Analysis of Relative Financial Impacts of Transportation Taxes by Household Income

Washington State Transportation Commission | September 2021

Executive Summary

In December 2019, the Washington State Transportation Commission (WSTC) adopted recommendations on how Washington can begin a gradual transition away from the State motor vehicle fuel tax (gas tax) and toward a road usage charge (RUC) system. These recommendations followed extensive research, statewide public engagement, and detailed analysis of participant feedback from a year-long pilot project.

In 2020, the State Legislature issued a proviso charging the WSTC to:

> *"Identify and measure potential disparate impacts of a road usage charge on designated populations, including communities of color, low-income households, vulnerable populations, and displaced communities."*

This memo provides information about the relative financial impacts by household income of Washington state transitioning from a gas tax to a RUC. This memo does not explore all angles of equity, but rather, focuses on income and specifically explores the following question: **Would households in different income brackets pay more or less under a potential RUC, compared with the gas tax?**

Under RUC, the exclusive determinant of how much a household would pay is how many miles they drive. The available data show a clear correlation between income and miles driven: the more income a household makes, the more they drive, and therefore the more they would pay. However, there is no evidence that households within any individual income bracket would, on average, pay more or less under a RUC than under the current gas tax. The proportion of household income that households spend on gas tax ranges from nearly zero to several percent. Low-income households devote, on average, 1.4% of their income to gas taxes, an amount that would be similar under a RUC. For most low-income households, the amount devoted to gas taxes is less than half the amount spent on state sales taxes and about one-fifth the amount spent on property taxes.

Income distribution: *Who are low-income households in Washington?*

We began our analysis with an exploration of different measures used by Washington agencies to define whether an individual or household is considered "low-income." We outlined the thresholds for "low-income" based on federal poverty guidelines, Department of Housing and Urban Development income limits, the State minimum wage, and Asset Limited, Income Constrained, Employed (ALICE). In this study, we do not use one specific definition for "low-income" but rather describe findings based on income bracket.

Next, we analyzed where lower income households live in the state among the geographic categories of urban incorporated, urban growth area, or rural. We found that on the west side of the state, there is **no disproportional representation by urban or rural households in any income bracket.** On the east side, there is a **larger share of rural households in the highest income bracket**, but there are fewer total households of any geographic category in the highest income bracket.

Looking at how incomes correspond with race and ethnicity in Washington, we found that White households and multiracial households are relatively evenly distributed across the income spectrum. Black households and American Indian and Alaska Native (AIAN) households are overrepresented among lower income groups. Asian American households are underrepresented among lower income groups. The distribution of Hispanic households, Native Hawaiian and Pacific Islander households, and households identifying as another race across income groups follows a version of a bell curve, with these households more concentrated among the middle-income groups of $25,000 to $74,999 and less concentrated in the lowest income and highest income groups. It is important to recognize that there is variation within each race and ethnicity group that is not captured by this Census data.

Comparing RUC costs with gas tax costs

When comparing a household's annual costs under the current gas tax compared with a proposed RUC, two of the primary factors to consider are the **vehicles miles traveled** (VMT) by that household and the **vehicle fuel efficiency** of that household's vehicles. VMT is the only factor that determines the total cost of RUC, while fuel efficiency is the only factor that determines the difference between the cost of RUC and the cost of gas taxes.

Vehicle fuel efficiency: *What is the relationship between fuel vehicle type, age, and fuel efficiency?*

First, we examined trends between fuel efficiency and vehicle types and found that **cars are more fuel efficient, while SUVs and pickup trucks are less fuel efficient.** Looking at the relationship between vehicle age and fuel efficiency, **older vehicles tend to be less fuel efficient**. As of 2019, cars are still the most prevalent vehicle in the Washington fleet (40% of the Washington fleet). However, SUVs have seen by far the most significant growth over the past several years. From 2014 to 2019, the number of registered SUVs increased by 44%, compared to 11% for pickups and vans and just 7% for cars.

Are there trends between household incomes and vehicle types, age of vehicles, or vehicle fuel efficiency?

Next, we examined whether there are trends between households' incomes and the types, ages, and fuel efficiency of households' vehicles. We found that lower income households have a higher proportion of cars, a lower proportion of SUVs, and a higher proportion of pickup trucks. Cars are more fuel efficient, while pickup trucks are less fuel efficient. At the same time, lower income households tend to have older vehicles. Because of these two findings, there is **no discernible trend between household incomes and fuel efficiency** of vehicles in Washington.

Vehicle miles traveled: *How many miles do Washington drivers and households tend to drive per year?*

Next, we reviewed miles driven, the primary factor that contributes to a household's annual gas tax costs and the only factor that contributes to its annual RUC costs. Because our analysis draws from both US drivers and Washington drivers, we wanted to understand the driving habits of Washington drivers. Washington drivers are **driving fewer miles** than US drivers in general. The ratio of average vehicle miles travelled (VMT) per vehicle in Washington compared with the US is around 0.7 for passenger cars and trucks, and lower for buses and motorcycles. The analysis also shows that **higher income households tend to drive** more miles than lower income respondent households.

Household costs paid under gas tax vs RUC

When looking at National Travel Household Survey (NTHS) respondent data at both the national and Washington state levels, estimated costs under the current gas tax and under a proposed RUC within an income bracket are **relatively similar, on average**. At the national level, there is a consistent trend that lower income households tend, *on average*, to save more under RUC compared to the gas tax; as income increases, households tend to pay more under RUC compared to the gas tax. However, these differences between the estimated cost per household under gas tax versus RUC are **not statistically significant**[1] **for any of the income brackets, in both the Washington state and national data**. In other words, within each income bracket, there is no statistically significant difference in how much the household would pay under a RUC compared with the gas tax.

Broader transportation equity discussion

This income-based equity analysis is only one piece of a larger discussion around transportation equity and funding. The broader discussion around transportation equity includes questions around who pays for transportation, where those revenues are invested, and how investments align with where and who revenues are collected from. The scope of this analysis is to examine the costs paid under RUC compared with the gas tax across various income levels. Other tasks in this study will explore the equity implications of operational features of a RUC system including payment frequency alternatives.

[1] The largest difference is $20 a year, for Washington state households with incomes between $100,000 and $149,999. "Not statistically significant" means that we *cannot* conclude that the small differences observed in estimated gas tax and RUC costs among the NHTS respondent households would exist across the Washington state or US populations as a whole.

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Introduction

In December 2019, the Washington State Transportation Commission (WSTC) adopted recommendations on how Washington can begin a gradual transition away from the State motor vehicle fuel tax (gas tax) and toward a road usage charge (RUC) system. These recommendations followed extensive research, statewide public engagement, and detailed analysis of participant feedback from a year-long pilot project.

In 2020, the State Legislature issued a proviso charging the WSTC to:

> *"Identify and measure potential disparate impacts of a road usage charge on designated populations, including communities of color, low-income households, vulnerable populations, and displaced communities."*

This memo provides information about the potential equity implications of Washington State transitioning from a gas tax to a RUC. This memo does not explore all angles of equity, but rather, focuses on income and specifically explores the following question:

- **Would households in different income brackets pay more or less under a potential RUC, compared with the gas tax?**

This report begins by defining equity for the purposes of this analysis, defining low-income, and outlining our assumptions and data sources. We then summarize work to date on the impacts of a potential transition from the gas tax to a RUC.

Next, we present our findings related to the following questions, which support the broader research questions above:

- **Income distribution:** Who are low-income households in Washington?
- **Vehicle trends:** What is the relationship between fuel economy and vehicle type or age?
- **Household incomes and vehicles:** Are there trends between household incomes and vehicle types, age of vehicles, or vehicle fuel efficiency?

Finally, we present a comparison of estimated costs paid annually under the gas tax compared with a RUC. We present data for both Washington and the nation.

Approach

DEFINING EQUITY

We begin our equity analysis with the recognition that there are a variety of definitions of equity in relation to taxation. Some lenses of equity are defined below in relation to a potential RUC:

- **Horizontal equity:** This concept of equity is the notion that everybody in a group should be taxed the same amount for the same usage. A RUC is a per-mile charge drivers would pay based on how much they use the road system, which is similar to how people pay for their utilities, including electricity or water. By its nature of being a flat per-mile fee, a RUC would address this dimension of

equity because everyone pays the same amount for the same usage of the resource. Those who do not drive personal vehicles would not directly pay the tax. Those who choose alternatives to personal vehicle travel would also pay less than those who use their personal vehicles for most transportation needs.

- **Vertical equity:** This concept of equity is about the ability to pay, and it considers the relative burden that a tax imposes upon households of different income levels. In other words, it refers to whether a tax is "regressive" or "progressive." A regressive tax results in lower-income households paying a greater share of their annual income than do higher-income households in return for the same benefit. A progressive tax is differentiated based on income, so that higher income households pay more than lower-income households to receive the same benefit. As a consequence, progressive taxes reduce or eliminate disparities in tax burden experienced by households of different income levels.
- **Vehicle weight equity:** This is about the question of whether light-duty vehicles or heavy-duty vehicles have different impacts on the road and whether that should impact how much users pay. Research shows that vehicles under about 10,000 pounds have equivalent pavement impacts regardless of weight.,[2] while vehicles above that weight tend to impact pavements more as their weight increases, suggesting that heavier vehicles ought to pay more for road usage than light-duty vehicles, perhaps on a sliding scale by weight. Washington's exploration of RUC has focused on light-duty vehicles under 10,000 pounds, so a weight-based RUC rate has not been explored for vehicles over 10,000 pounds.
- **Geographic equity:** This concept is about whether urban and rural areas would be impacted differently by a potential transition to a RUC. This analysis has been addressed in prior studies such as the 2015 WSTC study (*Road Usage Charge Assessment: Financial and Equity Implications for Urban and Rural Drivers*) and 2017 RUC West study (*Financial Impacts of Road User Charges on Urban and Rural Households)*, which are detailed in **Appendix A: Impacts of a RUC on Urban and Rural Households.** In general, these studies found that RUC improves geographic equity by bringing average payments per-mile closer together. Rural residents tend to drive less fuel-efficient vehicles than residents living in urban areas, equating to them paying slightly more under the gas tax on average. Under a RUC, rural residents driving less fuel-efficient vehicles would pay less than they pay under the gas tax, and urban residents driving more fuel-efficient vehicles would pay more than they pay under the gas tax. This outcome brings the average per-mile taxes paid closer together regardless of where one resides.
- **Cross-generational equity.** This considers the effects of current actions on the fair and just distribution of benefits and burdens to future generations. Examples relevant to a RUC could include health outcomes, climate change, and pollution. For example, because RUC is more salient (visible) than the gas tax, it could influence travel behavior and reduce or induce demand for transit, walking, and biking, even if the individual financial impact is, on average, the same as the gas tax. In turn, this could impact health, pollution, and carbon emissions over the long run.

[2] See, e.g., National Cooperative Highway Research Program Report 353, "Effects of Heavy Vehicle Characteristics on Pavement Response and Performance," 1993.

- **Systems equity / Operational equity:** This concept of equity is about the ability to interact with and comply with a potential RUC system in terms of user interface, technology, language, and trust.
- **Process equity:** This concept is about the ability of all affected parties to participate in and shape policy and implementation by providing input.

The latter two types of equity are being addressed through outreach efforts in the *Forward Drive* RUC research project, which aim to engage a broad cross-section of affected drivers to understand system impacts.

ASSESSING EQUITY

In the financial analysis reflected in this report, we focus on the financial equity implications of transitioning from the current road funding mechanism (gas tax and flat EV fees) to a RUC.

Assumptions

This analysis is based on the following assumptions:

- The RUC rate would be "revenue-neutral" and therefore equivalent to what a driver of an average fuel efficiency light duty vehicle in Washington currently pays under the 49.4 cents per gallon gas tax. The average fuel efficiency is assumed to be 20 miles per gallon. This rate is 2.4 cents per mile.

$$\frac{49.4\ cents\ per\ gallon}{20\ miles\ per\ gallons} = 2.4\ cents\ per\ mile$$

- We assume that vehicle owners paying a RUC would no longer pay the flat electric vehicle (EV) fee of $225 or pay the gas tax.
- We assume, consistent with literature on the subject, that consumers are currently bearing the full cost of the 49.4 cents per gallon gas tax (meaning that gas sellers do not absorb the cost of the tax). If Washington transitioned from a gas tax to a RUC, consumers would continue to bear the full cost of RUC, while no longer paying the 49.4 cents per gallon of gas tax. This means motorists would continue to pay for roads and bridges, so we can compare the impacts of the two taxing mechanisms among motorists by household income. (See **Appendix C** for more detail.)

Equity in Transportation Funding

This income-based equity analysis is only one piece of a larger discussion around transportation equity and funding. The broader discussion around transportation equity includes questions such as:

- How much of transportation funding is paid by whom?
- Where and on what are transportation revenues invested?
- How do the locations, modes, and types of transportation investments correspond to who and where revenues are collected from?

RUC is not an allocation mechanism, nor is it an expression of preferences or decisions about how much to spend or on what. RUC is a revenue collection mechanism proposed as a replacement for the existing mechanism of gas taxes and flat fees. Therefore, these broader questions about transportation equity are subject to separate analysis beyond the scope of the Commission's research.

Data

The primary data sources used in this analysis are:

- **US Federal Highway Administration's National Household Travel Survey (NHTS)**, which includes daily non-commercial travel by all modes, including characteristics of the people traveling, their household income, and their vehicles. The most recent year of data available is 2017, with the next survey publication anticipated before 2025. The 2017 NHTS collected responses from 129,696 US households with 650 of those households identifying as Washington drivers.
- **The American Community Survey (ACS)** is a nationwide survey conducted by the US Census Bureau, updated annually. The ACS collects information such as age, race, income, and other important data points from US individuals and households.
- **Federal Highway Administration (FHWA) Highway Performance Monitoring System (HPMS)** is a national information system that contains data on public roadways, including road miles, road characteristics, and miles traveled on roadways by vehicles. The Washington State Department of Transportation (WSDOT) makes HPMS data available for Washington roadways.
- **FHWA Highway Statistics Series** is a comprehensive set of annual reports on motor vehicle data, including vehicle miles traveled, vehicle registrations, and driver licenses. Data are available at both the national and state level.

Methodology

NHTS data was used to estimate annual costs to Washington households under the state's current motor vehicle fuel tax (gas tax) as well as under the proposed RUC rate described in the **Assumptions** section above. For each household in the NHTS, annual costs from the gas tax and proposed RUC were estimated based on estimated vehicle miles traveled, estimated fuel economy, and estimated gas consumption. The following is a description of how each of those three respective variables were derived for the NHTS:

- Vehicle miles traveled (VMT) were derived for each vehicle by the US Department of Energy's Oak Ridge National Laboratory based on either odometer readings, self-reported estimates of annual mileage, or extrapolation based on mileage a vehicle is driven during a designated sample day.
- Each vehicle's fuel economy was estimated based on EPA fuel economy test results and adjusted based on actual on-road, in-use differences observed during the NHTS data collection period.
- Fuel consumption (gallons) for each vehicle was derived by dividing each vehicle's estimated VMT by its estimated fuel economy.

Estimating Gas Tax Costs

- To estimate household gas tax costs, we added up estimated annual fuel consumption for each household vehicle based on NTHS data.
- The current tax rate of $0.494 per gallon was applied to each household's estimated annual fuel consumption to derive each household's annual gas tax cost. Note this represents only the State gas tax and does not include federal gas taxes (an additional $0.184 per gallon).

Estimating RUC Costs

- To estimate potential household RUC costs, we first calculated annual VMT for each household by adding together estimated VMT for each vehicle in each household, based on NTHS data.
- The assumed RUC rate of $0.024 per mile was applied to each household's estimated annual VMT to derive each household's annual RUC cost.

Given our analysis focused on differences in cost impacts by income, estimated household gas tax costs and RUC costs were totaled and averaged within each of the following income bands: Less than $25,000; $25,000 to $49,999; $50,000 to $74,999; $75,000 to $99,999; $100,000 to $149,999; and $150,000 or more.

DEFINING LOW-INCOME IN WASHINGTON

In Washington, there are several different measures used by various agencies to define whether an individual or household is "low-income." There is no one definition for a "low-income" household. Below, we outline several of the most commonly used measures.

Federal Poverty Guidelines

The federal poverty guidelines, also known as the federal poverty level (FPL), are measures of income issued annually by the US Department of Health and Human Services (HHS). The official poverty thresholds for the US that form the basis of the federal poverty guidelines were developed in the mid-1960s and have remained unchanged since, save for annual inflation adjustments. These thresholds were derived by determining the cost of a minimum food diet (the cost of providing basic nutrition for members of a household) multiplied by three, as the cost of food was estimated to be one-third of an average household's expenses.

- The guidelines vary based on family size and are issued in three sets: one for the contiguous 48 states, one for Hawaii, and one for Alaska.

There has been considerable discussion among researchers and advocates about the federal poverty guidelines, including that the guidelines are based on outdated measures, that the thresholds are set too low and are not capturing additional households that struggle to pay for basic necessities (see discussion on the United Way's Some local jurisdictions within Washington have set higher minimum wage standards than the State, such as Seattle and SeaTac, which are set at $16.69 and $16.57 per hour, respectively. As this study is taking a statewide look at which households or individuals are "low-income," we will focus on the State minimum wage when comparing low-income thresholds in Exhibit 4 below.

