gasoline costs, which allows us to estimate actual burdens instead of relying on modeled data. Additionally, limiting our definition of transportation energy burdens to the percentage of household income spent on gasoline enables us to analyze how gasoline burdens vary by income group, geography, and type of household (urban, suburban, or rural). Note that, as mentioned above, our definition excludes expenditures associated with vehicle maintenance, insurance, and other potential expenses related to vehicle ownership.

### *FACTORS THAT AFFECT TRANSPORTATION ENERGY BURDENS*

As a proportion of total annual household income, overall transportation costs (which include elements above and beyond fuel costs such as vehicle maintenance, insurance, and parking) have risen over the last several decades in the United States. According to data from the U.S. Bureau of Labor Statistics, the average American household spent 17.5% of its annual income on transportation in 2012, up from 13.4% in 1950 (Phillips 2014). This total

transportation burden was even higher in 2003, hitting 19.1%, possibly as a result of increased gas prices due to the Iraq war (Phillips 2014; Cortright 2008). More recent estimates, from 2017, show total transportation burdens specifically for moderate-income households and low-income households at 20% and 30%, respectively (Goldman 2017).

The picture is less clear for household gasoline burdens in particular. While the magnitude of these costs is largely determined by the cost of fuel, it can be affected by a number of other factors as well. Here we describe each one:

***Fuel costs.*** Fluctuations in the price of gasoline obviously have a direct impact on transportation energy expenses and household transportation expenses as a whole. Adjusted for 2020 levels of inflation, the real price of a gallon of gasoline marginally decreased from $2.26 in 2000 to $2.20 in 2020, but it fluctuated greatly in the interim, reaching a high of $4.13 in 2012 and a low of $1.95 in 2002 (EIA 2020).

***Vehicle efficiency.*** The fuel efficiency of a vehicle is as important as the price of fuel in determining transportation energy expenditures. Owning a high-efficiency vehicle can help create savings for any household, which is particularly meaningful for low-income households (Greene and Welch 2017). Unfortunately, efficient and advanced vehicles have historically had higher price tags than lower-efficiency models, meaning that they are typically inaccessible to the households that would benefit most from owning them (Greene and Welch 2017). As new high-efficiency vehicle models become more affordable and as efficient models begin to enter the used car market, low-income groups may have greater access to fuel-efficient vehicles, which could reduce their transportation burdens to some degree.

***Location efficiency.*** Current land use policies and the legacies of 20th-century city zoning and development practices also affect the severity of transportation energy burdens on specific city households and neighborhoods. Post–World War II zoning practices have traditionally separated industrial and residential uses of land, and some codes further divide land used for commercial, institutional, and recreational purposes. In combination with highway-focused transportation investment, this has encouraged suburbanization and sprawl, separating people's homes from where they work, shop, go to school, and enjoy recreation (Ribeiro et al. 2020). Research has also shown that the average vehicle miles traveled (VMT) is greater for vehicles owned by those in the bottom income quintile than for those in the top quintile (Greene and Welch 2017). This indicates that bottom-quintile earners may rely on personal vehicles as their primary mode of transportation while top-quintile earners use a broader spectrum of mobility options. Zoning practices that successfully implement compact and mixed-use development while also accommodating multiple modes of transportation that connect jobs, homes, and critical services can lessen VMT for low-income households, thereby trimming their transportation costs.

Separation from job centers, services, and amenities has notable impacts on rural communities as well. Rural counties have been shown to spend as much as 20% more on transportation fuel than their urban counterparts within the same state (Center for Rural Policy and Development 2009). In rural areas, transportation options other than driving a personal vehicle are generally limited or nonexistent, meaning that most if not all trips are made by car.

***Access to reliable transit.*** The same zoning practices that support mixed-use communities can also encourage the development of housing (particularly affordable housing) around transit nodes. Transit-oriented development provides households with direct access to public transportation, making it a reasonable alternative to travel by personal vehicle and thus reducing transportation energy burdens.

***Access to emerging mobility options.*** Urban transportation systems have evolved significantly in recent years. Technology-enabled options such as ride hailing, car sharing, and bike sharing have become increasingly popular mobility options.[1] However, deployment has often focused on middle- and upper-middle-class neighborhoods, leaving out the communities with the greatest need (Vaidyanathan 2017). Additionally, households in lower-income communities may not always have access to the technology needed to use these services (e.g., smartphones), which could indirectly lead to an overreliance on personal vehicles or incomplete transit services.

## Understanding the Magnitude of Transportation Energy Burdens

Little research has been done to understand the magnitude of transportation burdens. Even less has been done on gasoline-specific cost burdens and how those burdens vary by population group. Moreover, real-world data on transportation expenses have historically been difficult to find. Consequently, much of the limited analysis conducted thus far uses modeled data to estimate both total transportation and gasoline cost burdens. While this work has given decisionmakers a solid basis on which to make transportation investment and policy decisions, real-world data on household expenses around transportation would be useful for more targeted policymaking for those households that shoulder the highest burdens. Access to such data would give us a better picture of transportation burdens, and collecting it should be a research priority.

Nevertheless, a handful of studies exist that can help us not only identify fluctuations in gasoline burdens and overall transportation burdens but also understand whether certain demographic groups are disproportionately impacted.

### *GENERAL TRANSPORTATION COSTS*

There has been a consistent upward trend in total transportation spending between 1950 and the early 2010s (Phillips 2014). According to some estimates, household spending on transportation was as high as 17.5% of annual household income in 2012 (Phillips 2014). This fell to about 13% in 2019 (ITDP 2019).

