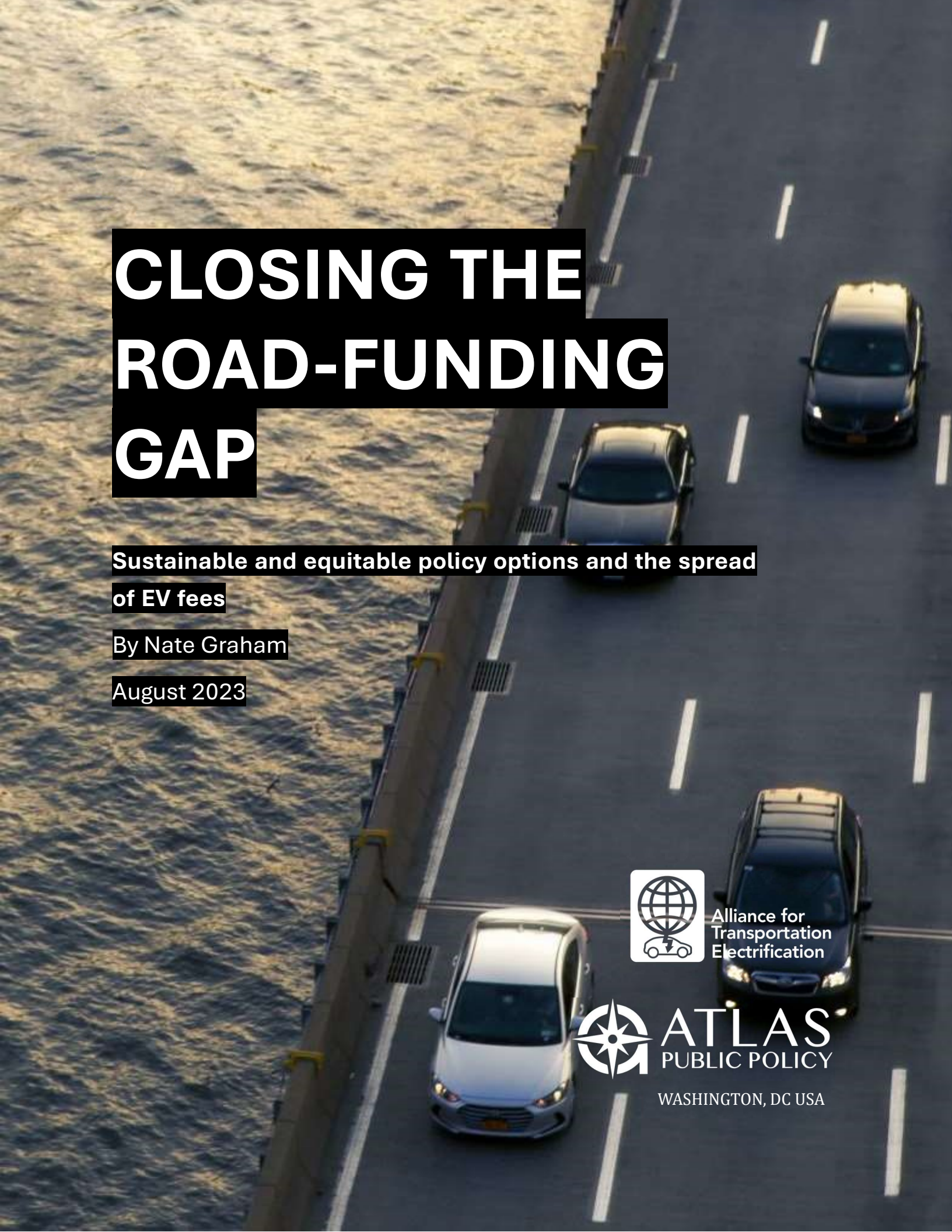


CLOSING THE ROAD-FUNDING GAP

Sustainable and equitable policy options and the spread of EV fees

By Nate Graham

August 2023

Alliance for Transportation Electrification

ATLAS PUBLIC POLICY

WASHINGTON, DC USA

Table of Contents

Acknowledgements

This report was coordinated with and supported by the Alliance for Transportation Electrification. We wish to thank Rick Tempchin from the Alliance for Transportation Electrification for extensive peer review and feedback. We would also like to thank Jamie Hall and Griffin Smith of General Motors, Tony Reinhart and Carter Wood of Ford, and Adriane Jaynes of American Electric Power for their peer review. The findings and views in this publication reflect the data, analysis, and views of the primary author of the report, Atlas Public Policy.

Acronyms

BEV	Battery electric vehicle
CAFE	Corporate Average Fuel Economy
CBO	Congressional Budget Office
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EIA	U.S. Energy Information Administration
EPA	U.S. Environmental Protection Agency
EV	Electric vehicle
FHWA	Federal Highway Administration
HEV	Hybrid electric vehicle
HTF	Highway Trust Fund
LDV	Light-duty vehicle
MPG	Miles per gallon
MPGe	Miles per gallon equivalent
NHCCI	National Highway Construction Cost Index
PHEV	Plug-in hybrid electric vehicle
RUC	Road usage charge
VMT	Vehicle-miles traveled

Executive Summary

Taxes on motor fuel have historically been the primary mechanism for funding public road infrastructure on the federal level and in recent years have provided roughly a third of road funding for state governments, which carry out the majority of road spending. However, over the past two decades, motor-fuel tax revenues have failed to keep pace with road spending in the face of inflation, fuel economy improvements, and slowing growth in vehicle-miles traveled (VMT), leading to a growing road-funding gap.

The accelerating sales growth of highly efficient cars and trucks, from gasoline vehicles to battery electric vehicles (BEVs), is now adding to the pressure on motor-fuel tax revenues. The latest federal fuel economy standards proposal would see new light-duty vehicles (LDVs) average an estimated 58 miles per gallon by 2032. However, the effect of electric vehicles (EVs) themselves is currently marginal compared to that of more efficient conventional vehicles. The 1.45 million light-duty BEVs registered in the United States in 2021 accounted for just 0.5 percent of all light-duty vehicles. Based on the gasoline taxes paid by the average new light-duty vehicle, this figure corresponds to just 0.5 percent of the gap between 2021 federal motor-fuel revenues and highway spending.