- ALICE measure on page 7), and that the measures don't account for cost-of-living differences among various states, metropolitan areas, rural areas, or other geographies.

The purpose of the federal poverty guidelines is administrative as they are used to determine financial eligibility for a wide variety of federal programs. Some state and local programs also use federal poverty guidelines to determine eligibility.

- Financial eligibility criteria are often expressed as percentage multiples of the federal poverty guidelines in order to extend eligibility to additional households above the poverty line who struggle with meeting basic needs.

For example, eligibility for the US Department of Agriculture's National School Lunch Program is either 130% of FPL (for free lunch) or 185% of FPL (for reduced lunch). For context, in 2021, 130% of FPL for a family of four would be $34,450, less than half of the state's median household income of $73,775.

Exhibit 1 details some examples of financial eligibility thresholds for programs that utilize federal poverty guidelines.

Exhibit 1. Financial Eligibility Thresholds Based on Federal Poverty Guidelines

Program	Eligibility Threshold
Supplemental Nutrition Assistance Program (SNAP)	200% of FPL
Washington Apple Health (Medicaid) coverage	133% of FPL
National School Lunch Program	130% of FPL (Free) 185% of FPL (Reduced)
Low-Income Home Energy Assistance Program (LIHEAP)	150% of FPL
King County Metro – ORCA LIFT	200% of FPL

Notes: SNAP is known as the Washington Basic Food Program in Washington State. Washington Apple Health provides a variety of programs – the eligibility threshold shown above is for adults between 19 and 65 years of age and who are not entitled to Medicare, among other requirements. Washington Apple Health also provides different programs targeted towards specific populations, such as pregnant women and children, which have different eligibility thresholds. For example, under Washington Apple Health coverage is provided to pregnant individuals with income at or below 193% FPL while coverage is provided to children in households with incomes at or below 210% FPL.

Sources: King County Metro, 2021; HHS, 2021; Department of Agriculture, 2021; BERK, 2021.

Department of Housing and Urban Development Income Limits

The US Department of Housing and Urban Development (HUD) sets annual income limits that determine eligibility for several housing programs. HUD income limits are based on Median Family Income (MFI) estimates for each metropolitan area, parts of some metropolitan areas, and each non-metropolitan county.

HUD defines low-income families and individuals as earning at or below 80% MFI, very low-income families and individuals as earning at or below 50% of MFI, and extremely low-income families and individuals as earning at or below 30% of MFI.

Minimum Wage

Another way to define "low-income" individuals may be to base the definition on the Washington State minimum wage. Currently, the minimum wage in Washington is set at $13.69 per hour. Assuming full time employment (i.e., working 40 hours a week), an individual earning the minimum wage would accrue a little over $28,000 in annual wages.

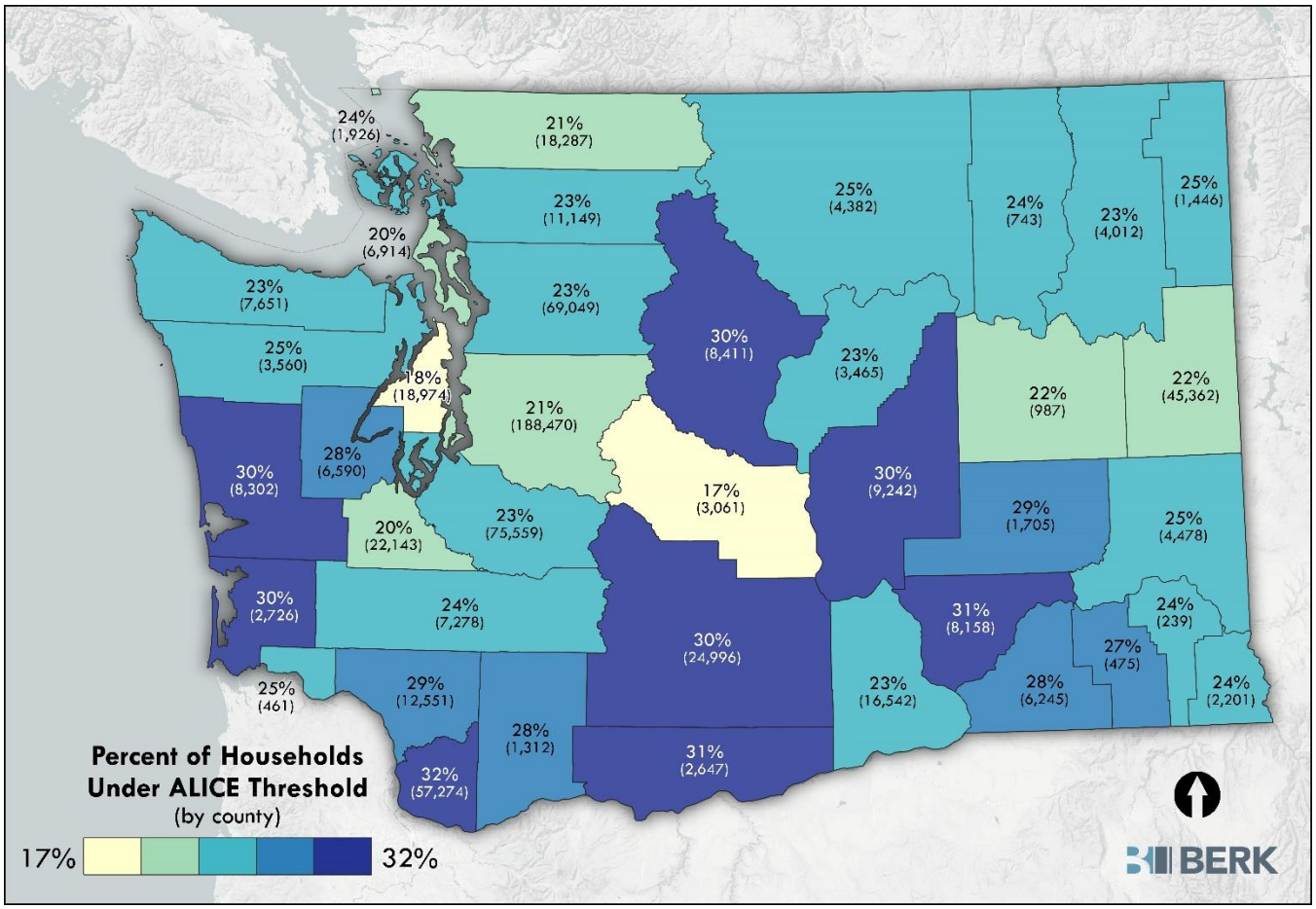
Some local jurisdictions within Washington have set higher minimum wage standards than the State, such as Seattle and SeaTac, which are set at $16.69 and $16.57 per hour, respectively. As this study is taking a statewide look at which households or individuals are "low-income," we will focus on the State minimum wage when comparing low-income thresholds in Exhibit 4 below.

ALICE

Another measure for defining individuals or families facing financial hardship is the ALICE (Asset Limited, Income Constrained, Employed) framework. Compiled by United Way of the Pacific Northwest, ALICE measures are based on the bare minimum cost of household basics necessary to live and work and are calculated separately by county and for different household types, capturing differences in costs of living across the state. Basic budget items include housing, childcare, food, transportation, technology, health care, as well as taxes and a contingency fund equal to 10% of the household budget.

As of 2018, 33% of Washington's households were classified as ALICE households compared with just 10% of Washington households that were classified living below the Federal Poverty Level (i.e., 100% FPL). As discussed earlier, FPL thresholds were developed in the mid-1960s and have remained unchanged since, save for annual inflation adjustments. They may not capture all the costs of living and differences by geography that are captured in the ALICE framework. Since ALICE thresholds are calculated by county and for different household types, it may be a more comprehensive view of household abilities to meet basic needs across the state. Exhibit 2 shows the share (percent) and number of households below the ALICE threshold in each county.

Exhibit 2. Percentage and Number of Households below ALICE Threshold by County

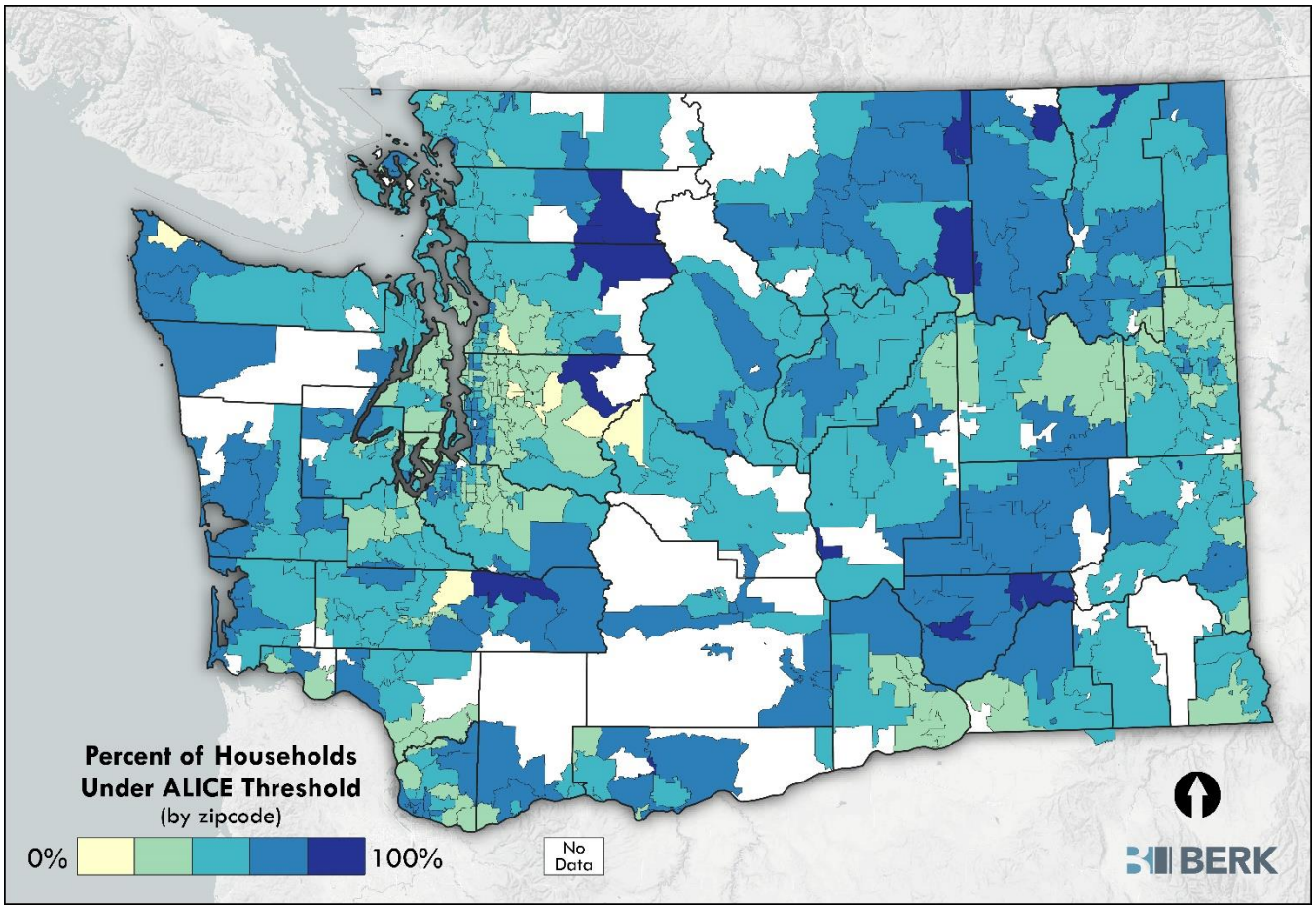


Note: The ALICE framework for defining individuals or families dealing with financial hardship is compiled by United Way and is based on the bare minimum cost of household basics necessary to live and work. It is calculated separately by county and for different household types. Basic budget items include housing, childcare, food, transportation, technology, health care, as well as taxes and a contingency fund equal to 10% of the household budget.

Sources: United Way ALICE Threshold, 2021; American Community Survey, 2018; BERK, 2021.

Exhibit 3 shows the share of households below the ALICE threshold in each zip code.

Exhibit 3. Percent of Households below ALICE Threshold by Zip Code



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Sources: United Way ALICE Threshold, 2021; American Community Survey, 2018; BERK, 2021.

Comparison of Low-Income Thresholds

Exhibit 4 shows annual incomes for different household sizes based on various low-income thresholds. Understanding the annual wages in dollar amounts rather than percentages for various household sizes can be helpful when discussing these low-income thresholds.

Exhibit 4. Comparison of Low-Income Thresholds

Household Size	135% of Federal Poverty Level (FPL)	200% FPL	HUD Low-Income Limit (80% of Median Family Income)	WA State Minimum Wage Equivalent (225% FPL)	Asset Limited, Income Constrained, Employed (ALICE)
1 Person	$17,388	$25,760	$51,300	$28,980	$22,524
2 Person	$23,517	$34,840	$58,600	$39,195	$33,828 - $42,254
3 Person	$29,646	$43,920	$65,950	$49,410	$45,132 - $61,984
4 Person	$35,775	$53,000	$73,300	$59,625	$56,436 - $81,714
5 Person	$41,904	$62,080	$79,150	$69,840	$67,740 - $101,444
6 Person	$48,033	$71,160	$85,000	$80,055	$79,044 - $121,174
7 Person	$54,162	$80,240	$90,850	$90,270	$90,348 - $140,904
8 Person	$60,291	$89,320	$96,750	$100,485	$101,652 - $160,634

Sources: HHS; 2021; HUD, 2021; United Way of the Pacific Northwest, 2020; BERK, 2021.

Findings

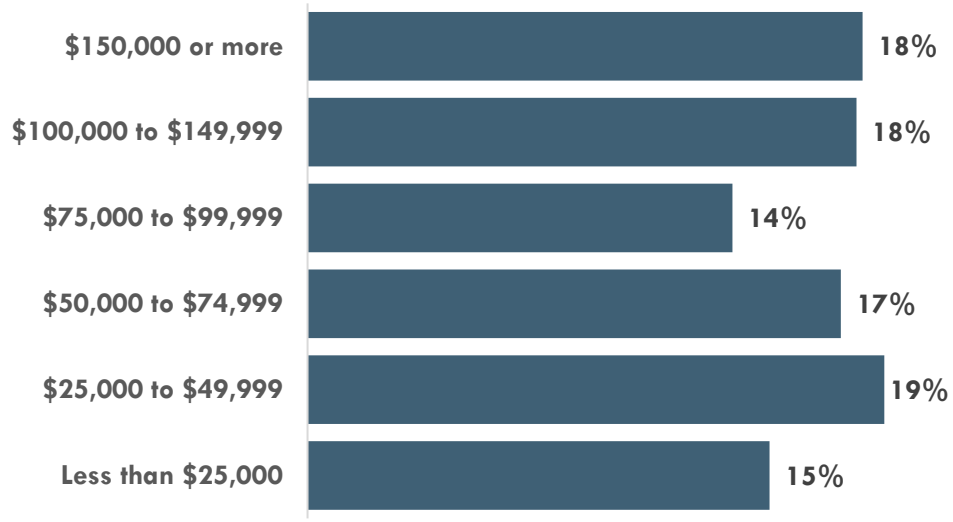
INCOME DISTRIBUTION IN WASHINGTON

Recognizing different definitions of low-income in Washington and how annual incomes correspond to these different threshold definitions, it is important to understand who low-income households are in the state. We begin with some baseline statistics showing how many people fall into each income bracket, trends between income levels and where households live, and the correlations between household income and race and ethnicity.

How many people fall into each income bracket?

We begin our income-based equity analysis with a summary of how Washington households are distributed across income brackets. Exhibit 5 shows the distribution of Washington households across income brackets. As a note, households of various sizes are contained within each income bracket. Around 15% of Washington households have an income of less than $25,000, and around 34% of Washington households have an income of less than $50,000.

Exhibit 5. Households by Income Bracket, Washington State Households



Sources: American Community Survey 5-Year Estimates, 2019; BERK, 2021.

Where do lower income households live?

Next, we analyze the question of how households across different geographic areas fall within income brackets. This examines the question of whether urban or rural households are disproportionately represented in any income brackets. The analysis shows that household location and geography is not a factor in determining whether a low-income household will pay more or less under RUC compared to the gas tax.

This analysis draws from the US Census. Using the Washington State Department of Ecology urban growth area layer from March 2021, each census block group was designated in one of three categories: Urban Incorporated, urban growth areas (UGAs), and Rural. If the geometric center of a block group fell within the boundary of an incorporated city or town, it was categorized as Urban Incorporated. If the centroid of a block group fell within the boundary of a UGA, it was categorized as a UGA. The remaining block groups were categorized as Rural.[3]

The costs of living in urban areas, UGAs, and rural areas may be different. While a similar percentage of households in each income bracket may be urban or rural households, it is possible that urban households with incomes of less than $50,000 are more likely to be low-income than rural households with less than $50,000.

This analysis displays the percentage of each income bracket from urban or rural households, but does not define different low-income thresholds based on geography.