The primary determinant of the magnitude of transportation cost burdens is household income. Research from the Institute for Transportation and Development Policy found that in the United States in 2016, the bottom quintile of wage earners spent an average of 29% on transportation costs. These households made on average approximately $12,000 a year. For households earning $30,000 a year, transportation expenditures averaged about 22%, still significantly higher than the 13% average across all income quintiles (ITDP 2019). In

[1] Ride-hailing services such as Uber and Lyft provide customers with an on-demand ride to a specified location. Car-sharing services such as Zipcar loan cars to customers for short trips.

Portland, Oregon, similar trends were observed for total transportation expenditures in the city's 2010 *Housing and Transportation Cost Study*. Low-income households living in multifamily buildings faced the highest combined housing and transportation costs, spending almost 79% of their income on both these critical necessities (Portland 2010).

Housing location is another primary determinant of transportation burdens. A CNT study of 28 metro areas across the country identified suburban and urban fringe neighborhoods as areas where households generally shoulder greater burdens as a result of higher total transportation costs (Haas et al. 2006). In such locations, transit may be difficult to access, necessitating driving and increasing household transportation spending (CNT 2010).

Households located in the urban core with access to public transit appear to generally enjoy proportionally lower transportation costs, but location efficiency in and of itself is not enough to combat high transportation costs (Haas et al. 2006; Portland 2010). Some households located in dense urban areas with access to public transit can still be highly burdened by transportation costs (Portland 2010). In fact, transportation expenses in the Portland metro area have rendered at least 9.45% of "affordable" HUD housing unaffordable, according to the CNT H+T Index, when both housing and transportation costs are considered together (Schmitt 2016). A multitude of factors have likely led to this outcome, including the lack of a consistent methodology to evaluate the true cost of living in a location once affordable housing is constructed, and potentially inaccurate regional assumptions regarding the modes of transportation people choose to use that inform the placement of affordable housing developments (Portland 2010).

Research has consistently found that rural households are highly burdened by both total transportation costs and transportation energy costs, and certain suburban communities can be negatively impacted by the effects of high-mileage driving as well. Approximately 90% of neighborhoods with above-average transportation costs are located outside employment centers that have a minimum of 5,000 jobs with a job density of at least 7 jobs per acre (Haas et al. 2006). On average these neighborhoods are located 31 miles from the nearest city center, meaning that the vast majority of overburdened households are in either exurb or rural locations (Haas et al. 2006). Exurb households in large metro areas such as Minneapolis–Saint Paul have been estimated to pay as much as 30% of their household incomes on transportation annually (Cortright 2008).

### *GASOLINE EXPENDITURES*

If we look specifically at gasoline burdens, we find a number of the same trends that we find for overall transportation costs. ICF International's analysis of transportation fuel expenditures placed the national average household fuel burden at approximately 3.7% of household income in 2004 and 4.6% in 2006 (Bailey 2007). In Vermont, fuel burdens average about 4% of annual household income statewide, with some households shouldering burdens as high as 10% (Sears and Lucci 2019).

Looking across income groups, research from Minnesota and Vermont provides some insight into how gasoline costs can vary by household income. The Efficiency Vermont 2019 *Energy Burden Report* found that low-income households shouldered more than twice as heavy a transportation energy burden as high-income households (approximately 7.35%

versus 3.2%) within the state (Sears and Lucci 2019). The three Vermont towns with the highest transportation energy burdens had a median annual income of $36,833, nearly $20,000 lower than the statewide median of $57,513 in the same year (Sears and Lucci 2019). Additionally, Vermont renters—nearly 80% of whom are considered low-income—were shown to bear a larger transportation energy burden than homeowners. And the story is no different in Minnesota, where low-income households located in rural areas were shown to shoulder high gasoline burdens than the average Minnesotan household, paying as much as 20% more on transportation fuel.

Likewise, these reports speak to the role that location plays in determining gasoline burdens. Long drives between rural homes and centers of employment, goods and services, and other amenities have negative household budgetary impacts, and these are only exacerbated by volatility in fuel markets. In 2008 the expected gasoline burden for rural Minnesota households was between 5.8% (when gas was at its lowest price) and 9% when gas prices were peaking, compared to 3.2% and 4.9%, respectively, for urban households within the state over the same period (Center for Rural Policy and Development 2009). These numbers are consistent with findings in Vermont, where households without access to public transit were typically shown to bear the weight of larger fuel burdens (Sears and Lucci 2019). This is an especially difficult issue to address in rural areas due to a lack of viable alternatives to personal vehicles for transportation (Center for Rural Policy and Development 2009).

It is important to note that aside from the Vermont study, much of the research cited here was released before 2010 and does not account for recent changes in travel patterns. Transportation systems in the United States have evolved greatly in recent years, and the advent of technology-enabled services like ride hailing, shared bicycles, and scooter sharing has meant that people have more transportation options to choose from, particularly in urban areas. We will need updated research that considers the impacts of these new travel options on household gasoline burdens. Additionally, COVID-19 not only has changed the way people travel but has also had a disproportionate impact on low-income communities and communities of color that rely on public transportation, potentially exacerbating the magnitude of household burdens in these communities.