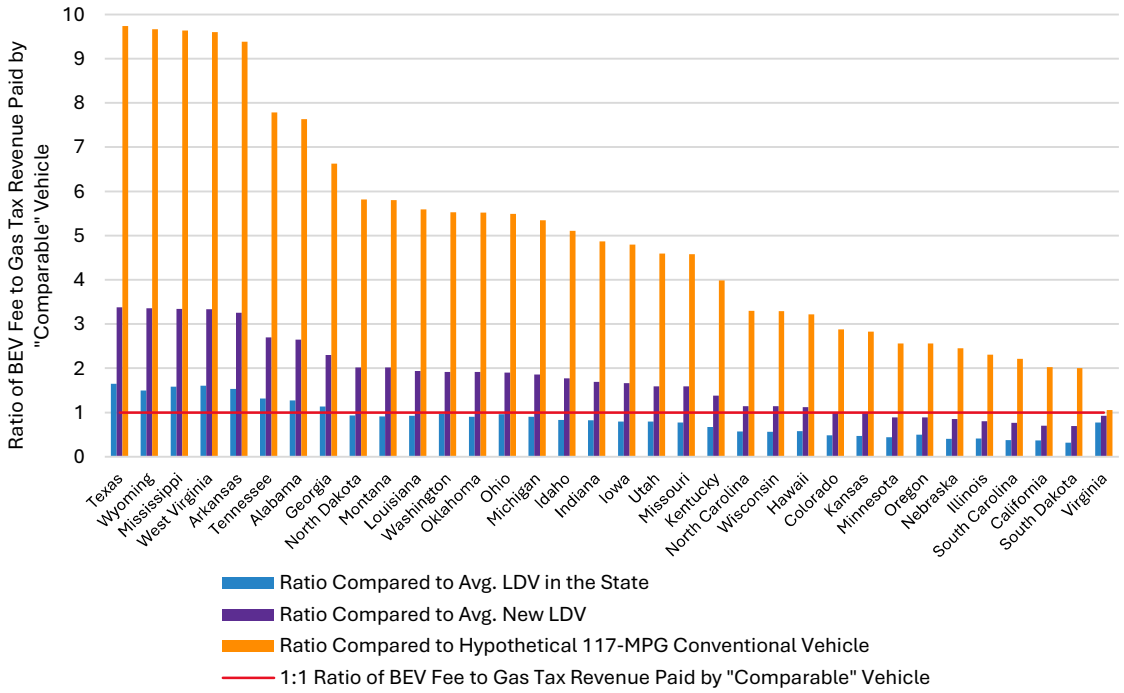
Despite the marginal impact of EVs on highway revenues to date, and likely for some years into the future, additional annual registration fees for EVs have been at the center of the road-funding conversation in many states. For BEVs, these fees range from $50 to more than $200 and average $126 (weighted by vehicle stock) among the 34 states that have adopted them. While they can play a role in ensuring that EV drivers contribute fairly to funding roads in lieu of paying gas taxes, in a number of states, these fees also result in EV drivers paying, on average, more than their fair share.

No flat registration fee will be as fair as a fee that is actually based on an individual's road use, but barring that, the "fair" level for an EV registration fee is a matter of perspective. One definition of a fair BEV fee is one equivalent to the annual gas tax revenue paid for the average LDV registered in the state, which would maintain funding close to current levels. Another option is for EV drivers to pay a registration fee equivalent to the gas taxes paid for the average new vehicle. This reflects the fact that new vehicles are overall more efficient than the average vehicle currently registered.

A third method is for EV drivers to pay a fee equivalent to the hypothetical gas tax they would pay for a comparable, highly efficient gasoline vehicle based on their EV's miles per gallon equivalent (MPGe). With an average of 117 MPGe, BEV drivers would pay far less in taxes than other drivers, but they also pose fewer non-road-use external costs such as greenhouse gas emissions along with air and noise pollution, bearing in mind that they still contribute to externalities such as congestion, collisions, and road damage.

Depending on the definition of fairness, of the BEV fees currently in place across the country, the number that charge EV drivers more than their fair share ranges from eight to all 34, as shown in the following figure.

Figure ES-1: Comparison of Existing BEV Fees with Gas Taxes Paid by Three Definitions of "Comparable" Vehicle



This figure shows how each state's BEV fees compare to the gas tax revenue paid by the average "comparable" vehicle in their state, represented by the red line, using three definitions of "comparable." These are: a) the average light-duty vehicle currently registered, for which fuel economy data varies by state, b) the average new light-duty vehicle, which has an estimated 40.6 MPG based on model year 2024 CAFE standards, and c) a hypothetical conventional vehicle with a fuel economy of 117 MPG, which is the energy-basis MPGe of an average BEV. Note that states are listed in descending order according to point of comparison "c." State-level VMT data and gas tax rates are used for each comparison.

Source: U.S. Energy Information Administration, U.S. Department of Transportation, U.S. Department of Energy, Atlas Public Policy

In addition to being unfair in some cases, and only marginally helpful for closing the road-funding gap, these fees can potentially depress EV adoption even as other policies seek to drive it up. Researchers at the University of California, Davis estimated in 2018 that a $100 annual fee could result in a decrease in EV adoption of 11 to 24 percent. Thus, there is a need to broaden the focus from EVs to a policy mix that will fund roads sustainably, equitably, and adequately.

A range of other road-funding policies are used to varying degrees in the United States. While the federal government and all 50 states tax motor fuel, the rates vary substantially and most do not automatically rise with inflation. Tolls are another mechanism used in around 35 states. Three states have voluntary road usage charge (RUC) programs that charge drivers by the mile, while at least 30 others are studying this method. Many states and the federal government collect additional taxes and fees on commercial road use and several states dedicate a portion of general revenues to transportation. Recently, numerous states have turned their focus to collecting revenue from efficient vehicles, mostly through the registration fees discussed, but also through taxes on the electricity used at public EV charging stations. Seven states have enacted such taxes to date.

All the policies discussed above come with tradeoffs when evaluated against criteria that policymakers are likely to consider within the context of their jurisdiction. These include revenue sustainability, fairness, equity, cost-effectiveness, political viability, and a policy's role in reducing environmental impact and advancing transportation electrification. Potential for revenue generation is an additional criterion but is highly dependent on the rates of taxes or fees, which in turn depend heavily on other criteria and how a given measure fits within a state's policy mix.

If states choose to use EV fees to collect transportation revenue as part of their policy package, they should do so in a way that does not disproportionately burden EV drivers, particularly as they seek to encourage EVs with other policies. In doing so, they could consider other taxes, such as a sales tax or gross receipts tax on electricity, that EV drivers already pay, and whether this revenue can be redirected to transportation if it is not already. They could also blunt the impact of EV fees on adoption, such as through phase-ins, and avoid double taxation pitfalls, such as seeking to recover lost federal gas tax revenues through state EV fees. As used and more affordable EV models become available, reducing the barrier of large one-time costs, such as through an option to pay in installments, will grow in importance as an equity issue.

Ultimately, though, in most states EV drivers will contribute only marginally to the funding gap for some time, and in general, road-funding policies should focus on ensuring that all drivers equitably and sustainably fund roads. To do so, policymakers can enact a suite of complementary, nonoverlapping policies based on their state's transportation funding sources and needs and on the priorities, demographics, and economic realities of their constituents.