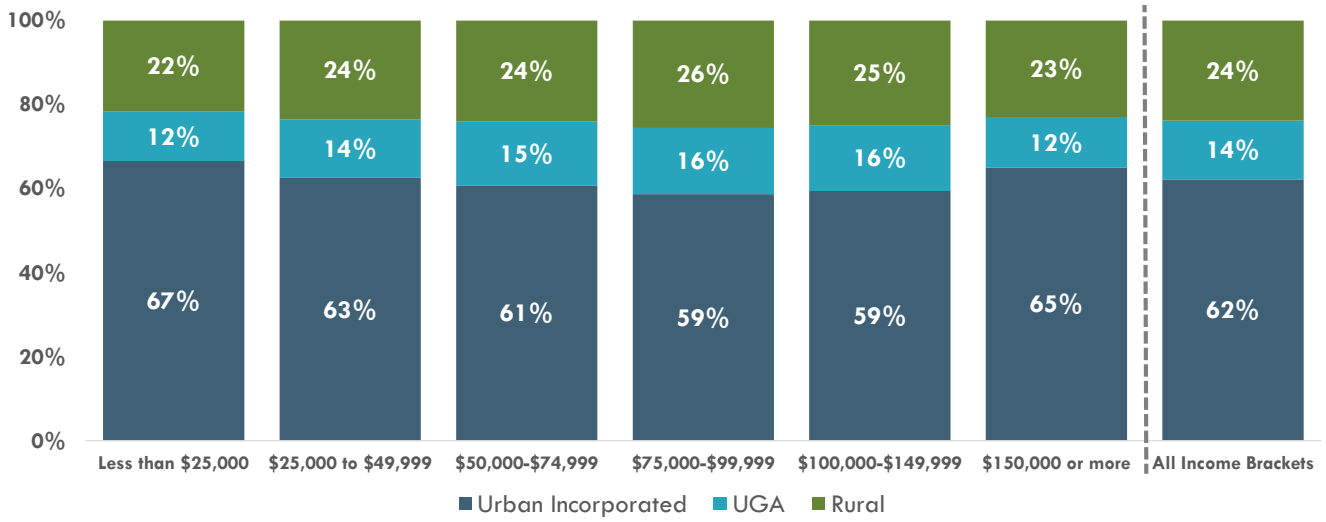
From WSTC's prior research, we know that perceptions and concerns about RUC vary by geography. Support in rural areas is lower than in urban areas, driven by a perception among rural households that RUC is punitive given the longer distances they must drive for non-discretionary trips such as groceries. Given these differences by geography, understanding where households live by income group is important as we consider the impact of implementing a RUC on households of different income levels.

Below are several exhibits that summarize the distribution of households in Washington by location (east vs. west), geography (urban, UGA, and rural), and income. This information shows us the following:

- Exhibit 6 shows the proportional distribution of households by geography and income for the west side of the state. Exhibit 7 shows this information along with the total number of households in each income bracket. For Western Washington households, the likelihood of living in an urban, suburban, or rural area does not vary by household income.
- Exhibit 8 shows the proportional distribution of households by geography and income for the east side of the state. Exhibit 9 shows this information along with the total number of households in each income bracket. For Eastern Washington households, the likelihood of living in an urban, suburban, or rural area *does* vary by income – higher-income Eastern Washington households are more likely to live in rural areas than lower-income Eastern Washington households.

[3] These categories are consistent with how buildable lands are generally categorized. This approach may slightly underestimate the urban/UGA population because census geographies rarely coincide cleanly with city and UGA boundaries. Some block groups split between a city and UGA will fall into a UGA using this method. If urban/UGA populations are underestimated, this would be across all income groups, and not skewed toward any income groups in particular.

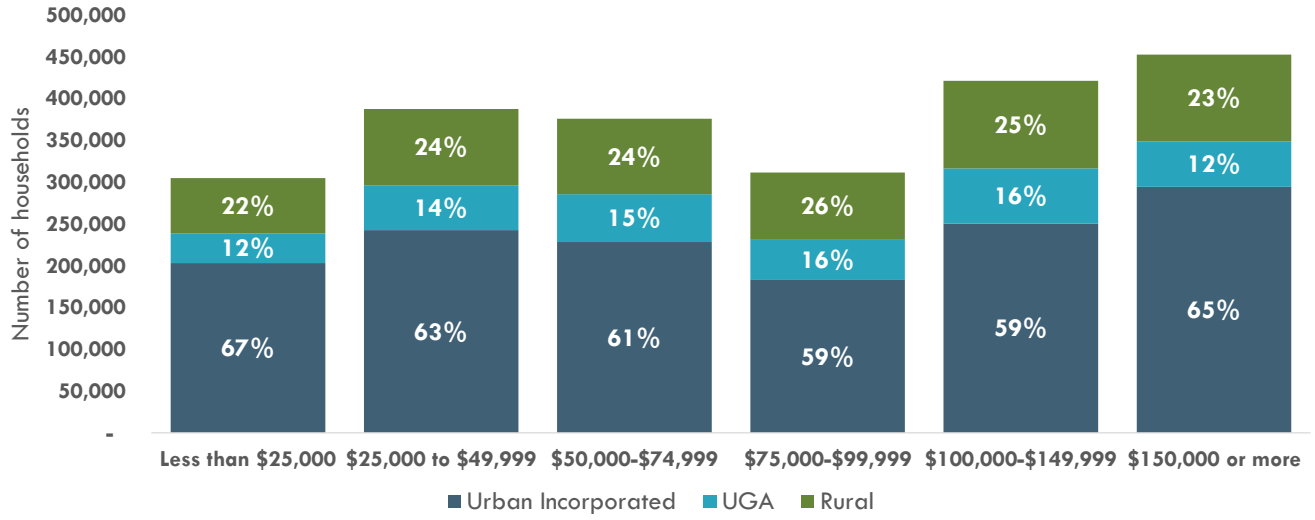
Exhibit 6. Households by Income Bracket and Geographic Category: West



Note: West includes the following counties: Clallam, Clark, Cowlitz, Grays Harbor, Island, Jefferson, King, Kitsap, Lewis, Mason, Pacific, Pierce, San Juan, Skagit, Skamania, Snohomish, Thurston, Wahkiakum, and Whatcom.

Sources: American Community Survey 5-Year Estimates, 2019; Washington State Department of Ecology, 2021; BERK, 2021.

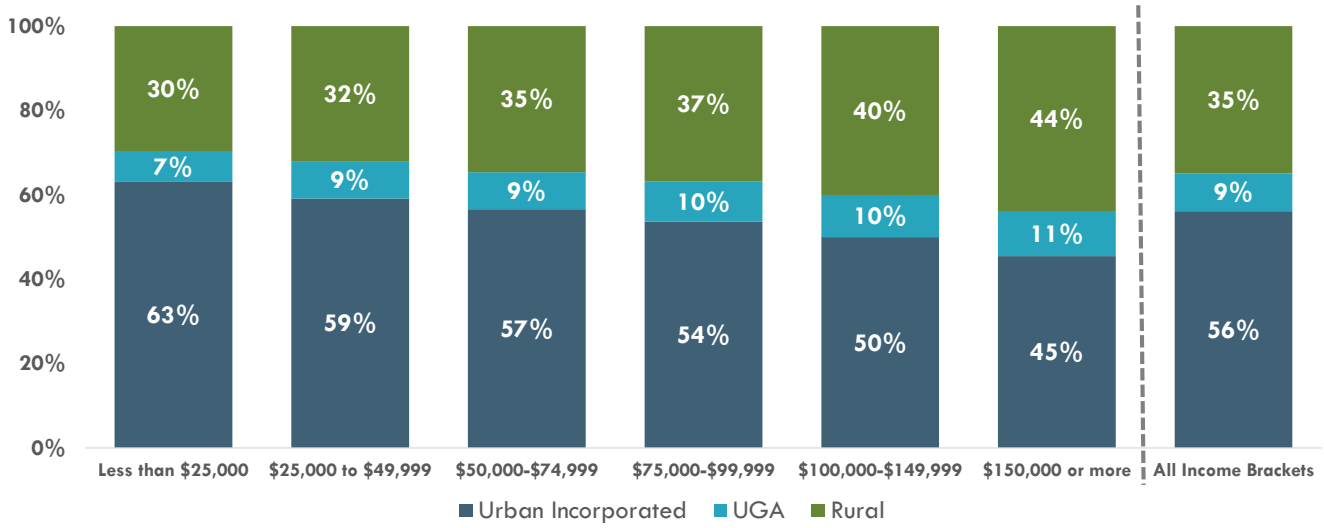
Exhibit 7. Households by Income Bracket and Geographic Category: West



Note: West includes the following counties: Clallam, Clark, Cowlitz, Grays Harbor, Island, Jefferson, King, Kitsap, Lewis, Mason, Pacific, Pierce, San Juan, Skagit, Skamania, Snohomish, Thurston, Wahkiakum, and Whatcom.

Sources: American Community Survey 5-Year Estimates, 2019; Washington State Department of Ecology, 2021; BERK, 2021.

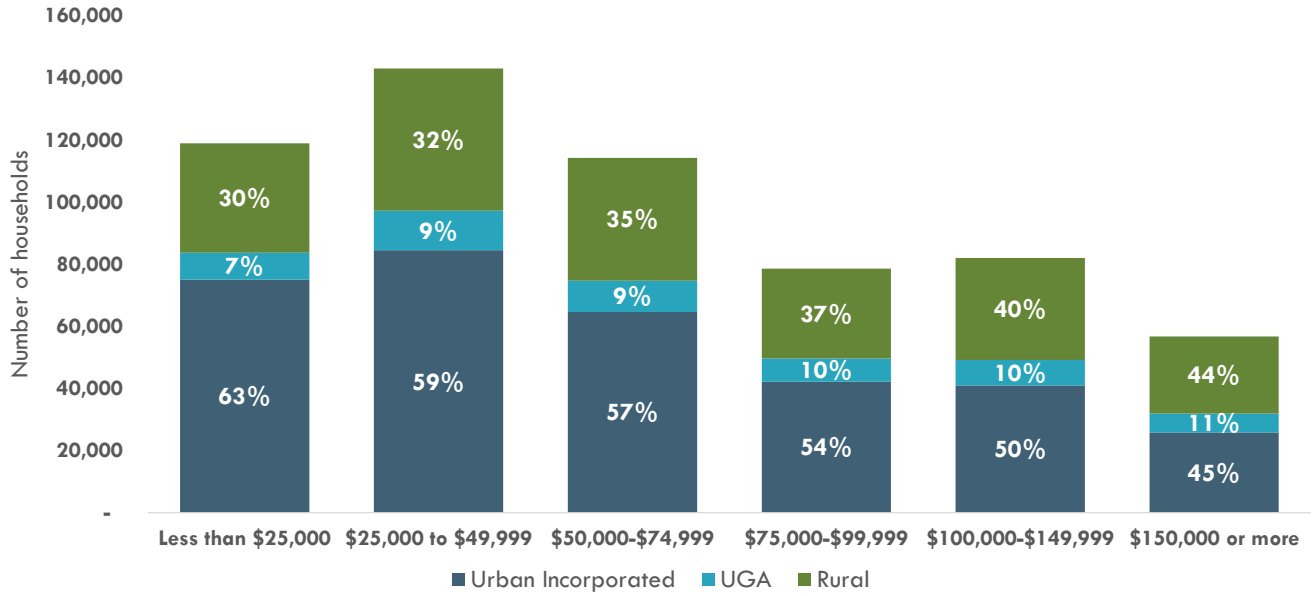
Exhibit 8. Households by Income Bracket and Geographic Category: East



Note: East includes the following counties: Adams, Asotin, Benton, Chelan, Columbia, Douglas, Ferry, Franklin, Garfield, Grant, Kittitas, Klickitat, Lincoln, Okanogan, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman, and Yakima.

Sources: American Community Survey 5-Year Estimates, 2019; Washington State Department of Ecology, 2021; BERK, 2021.

Exhibit 9. Households by Income Bracket and Geographic Category: East



Note: East includes the following counties: Adams, Asotin, Benton, Chelan, Columbia, Douglas, Ferry, Franklin, Garfield, Grant, Kittitas, Klickitat, Lincoln, Okanogan, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman, and Yakima.

Sources: American Community Survey 5-Year Estimates, 2019; Washington State Department of Ecology, 2021; BERK, 2021.

The geographic distribution of the low-income population in Washington means that, on the whole, lower-income households in Washington are unlikely to be disproportionately burdened by RUC based solely on *where* they live (in a rural or urban area). See **Appendix A: Impacts of a RUC on Urban and Rural Households** for a summary of prior research on the impact of a transition from the gas tax to a RUC on urban and rural households. Again, what type of vehicle they drive is the sole determinant of how low-income households are affected by RUC relative to the gas tax.

How do incomes correspond with race and ethnicity?

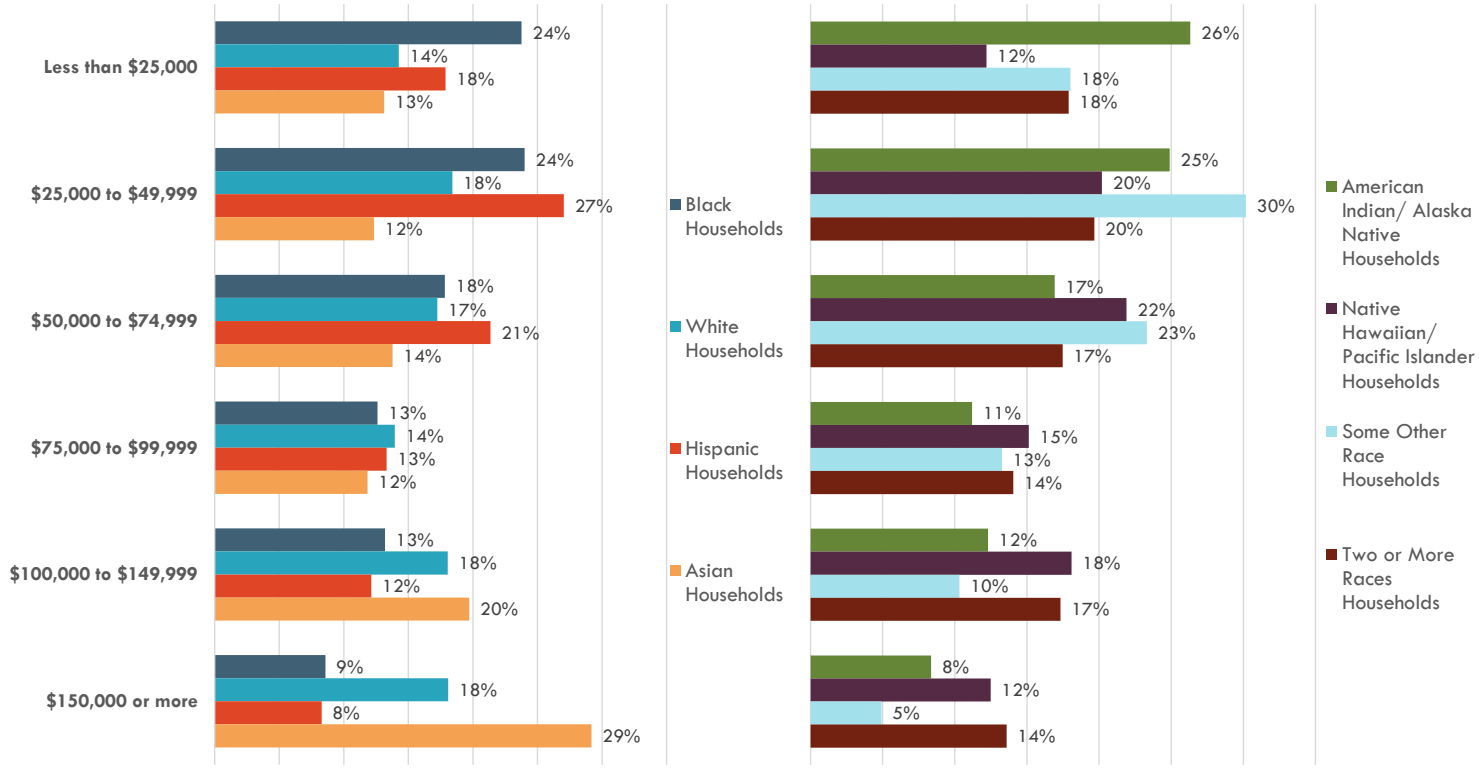
In this section, we analyze Washington household income by race and ethnicity. We are interested in understanding whether any households are disproportionately represented in any income brackets. Exhibit 10 shows the distribution of households within each racial group across six income categories. Key takeaways are:

- White households and multiracial households are relatively evenly distributed across the income spectrum.
- Black households and American Indian and Alaska Native (AIAN) households are overrepresented among lower income groups and underrepresented among higher income groups.
- Asian American households are underrepresented among lower income groups and overrepresented among higher income groups.
- The distribution of Hispanic households, Native Hawaiian and Pacific Islander households, and households identifying as another race across income groups follows a version of a bell curve, with these households more concentrated among the middle-income groups of $25,000 to $74,999 and less concentrated in the lowest income and highest income groups.

It is important to recognize that there is variation within each of these race and ethnicity groups that is not captured by the Census data.

Understanding how household incomes differ by race and ethnicity is important as we consider the impact of implementing a RUC. If a RUC were to burden lower-income households more than higher-income households, Black and AIAN households would be disproportionately affected.