## Quantitative Analysis of Transportation Energy Burdens by Household

In an effort to build upon the existing estimates of average transportation energy burdens, ACEEE analyzed transportation-related energy costs using data from the U.S. Census Bureau and HUD's American Housing Survey (AHS) from 2013, the last time the AHS included self-reported data on monthly gasoline expenditures. We recognize that other assessments of transportation burdens have typically used industry-standard data from the Bureau of Labor Statistics' Consumer Expenditure Survey, and we acknowledge that the AHS data are fairly dated at this point. However, this is the only available source that we have found of real-world rather than modeled data on transportation expenditures. Additionally, our use of AHS data allows a direct comparison of transportation energy costs and housing energy costs outlined in ACEEE's assessment of residential energy affordability (Drehobl, Ross, and Ayala 2020). Finally, we chose to focus on gasoline because, significantly, only a few households in the AHS sample reported nonzero monthly

transit expenditures and the amounts tended to be low. Average burdens with transit costs included are fairly similar to the gasoline-only burdens presented below.

### *METHODOLOGY*

For this analysis, we examined gasoline expenditures as a percentage of income across several variables. We chose to define low-income households as those making less than 200% of the federal poverty level (FPL) and classified all other households as higher income. While many other burden analyses estimate total transportation spending (CNT 2021; Sears and Lucci 2019; ICF 2007; Portland 2010; ITDP 2019) or examine spending based only on income (ITDP 2019), we used publicly available survey data to examine actual costs at the household level. The biennial AHS samples households across the United States to gather information on housing stock characteristics, housing and energy costs, occupant characteristics, and other related information, including transportation spending and patterns. The survey's unit of analysis is the household, the results incorporate weighting to produce a national sample, and all the responses are self-reported.

In addition to containing a nationally representative cross section of the population, the AHS survey also collects information on a subset of metropolitan statistical areas (MSAs) in each edition (Census Bureau 2015). The national sample for the 2013 AHS contains representative data for four major MSAs: New York City, Chicago, Philadelphia, and Detroit; the metropolitan sample contains representative data on those four cities plus another 20 major MSAs (see Table 6).[2] The 24 MSAs represent approximately 28% of the total U.S. population based on the 2010 Census (Census Bureau 2021).

We conducted an analysis of the national sample and another on the metropolitan sample. We limited our samples to households with positive income, positive gasoline spending, and a calculated transportation energy burden of less than 100%. This reduced our national sample to 22,313 surveyed households. For the metropolitan sample, 29,761 households met these criteria.

> ***Metropolitan Statistical Area*** *– An area consisting of at least one urbanized area that has a population of at least 50,000. The Metropolitan Statistical Area contains a core urban area, plus adjacent outlying counties that are highly integrated with the core based on commuting patterns (OMB 2010). The urban core of an MSA can also be connected to rural communities and suburban communities. Transportation trends and vehicle use can vary significantly within any given MSA.*

In addition to examining gasoline burdens for households earning below 200% of FPL, for further detail we also divided households in each sample into quintiles based on their weighted income, with each quintile calculated to represent 20% of households nationwide or in the 24 MSAs. The income thresholds for each quintile were calculated separately for

[2] The national public use file distinguishes between the portion of the New York City MSA that is in New York State and the portion in northern New Jersey. For the purposes of this analysis, we have combined them into one New York City MSA.

each sample, and incomes were broadly higher in the metropolitan sample. Income thresholds are outlined in table 1 below.

Table 1. Household income thresholds

| Sample | First quintile | Second quintile | Third quintile | Fourth quintile | Fifth quintile |
|---|---|---|---|---|---|
| National | $1–20,799 | $20,800–38,399 | $38,400–61,973 | $61,974–99,987 | $99,988 and above |
| Metropolitan | $1–22,999 | $23,000–42,934 | $42,935–70,985 | $70,986–116,986 | $116,987 and above |

Beyond income and metropolitan area, we also examined gasoline burdens for Black, white, Asian, American Indian, and Hispanic households. Finally, we looked at how these burdens change across urban form (e.g., urban, suburban, and rural) and housing type, both of which can greatly impact transportation spending and travel decisions. We used variables from the AHS that indicate whether a household is within a metropolitan area or not, based on the Census designation, as well the type of housing occupied by the household (including single family homes, apartments, and mobile homes) (Census Bureau 2019).

### Data Limitations

The data in the American Housing Survey provide only a snapshot in time, and 2013 is the last time gasoline expenditures were reported, meaning that these data may not reflect current burdens. Gasoline prices can vary considerably from year to year, greatly affecting the average gasoline burden of households. The data are also self-reported and only represent monthly averages; further, these figures are often rounded by the respondent, which reduces accuracy. Despite these limitations, these data still allow us to estimate actual burdens and not have to rely on modeling, an advantage over many other national studies. Modeling transportation energy burdens requires the modeler to make several assumptions and extrapolations that introduce uncertainty in the results.

## *RESULTS*

The average gasoline burden for low-income households is more than three times larger than the burden for households with incomes above 200% of FPL. In our national sample, low-income households have an average burden of 13.8% compared with just 4.1% for higher-income households (see table 2). The disparity is even larger in the metropolitan sample. There, low-income households experience average burdens more than three and a half times larger than the burden for all other households, at 14.0% versus 3.8%. Average monthly gasoline spending is greater for the higher-income households, at $252 per month in both the national and metropolitan samples.