Introduction

Taxes on motor fuel have historically been the primary mechanism for funding public road infrastructure on the federal level and in recent years have provided roughly a third of funding on the state level, where the majority of spending takes place.[1] This is based on the premise that road users should contribute more than others to maintaining and expanding the highway system. However, over the past two decades, motor-fuel tax revenues have failed to keep pace with expenditures due to inflation, stagnant motor-fuel tax rates, increasing fuel economy, and slow growth in vehicle-miles traveled (VMT). Despite the prevalence of these factors, in recent years, the increasing popularity of electric vehicles (EVs) and the potential to decrease transportation tax revenues have led to a disproportionate focus on charging EV drivers to fund transportation. Annual registration fees and similar measures such as energy-based taxes on charging, or "EV charging taxes" for short, that are focused only on EV drivers can discourage EV adoption at a critical juncture for the decarbonization of the transportation sector and in many states, introduce a financial burden for EV drivers that could be considered unfair.

This issue brief summarizes the current sources of federal and state road funding, discusses funding trends and the reasons for the road-funding gap, and illustrates that EVs currently represent a very small share of the problem. It lays out a series of policy options for states to fund roads sustainably and equitably and ensure that all users, including EV drivers, pay their fair share. The paper also sketches out the national state of play for each of these policies and assesses their performance along key criteria, outlining each policy's inherent tradeoffs. Finally, given the current popularity of additional registration fees for EVs as a transportation-funding tool, this brief will discuss several interpretations of how a "fair" EV fee would be designed, and how current state policies stack up against these different definitions.

[1] Motor-fuel taxes generate funds for public transit in addition to roads. For instance, in 2021, roughly one sixth of federal motor-fuel tax revenues were destined for the Federal Highway Trust Fund's Mass Transit Account, with the rest dedicated to the Highway Account [2]. Although the funding gap from motor-fuel tax collections affects public transit, this paper focuses on road funding because it is the primary use of motor-fuel tax revenue. Additionally, data on the sources and uses of funding for roads is publicly available through the Federal Highway Administration's annual Highway Statistics Series, on which this report relies considerably.

State of U.S. Road Funding

In 2020, federal, state, and local governments in the United States spent nearly $270 billion on roads (synonymously, "highways") [1].[2] State governments generated roughly 55 percent of this funding, while local governments raised 28 percent, and the federal government, 17 percent. However, almost all federal road funding (95.4 percent in 2021) is ultimately channeled to state and local governments, which own over 99 percent of public roads [2] [3]. The sources of funding for highways vary by jurisdiction, but motor-fuel taxes are generally an important and declining revenue stream.

Federal Funding Sources and Trends

Taxation of motor fuel is the most important source of federal highway funding. From 2012 to 2021, motor-fuel taxes accounted for roughly two thirds of federal highway funding, with the rest coming from general funds and from taxes on tires and on the sale and use of heavy-duty vehicles [4]. In fact, until 2008, the federal Highway Trust Fund (HTF) was funded exclusively by fuel and vehicle fees based on a) the premise that users should be the ones paying for highway maintenance and expansions and b) the assumption that these fees would provide a consistent source of revenue without the need for congressional approval [5]. Over the last two decades, however, motor-fuel tax revenues have failed to keep pace with highway spending, leading to a growing funding gap (see Figure 1).

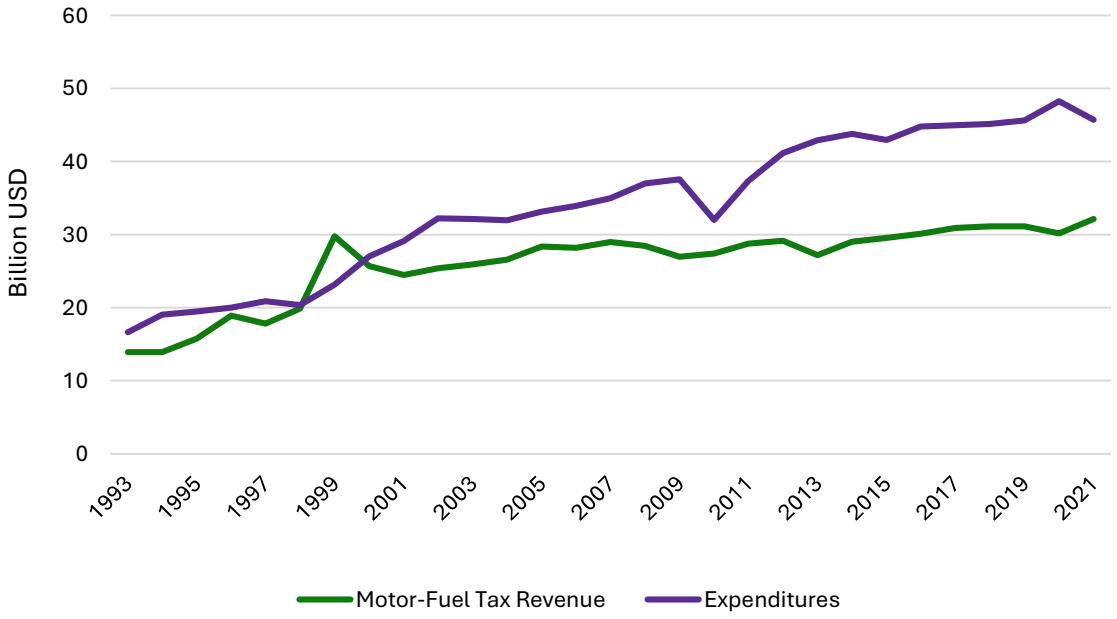
In 2021, federal motor-fuel tax revenues covered only 70 percent of highway expenditures, in contrast with 1999, when revenues exceeded spending by 30 percent [4]. As a result, the federal government has increasingly relied on transfers of general funds for highway spending. From 2008 to 2021, Congress transferred over $150 billion in general funds to the HTF and in 2021 the Congressional Budget Office (CBO) projected that the HTF would be "exhausted" in 2022 [3]. However, the 2021 Infrastructure Investment and Jobs Act (IIJA) ensured the fund's solvency until 2027 with a new infusion of $118 billion of general funds [6].

Even with general revenue transfers, current spending levels are not meeting U.S. infrastructure needs. The CBO estimates that to maintain current highway conditions and performance, average annual spending from 2022 to 2031 would have to be 22 percent greater than in 2021, and to fund all net-benefit projects, 58 percent greater [3].

---

[2] There is a valuable debate over how government spends money on transportation, for example, by expanding highways and implicitly providing an incentive for greater road use while underinvesting in public transportation and other modes of transit. This issue brief assumes that a large degree of funding for roads is essential and focuses on strategies for collecting this revenue.

Figure 1: Federal Motor-Fuel Tax Revenue and Highway Expenditures



This figure shows how federal highway expenditures have increased at a faster rate than federal motor-fuel tax revenues over the past three decades, leading to a growing funding gap and an increased reliance on general transfers. Over the 2017-2021 period, the expenditures of the HTF Highway Account exceeded its motor-fuel tax revenues by more than $74 billion.