Exhibit 10. Distribution of Income by Race, Washington State Households



Sources: American Community Survey 5-Year Estimates, 2019; BERK, 2021.

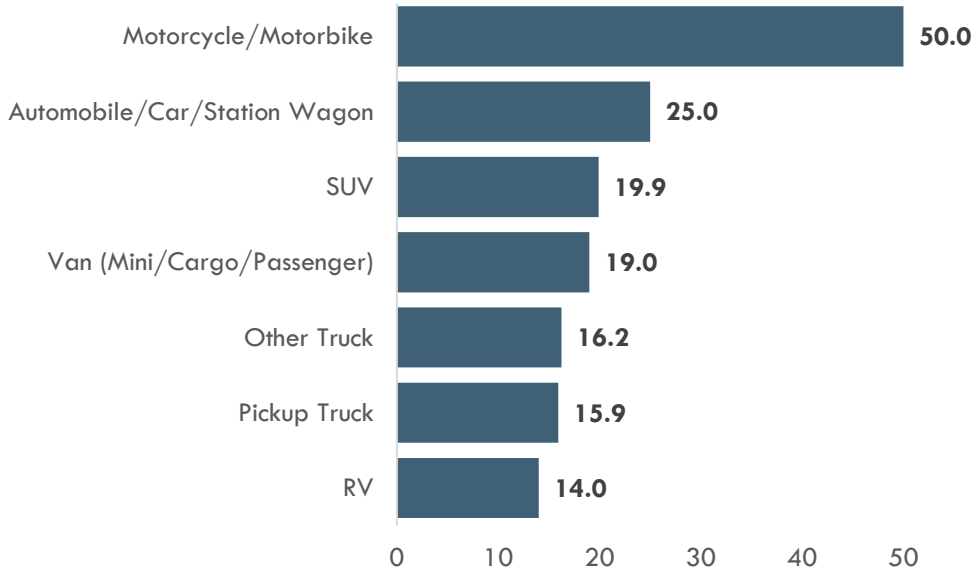
VEHICLE FUEL ECONOMY

When comparing costs to a household under the current gas tax compared with a proposed RUC, two of the primary factors to consider are the vehicles miles traveled by that household and the vehicle fuel efficiency of that household's vehicles. The next set of research questions focus specifically on vehicle fuel efficiency and how that relates to vehicle type, age, and income.

What types of vehicles have lower fuel economy?

Exhibit 11 compares average fuel economy across vehicle categories in the US as of 2017. Fuel efficiency varies across vehicle types. Among the most common vehicle types in the US fleet, automobiles, cars, and station wagons have an average fuel economy of 25.0 miles per gallon while SUVs have an average fuel economy of 19.9 miles per gallon.

Exhibit 11. Average Fuel Economy by Vehicle Category, 2017, US

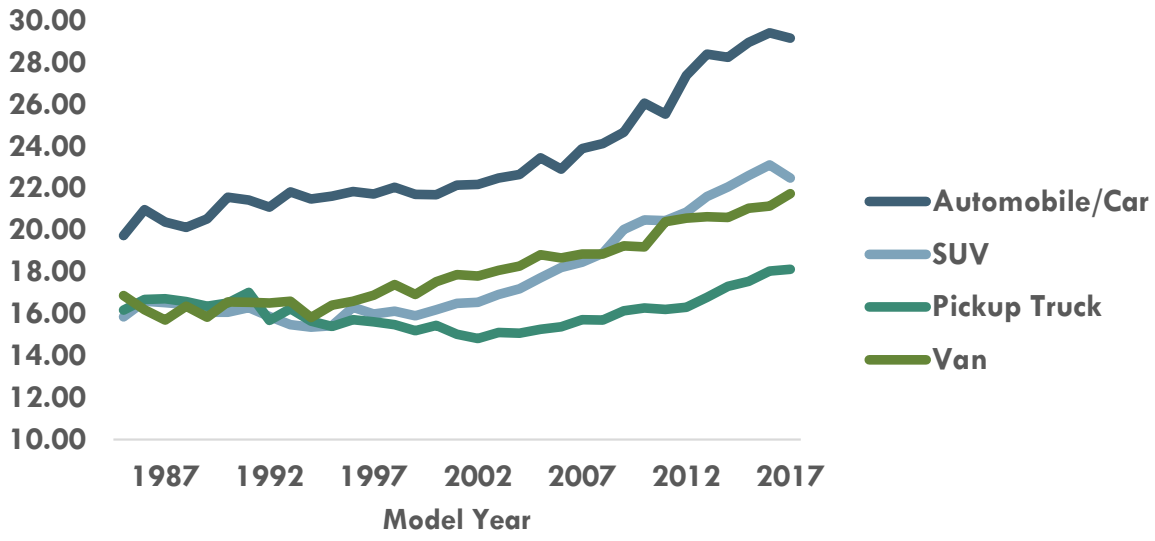


Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

How does fuel economy vary by vehicle age?

Exhibit 12 compares average vehicle fuel efficiency with vehicle model year. The data shows that older automobiles/cars, SUVs, pickup trucks, and vans tend to be less fuel efficient than newer vehicles.

Exhibit 12. Average Vehicle Fuel Efficiency by Vehicle Model Year, Washington Households



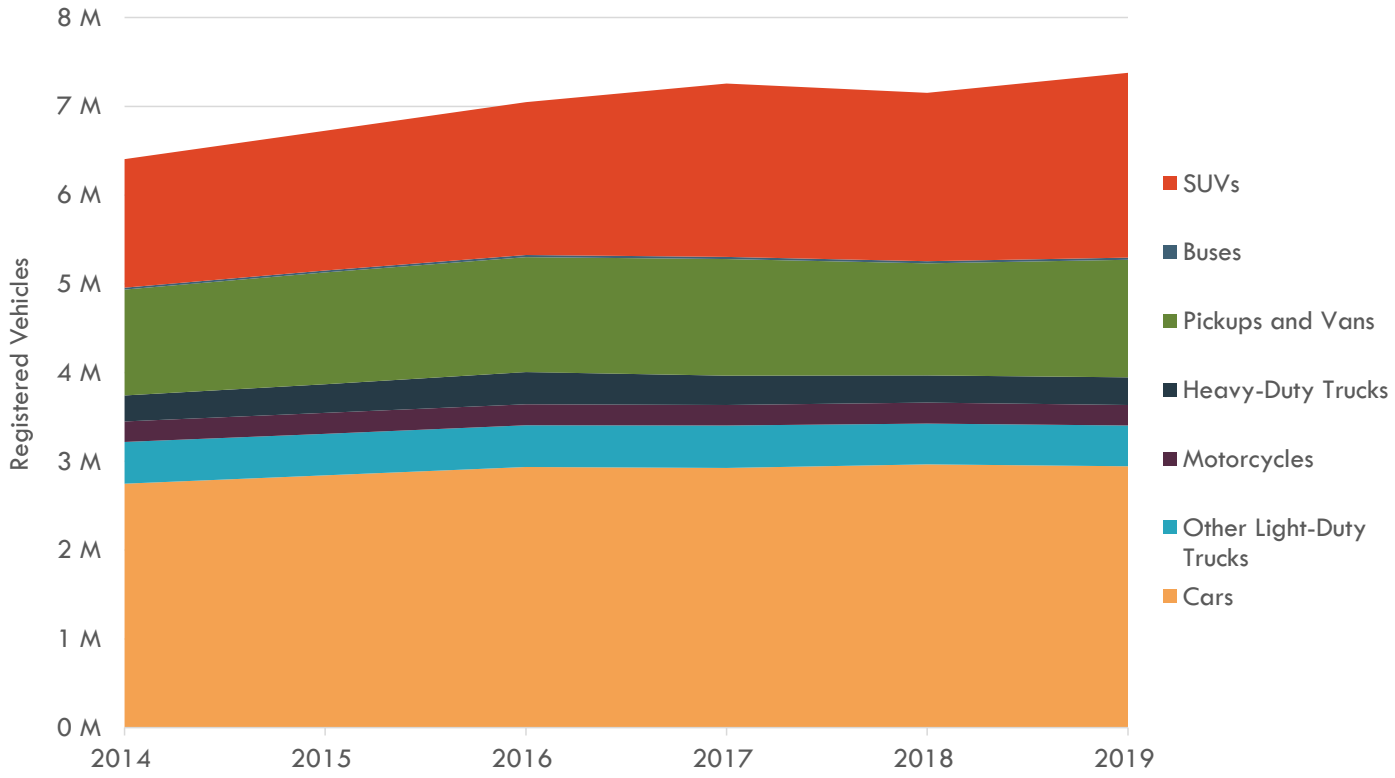
Note: NHTS results may not be representative of Washington state households as a whole as the survey was not designed to be representative at the state level.

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

What are the vehicle trends in Washington?

Washington residents have been purchasing more SUVs in recent years, which tend to be less fuel efficient than smaller vehicles. Exhibit 13 shows total vehicle registrations in Washington state by vehicle type between 2014 and 2019. **Most of the increase in the number of registered vehicles is driven by an increase in the number of registered SUVs** (including crossover utility vehicles, or CUVs, which are smaller than traditional SUVs). From 2014 to 2019, the number of registered SUVs increased by 44%, compared to 11% for pickups and vans and just 7% for cars.

Exhibit 13. Registered Vehicles by Vehicle Type, Washington State

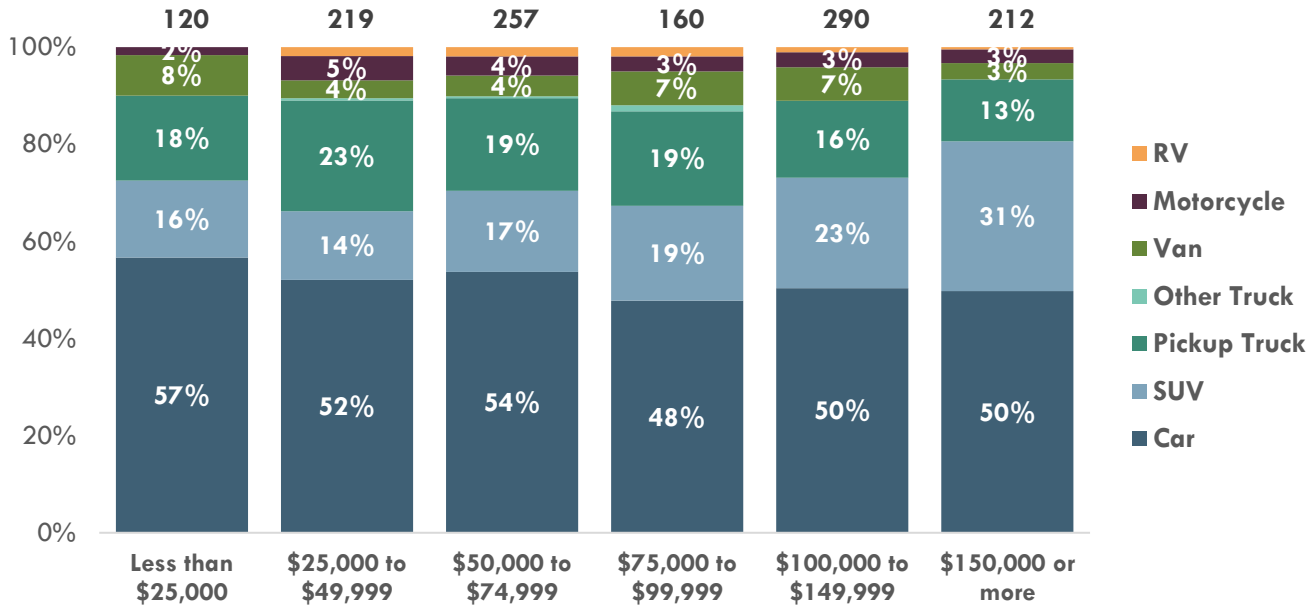


Sources: FHWA Highway Statistics, 2019; BERK, 2021.

How do household vehicle types vary based on income?

Exhibit 14 outlines the distribution of vehicle types by household income bracket for Washington households. The data suggests that the vehicle fleet for lower income respondent households consists of a **higher proportion of cars, a lower proportion of SUVs, and higher proportion of pickup trucks** relative to the vehicle fleet of higher-income respondent households.

Exhibit 14. Household Vehicle Types by Household Income, Washington Households



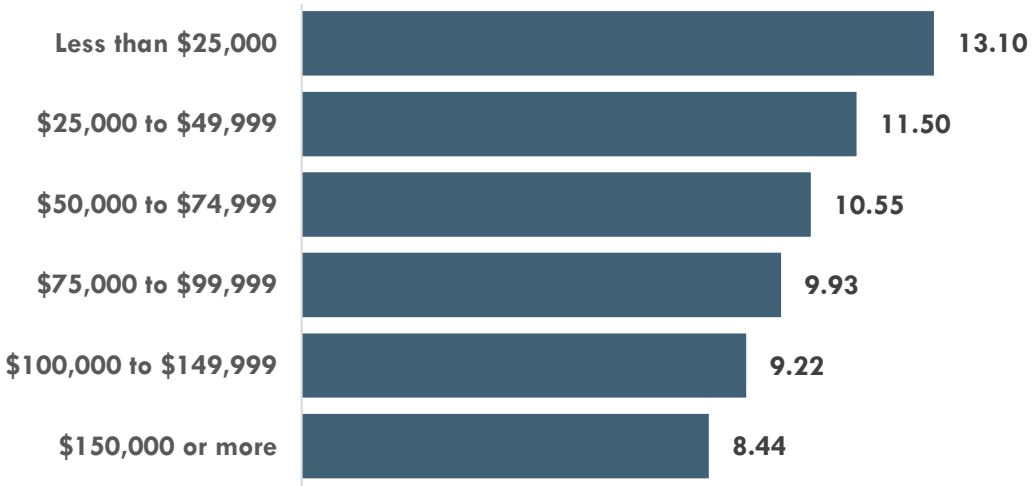
Note: NHTS results may not be representative of Washington state households as a whole as the survey was not designed to be representative at the state level.

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

How does vehicle age vary by household income?

Exhibit 15 shows the average age of personal vehicles based on household incomes in the US. The national data suggests **that there is a negative correlation between vehicle age and income; the lower one's household income, the older the vehicle(s) in the household.**

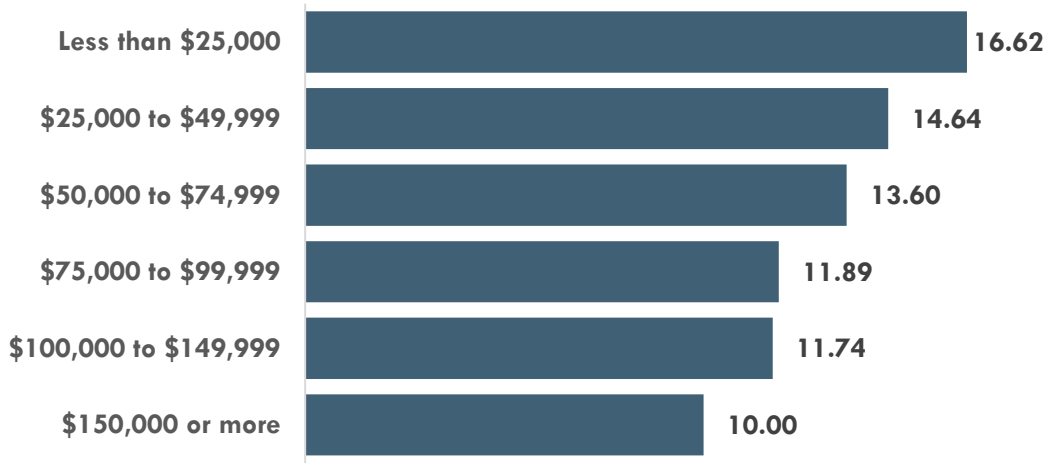
Exhibit 15. Average Age of Personal Vehicle by Household Income, Vehicles in US Households (N=256,115)



Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

Similar to the national dataset, Exhibit 16 showing Washington households suggests that **lower income respondent households tend to have older vehicles,** compared with higher income households. Households with annual incomes of less than $25,000 drive vehicles with an average age of 16.62 years, while households with annual incomes of over $150,000 drive vehicles with an average age of 10.00 years.

Exhibit 16. Average Age of Personal Vehicle by Household Income, Vehicles in Washington Households (N=1,306)



Note: NHTS results may not be representative of Washington state households as a whole as the survey was not designed to be representative at the state level. Households without vehicles have been removed from this analysis.

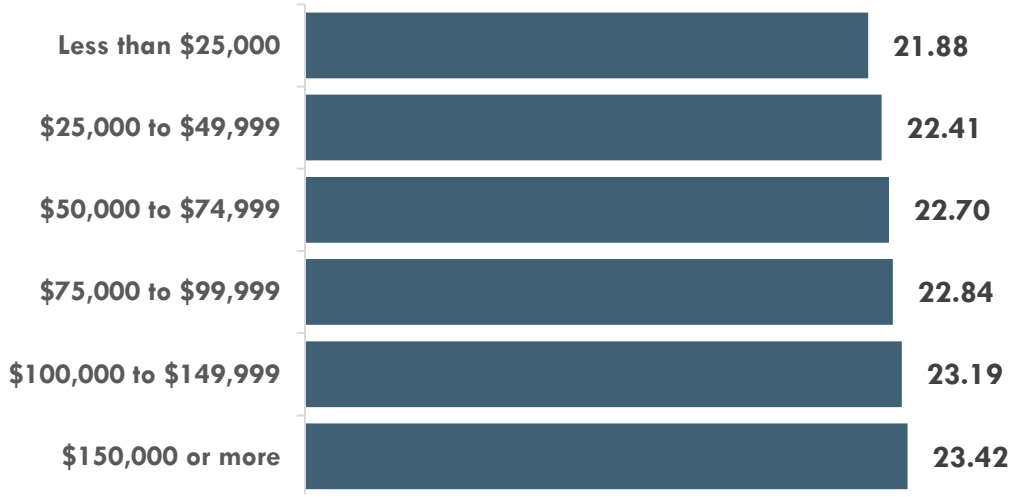
Sources: National Household Travel Survey, 2017; BERK, 2021.