Table 2. Average gasoline burden by income and sample

| | <200% of FPL | | | >200% of FPL | | |
|---|---|---|---|---|---|---|
| Sample | Mean income | Mean monthly gasoline expenditure | Mean gas burden | Mean income | Mean monthly gasoline expenditure | Mean gas burden |
| National | $21,822 | $189 | 13.8% | $95,930 | $252 | 4.1% |
| Metropolitan | $22,374 | $192 | 14.0% | $108,467 | $252 | 3.8% |

### Gasoline Burden by Income Quintile

In both the national and metropolitan samples, households in the lowest quintile have burdens more than three times that of households in the middle quintile, as shown in table 3. In the national sample, households in the lowest quintile spend 18.3% of their income on gasoline, and those in the second-lowest quintile spend 7.9%. The figures are similar in the metropolitan sample, with burdens at 17.8% and 7.5%, respectively. Burdens for each quintile are lower in the metropolitan sample than in the national sample, by a consistent margin of 0.3 to 0.6 percentage points. In both samples, monthly gasoline expenditures increase as incomes increase, but at a slower rate, causing burdens to decline.

Table 3. Average gasoline burden by quintile[3]

| Sample | First quintile | Second quintile | Third quintile | Fourth quintile | Fifth quintile |
|---|---|---|---|---|---|
| National | 18.3% | 7.9% | 5.6% | 4.1% | 2.5% |
| Metropolitan | 17.8% | 7.5% | 5.0% | 3.6% | 2.1% |

### Gasoline Burden by Urban Form

On average, households located in an MSA in our national sample have a transportation energy burden of 6.6%, while those outside an MSA have a burden ranging from 7.8% to 8.6% (See table 4). This is despite the fact that households outside an MSA spend almost the same per month on gasoline, on average, as those within an MSA ($231 versus $234). Households outside MSAs do, however, have considerably lower household incomes, at around $57,000 on average compared with $76,805 for households living within an MSA. The households with the highest average burden are in rural areas outside an MSA, at 8.6%. This could likely reflect the lack of transportation alternatives to driving in many rural communities as well as the longer travel distances.

[3] The national MSA and "big four" MSA samples come from the national sample and use the national sample income thresholds, so the number in each quintile will vary.

Table 4. Gasoline burden by urban form

| | Inside MSA | Outside MSA, urban | Outside MSA, rural |
|---|---|---|---|
| Mean income | $78,605 | $55,853 | $57,872 |
| Mean monthly gasoline expenditure | $234 | $199 | $248 |
| Mean gas burden | 6.6% | 7.8% | 8.6% |

The 24 MSAs in our metropolitan sample have a lower average gasoline burden than the nation overall, at 6.3% versus 7.0% for all households. Households in these MSAs have higher incomes on average than the nation overall, at about $87,000 versus $73,620 for all households, while spending slightly more per month on gasoline on average, at $237 versus $233. There is also considerable variation among the 24 MSAs in terms of mean household income, mean monthly gasoline expenditures, and mean gasoline burden, as detailed in table 5.

The United States has notable geographical differences in gasoline burdens. The MSA with the lowest mean burden is Boston. Six of the 10 MSAs with the lowest burdens are in the Northeast region. The five MSAs with the highest burdens are all in the Sunbelt, apart from Detroit. Of the 18 large metro areas logging the most trips (per capita) by mass transit, only 4 are in the Sunbelt: Los Angeles, Las Vegas, San Diego, and Atlanta. Unfortunately, of these four, only Las Vegas, which has the 10th-highest burden, is included in our metropolitan sample. Only two Sunbelt cities on our list of MSAs are among those with the lowest burdens: Tampa and Tucson (Fulton et al. 2020).

Table 5. Mean income, monthly gasoline expenditure, and gasoline burdens for MSAs in metropolitan sample

| Metro area[4] | Mean income | Mean monthly gasoline expenditure | Mean gasoline burden | 2019 population (thousands)[5] |
|---|---|---|---|---|
| Austin, TX | $81,801 | $245 | 6.52% | 2,227 |
| Baltimore, MD | $100,099 | $252 | 5.81% | 2,800 |
| Boston, MA–NH | $121,009 | $207 | 3.91% | 4,873 |
| Chicago, IL | $86,516 | $246 | 6.51% | 7,123 |
| Detroit, MI | $72,759 | $258 | 7.97% | 1,749 |
| Hartford, CT | $92,336 | $258 | 6.00% | 1,205 |
| Houston, TX | $77,811 | $273 | 7.90% | 7,066 |
| Jacksonville, FL | $68,657 | $234 | 7.61% | 1,560 |

[4] MSAs generally use 2003 Office of Management and Budget definitions, with the exception that the Chicago MSA excludes Dekalb County, Illinois, and areas outside Illinois; the Detroit MSA includes the Monroe, Michigan, MSA; and the Philadelphia MSA excludes the Wilmington, Delaware, MSA.