Source: Federal Highway Administration (FHWA)

There are several reasons for the increasing gap between motor-fuel revenues and highway spending. The first is simply inflation. The federal tax rates on gasoline and diesel have not increased from 18.4 cents and 24.4 cents per gallon, respectively, since 1993 [7]. Had these rates been indexed to an inflation rate like the consumer price index, they would now be roughly 39 and 51 cents per gallon [8]. However, over the past three decades they have remained flat as highway construction costs have risen substantially, even outpacing the overall rate of inflation. The National Highway Construction Cost Index (NHCCI), compiled by the Department of Transportation (DOT) since 2003, shows that costs more than doubled between 2003 and 2021 alone [9].

The second reason for the federal road-funding shortfall is increased fuel economy due to technological improvements and government regulation. Federal Corporate Average Fuel Economy (CAFE) standards, after remaining largely flat from 1985 to 2010, have nearly doubled since 2010 to 52.9 miles per gallon (MPG) for model year 2024 passenger cars, and risen by 60 percent to 37.5 MPG for 2024 light-duty trucks [10]. In real terms, from 2005 to 2020 this corresponded to a 29 percent improvement in the average fuel economy

of new light-duty vehicles (LDVs) and a 14 percent improvement in the fuel economy of the overall light-duty vehicle fleet [11] [12]. This has led to a slowdown in the increase in motor fuel consumed. While vehicle registrations grew 25 percent from 2000 to 2019, the total motor-fuel volume taxed rose just 15 percent during that period after rising 40 percent over the previous two decades [13] [14]. This upward pressure on fuel economy will continue. The latest federal fuel economy standard proposal would see new LDVs average an estimated 58 MPG by 2032 [15].

Since model year 2014, the Environmental Protection Agency (EPA) has also begun implementing standards for medium- and heavy-duty vehicles given their significant contribution to air pollution and greenhouse gas emissions. This will further cut into highway funding revenues. Until recently, a lack of standards for larger vehicles has slowed the fuel economy improvement of the total fleet. Overall, vehicle-miles traveled per gallon of motor fuel taxed increased just 3.5 percent from 2000 to 2019 [14] [16].

Additionally, although increased VMT is inherently positive for motor-fuel tax revenue, substantially slower VMT growth over the past two decades has negatively impacted revenue relative to what may have been expected based on historical trends. After growing 76 percent from 1980 to1999, total national VMT grew just 19 percent from 2000 to 2019 [16]. There are multiple possible reasons for this, including a slowdown in suburbanization, a dip due to the Great Recession of 2008, and the ageing of the population [17]. Regardless of the reasons, this trend is expected to continue, with important implications for the planning of road funding. The U.S. Energy Information Administration (EIA) projects that light-duty VMT will increase just 23 percent between 2022 and 2050 [18].

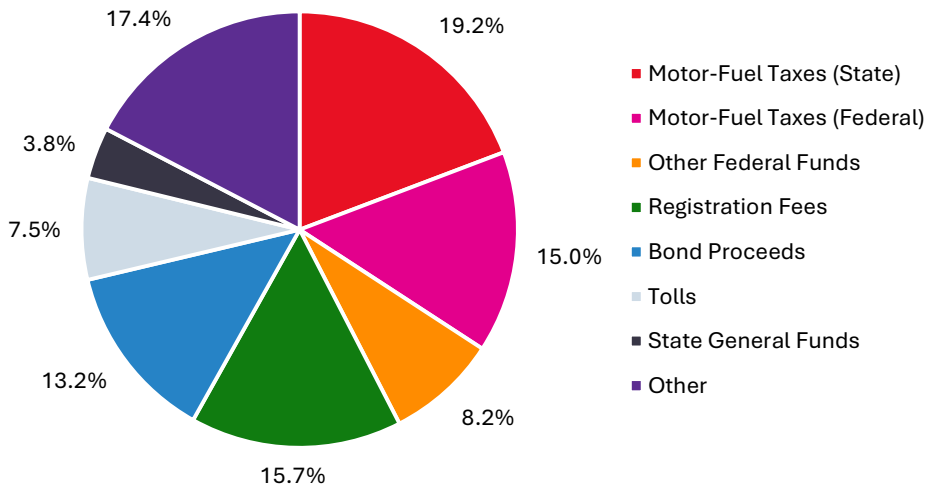
Finally, the increase in fuel economy of the overall vehicle fleet has begun to accelerate with the advent of battery electric vehicles (BEVs), which consume no motor fuel whatsoever and average over 100 miles per gallon equivalent according to the Department of Energy (DOE) [19]. The market share of BEVs in new LDV sales has nearly tripled in less than two years, reaching an all-time high of almost 7.5 percent in Q1 of 2023 [20].

Still, given the low turnover rate of the LDV fleet, so far, the effect of EVs on motor-fuel tax revenues has been extremely marginal. Light-duty vehicles in the United States have an average useful life of about 17 years and many, especially light trucks, stay in use for 30 years or more [21]. The number of light-duty BEV sales in 2022 was equivalent to just 0.3 percent of all light-duty vehicles registered the previous year [22] [23]. In 2021, 1.45 million light-duty BEVs were registered in the United States, accounting for 0.52 percent of all vehicles [24]. Based on the gasoline taxes paid by the average new light-duty vehicle, this figure corresponds to a loss of just 0.2 percent of total federal highway revenues from motor fuels, and 0.5 percent of the gap between 2021 federal motor-fuel revenues and highway expenditures.

State Funding Sources and Trends

Compared to the federal level, motor-fuel taxes account for a much smaller share of road funding for state governments, which carry out the majority of road spending. From 2017 to 2021, state motor-fuel taxes accounted for only 19.2 percent of state revenues for highways, with the contribution of federal motor-fuel taxes to federal highway aid adding another 15 percent (see Figure 2). The other two thirds of state funding came from a diversity of sources including registration fees (15.7 percent) and bond proceeds (13.2 percent) [25] [26] [27] [28] [29].

Figure 2: Revenues Used by States for Highways (2017-2021)



This figure shows that while over a third of revenues that states spent on highways from 2017 to 2021 came from motor-fuel taxes, a range of other sources also contributed. Appendix A shows that this breakdown varies significantly by state.

Source: FHWA

The breakdown of funding sources varies significantly from state to state. For example, from 2017 to 2021, federal funding ranged from a share of just 10.4 percent in Delaware to 59.9 percent in Montana. Overall reliance on motor-fuel tax revenue (both state and federal) ranged from 9.8 percent in New Jersey to 64.7 percent in Tennessee. Registration fees accounted for 44.3 percent of highway spending in Iowa and tolls reached 26.4 percent in New York. Washington, DC (26.0 percent) and Alaska (20.5 percent) led the nation in use of state general funds and Massachusetts in bond proceeds (51.6 percent). Appendix A shows the detailed breakdown for each state.

The same set of factors that affect federal motor-fuel tax revenues (inflation, fuel economy, and VMT) do so on the state level as well. However, because states are generally less reliant on motor-fuel tax for highway spending than the federal government, the impacts are less pronounced on average. There is also considerable variation among states.