How does vehicle fuel efficiency vary by household income?

The previous analysis shows that 1) lower income respondent households in Washington tend to drive a higher proportion of cars, a lower proportion of SUVs, and higher proportion of pickup trucks; and 2) lower income respondent households tend to drive older vehicles. Because cars are more fuel efficient while pickup trucks are less fuel efficient, together, these two findings mean there is **no clear trend between household incomes and household vehicle fuel efficiency among respondent households.**

At the national level, shown in Exhibit 17, the data suggests a slight trend between household income and fuel efficiency; however, the national dataset may not be representative of Washington drivers.

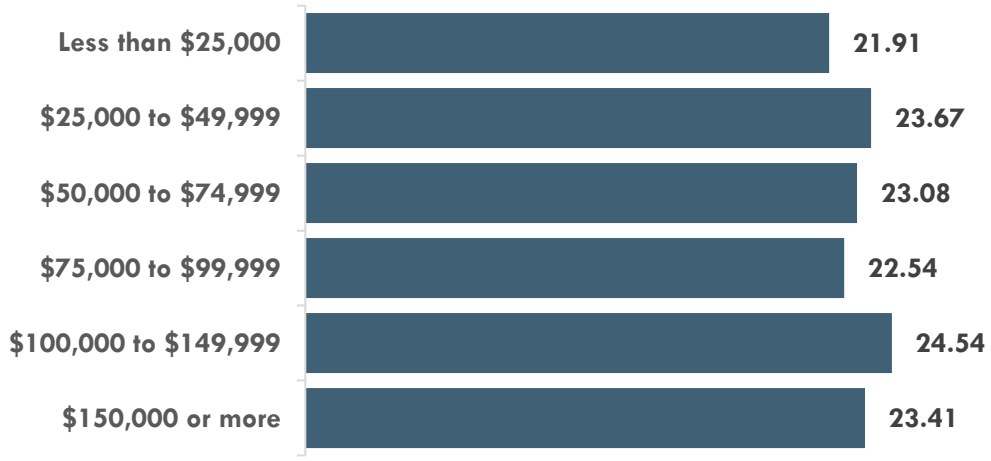
Exhibit 17. Average Fuel Efficiency (in MPG) of All Household Personal Vehicles by Household Income, US Households (N=123,447)



Note: Households without vehicles have been removed from this analysis.

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

Exhibit 18. Average Fuel Efficiency (in MPG) of All Household Personal Vehicles by Household Income, Washington Households (N=620)



Note: NHTS results may not be representative of Washington state households as a whole as the survey was not designed to be representative at the state level. Households without vehicles have been removed from this analysis.

Sources: National Household Travel Survey, 2017; BERK, 2021.

VEHICLE MILES TRAVELED

Vehicle fuel efficiency, discussed in the previous section, is one factor that contributes to a household's gas tax costs. Miles driven per year, or vehicle miles traveled (VMT), is the other. This section explores how VMT varies across Washington state and US households.

How many miles do Washington drivers and households tend to drive per year?

Exhibit 19 summarizes average VMT by vehicle type. Washington drivers are **driving fewer miles** than US drivers in general. The ratio of average VMT per vehicle in Washington compared with the US is around 0.7 for passenger cars and trucks, and lower for buses and motorcycles.

Exhibit 19. Average Vehicle Miles Traveled (VMT) by Vehicle Type, US Vehicles, 2019

Washington State

	Passenger Cars (incl. pickups & SUVs)	**Trucks**	**Buses**	**Motorcycles**
Total VMT	56,713,735,936	5,448,866,236	227,010,036	147,587,792
Registered vehicles	6,756,390	363,703	24,563	232,371
Average VMT per vehicle	**8,394**	**14,982**	**9,242**	**635**

United States

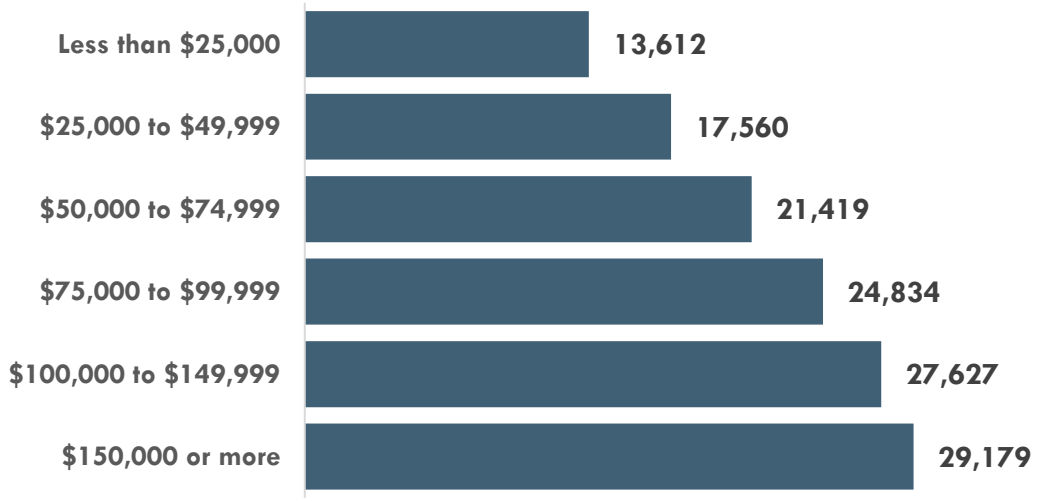
	Passenger Cars (incl. Pickups and SUVs)	**Trucks** (Single-unit and Combination)	**Buses**	**Motorcycles**
Total VMT	2,924,053,220,366	300,050,408,534	17,979,988,907	19,688,045,034
Registered vehicles	252,530,488	14,369,339	995,033	8,596,314
Average VMT per vehicle	**11,579**	**20,881**	**18,070**	**2,290**
WA to US ratio:	**0.725**	**0.717**	**0.511**	**0.277**

Sources: Federal Highway Administration Highway Statistics Series, 2019; Washington State Department of Transportation, 2019; BERK, 2021.

Exhibit 20 and Exhibit 21 summarize average VMT of personal vehicles in each household, based on household income, across the US and in Washington. It is important to note that Washington results may not be representative of Washington state households as a whole as the NHTS was not designed to be statistically representative at the state level.

- The VMT totals in these exhibits are higher than those in the previous exhibit because Exhibit 19 shows VMT per vehicle, while Exhibit 20 and Exhibit 21 show average VMT per household; households may have multiple vehicles.
- Again, the data shows that Washington respondents drive fewer miles than US respondents in general.
- In general, Exhibit 20 and Exhibit 21 suggest that higher income respondent households tend to drive more than lower income households.

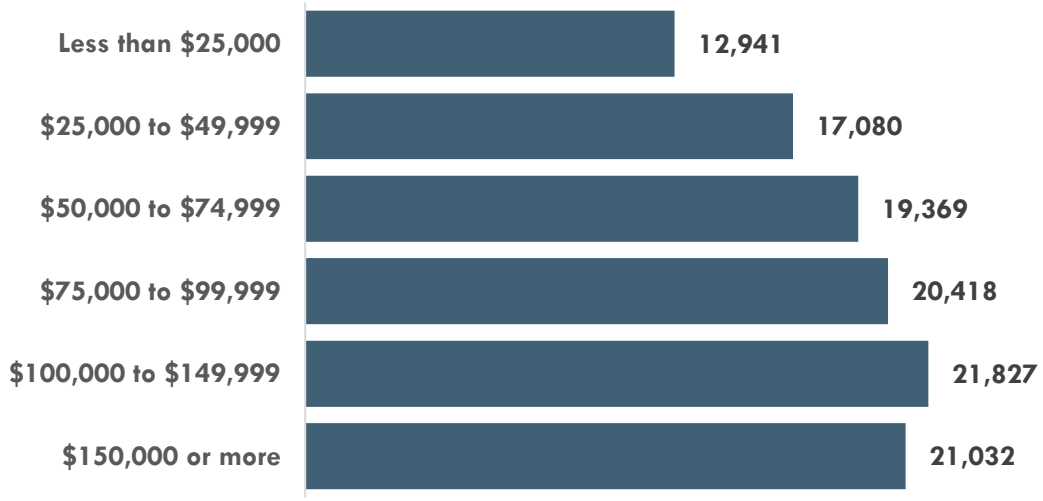
Exhibit 20. Average Vehicle Miles Traveled of All Household Personal Vehicles by Household Income, US Households (N=123,447)



Note: Households without vehicles have been removed from this analysis.

Sources: National Household Travel Survey, 2017; BERK, 2021.

Exhibit 21. Average Vehicle Miles Traveled of All Household Personal Vehicles by Household Income, Washington Households (N=620)



Note: NHTS results may not be representative of Washington state households as a whole as the survey was not designed to be representative at the state level. Households without vehicles have been removed from this analysis.

Sources: National Household Travel Survey, 2017; BERK, 2021.

COST PAID UNDER GAS TAX VS. RUC

Would households in different income brackets pay more or less under a potential RUC, compared with the gas tax?

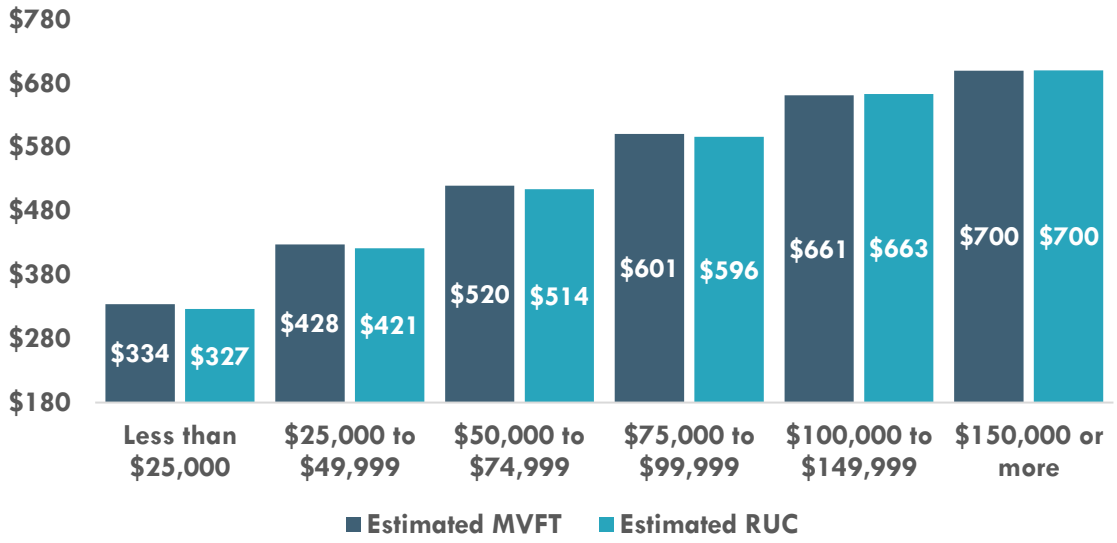
Exhibit 22 and Exhibit 23 show the estimated costs among households in the NHTS data set for the current gas tax as well as under a proposed RUC, for the US and Washington state. It is important to again note that NHTS data may not be representative of Washington state households given that the NHTS was not designed to support state-level analysis. As a result, US findings are shown for contextual purposes. The data show a clear trend at the national level, with lower income households paying less in RUC than under a gas tax, and higher income households paying the same or more in RUC than under a gas tax. Within Washington, the results are mixed: At the state level for Washington, results between income brackets are mixed: the lowest-income households (under $25,000) pay less under RUC, while households with incomes between $25,000 and $74,999 pay more. Households from $75,000 to $99,999 would pay less under RUC, while households between $100,000 and $149,999 would pay more. Households in the highest income bracket (over $150,000) would pay more.

The most any one income bracket would save under RUC, on average, is $8 per year for the lowest income bracket (a savings of 2%). The largest increase any one income bracket would see under RUC, on average, is $20 per year for the income bracket $100,000 to $149,999 (a 4% increase). Given the relatively small differences in average cost increases and cost savings, and the relatively small sample sizes of households, ***there is no statistically significant difference in how much the household would pay under a RUC compared with the gas tax.*** In other words, the differences shown in what households pay by income in Exhibits 23 and 24 are so small that, extrapolated to the population as a whole, we must assume the average difference is statistically no different from zero

Why is this true?

- ***On a per mile basis,*** the difference between gas tax and RUC costs are completely determined by fuel efficiency. For two households driving the same number of miles, fuel efficiency determines the difference between what the two households would pay in gas tax on an annual basis. The household with the less fuel-efficient car will pay more in gas taxes to drive the same amount of miles. Under a RUC, by contrast, both households would pay the same. As a result, since fuel efficiency does not appear to meaningfully vary by income, the average costs paid under gas tax and RUC within income brackets likewise do not vary.

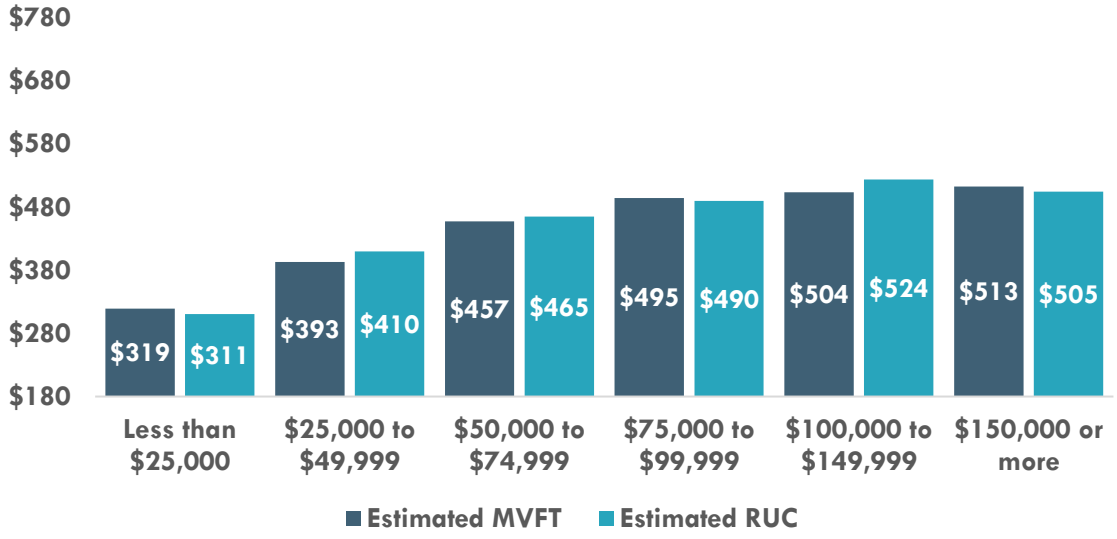
Exhibit 22. Estimated Average Motor Vehicle Fuel Tax (MVFT) vs. RUC Paid by Income Bracket, US Households (N=123,447)



Note: Households without vehicles have been removed from this analysis

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

Exhibit 23. Estimated Average Motor Vehicle Fuel Tax (MVFT) vs. RUC Paid by Income Bracket, Washington Households (N=620)



Note: NHTS results may not be representative of Washington state households as a whole as the survey was not designed to be representative at the state level. Households without vehicles have been removed from this analysis.