[5] Based on current MSA definitions. *Source:* Census Bureau 2021.

| Metro area[4] | Mean income | Mean monthly gasoline expenditure | Mean gasoline burden | 2019 population (thousands)[5] |
|---|---|---|---|---|
| Las Vegas, NV | $69,081 | $211 | 6.89% | 2,267 |
| Louisville, KY–IN | $62,898 | $232 | 7.32% | 1,265 |
| Miami, FL | $71,397 | $262 | 7.81% | 6,166 |
| Minneapolis–St. Paul, MN–WI | $93,466 | $237 | 5.23% | 3,640 |
| Nashville, TN | $79,065 | $248 | 7.23% | 1,934 |
| New York City, NY–NJ | $95,145 | $225 | 5.31% | 19,216 |
| Oklahoma City, OK | $69,030 | $254 | 7.77% | 1,409 |
| Orlando, FL | $64,776 | $249 | 7.92% | 2,608 |
| Philadelphia, PA–NJ | $86,267 | $210 | 5.76% | 6,102 |
| Richmond, VA | $76,102 | $243 | 6.32% | 1,292 |
| Rochester, NY | $72,862 | $234 | 6.35% | 1,070 |
| San Antonio, TX | $67,050 | $248 | 8.13% | 2,551 |
| Seattle, WA | $98,948 | $227 | 4.98% | 3,980 |
| Tampa–St. Petersburg, FL | $72,906 | $200 | 6.06% | 3,195 |
| Tucson, AZ | $65,962 | $169 | 6.11% | 1,047 |
| Washington, DC–VA–MD–WV | $128,668 | $227 | 4.94% | 6,280 |
| Metropolitan sample average | $87,046 | $237 | 6.32% | 92,626 |
| United States average[6] | $73,620 | $233 | 7.0% | 328,240 |

### Gasoline Burden by Race and Ethnicity

In addition to income, race and ethnicity are key factors that influence a household's gasoline cost burden in our analysis. This is not altogether surprising given the racial inequalities and injustices that exist in the U.S. transportation system and the poor access Black and brown communities have historically had to reliable transportation alternatives and job centers (Spieler 2020). In both our national and metropolitan samples, income, monthly gas spending, and gas burdens vary significantly by race and ethnicity, indicating a need for policies that are specifically targeted at lowering gasoline burdens in low-income communities and communities of color.

In our national sample, white households have slightly lower gasoline burdens than the overall average; all other racial and ethnic groups show a greater divergence from that average (see table 6). Black, American Indian, and Hispanic households have burdens well above the national average, while Asian households have lower burdens on average. Nationally, American Indian households face the highest gasoline burdens, at 10.9%, and

[6] Based on National Sample and includes households outside MSAs.

Hispanic households have the next-highest national burdens, at 9.2%. Asian households have the lowest burdens in both the national and metropolitan samples.

Table 6. Overall mean gasoline burden by race and ethnicity

| | Overall | White | Black | Asian | American Indian | Hispanic, of any race |
|---|---|---|---|---|---|---|
| National sample | 7.0% | 6.3% | 9.1% | 5.3% | 10.9% | 9.2% |
| Metropolitan sample | 6.4% | 5.5% | 8.3% | 5.1% | 10.2% | 8.3% |

Gasoline spending by race and ethnicity in the metropolitan sample is largely similar to the national sample, but mean household income is higher for each group in the 24 MSAs sampled. Additionally, every group has a lower average gasoline burden in the metropolitan sample compared to the national one. The other trends among the groups are the same as they are in in the national sample, including Hispanic households continuing to have the highest monthly gasoline spending. The racial differences in average burdens among low-income households mirror the trends we see for households nationally. As table 7 indicates, low-income American Indian households have the highest burden of any low-income group, at 17.3%, and low-income Asian households experience the lowest average burden at 10.9% in our national sample. The variation is similar in the metropolitan sample. In both samples, the differences in average burdens between races were much smaller among higher-income households. In both the national and metropolitan samples, among households that earn more than 200% of the federal poverty level, Hispanic households had the highest average burden, followed by Black households.

Table 7. Burdens by race, ethnicity, and income[7]

| | <200% of FPL | | | >200% of FPL | | |
|---|---|---|---|---|---|---|
| | Mean income | Mean monthly gas expenditure | Mean gasoline burden | Mean income | Mean monthly gas expenditure | Mean gasoline burden |
| National sample | $21,822 | $189 | 13.8% | $95,930 | $252 | 4.1% |
| White | $20,873 | $178 | 13.5% | $99,270 | $248 | 3.9% |
| Black | $19,931 | $181 | 15.1% | $75,313 | $251 | 4.8% |
| Asian | $25,797 | $186 | 10.9% | $113,536 | $256 | 3.5% |
| American Indian | $20,947 | $199 | 17.3% | $93,791 | $240 | 3.9% |
| Hispanic, of any race | $25,695 | $232 | 14.0% | $82,010 | $282 | 5.0% |
| Metropolitan sample | $22,374 | $192 | 14.0% | $108,467 | $252 | 3.8% |
| White | $20,632 | $173 | 13.8% | $114,889 | $248 | 3.5% |
| Black | $21,050 | $193 | 15.6% | $84,057 | $246 | 4.4% |
| Asian | $26,617 | $194 | 12.0% | $129,036 | $251 | 3.2% |
| American Indian | $18,766 | $186 | 18.3% | $90,557 | $239 | 4.2% |
| Hispanic, of any race | $26,111 | $227 | 13.3% | $87,006 | $279 | 4.8% |

While the racial differences in gasoline burdens persist across all regions in the United States, the average burden by race varies. Nationally, burdens for all households are the lowest in the Northeast at 5.9% and highest in the South Central region at 8.5%. White households see lower-than-average burdens in every area, including 5.5% in the Northeast and 7.1% in the South Central region. For Black households, the highest average burden is in the South Central region at 10.1%, and the lowest is in the West at 7.6%, still marginally higher than the highest white gasoline burden (6.5% in the Midwest). Trends for Hispanic households mirror those for white households, with Hispanics in the Northeast seeing the lowest burdens at 7.6% and those in the South Central region experiencing the highest average burdens at 10.9%. These results are shown in figure 1, below.