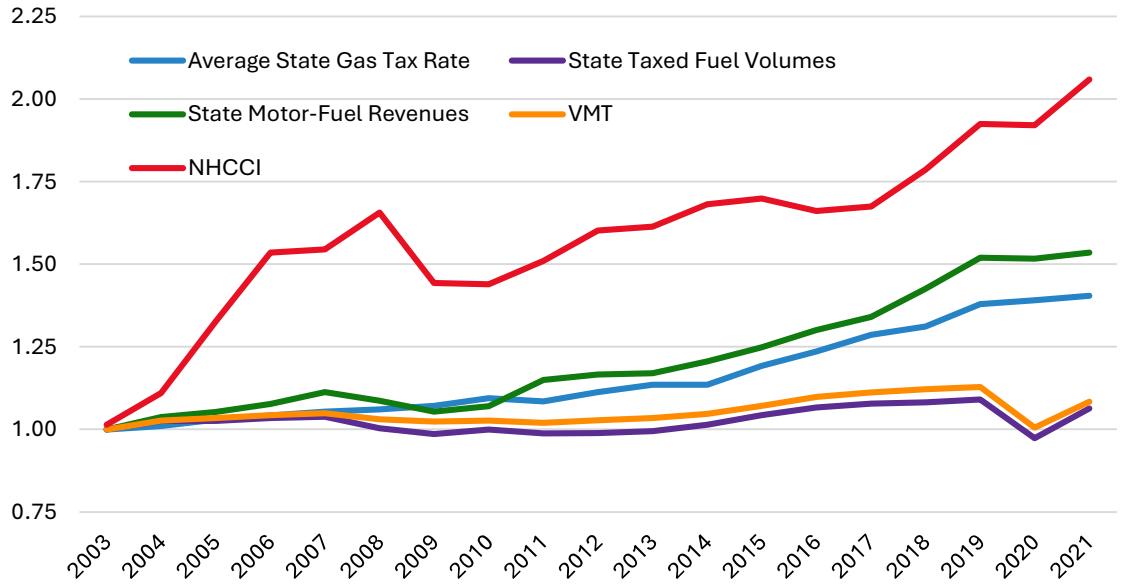
With respect to inflation, while the federal tax rate on gasoline and diesel has not increased for three decades, most states have raised taxes at least to a degree. On average, state gasoline tax rates in 2021 were about 40 percent higher than in 2003 (see Figure 3) [30]. While New Mexico and Mississippi had rates slightly below 2003 levels, New Jersey and Georgia had rates more than 3.5 times as high as 2003 levels. Overall, state gasoline tax rates have increased faster than the NHCCI in just six states.

Data on state-level trends in fuel economy and VMT are more limited, but the trend of taxed motor-fuel volumes is clear. The state with the largest growth in taxed motor fuel-volumes from 2003 to 2021 was Idaho, with growth of 42 percent, while 19 states, plus the District of Columbia, saw volumes decrease [14]. When combined with the slow increases in motor-fuel tax rates, the result is that five states plus DC already collect less motor-fuel tax revenue than 20 years ago. Only two states, Georgia and California, saw growth in revenues from 2003 to 2021 that exceeded the growth in the NHCCI.

Figure 3 shows how the NHCCI has outpaced the growth of various metrics related to highway funding over the past two decades.

While EV adoption also varies substantially across states, in no state did BEVs surpass two percent of LDV registrations in 2021. Only California (1.61 percent), Hawaii (1.32 percent), and DC (1.15 percent) had penetration of greater than one percent. Mississippi and North Dakota had penetration of just 0.05 percent, while the median state was Pennsylvania, with 0.26 percent [24]. See Figure 4 for a tally of the states with the top EV share of light-duty vehicles, including plug-in hybrid electric vehicles (PHEVs).

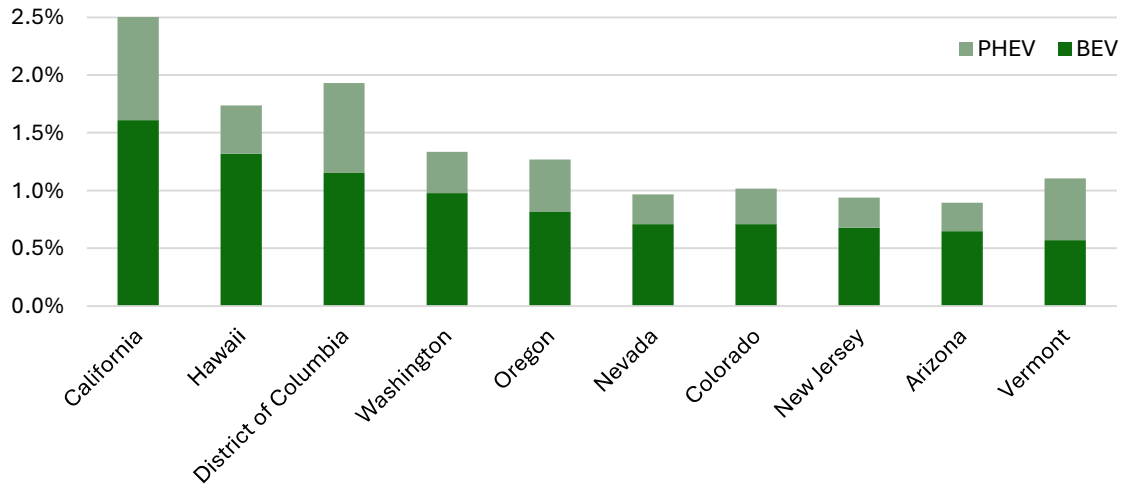
Figure 3: Trends Related to Transportation Funding (2003 = 1)



This figure shows how the NHCCI has significantly outpaced the growth of various metrics related to state highway funding over the past two decades.

Source: FHWA, EIA, DOT, Atlas Public Policy

Figure 4: EV Share of Light-Duty Vehicles in Top Ten States (2021)



This figure shows that even in the top 10 states, including DC and ranked in descending order by BEV penetration, EVs represent a very small fraction of the light-duty vehicle stock. The low turnover rate of light-duty vehicles counteracts EVs' rapidly increasing share of new sales.

Source: DOE

Accordingly, the impact of EVs and the associated loss of motor-fuel tax revenue is currently very low. Based on the gas taxes paid by the average new light-duty vehicle, the loss of state motor-fuel tax revenue from light-duty BEVs in 2021 was at most equivalent to 0.45 percent of state highway spending (California). In Alaska, North Dakota, and Mississippi it accounted for less than 0.01 percent. Overall, lost state motor-fuel tax revenue from light-duty BEVs was equivalent to 0.09 percent of state highway spending in 2021.

In addition to the small but growing share of EVs in the light-duty vehicle fleet, conventional hybrids have grown in popularity in recent years, reaching almost two percent of registrations in 2021 [24]. More importantly, the fuel economy of conventional vehicles has increased substantially. For example, between model years 2011 and 2018, the combined fuel economy of a gasoline-fueled, two-wheel-drive Ford F-150 pickup increased almost 60 percent, from 14 to 22 MPG [31]. These factors negatively impact motor-fuel tax revenues far more than the rise of electric vehicles.