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

BROADER TRANSPORTATION EQUITY QUESTIONS

This income-based equity analysis is only one piece of a larger discussion around transportation equity and funding. The broader discussion around transportation equity includes questions such as:

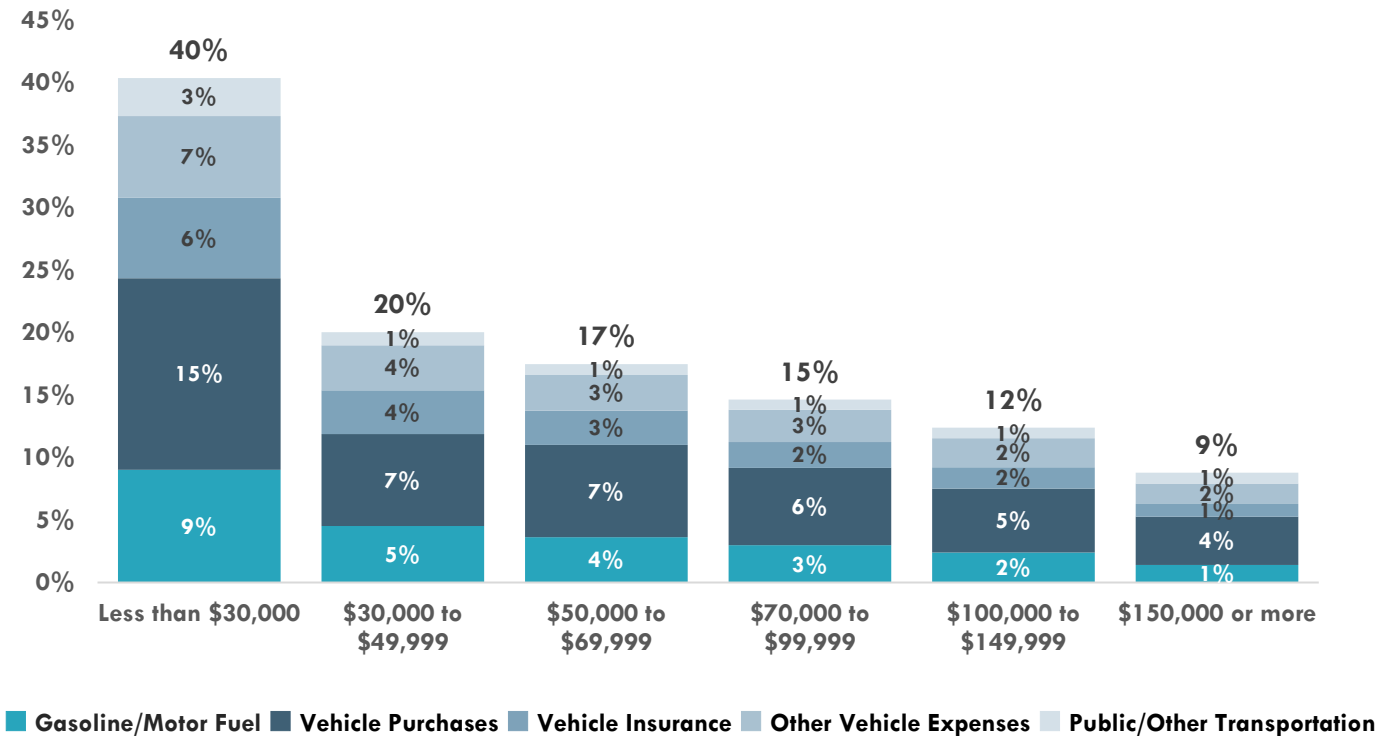
- How much of transportation funding is paid by whom?
- Where and on what are transportation revenues invested?
- How do the locations, modes, and types of transportation investments correspond to who and where revenues are collected from?

This analysis examines the costs paid under RUC compared with the gas tax for each household income bracket. The questions above are beyond the scope of this research. Other tasks in this study will explore the equity implications of operational features of a RUC system, including payment frequency alternatives.

What percentage of household income is spent on transportation costs?

As of 2019, data from the Bureau of Labor Statistics Consumer Expenditure Survey shows that an average US household spends around 13% of its household income on transportation costs. Transportation costs include vehicle purchases, gasoline and other motor vehicle fuel costs, maintenance and repairs of vehicles, vehicle insurance, vehicle finance charges, and public transportation or other transportation costs. Gasoline and other motor vehicle fuel costs represent around 2.5% of an average US household's annual income. Unsurprisingly, the portion of a US household's income, on average, that is devoted to transportation varies by income level. As with any consumer expenditure, lower income households tend to spend a higher proportion of income on transportation. Exhibit 24 below details the average percentage of household income spent on transportation costs by income level for US households, while Exhibit 26 shows the percentage spent on fuel taxes specifically. Looking specifically at the tax component of fuel costs, households spend between 0.2% of income (for the highest income households) and 1.4% (for the lowest income households) on fuel taxes.

Exhibit 24. Percentage of Household Income Spent on Transportation by Income, 2019, US Households



Sources: Bureau of Labor Statistics Consumer Expenditure Survey, 2019; BERK, 2021.

Exhibit 25. Percentage of Household Income Spent on Fuel Taxes by Income, 2019, US Households

	Less than $30,000	$30,000 to $49,999	$50,000 to $69,999	$70,000 to $99,999	$100,000 to $149,999	$150,000 or more
% of Income Estimated to be Spent on WA State Gas Tax	1.4%	0.7%	0.6%	0.5%	0.4%	0.2%

For households with incomes of less than $30,000, transportation costs represent around 40% of household annual income, on average.

- Gasoline or other motor vehicle fuel purchases represent around 9% of household annual income, on average.
- Based on 2019 fuel price information from WSDOT, a gas tax rate of $0.494 is estimated to represent around 1.4% of household annual income on average, for households at this income level.
- Other state taxes represent a larger share of household income than gas taxes. Sales taxes, for example, represent two to three times the amount spent on fuel taxes, while property taxes account for as much as five times the average amount spent on fuel taxes.[4]

[4] Calculated using Smart Asset, assuming a married household in Seattle earning $30,000 per year.

For households making $150,000 or more, transportation costs only represent around 8% of household annual income, on average.

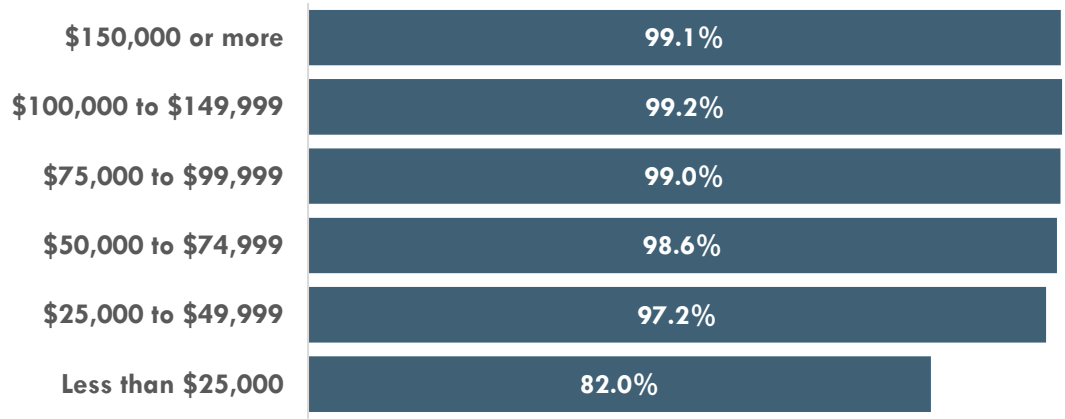
- Gasoline or other motor vehicle fuel purchases only represent around 1% of household annual income, on average.
- Based on 2019 fuel price information from WSDOT, a gas tax rate of $0.494 is estimated to represent around only 0.2% of household annual income, on average, for households at this income level.

In some regions in the state, significant portions of households make above $150,000. For example, in the Seattle area over 28% of households make $150,000 or more.

Who owns a vehicle? How does vehicle ownership correspond with income levels?

According to the NHTS, as of 2017, around 95% of US households own a household vehicle. Data suggests that vehicle ownership does vary between income levels. Exhibit 26 below outlines the vehicle ownership by income level for US households.

Exhibit 26. Percentage of Vehicle Ownership by Income, 2017, US Households



Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

As shown above, US households have very high rates of vehicle ownership, on average. As an example, around 99% of households making $50,000 and above have access to a vehicle and around 97% of households making between $25,000 to $49,999 have access to a vehicle. The majority of households on the lowest end of the income spectrum own vehicles though at lower rates than higher income households. Around 82% of households making below $25,000 have access to a vehicle.

Who owns an electric vehicle?

In 2020, electric vehicle (EV) registrations in the US reached a market share of 1.8%, a record high. EV market share is highest in the Western Region of the US, where 4.8% of all new vehicles registered are electric vehicles. As of May 2021, there are over 73,000 electric vehicles registered in the State of Washington, an increase of around 72% from electric vehicle registrations as of December 2018 (around

43,000 electric vehicle registrations).[5,6] All these trends suggest that US consumers, particularly those in Washington and the rest the western US, are showing increasing interest in electric vehicles.

However, data suggests that EVs are disproportionately purchased and owned by high income customers. According to a 2019 study by the Congressional Research Service about the plug-in electric vehicle tax credit, 78% of electric vehicle tax credits were claimed by filers with an adjusted gross income (AGI) of $100,000 or more.[7] For context, only about 17% of total tax filings have a an AGI of $100,000 or more. Moreover, about 7% of credits claimed were claimed by filers with a AGI of $1 million or more – only about 0.3% of total tax filings have an AGI of $1 million or more.

Conclusion

This memo provides information about the potential equity implications of Washington state transitioning from a gas tax to a RUC. Rather than exploring all angles of equity, this analysis focuses on income and specifically explores the following questions:

- **Would households in different income brackets pay more or less under a potential RUC, compared with the gas tax?**

KEY FINDINGS

Low-income households

In Washington, there are several different measures used by agencies to define whether an individual or household is considered "low-income." There is no one definition for a "low-income" household. To frame this analysis, we first outlined the thresholds for "low-income" based on federal poverty guidelines, Department of Housing and Urban Development, minimum wage, and ALICE. In our analysis, we do not use one specific definition for "low-income" but rather describe findings based on income bracket.

Next, we analyzed where lower income households live by geographic category of urban incorporated, urban growth area, or rural. We found that on the west side of the state, there is **no disproportional representation by urban or rural households in any income bracket.** On the east side, there are a **larger share of rural households in the highest income bracket,** but there are fewer total number of households of any geographic category in the highest income bracket.

Looking at how incomes correspond with race and ethnicity in Washington, we found that White households and multiracial households are relatively evenly distributed across the income spectrum. Black households and American Indian and Alaska Native (AIAN) households are overrepresented among lower income groups and underrepresented among higher income groups. Asian American households are underrepresented among lower income groups and overrepresented among higher income groups. The distribution of Hispanic households and households identifying as another race across income groups follows a version of a bell curve, with these households more concentrated among the middle-income groups of $25,000 to $74,999 and less concentrated in the lowest income and highest income groups.

[5] https://data.wa.gov/Transportation/Electric-Vehicle-Population-Data/f6w7-q2d2
[6] http://www.westcoastgreenhighway.com/pdfs/Map_WAEVRegistrationByCounty.pdf
[7] https://fas.org/sgp/crs/misc/IF11017.pdf

Vehicle trends

Next, examining the trends between fuel efficiency and vehicle types, we found that fuel efficiency varies across vehicle types. Cars are more fuel efficient, while SUVs and pickup trucks are less fuel efficient. Looking at the relationship between vehicle age and fuel efficiency, older vehicles do tend to be less fuel efficient. As of 2019, the cars are still the most prevalent vehicle in the Washington fleet (40% of the Washington fleet). However, SUVs have seen by far the most significant growth over the past several years. From 2014 to 2019, the number of registered SUVs increased by 44%, compared to 11% for pickups and vans and just 7% for cars.

Household incomes and vehicles

Based on the analysis of vehicle type, age, and fuel efficiency, we examined whether there are trends between households' incomes and the types, ages, and fuel efficiency of households' vehicles. The analysis showed that lower income households have higher proportion of cars, a lower proportion of SUVs, and higher proportion of pickup trucks. Cars are more fuel efficient, while pickup trucks are less fuel efficient. At the same time, lower income households tend to have older vehicles. Because of these two findings, there is **no clear trend between household incomes and fuel efficiency** of their vehicles in Washington.

Washington drivers

Because this analysis draws from both US drivers and Washington drivers, we wanted to understand the driving habits of Washington drivers. Washington drivers are **driving fewer miles** than US drivers in general. The ratio of average VMT per vehicle in Washington compared with the US is around 0.7 for passenger cars and trucks, and lower for buses and motorcycles. The analysis also shows that **higher income respondent households tend to drive** more miles than lower income respondent households.

Cost paid under gas tax vs RUC

In general, when looking at respondent information from the NHTS at both the national and Washington state level, estimated costs under the current gas tax and under a proposed RUC are **relatively similar, on average**.

Differences between the estimated cost per household under gas tax versus RUC are found to be **not statistically significant for any of the income brackets, in both the Washington state and national data**. This means that we *cannot* conclude that the small[8] differences observed in estimated gas tax and RUC costs among the NHTS respondent households would exist across the Washington state or US populations as a whole.

[8] The largest difference is $20 a year, for Washington state households with incomes between $100,000 and $149,999.

Appendix A: Impacts of a RUC on Urban and Rural Households

REVIEW OF RUC STUDIES ON IMPACTS TO URBAN AND RURAL HOUSEHOLDS

Two studies looking at Washington state and the Western US have explored whether a potential transition from the gas tax to a RUC would disproportionately impact rural households.

In 2015, the WSTC studied the urban and rural financial and equity implications of a potential RUC system in Washington.[9] The study compared estimated annual payments for personal light-duty vehicles under current gas tax rates and under a hypothetical RUC for urban and rural residents of Washington. The study assumes that gross revenue generated under a RUC would be the same as gas tax revenue for calendar year 2014.

The study is based on 1) a fuel consumption and VMT allocation model, 2) the Voice of Washington State (VOWS) survey panel on perceived vehicle miles driven and miles per gallon, and 3) Census Bureau and Bureau of Labor Statistics data on commute distances for rural and urban workers.

The study finds that:

- **The tax burden for each group does not appear to significantly change** with a switch from fuel taxes to a RUC. **Rural drivers would benefit slightly** from the change, and urban drivers would likely pay slightly more than they do in gas taxes. This is because rural residents tend to drive less fuel-efficient vehicles and more miles per year than residents living in urban areas.
- Rural drivers *perceive* higher miles driven than urban drivers/households. There are no significant differences between urban and rural in regard to *perceived* fuel economy of vehicles.
- More urban and rural individuals are commuting longer distances over the last ten years.

In 2017, RUC West analyzed the financial impacts of a RUC for urban and rural drivers in eight western states.[10] The study used a revenue-neutral RUC rate that would generate the same total state tax revenue as currently provided by the gas tax.

The study uses data from the 2009 National Household Transportation Survey (NHTS) and the 2009-2013 American Community Survey (ACS) data. The study found that:

- Generally, rural residents drive older, less fuel-efficient vehicles, which increases gas taxes.
- Rural drivers tend to travel longer distances per trip but drive less frequently than urban drivers.
- Under a RUC, across eight states, rural households will pay 1.9%-6.3% less and urban households will pay 0.3%-1.4% more state tax under a RUC system than they would under the current state gas tax. This range reflects differences across states. **In Washington, rural households will pay 4.8% less** and **urban households will pay 1.0%** more state tax under a RUC system compared with the current gas tax.

[9] WSTC, *Road Usage Charge Assessment: Financial and Equity Implications for Urban and Rural Drivers, 2015.* https://waroadusagecharge.org/wp-content/uploads/2020/03/20150227URBANRURALREPORT.pdf
[10] RUC West, *Financial Impacts of Road User Charges on Urban and Rural Households,* 2017. https://www.ebp-us.com/sites/default/files/project/uploads/FINAL-REPORT---Financial-Impacts-of-RUC-on-Urban-and-Rural-Households_Corrected.pdf

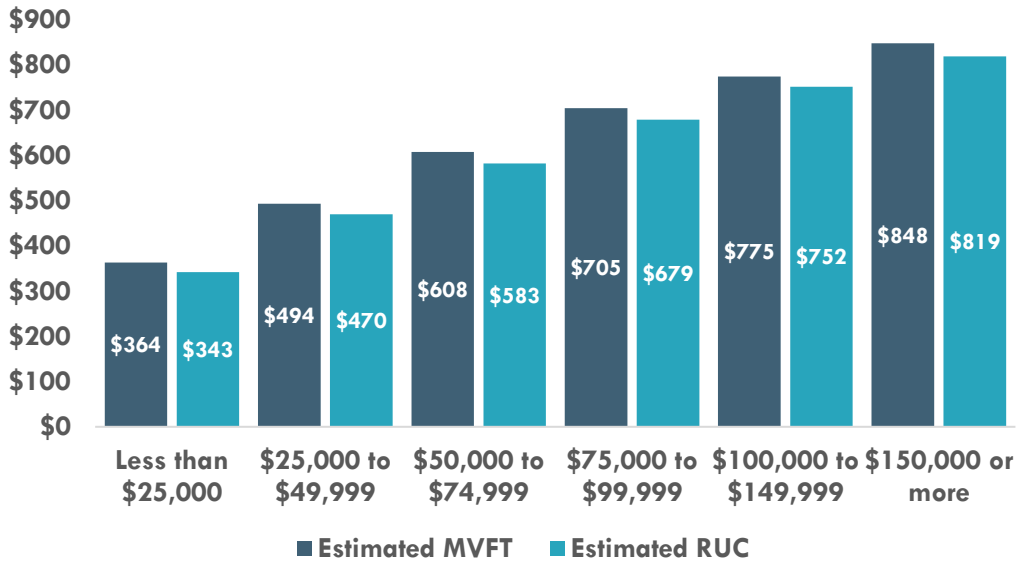
ANALYSIS OF THE IMPACT OF A RUC ON RURAL, SUBURBAN, AND URBAN HOUSEHOLDS USING NHTS DATA

As part of this current analysis of the financial and equity implications of transitioning from a gas tax to RUC for households by income level, we considered how average annual costs under these two programs would vary by rural, suburban, and urban geography. Using the data from the 2017 NHTS, we compared RUC and gas tax costs for rural, suburban, and urban US respondent households by income group, using their reported annual fuel consumption, vehicle fuel efficiency, and annual vehicle miles traveled.