[7] AHS categorizes households as Black, white, Asian, and American Indian and also gives household a second categorization as Hispanic or non-Hispanic. For our analysis, we chose to highlight Hispanic households as a separate group entirely from white, Black, Asian, and American Indian households. Therefore, all white, Black, Asian, and American Indian households are all non-Hispanic in our analysis.

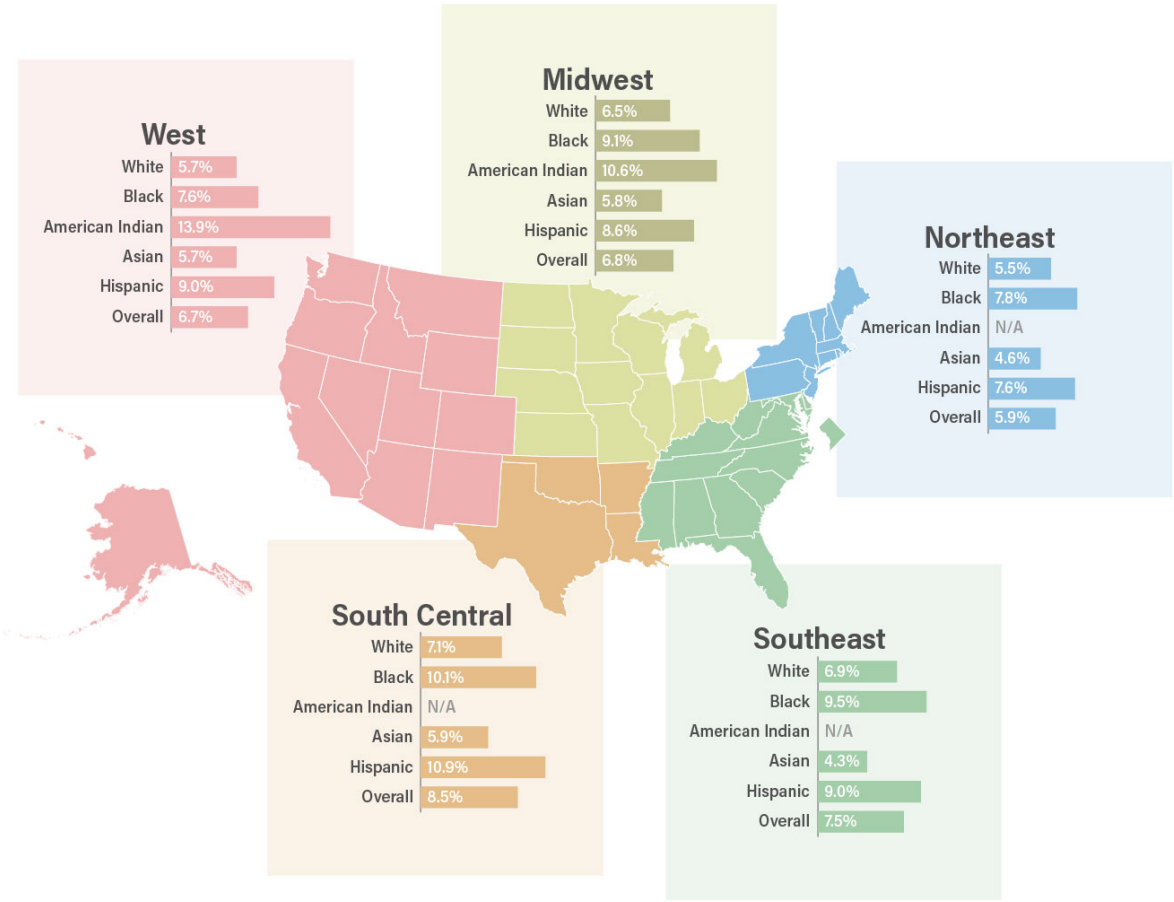


Figure 1. Transportation energy burden by region, race, and ethnicity. *Note:* Insufficient data exist for American Indian households in South Central, Southeast, and Northeast regions.

### Gasoline Burden by Housing Type

Spending on transportation is greatly influenced by the neighborhood one lives in, which often dictates what mobility options are available and the travel required to reach work, services, and amenities. While we could not accurately measure gasoline burdens by factors such as neighborhood population density or transit availability, we could use the type of unit the household occupies as a proxy for these values. For the national sample, we were able to examine income, monthly gas expenditure, and gasoline burden according to whether the household resided in a detached single-family home, an attached single-family home, an apartment (in a building with two or more units), or a mobile home.

Table 8. Gasoline burden by unit type

| | Mean income | Mean monthly gasoline expenditure | Mean gasoline burden |
|---|---|---|---|
| Single-family, detached | $83,708 | $254 | 6.4% |
| Single-family, attached [8] | $74,115 | $197 | 6.4% |
| Apartment | $50,291 | $179 | 8.2% |
| Mobile home | $37,342 | $215 | 10.1% |

The average burden for households living in detached and attached single-family homes is the same at 6.4%. Households living in mobile homes bear the greatest gasoline burden, at 10.1%, and apartment dwellers fall about halfway in between. Approximately 70% of mobile-home households in the AHS national sample live in rural areas, and this could contribute to the high burdens they face. There is also a strong link between housing type and income, and this too explains a portion of the burden difference, given the significantly higher burdens among lower-income households.