If transportation electrification trends continue, EVs will eventually play a greater role in the road-funding gap. Tax incentives in the 2022 Inflation Reduction Act (IRA) could result in EVs accounting for 19-57 percent of LDV sales in 2030, depending on production costs [32]. Still, low LDV turnover will depress the impact of these sales on the overall fleet. The International Energy Agency projects that EVs will account for just 16 percent of cars on the road in the United States in 2030 [33]. Meanwhile, the growing efficiency of conventional gasoline and diesel vehicles and rising road construction costs will continue to play major roles in the road-funding challenge.

Despite the extremely marginal impact of EVs on highway revenues to date, and likely for some years into the future, additional charges for EVs have been at the center of the road-funding conversation in many states. These fees focus on forcing EV drivers to pay their fair share of road funding even as the persistent shortfall in road funding indicates that not even the *average* driver is paying their fair share. In some cases, states charge EV drivers more than the average driver pays in gas tax, which could slow EV adoption even as other state policies seek to expand EV adoption to mitigate climate change and reduce local air pollution. Thus, there is a need to broaden the focus from EVs to a policy mix that will fund roads sustainably, equitably, and adequately.

Policy Options

A range of policies to collect revenue for roads are used or discussed to varying degrees in the United States, as summarized in Table 1. These currently include:

- **Motor-fuel taxes**, including taxes automatically indexed to factors like inflation or average fuel economy.
- **Tolls**, including congestion pricing, which charge users in rough proportion to the benefits they receive from road use and the costs they impose on road conditions and other drivers.
- **Road usage charges** (RUCs), also known as VMT fees or mileage-based user fees (MBUFs), which are more exact usage-based fees that precisely quantify individuals' road use regardless of fuel type.
- **Taxes on commercial activities**, such as increased registration fees and tolls for commercial vehicles, weight-distance taxes on heavy vehicles, retail delivery fees, commercial VMT programs, or commercial activity surcharges [34].
- **Efficient-vehicle registration fees**, which seek to recoup motor-fuel tax revenues not collected from drivers of EVs, PHEVs, conventional hybrid electric vehicles (HEVs), and high-MPG conventional vehicles, generally through a flat annual surcharge.
- **EV charging taxes**, which mimic a motor-fuel tax by charging EV drivers for the electricity they use to power their vehicles, either by the unit of energy (kilowatt-hour) or the retail cost.
- **General revenues** collected from sources such as income and sales tax that are earmarked for transportation but unrelated to road use.

Table 1: Sample Federal and State Road-Funding Policies and Status

Policy Option	State of Play
Motor-fuel taxes	• All 50 states and the federal government tax motor fuel. • Federal gasoline and diesel taxes have not risen since 1993 and stand at 18.4 and 24.4 cents per gallon, respectively [7]. • State gas taxes range from eight cents per gallon (AK) to 61 cents per gallon (PA), with an average of 27.1 cents per gallon [35] [36]. • 10 states have a gas tax rate equal to or below the rate in 2003 [30] [35] [36]. • 15 states have raised gas tax rates in 2023 [35] [36]. • 10+ states vary gas tax rates with inflation, highway construction costs, and/or revenue needs [37]. • GA varies gas tax rates in line with both inflation and improvements in fuel economy.
Tolls	• ~35 states have existing toll roads. • Cities in various states, including CA, FL, MN, NY, TX, and VA, use forms of congestion pricing [38]. • In 2024, New York City will become the first U.S. city to charge drivers to enter a specific zone (Manhattan's central business district), known as "cordon pricing" [39].
Road usage charges	• OR, UT, and VA have voluntary RUC programs. • At least 30 additional states have researched and/or piloted such systems, including through the Eastern Transportation Coalition and RUC America [40] [41] [42]. • The U.S. Department of Transportation is conducting a nationwide RUC pilot testing different collection tools, methodologies, and public awareness campaigns [43].
Taxes on commercial activities	• The federal government imposes excise and use taxes on heavy-duty vehicles, which accounted for roughly 13 percent of net income to the HTF Highway Account in 2021 [4]. • Heavy vehicles generally pay higher tolls based on axle count, size, and/or weight [44], as well as higher registration fees.

Policy Option	State of Play
	• In 2023, CT became the fifth state that collects weight-distance taxes on heavy vehicles [45]. • CO and MN have both recently passed fees on retail deliveries to fund transportation [46] [47]. CO's also cover ride sharing. WA and NY have also considered such measures [48] [49].
Efficient-vehicle registration fees	• 34 states charge BEV drivers additional annual registration fees, ranging from $50 (HI, SD) to $225 (WA). • 28 of those states charge additional fees on PHEV drivers as well, and 15 on HEV drivers. • OR and VA charge fees for high-MPG gasoline vehicles. • These fees are all detailed in Appendix B.
EV charging taxes	• Seven states have passed additional taxes on electricity used at public EV charging stations (see Appendix B). UT charges a 12.5 percent tax on the retail cost, and the other six states charge by the kilowatt-hour (1.8 cents in PA, 2.6 cents in IA, 2.8 cents in GA, and 3.0 cents in KY, MT, OK). • PA's measure applies to private charging as well, but this is based on self-reporting and compliance is low [50].
General revenues	• From 2017 to 2021, most states used state general funds to some degree, but they accounted for just 3.8 percent of overall state highway spending [25] [26] [27] [28] [29]. • ID, LA, and NC have all recently passed legislation permanently dedicating a portion of sales taxes to transportation infrastructure [51] [52] [53]. • The use of general revenues is generally much more prevalent on the federal level than the state level. Ad hoc general revenue transfers account for around a quarter of federal highway spending since 2008 [4].

This table shows some of the policy options for funding roads and examples of how they are currently used at the federal and state levels. As the traditional funding stream of motor-fuel taxes has become less reliable in recent decades, some states have responded by raising these taxes, while others have turned to more novel solutions, especially in recent years. These solutions include EV registration fees, EV charging taxes, retail delivery fees, and road usage charges.

Policy Criteria

As the federal government and states seek solutions to chronically underfunded transportation, they are likely to evaluate their policy options within the context of their jurisdiction and along a range of criteria which could include revenue sustainability, fairness, equity, cost-effectiveness, political viability, and their role in reducing environmental impact and encouraging transportation electrification [54]. Potential for revenue generation is an obvious additional criterion but is highly dependent on the rates of taxes or fees, which in turn depend heavily on other criteria and how a given measure fits within a state's policy mix.

Revenue Sustainability

Road-funding policies should provide a long-term solution, as opposed to short-term stopgap measures like the periodic general revenue transfers that have maintained the solvency of the HTF. A predictable and consistent stream of revenues for roads enables long-term planning not just in transportation, but also in other areas that rely on general funds.