Exhibit 27, Exhibit 28, and Exhibit 29 show this breakdown for rural, suburban, and urban households, respectively. The key takeaways are:

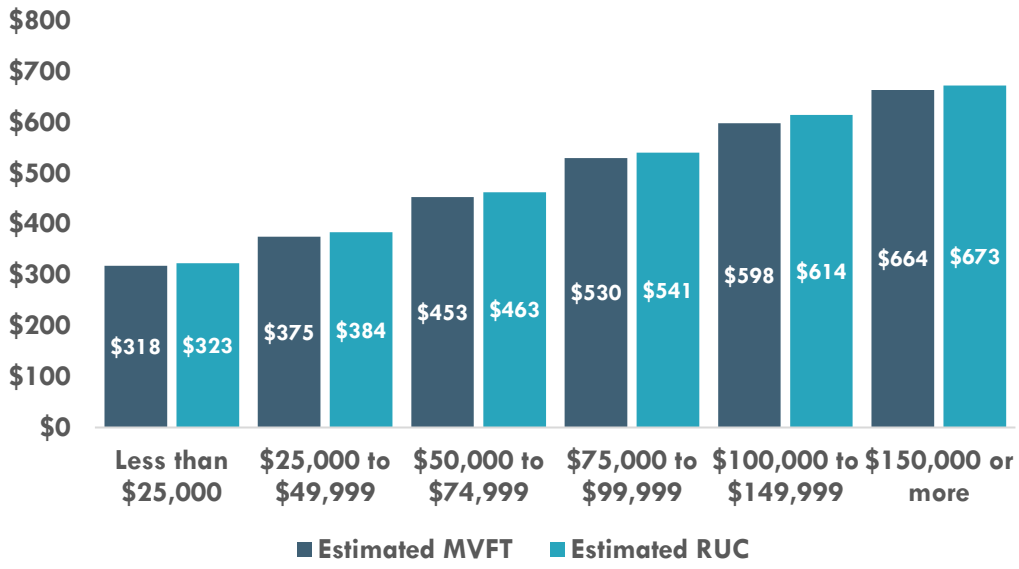
- On average, rural households pay more in gas tax than do urban households, with suburban households falling in the middle. This is true across all income groups.
- Under a RUC, rural households of all income levels would pay a little less (between $21 and $29 less, on average) on an annual basis than they do under the gas tax. The average rural household would pay $24 less annually.
- Under a RUC, suburban households of all income levels would pay slightly less (between $5 and $16 less, on average) on an annual basis than they do under the gas tax. The average suburban household would pay $10 less annually.
- Under a RUC, urban households of would pay a little more (between $13 and $43 more, on average) on an annual basis than they do under the gas tax. The average urban household would pay $27 more annually.
- Urban and suburban households would still pay more, on an annual basis, than urban households under a RUC, but the difference would be somewhat narrowed.

Exhibit 27. Estimated Average Gas Tax vs. RUC Paid by Income Bracket, US Rural Households



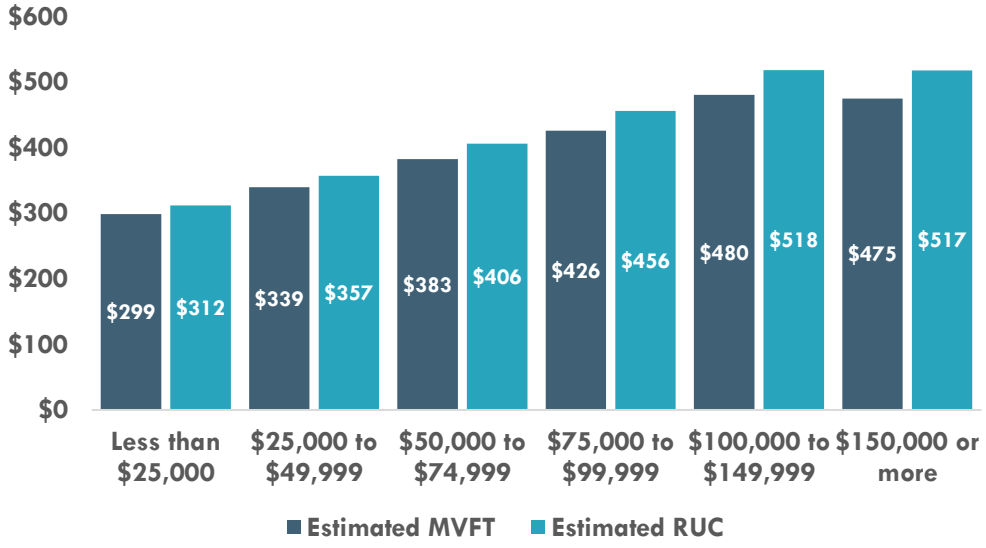
Sources: National Household Travel Survey, 2017; BERK, 2021.

Exhibit 28. Estimated Average Gas Tax vs. RUC Paid by Income Bracket, US Suburban Households



Sources: National Household Travel Survey, 2017; BERK, 2021.

Exhibit 29. Estimated Average Gas Tax vs. RUC Paid by Income Bracket, US Urban Households



Sources: National Household Travel Survey, 2017; BERK, 2021.

Appendix B: Statistical Analysis of Household Gas Tax and RUC Costs

In this current analysis of the financial and equity implications of a potential transition to a RUC, we estimate household costs under the gas tax and RUC (see Exhibit 22 and Exhibit 23) using data from the 2017 NHTS. We conducted a statistical analysis **to understand how these estimates, which are based on households in the NHTS sample of the US population, relate to the actual costs for the full US and Washington state populations.**

DATA

The NHTS sample data includes the following data points for households in its dataset:

- Combined vehicle miles traveled (VMT) by all vehicles in the household.
- Total motor vehicle fuel consumption by the household.
- Calculated household vehicle fuel efficiency (calculated by dividing total household fuel consumption by household VMT).
- Household income (a categorical variable).

We used these datapoints to calculate the costs that each household in the sample would pay under the current Washington State gas tax and under RUC. These datapoints were calculated by multiplying the household's annual fuel consumption in gallons by the current gas tax rate of 49.4 cents per gallon (for total state gas tax costs) and by multiplying the household's annual VMT by the proposed RUC rate of 2.4 cents per mile (for total state RUC costs).

We then grouped households into six income groups and calculated the average annual costs under gas tax and under RUC for each group. As Exhibit 22 shows, in the national sample, for the income groupings under $100,000, households would pay less, on average, under RUC than under the gas tax. Households earning $100,000 or more would pay an almost identical amount, on average, under the gas tax and RUC.

However, the results for the Washington state sample do not show a clear pattern – while all of the estimated average gas tax and RUC costs are similar within income groupings (the largest difference is $20/year), the pattern of which tax/charge is higher is not consistent across income groupings. Given this inconsistency and the small size of the Washington state sample in the NHTS (620 households), we conducted a statistical analysis to understand whether these differences were statistically significant or rather reflect random variation within the samples that does not reflect actual underlying differences in the population.

STATISTICAL ANALYSIS

We conduct paired samples t-tests for each income grouping to understand if the differences observed in average gas tax and RUC costs in the national and Washington state samples reflect actual differences in these calculated gas tax and RUC costs for the national and state populations.

The t-test is a statistical method that considers the size of two samples and the variance within them, as compared to the expected variance in the overall population, to evaluate whether the observed differences between the two samples are likely to reflect an actual difference between the populations underlying the samples. A paired samples t-test is a type of t-test used when the two samples represent two different measurements taken from the same set of units – in this case, the calculated gas tax cost (measurement 1) and the calculated RUC cost (measurement 2) for the same set of households.

The paired samples t-tests allow us to **evaluate how likely it is that the small differences observed in average household costs under the gas tax versus RUC were due to random chance, or due to actual differences in the population**, where "population" means all households of a specific income level in either Washington state or the US.

In this case, the "actual differences" in the population are theoretical, as no Washington state households or US households currently pay RUC. However, the calculated RUC costs used in this analysis are based on an actual metric - household annual VMT. The same holds true for the calculated gas tax costs – the gas tax costs for US households outside of Washington state are not "actual," because they are based on the Washington State gas tax rate of 49.4 cents per gallon. However, the calculated gas tax costs for US households *are* based on an actual metric – household annual fuel consumption.

Thus, the results of the paired samples t-test allow us to analyze:

1. The likelihood that there is a difference between the amount that **US households** (within six different income groupings) would pay per year in gas tax (on average) if they paid the Washington State gas tax rate and what they would pay per year in RUC (on average). *Note that this assumes that each household drives the same number of miles in the same car (or a car of equivalent fuel efficiency) in both the gas tax and RUC scenarios.*
2. The likelihood that there is a difference between the amount that **Washington state households** (within six different income groupings) currently pay per year in gas tax (on average) and what they would pay per year in RUC (on average). *Note that this assumes that each household drives the same number of miles in the same car (or a car of equivalent fuel efficiency) in both the gas tax and RUC scenarios.*

PAIRED SAMPLES T-TESTS FOR US HOUSEHOLDS

Exhibit 30 shows the outputs of the paired samples t-tests for each of the six income groupings for US households. Because we do not have a hypothesis about whether the amount paid under gas tax and RUC will be higher (the direction of the difference), we use two-tailed tests. These tests use an alpha of 0.05.

The null hypotheses for the six tests are as follows:

1. There is no difference between the amount that US households with incomes less than $25,000 would pay under gas tax and the amount they would pay under RUC.
2. There is no difference between the amount that US households with incomes of $25,000-$49,999 would pay under gas tax and the amount they would pay under RUC.
3. There is no difference between the amount that US households with incomes of $50,000-$74,999 would pay under gas tax and the amount they would pay under RUC.
4. There is no difference between the amount that US households with incomes of $75,000-$99,999 would pay under gas tax and the amount they would pay under RUC.
5. There is no difference between the amount that US households with incomes of $100,000-$149,999 would pay under gas tax and the amount they would pay under RUC.
6. There is no difference between the amount that US households with incomes greater than $150,000 would pay under gas tax and the amount they would pay under RUC.

As shown in Exhibit 30, none of the p-values (highlighted in pink) for any of the six tests are below the threshold of 0.05. This means that, for each test, there is a greater than 5% chance that we would see the differences between the sample means (average gas tax and average RUC costs) that we see if there were truly no difference between the two among these income groupings in the general US population. This probability is too high for us to accept the null hypotheses, so we reject the null hypotheses and **conclude that we do not observe a statistically significant difference in costs paid under the gas tax versus RUC for any income group.**

Exhibit 30. Results from Paired Samples T-Test Comparing Gas Tax and RUC Costs for US Households, by Income Grouping

T-Test: Paired Two-Sample Assuming Equal Variances

Less than $25,000

	MVFT	*RUC*
Mean	337.8391	330.5332
Variance	174429.6	145413.1
Observations	19665	19665
Pooled Variance	159921.4	
Hypothesized Mean Difference	0	
df	39328	
t Stat	1.811561	
P(T<=t) two-tail	0.070062	
t Critical two-tail	1.960024	

$25,000 to $49,999

	MVFT	*RUC*
Mean	429.6844	423.3923
Variance	216916.4	173818.8
Observations	26867	26867
Pooled Variance	195367.6	
Hypothesized Mean Difference	0	
df	53732	
t Stat	1.649928	
P(T<=t) two-tail	0.098964	
t Critical two-tail	1.960008	

$50,000 to $74,999

	MVFT	*RUC*
Mean	520.4885	514.8233
Variance	245661.6	193965.5
Observations	22044	22044
Pooled Variance	219813.6	
Hypothesized Mean Difference	0	
df	44086	
t Stat	1.268586	
P(T<=t) two-tail	0.204596	
t Critical two-tail	1.960018	

$75,000 to $99,999

	MVFT	*RUC*
Mean	601.1436	596.6046
Variance	278896.5	221579.2
Observations	16511	16511
Pooled Variance	250237.9	
Hypothesized Mean Difference	0	
df	33020	
t Stat	0.82443	
P(T<=t) two-tail	0.409701	
t Critical two-tail	1.960036	

$100,000 to $149,999

	MVFT	*RUC*
Mean	661.6221	663.3459
Variance	288942.7	244550.3
Observations	19622	19622
Pooled Variance	266746.5	
Hypothesized Mean Difference	0	
df	39242	
t Stat	-0.33059	
P(T<=t) two-tail	0.740956	
t Critical two-tail	1.960024	

$150,000 or more

	MVFT	*RUC*
Mean	699.9715	700.6949
Variance	310830.3	233127.4
Observations	14274	14274
Pooled Variance	271978.9	
Hypothesized Mean Difference	0	
df	28546	
t Stat	-0.11718	
P(T<=t) two-tail	0.90672	
t Critical two-tail	1.960047	

Note: Households without vehicles and households where data was missing for any of the relevant variables (fuel consumption, VMT, income) were removed from this analysis. Due to the removal of these households from this analysis, sample means and sample sizes may differ slightly from those shown in Exhibit 22 and Exhibit 23.

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

PAIRED SAMPLES T-TESTS FOR WASHINGTON STATE HOUSEHOLDS

Exhibit 31 shows the outputs of the paired samples t-tests for each of the six income groupings for Washington state households. Because we do not have a hypothesis about whether the amount paid under gas tax and RUC will be higher (the direction of the difference), we use two-tailed tests. These tests use an alpha of 0.05.

The null hypotheses for the six tests are as follows:

1. There is no difference between the amount that Washington state households with incomes less than $25,000 would pay under gas tax and the amount they would pay under RUC.
2. There is no difference between the amount that Washington state households with incomes of $25,000-$49,999 would pay under gas tax and the amount they would pay under RUC.
3. There is no difference between the amount that Washington state households with incomes of $50,000-$74,999 would pay under gas tax and the amount they would pay under RUC.
4. There is no difference between the amount that Washington state households with incomes of $75,000-$99,999 would pay under gas tax and the amount they would pay under RUC.
5. There is no difference between the amount that Washington state households with incomes of $100,000-$149,999 would pay under gas tax and the amount they would pay under RUC.
6. There is no difference between the amount that Washington state households with incomes greater than $150,000 would pay under gas tax and the amount they would pay under RUC.

As shown in Exhibit 31, none of the p-values (highlighted in pink) for any of the six tests are below the threshold of 0.05. This means that, for each test, there is a greater than 5% chance that we would see the differences between the sample means (average gas tax and average RUC costs) that we see if there were truly no difference between the two among these income groupings in the general Washington state population. This probability is too high for us to accept the null hypotheses, so we reject the null hypotheses and conclude that **we do not observe a statistically significant difference in costs paid under the gas tax versus RUC for any income group.**

Exhibit 31. Results from Paired Samples T-Test Comparing Gas Tax and RUC Costs for Washington State Households, by Income Grouping

T-Test: Paired Two-Sample Assuming Equal Variances

Less than $25,000

	MVFT	*RUC*
Mean	323.8469	314.7822
Variance	86073.84	70210.04
Observations	74	74
Pooled Variance	78141.94	
Hypothesized Mean Difference	0	
df	146	
t Stat	0.197246	
P(T<=t) two-tail	0.843909	
t Critical two-tail	1.976346	

$25,000 to $49,999

	MVFT	*RUC*
Mean	393.1894	409.9088
Variance	179051.2	291666.6
Observations	110	110
Pooled Variance	235358.9	
Hypothesized Mean Difference	0	
df	218	
t Stat	-0.25559	
P(T<=t) two-tail	0.798512	
t Critical two-tail	1.970906	

$50,000 to $74,999

	MVFT	*RUC*
Mean	461.1609	468.5456
Variance	142040.8	129677.4
Observations	126	126
Pooled Variance	135859.1	
Hypothesized Mean Difference	0	
df	250	
t Stat	-0.15902	
P(T<=t) two-tail	0.873779	
t Critical two-tail	1.969498	

$75,000 to $99,999

	MVFT	*RUC*
Mean	494.5397	490.0406
Variance	153353	132674.2
Observations	80	80
Pooled Variance	143013.6	
Hypothesized Mean Difference	0	
df	158	
t Stat	0.075243	
P(T<=t) two-tail	0.940116	
t Critical two-tail	1.975092	

$100,000 to $149,999

	MVFT	*RUC*
Mean	503.5153	523.8578
Variance	117017.6	108985.3
Observations	119	119
Pooled Variance	113001.4	
Hypothesized Mean Difference	0	
df	236	
t Stat	-0.46679	
P(T<=t) two-tail	0.641081	
t Critical two-tail	1.970067	

$150,000 or more

	MVFT	*RUC*
Mean	512.7429	504.7609
Variance	143440.3	97584.83
Observations	88	88
Pooled Variance	120512.5	
Hypothesized Mean Difference	0	
df	174	
t Stat	0.152519	
P(T<=t) two-tail	0.878955	
t Critical two-tail	1.973691	

Note: Households without vehicles and households where data was missing for any of the relevant variables (fuel consumption, VMT, income) were removed from this analysis. Due to the removal of these households from this analysis, sample means and sample sizes may differ slightly from those shown in Exhibit 22 and Exhibit 23.

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

REGRESSION ANALYSIS OF ESTIMATED RUC COSTS

The finding of no difference between average gas tax and RUC costs raises a question about the impact that vehicle fuel efficiency has on gas tax costs. Because RUC costs are purely driven by VMT and gas tax costs are driven by a combination of VMT and vehicle fuel efficiency, the finding of no difference in costs between the two programs seemingly implies that **vehicle fuel efficiency has minimal impact on the variation in total annual gas tax costs among Washington state households**.