## Discussion

In general, our findings suggest that even before the unique transportation conditions created by the COVID-19 pandemic in 2020, low-income and Black, Hispanic, and American Indian communities had particularly high gasoline burdens across the United States. Using 2013 self-reported data, our analysis shows that American households have an average gasoline burden of about 7.0%, higher than the 3.7–4.6% range indicated in the literature we reviewed. Likewise, gasoline burdens for low-income households—those earning less than 200% of FPL—are significantly higher in our analysis, ranging from 13.8% to 14.1%, depending on the sample evaluated.

The results from our analysis additionally highlight the following key insights:

- Gasoline cost burdens for low-income households are more than **three times larger** than the burdens for higher-income households.
- Among low-income households, these burdens are higher for **Black, Hispanic, and American Indian households** than for white and Asian households.
- Metropolitan areas in the **Northeast** have some of the lowest average burdens, while those in the **Sunbelt** have some of the highest.
- Households **outside key metropolitan areas** bear gasoline cost burdens that are 25% higher than those borne by households located within metro regions.
- Gasoline burdens are higher for households living in **apartments and mobile homes** than for those in single-family dwellings.

[8] A single-family attached unit, also referred to as a townhome or row house, consists of a single-unit building that shares walls with other buildings.

## *POLICY RECOMMENDATIONS*

The findings highlighted in this paper suggest the need for tailored policies at city, state, and federal levels that address the specific burdens encountered by low-income households and communities of color. Additionally, access to affordable transportation is critical for connecting communities to services and job centers and for keeping transportation energy burdens low. Policy needs to be able to address the service gaps that exist in Black, Hispanic, American Indian, and low-income communities while also ensuring that costs are kept in check.

However, it is important to note that addressing transportation burdens will require integrating transportation into other policy areas, and to understand that policy is not necessarily one-size-fits-all. Each city will each require its own tailored suite of policies, designed using input from residents, to effectively moderate transportation-related burdens. Rural communities will have entirely different policy needs, as most do not have the density required to support a substantial public transit network. Additionally, the way each community, city, or state defines transportation energy burdens will determine the cost effectiveness of any suite of policy solutions. The options discussed below are presented simply as a starting point to the policy discussion.

### Ensure Continued Public Transportation Investment

The most urgent policy needs relate to public transportation. Americans who commute to work via public transit have been shown to save as much as 40% on transportation expenditures relative to those who commute using their personal vehicles. This is especially impactful for low-income households, for which the costs of private vehicle ownership account for as much as 95% of their annual household transportation expenditures (STPP 2003). Additionally, our analysis shows transportation energy burdens are three times greater for low-income households than for all other income groups. Reliable public transit can go a long way toward reducing costs for these households.

Ridership on public transportation has plummeted during the pandemic in major urban environments. New York, Washington, DC, and the San Francisco Bay Area saw 74%, 79%, and 87% drops in ridership, respectively, during the worst months of the pandemic (Sadik-Khan and Solomonow 2020). As a result of declining fare-based revenues, transit agencies have scaled back service and operations, leaving many communities of color and low-income communities without a reliable, safe way to travel. Some 36%of all transit commuters are essential workers and rely on public transportation to access their jobs and other services every day (TransitCenter 2020). There is also a difference between bus and rail commuters. According to the Eno Center for Transportation, bus riders generally have lower incomes than commuter rail riders and are also less likely to have access to affordable transportation alternatives (Puentes 2020).

Transit systems are the backbone of passenger movement in major urban environments in the United States. Given the impact that COVID-19 has had on ridership and revenues, immediate policy action will be needed to generate the necessary financial support to keep these critical systems afloat and to ensure that burdens will not rise for low-income and minority households. Federal stimulus funding in March allocated $25 billion in relief for transit agencies. An additional $30 billion was set aside in the stimulus bill that was passed

in March. However, given the uncertain duration of COVID-19 in the United States, this amount will need to be supplemented by more sustainable forms of transit funding, and states and cities will play a critical role in creating this supplemental support. Many states have directed retail and sales tax revenues, for instance, toward transit maintenance and expansion (Ribeiro et al. 2020). Several states, such as Washington, also permit transit districts to levy additional sales taxes to help cover local transit system expenditures (MRSC 2021).

### Expand Access to Emerging Mobility

Urban transportation systems have evolved substantially over the last decade, and a number of new mobility options have emerged to help address existing service gaps. Technology-enabled solutions like ride hailing, bike sharing, and electric scooter programs offer city residents an alternative to driving personal vehicles for certain trips, and in some cases these options can help remove the onus of owning a personal vehicle in cities where the cost of maintaining a car outweighs the benefits of driving (Vaidyanathan 2018).

However, deployment of these emerging mobility options tends to be concentrated in neighborhoods that are already well connected, often leaving out low-income neighborhoods and communities of color that could most directly benefit from additional travel options (Fedorowicz et al. 2020). Policies and programs should be designed to guarantee new mobility for all. Increasingly cities and states have created dedicated funding streams for and programs targeted to marginalized communities. Funds from California's carbon tax revenues have been used to create the Blue LA car-sharing program, which focuses exclusively on what California classifies as disadvantaged communities. The Better Bike Share Partnership allows cities to apply for funding to build equitable and replicable micromobility programs (Thomas 2020). Austin, Boston, and Charlotte, North Carolina, are among the recipients of this funding.