Raising motor-fuel taxes may be sustainable in the short and medium term, particularly if rates automatically increase in line with inflation, revenue needs, or some other measure. Automatically raising rates by a small amount each year gives consumers visibility into future gas tax rates and preempts the need for increases that are large, irregular, and politically challenging. While inflation is an important factor that depletes the real value of transportation revenues, policies can also account for other factors. For instance, Georgia's increasing gasoline tax rate accounts not only for inflation, but also for improvements in fuel economy. The National Resources Defense Council has proposed going one step further by indexing the gas tax to total fuel consumption so that effectively the same amount of revenue is collected each year [55].

Eventually, however, longer-term solutions will be necessary to replace gas tax revenues. Either EVs will become a large enough share of the fleet that even inflation-adjusted fuel taxes are insufficient, or, if indexing to total fuel consumption, the tax rate will rise to a level that is politically infeasible, likely with greater incidence on lower-income drivers who are less able to purchase an EV. Any of the other options cited above (e.g., tolls, RUCs, and EV registration fees) could theoretically serve as a substitute as long as revenues increase at a rate consistent with road construction costs.

Fairness

There are different ways of thinking about whether policies are fair to road users and those who benefit indirectly from road use. The traditional "user pays" principle dictates that one's contribution to road spending should be proportionate to their road use. Alternatively, a "beneficiary pays" principle reflects the degree to which one benefits from road use, for instance, through the transportation of goods.

Mechanisms such as RUCs and tolls adhere to the "user pays" principle while discouraging unnecessary road use, thereby reducing road damage. Tolls with congestion pricing have the added benefit of accounting for costs to other users due to using the road at a certain time and thereby encouraging alternate routes or timings. Similarly, weight-based RUCs, tolls, or registration fees reflect the greater road damage that heavier vehicles cause. Fuel taxes, for their part, correspond to one's road use in a general sense, but decreasingly so as efficient vehicles become more popular.

One fairness-related drawback of RUCs is that barring coordination between states, they fail to collect revenue from out-of-state drivers in the way that tolls and fuel taxes do. The size of this issue depends on the state but can be significant. For example, an analysis in Vermont, which has a relatively high share of tourism and pass-through traffic, found that roughly 25 percent of gas bought with a credit card was tied to an out-of-state address [56]. In Wisconsin, a state which is not considered a "pass-through" state, officials have still estimated that 10-15 percent of motor-fuel tax revenue is attributable to out-of-state drivers [57]. Taxes on public EV charging may counteract this by mimicking a tax on fuel sales.

Meanwhile, taxes on commercial activities, which are presumably passed onto the final consumer, reflect the "beneficiary pays" principle and can be designed to account for the highly disproportionate impact that heavy vehicles have on roads.

Equity

Equity relates to the impact of a policy on different groups of drivers. For instance, fuel taxes are generally regressive, imposing a greater burden relative to income on lower-income drivers both through their own fuel consumption and increases in the prices of shipped goods [58]. Given that high-income drivers account for a disproportionate share of EV adoption, at least for now [59], dependence on fuel taxes for funding roads may inherently become even more regressive. Fuel taxes also disproportionately impact rural drivers since they drive more on average.

RUCs also tend to be both regressive and disproportionately burdensome for rural drivers, although if EV uptake continues to be driven by high-income groups, RUCs may become less regressive compared to gas taxes [60].

By contrast with motor-fuel taxes and RUCs, the burden of EV registration fees disproportionately falls on high-income drivers since EV drivers currently have higher incomes on average. However, this relationship will fade over time as more affordable models become available and more EVs enter the used market. Additionally, flat EV fees are regressive since they constitute a larger share of vehicle value for less expensive vehicles, and as a large one-time cost, they can present a greater financial barrier for lower-income drivers. Pennsylvania has proposed an option to pay its fee in monthly installments [50], though this comes with an administrative burden for drivers who choose it. Texas, on the other hand, charges an initial fee of $400 that accounts for the first two years of registration [61].

Like EV registration fees, taxes on EV charging may disproportionately affect higher-income drivers at present. However, if such taxes are limited to public charging, their impact may instead be concentrated on EV drivers who do not have access to home charging, such as renters, who may have lower incomes on average. According to the Federal Reserve, the median income of renters is less than half that of homeowners [62]. Renters often do not have dedicated access to charging, which may explain lower rates of EV ownership among renters, even controlling for income [63].

The equity implications of taxes on commercial activity depend on their design. For instance, a commercial VMT program would disproportionately burden lower-income households because higher-income households consume more non-tradable goods not requiring transportation [60]. By contrast, Minnesota's retail delivery fee, passed in 2023, mitigates equity impacts by exempting orders under $100 and deliveries of food, drugs and medical supplies, and baby products [47].

Finally, the use of general revenues can produce regressive or progressive effects depending on the source of the revenue. For instance, using revenue from a graduated income tax would be progressive, while using revenue from sales tax would be regressive.

Cost-Effectiveness

The policies presented also differ substantially in how cost-effectively they collect revenue. For instance, raising fuel taxes and using general revenues would have low costs because the collection systems already exist. Registration surcharges on EVs are also inexpensive to administer since all states already impose annual or biennial registration fees [64].

By contrast, a tax on EV charging has high implementation costs for whoever must collect the tax, be it an electric utility, the owner of a public charging station, etc. (see Box 1). Taxes

on commercial activity vary in terms of their cost-effectiveness from the state perspective, but generally impose compliance costs on businesses that are passed on to the final consumer. Backlash over the administrative costs of Colorado's retail delivery fee, which required businesses to print the fee as an extra line item on receipts, led to an amendment allowing businesses to pay the fee on behalf of customers [65].

Usage-based charges also vary in terms of their cost-effectiveness. Although toll-based systems have clear implementation costs, they are lower than those of more exact methods like RUCs, which entail significant administrative costs and either require installation of GPS devices or must rely on less exact methods such as self-reporting, which raises questions of compliance, or annual odometer readings, for instance during mandatory emissions-testing visits, which would unfairly include driving done in other states.

Political Viability

The political prospects of various policies also warrant consideration. Thirty-four states have adopted EV registration fees, which may be popular with policymakers because they currently affect a small number of users. By contrast, tolls and higher gas taxes are politically unpopular, partially because they impact large numbers of drivers and partially because of their salience to users, who see the charges every time they pay a toll or a tax at the pump [60]. However, research shows that support for gas taxes can increase drastically when policymakers are specific about the purpose of the revenues, such as maintaining roads, improving traffic safety, and reducing congestion and local air pollution [66].

Taxes on commercial activity generally face opposition from industry, and may face opposition from consumers as well, depending on the salience of the charges. For example, the growing ubiquity of delivery services and the application of delivery fees at the point of sale may generate consumer opposition to bills like those passed in Colorado and Minnesota. Because of their dependence on location data, RUCs designed for maximum accuracy may face political headwinds rooted in privacy concerns. Polling shows that the idea of having one's mileage tracked bothers nearly 60 percent of drivers, even when they are reminded that their phone may already be tracking their location [66]. Implementation and communication of standards related to individual data could potentially mitigate these concerns.