To test this question, we run a regression analysis with household gas tax costs as the dependent variable and VMT and vehicle fuel efficiency as the independent variables. The advantage of using a regression analysis in this case is that it allows us to examine how much of the variation in total annual household gas tax costs is explained by VMT versus fuel efficiency.

The results of the regression analysis show that more than 90% of the variation in total annual gas tax costs for US households is explained by VMT and fuel efficiency together. Separate regressions analyzing the isolated impact of VMT and fuel efficiency show that **VMT accounts for 88.8% of the variation in total annual household gas tax costs, while fuel efficiency accounts for just 2.9% of the variation** (see Exhibit 33 and Exhibit 35**).**

The results of the same regressions for Washington state households have similar results – 88.7% of the variation in in total annual gas tax costs for Washington state households is explained by VMT and fuel efficiency together (Exhibit 35), with VMT explaining 86.2% of the variation and fuel efficiency explaining just 2.8% (results not shown).

Another way to consider this finding is to look at the coefficients for the VMT and fuel efficiency variables in the regression analysis (Exhibit 32). For each additional mile a US household drives, their annual gas tax costs increase by 2.5 cents – this is nearly identical to the proposed RUC rate of 2.4 cents, which makes sense as the proposed RUC rate has been calculated to be equivalent to the current per-mile gas tax costs for the average Washington state household. In fact, in the regression analysis for Washington state households, each additional mile driven increases a household's annual gas tax burden by 2.4 cents (Exhibit 35).

On the other hand, each additional mile-per-gallon (MPG) of fuel efficiency reduces a US household's annual gas tax burden by $12.26 (for Washington state households, it is $10.16). At first glance, this may seem large in comparison to the impact of miles driven, but the reverse is actually true when the full context is considered. The number of miles that US and Washington state households drive per year varies widely and one additional mile is a very small increment.

For example, US households at the 25th percentile of VMT drive 9,519 miles per year, but those at the 75th percentile drive 28,647 miles per year, a difference of more than 19,000 miles. The difference in total gas tax burden between these two households (if they have the same vehicle fuel efficiency) is $416.55 over the course of a year.

In contrast, the range of vehicle fuel efficiencies among US households is much narrower. A US household at the 25th percentile of fuel efficiency has an efficiency of 19.0 MPG, while a household at the 75th percentile has an efficiency of 25.0 MPG. The difference in total gas tax burden between these two households (if they drive the same number of miles) is $135.64 over the course of a year.

It is worth noting that these findings are based on 2017 data, when the percentage of hybrid and electric vehicles in the US and Washington state fleets are lower than they are in 2021, and likely

significantly lower than they will be in the years to come. As the proportion of hybrid and electric vehicles increases, the range of vehicle fuel efficiencies will increase and the impact of fuel efficiency on total annual gas tax burden is likely to rise as well.

Exhibit 32. Results from Regression Analysis of the Impact of VMT and Fuel Efficiency on Household Gas Tax Costs for US Households

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.953149784
R Square	0.908494511
Adjusted R Square	0.908493023
Standard Error	154.4201625
Observations	123002

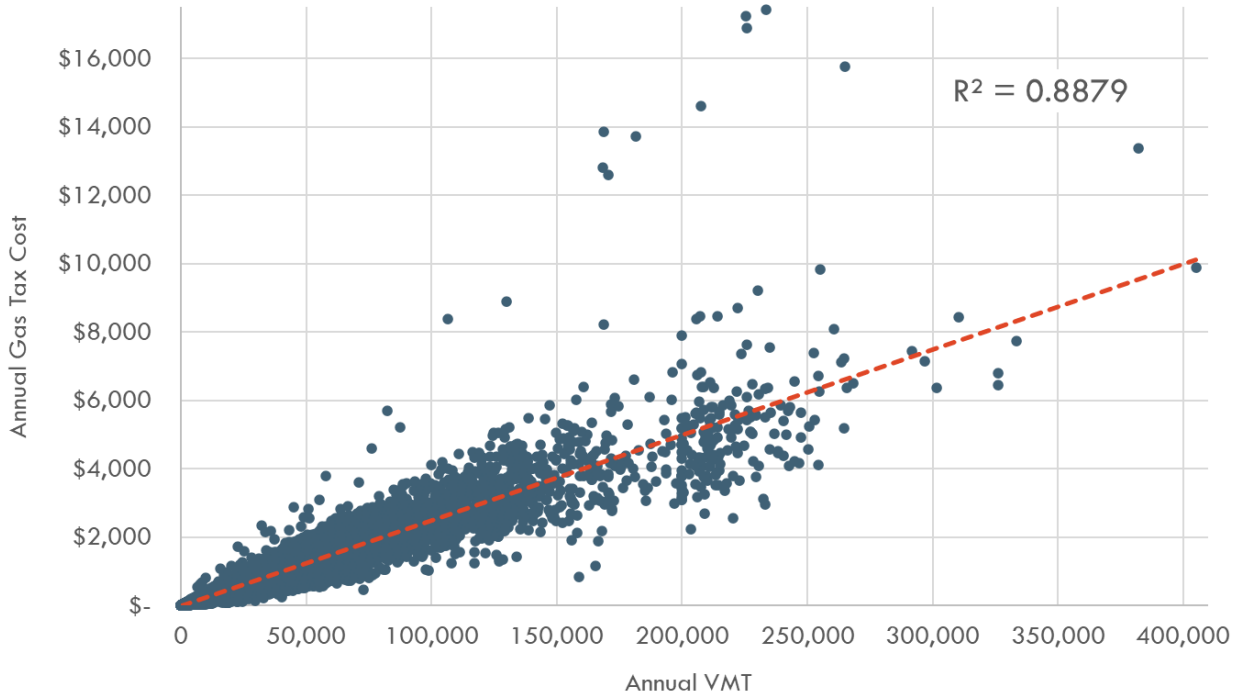
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	29119556249	14559778125	610585.8652	0
Residual	122999	2932983306	23845.5866		
Total	123001	32052539555			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	262.761128	1.809513175	145.2109504	0	259.2145124	266.3077435	259.2145124	266.3077435
Total VMT	0.02488538	2.28874E-05	1087.296577	0	0.024840521	0.024930239	0.024840521	0.024930239
Total MPG	-12.25867056	0.073657735	-166.427471	0	-12.40303848	-12.11430263	-12.40303848	-12.11430263

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

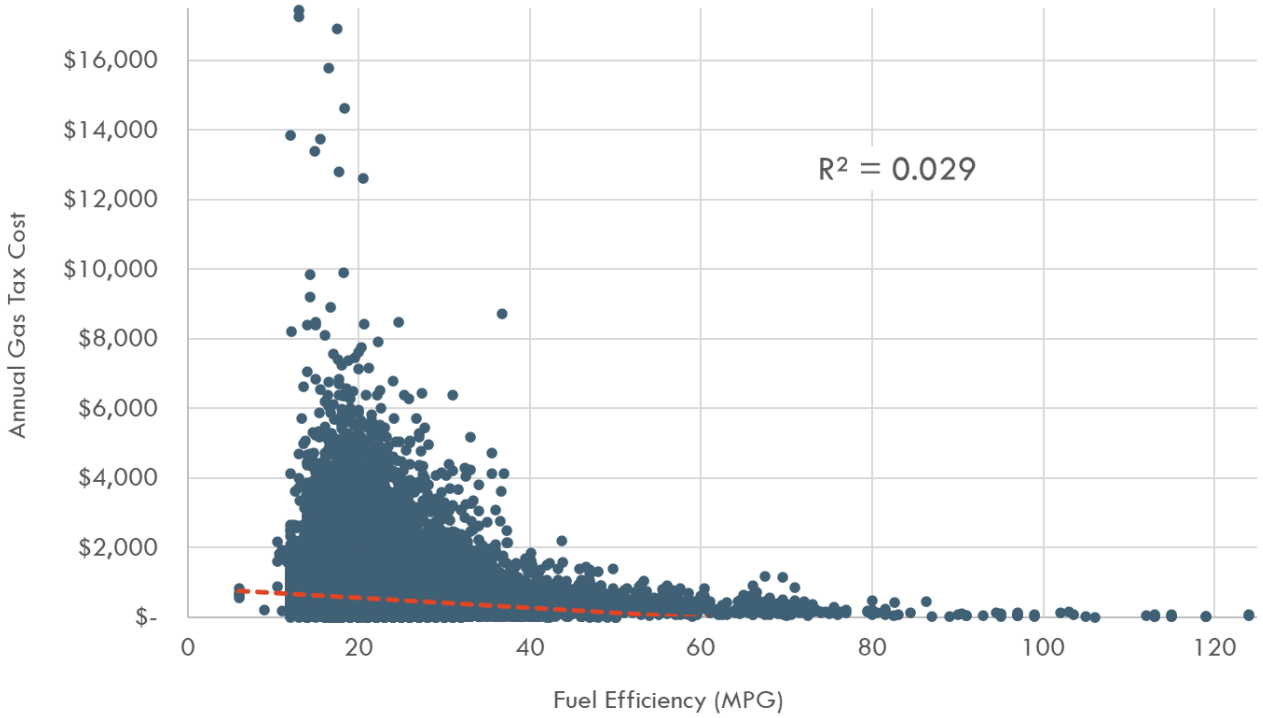
Exhibit 33. Relationship Between Annual VMT and Gas Tax Costs, US Households



Note: R^2 is a statistical measure that indicates the proportion (or percentage) of variation in a dependent variable that is determined by the variation in one or more independent variables.

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

Exhibit 34. Relationship Between Vehicle Fuel Efficiency and Gas Tax Costs, US Households



Note: R^2 is a statistical measure that indicates the proportion (or percentage) of variation in a dependent variable that is determined by the variation in one or more independent variables.

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

Exhibit 35. Results from Regression Analysis of the Impact of VMT and Fuel Efficiency on Household Gas Tax Costs for Washington State Households

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.942186784
R Square	0.887715936
Adjusted R Square	0.887351969
Standard Error	144.2370968
Observations	620

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	101483398.8	50741699.41	2438.995862	1.0547E-293
Residual	617	12836277.84	20804.3401		
Total	619	114319676.7			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	239.3346767	21.969702	10.89385175	2.13486E-25	196.1902187	282.4791346	196.1902187	282.4791346
Total VMT	0.023764592	0.000346045	68.67482866	3.62774E-291	0.023085023	0.024444161	0.023085023	0.024444161
Total MPG	-10.16212218	0.860365779	-11.81139747	3.62645E-29	-11.85172248	-8.472521876	-11.85172248	-8.472521876

Sources: Federal Highway Administration National Household Travel Survey, 2017; BERK, 2021.

Appendix C. Tax Incidence of State Gas Tax

This appendix provides justification for our assumption that consumers are currently bearing the full cost of the 49.4 cents per gallon gas tax (rather than sharing the true cost with fuel suppliers). If Washington transitioned from a gas tax to a RUC, consumers would continue to bear the full cost of the RUC cost. This means there would be no change in who is paying the true cost and we can compare the two taxing mechanisms using the full rate of 49.4 cents per gallon.

One of the primary differences between the proposed road usage charge (RUC) and the existing Washington State gas tax is that the RUC charges people for use of a resource (roads), while the gas tax charges people for a good they buy (gasoline).

- By design, there are only **two parties** involved in the process of paying the RUC – the vehicle owner (who pays the RUC) and the State (which receives the RUC).
- For the gas tax, there are **three parties** involved – the gas buyer, the gas seller, and the State.
- Foundational economic theory and extensive research by economists has shown that when a tax is imposed on a good that has a buyer and a seller, the tax burden is split between the buyer and seller (*even if the consumer appears to pay the price upfront*).[11] The nature of the split depends on the good.

To compare the impacts of a RUC and gas tax on taxpayers, we need to first understand what proportion of the current gas tax burden is borne by consumers of gasoline, as opposed to sellers. ***If consumers bear the full costs under both taxing mechanisms, then we can compare the two directly****, without adjusting the effective gas tax rate to account for any absorption of costs by gas sellers.*

Who pays taxes?

An important consideration when a government decides to impose a new tax on a good is, "**who will pay the tax?**" The distribution of the tax burden between consumers (or buyers) and producers (or sellers) is called the **tax incidence**.

An example: sales and excise taxes

For most sales and excise[12] taxes, the retailer collects the tax from customers and remits the revenue to the government that has imposed the tax.

For example, the State of Washington levies a 6.5% sales and use tax on most goods sold in the state. Retailers set prices for the goods they sell, calculate 6.5% of the sale price, and then charge that amount to consumers in sales tax at time of purchase. The retailer then remits the tax revenue collected from all its customers to the State monthly. In this case, **it seems like the consumer is paying the full amount of the sales tax**, because 6.5% is added to the sale price and the consumer pays this amount.

[11] Among others, see François Quesnay (1762), Adam Smith (1776), Edwin R.A. Seligman (1892), Gordon Hayes (1921), and Peter Mieszkowski (1969).

[12] Excise taxes are sales taxes on a specific good. The gas tax is an excise tax, along with alcohol taxes, cigarette taxes, etc.

However, in reality, retailers actually adjust the underlying price (the pre-tax price) of goods to account for the fact that consumers will pay a higher total price when the tax is applied. If retailers didn't adjust the underlying price, then they would sell fewer items because the price increase caused by the tax would lead some consumers to buy fewer goods. To avoid losing this revenue, retailers lower the price of their goods (thus absorbing some of the tax).

How much do they lower the price by?

The amount that the retailer will lower the price by depends on the type of good.

- For example, toilet paper and soap are household staples, so most people will continue buying the same amount they did before, even if the price is now 6.5% higher due to the tax.
  - If a retailer keeps the price of toilet paper or soap the same after a new tax is imposed, this likely will only have a very small effect on the number of toilet paper rolls or bars of soap it sells. Retailers can still sell the same number of toilet paper rolls and bars of soap even if they only reduce the pre-tax price by a very small amount.
  - For these types of goods, **consumers will bear most of the burden of the tax.**
- On the other hand, jewelry or leather handbags are not household staples and consumers that have limited ability to pay or who are frugal can more easily adjust their behavior to avoid paying the extra 6.5% due to a tax.
  - If a new tax is imposed that applies to jewelry or leather handbags, even small changes in price will cause some consumers to purchase these items less frequently or purchase lower-end versions of them.
  - Retailers have an incentive to lower the pre-tax price of the jewelry and handbags because selling them at a lower price is preferable to not selling them at all. So, retailers will reduce the pre-tax price by some percentage between 0% and 6.5%, *thus absorbing part of the cost of the tax,* even though the customer still pays 6.5% in tax beyond the new "pre-tax" price.
  - For these types of goods, **retailers will bear most of the burden of the tax.**

Price Elasticity

The factor that determines what proportion of the tax incidence falls on producers versus consumers is the **relative price elasticity of supply and demand. Price elasticity** refers to how sensitive consumers and producers are to changes in the price of a good.

- If consumer demand is highly price elastic (like jewelry or leather handbags), consumers as a group will respond to even small increases in the price of a good by reducing the quantity of that good that they collectively consume.
- If consumer demand is highly inelastic (like toilet paper and soap), then it requires a very large price change for consumers collectively to change the quantity of the good that they consume. Also inelastic are goods that have few or no substitutes (e.g., a name brand prescription drug without a generic alternative) and goods where consumers need lots of time to change their consumption patterns (e.g., automobiles, which most people only buy every few years at most).

The same principle applies to price elasticity of supply.

- If supply is highly elastic, producers will respond to small price drops by reducing the quantity of that good that they supply, while if it is highly inelastic, it will require a large price change for them to change the quantity they supply.
- The type of good and the way it is produced affects how easily producers can adjust the quantity that they supply.

Tax Incidence of the State Gas Tax

Economists have extensively studied the tax incidence of gasoline taxes.

- Chouinard and Perloff (2003) found that the incidence of state gasoline taxes **fall almost entirely on consumers**. In contrast, the incidence of the federal gasoline tax is split relatively evenly between consumers and producers. This is because producers can relatively easily adjust the quantity that they supply to states in response to their specific gas taxes. Consumers, on the other hand, have a hard time reducing their gasoline consumption in the short-term because decisions like moving closer to one's workplace, buying a more fuel-efficient vehicle, etc., cannot be made quickly. Thus, the price elasticity of supply is relatively more elastic than the price elasticity of demand as far as state gas taxes are concerned. It is more difficult for suppliers to adjust their quantity supplied on a national scale, so the incidence of the federal gas tax is more evenly split between producers and consumers.
- Marion and Muehlegger (2011) also find that state gasoline taxes are **fully and instantly passed on to consumers,** though they note this incidence shifts somewhat at times of supply chain constraint, such as during peak driving seasons and after natural disasters.

Washington State's Gas Tax

Given this study's exclusive focus on the State gas tax and its orientation towards order-of-magnitude estimates of consumer impact, **it appears justified to assume that the incidence of the Washington State gas tax falls entirely on consumers.** If Washington transitioned from a gas tax to a RUC, consumers would bear the full cost of the RUC cost.

This means there would be no change in who is paying the true cost under such a transition and we can compare the two taxing mechanisms as we have in this study.