### Subsidize Access to Reliable, Efficient Transportation

As emerging mobility options proliferate and public transit bounces back, keeping these options affordable for low-income residents and communities of color will be crucial to slowing the growth of transportation burdens. The most direct way to make public transit and emerging mobility financially viable to these communities is by providing discounts to defray the high costs involved in using these services. A number of cities fund discounted transit passes and bike-share memberships for residents who meet a particular income threshold. Eleven out of the 100 cities evaluated as part of ACEEE's *2020 City Clean Energy Scorecard* had comprehensive programs targeted at low-income commuters. As an example, Washington DC's popular Capital Bikeshare has a Community Partners Program that offers a $5 annual membership rate for qualifying residents, including members of low-income households. The program now has more than 1,300 participants (Ribeiro et al. 2020).

### Incentivize the Creation of Affordable Housing around Transit

Integrating housing, land use, and transportation policy will be necessary to keep gasoline burdens low and provide low-income communities and communities of color access to reliable, safe, and affordable transportation options. Housing around transit facilities typically comes at a high premium, effectively excluding residents who cannot afford to buy or rent homes in those areas. The costs of constructing affordable housing within location-

efficient areas continue to rise, making truly affordable housing stock difficult to design in urban areas (Howell et al. 2018). Maintaining existing housing and creating new affordable units will be key to addressing high gasoline burdens. Joining housing and transit is also important as a means for connecting low-income communities and communities of color to relevant work opportunities (Yeganeh et al. 2018).

States and cities can use two common policy levers to achieve this outcome. The first involves offering developers incentives such as density bonuses, floor-to-area ratio (FAR) increases, and expedited permitting to locate new construction near public transportation hubs and facilities.[9] Alternatively, zoning codes can be updated to require developers to set aside a percentage of new housing units as affordable housing. Washington, DC's 2015 housing code requires that 30% of housing units constructed be set aside as affordable housing if the project is located close to transit, and 20% if it is not (Ribeiro et al. 2020).

To create change in the long term, well-crafted zoning codes can promote the creation of walkable, mixed-use, location-efficient communities that can keep transportation-related costs down while also moderating overall VMT and energy use (Newmark and Haas 2015). They may even eliminate the need to drive as households are often positioned near public transit, employment centers, schools, and other amenities (Newmark and Haas 2015).

#### Promote Fuel-Efficient Vehicles through Standards and Incentives

Access to high-efficiency and advanced-technology vehicles will be critical to reducing gasoline burdens for low-income households and for families reliant on cars, including rural households without access to comprehensive transportation alternatives. As cities have grown outward and jobs have moved away from urban cores, many low-income and minority communities are forced to rely on inefficient personal vehicles as the primary mode of transport. As a result, fuel expenditures for these households can be very large and unpredictable (Vaidyanathan 2016).

Financial and nonfinancial incentives to promote the uptake of highly efficient gasoline vehicles and electric vehicles (EVs) are becoming increasingly common in states across the country. Twenty states currently provide some sort of financial incentive for the purchase of high-efficiency vehicles or EVs (Berg et al. 2019). To ensure that efficient vehicles are landing in the hands of people of color and low-income drivers, supplemental policies will be needed to defray the higher upfront costs of these vehicles. These could take the form of making additional discounts available at the time of purchase for income-qualified drivers or ensuring that existing incentives can be extended for purchases of used vehicles.

Outside of providing incentives, adopting ambitious fuel efficiency standards for light-duty vehicles will go a long way toward reducing gasoline-related burdens. States can currently choose to follow federal fuel efficiency standards or opt in to California's tailpipe emissions program, which now offers more stringent standards than the national standards given the partial rollback of goals for model years 2021 to 2025. Thirteen states (besides California)

[9] The floor-to-area ratio measures a given building's floor area in relation to the size of the lot that the building sits on.

and the District of Columbia now use California's GHG regulations; the states are Colorado, Connecticut, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington (Berg et al. 2019). Nine of these states and the District of Columbia have adopted California's zero emission vehicle (ZEV) requirements as well, which requires manufacturers of passenger vehicles to offer a certain number of ZEVs by a specific year.

## Conclusion

This report demonstrates that low-income households and households of color bear disproportionate gasoline cost burdens. Results from ACEEE's analysis show that gasoline cost burdens for the lowest-income quintile nationally are three times larger than the burdens of higher-income households. Likewise, burdens are significantly higher for Black, Hispanic, and American Indian households, with Hispanic households having the highest monthly gas expenditures overall. While these results are consistent with findings from other research on this issue, our analysis highlights significantly larger burdens for low-income households and households of color.

In general, our findings point to the need for tailored transportation policies and programs for these communities. While we have outlined a number of policy levers above, the most successful versions of these policies will take into account the specific needs of low-income households and communities of color and include them in decision making.

Finally, a number of research questions about transportation energy burdens remain unanswered. The impacts of transportation-specific energy burdens on American households is still not entirely understood at the national level, and there is much work still to be done in this field. We continue to need access to more recent real-world data on household fuel expenditures to determine whether the findings described above require revision, given recent changes in travel trends and the transportation system as a whole. A better understanding of differences in spending patterns between car-reliant households and those that primarily use other modes of transportation could help in further tailoring policies to suit specific transportation needs. Likewise, a more detailed geographic assessment to pinpoint the areas of greatest burden across the country would help create a more detailed picture of transportation energy burdens in the United States.

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