Box 1: Electric Vehicle Charging Taxes

To date, seven states have passed additional taxes on electricity consumed at public EV charging stations, as detailed in Appendix B. However, only Pennsylvania and Iowa's fees are in full effect as of August 2023, with Montana's in effect for new stations only. EV charging taxes may seem like a logical replacement for lost gas tax revenue because they tax the fuel that powers an EV and capture revenue from out-of-state road users. Yet, they have high implementation costs and can create double taxation and equity issues for drivers without home charging.

For example, not all public chargers currently measure energy use in a way that facilitates the collection of a tax per kilowatt-hour consumed by a driver. Adding a tax to a charger's payment system is also an administrative burden that could lead some stations, such as free-to-use public chargers, to simply close rather than add such capabilities. One option to avoid such side effects would be to apply the tax only to direct-current fast chargers, which are more likely to have separate meters, although this could produce its own unintended consequences. Montana's new EV charging tax partially acknowledges the retrofitting challenge by exempting charging stations installed pre-2023 from collecting the tax until 2025 [67].

More importantly, according to DOE, 80 percent of charging takes place at home [68], where expensive and potentially cost-prohibitive submetering and billing upgrades would be necessary to separate EV charging from other electricity consumption. Likely because of these costs, only Pennsylvania collects a tax on private EV charging, which very few users actually pay because it relies on a confusing self-reporting system that some users are not even aware of [50].

Additionally, taxes on public charging may affect not just out-of-state drivers, but also in-state drivers who lack home charging and are already paying extra registration fees for their EV. Aside from Pennsylvania, all states with EV charging taxes also collect extra registration fees for EVs. On top of EV fees and EV charging taxes, some states also levy sales or gross receipts taxes on electricity but not on gasoline, meaning that EV drivers may pay three overlapping taxes that drivers of conventional vehicles do not pay.

As more states implement taxes on public EV charging, it will be important to study the incidence of these taxes on in-state drivers, especially from an equity standpoint, as well as their implementation costs and their effect on public charging availability and potentially EV adoption.

Environment and Electrification

Finally, road-funding policies can have a range of environmental impacts based on how they affect driving behaviors and EV adoption. To varying degrees based on how high they are set, all user fees (e.g., motor-fuel taxes, tolls, road usage charges, taxes on commercial activity, and EV charging taxes) provide incentives to use roads more efficiently and thereby reduce air and noise pollution. Motor-fuel taxes also specifically encourage drivers to choose EVs or conventional vehicles with greater fuel economy, yielding a host of benefits including local air pollution reduction, climate change mitigation, and cost savings. Fuel economy improvements over the past 50 years have reduced emissions by more than 14 billion metric tons [69], equivalent to three times total U.S. emissions in 2022 [70]. Although fossil fuels accounted for 60 percent of U.S. electricity generation in 2022 [71], EVs are far more efficient than the most efficient conventional vehicles on an energy basis, with an average MPG-equivalent (MPGe) of 117 [19].

Citing their lower environmental impact, greater energy efficiency, and other factors, the federal government and most states are seeking to drive up EV adoption. This is an important consideration when choosing how to fund roads. The federal government has a host of EV policy programs and 38 states provided financial incentives for EVs in 2022 [72]. All 50 states have also submitted plans in order to receive federal National Electric Vehicle Infrastructure (NEVI) funding [73]. Thus, road-funding policies should ideally be consistent with encouraging EV uptake but at the very least should not disproportionately burden EV drivers in a way that counteracts EV incentives. EV registration fees and energy-based EV charging taxes can have this effect depending on how high they are set.

Summary Comparison of Policy Options

All the policies discussed in this brief come with tradeoffs when evaluated against the criteria presented. The performance of each policy with respect to each criterion ultimately depends on its design, and the policy's net benefit in turn depends on the specific context of the jurisdiction and the priorities of its policymakers and constituents.

Table 2 makes general characterizations about how each policy option compares to the others in terms of the criteria discussed.

Table 2: Performance of Policy Options Along Key Criteria

Policy Option	Revenue Sustainability	Fairness	Equity	Cost-Effectiveness	Political Viability	Environment & Electrification
Motor-fuel taxes	User base will diminish over time, eroding impact of raising rates	Only roughly reflect "user pays," and to a shrinking degree	Regressive, and increasingly so as high-income drivers buy newer, more efficient vehicles	Current collection system easily modified	Depends on messaging, rate of increase, and other factors	Incentive to reduce fuel consumption and to consider an EV
Tolls	Some risk of changing traffic patterns to avoid tolls	Reflect "user pays" in localized or specific contexts	Regressive	Some administrative and technology costs	Generally unpopular but used in most states	Incentive to reduce road use and energy use in localized or specific contexts
Road usage charges	Vehicle-miles traveled generally grow or remain fairly consistent	Designed to closely reflect "user pays"	Regressive, and outsized impact on rural drivers because they drive more	High administrative costs and possibly high technology costs	Largely TBD, but privacy a major issue; majority of states are researching	Incentive to reduce road use and thereby energy use
Taxes on commercial activities	Commercial road use likely to continue growing	Reflects greater road impact of heavy vehicles; "beneficiary pays"	Depends on covered goods/activities	Depends on type of tax and implementation strategy	New such taxes likely to face opposition from both consumers and industry	Incentive to reduce road use and thereby energy use
Efficient-vehicle registration fees	User base currently very small, but will grow over time	Not linked to road use; may exceed average revenue from "comparable" vehicles	Overall progressive for the time being, but regressive for affected drivers	Easily added to existing registration system	High based on rapid rate of state adoption; currently affect a small number of users	Disincentive to purchasing an EV or other efficient vehicle and unrelated to energy use
EV charging taxes	User base currently very small, but will grow over time	Like fuel taxes, roughly reflect "user pays," though only if inclusive of home charging	Overall progressive for the time being, but regressive for EV drivers	High costs for utilities and/or charging providers	State adoption limited but growing; currently affect small number of users	Disincentive to purchasing an EV outweighs incentive to reduce energy consumption
General revenues	Rates can adjust to meet revenue needs	Not linked to road use	Depends on source (sales tax regressive, graduated income tax progressive, etc.)	Current collection system easily modified	Depends on source of revenue and constituency	Unrelated to road use and energy consumption

High	Moderate	Low

This table shows a general characterization of the performance of road-funding policy options along key criteria and is primarily meant to illustrate the tradeoffs associated with each policy. The weight assigned to each criterion depends on context (i.e., they are not all necessarily equally important). Performance is evaluated as high, moderate, or low, with policies marked "moderate" either because they perform moderately well compared to the alternatives or because their performance is especially dependent on their design. The potential for revenue generation is not included because of its dependence on the rates at which taxes or fees are set, and the dependence of these rates on other criteria.

Electric Vehicle Registration Fees

Amid the array of policy options to increase revenues for roads, additional registration fees for electric vehicles are currently among the most popular and warrant further discussion. These fees can play a role in ensuring that EV drivers contribute fairly to funding roads in lieu of paying gas taxes. However, depending on how one defines fairness, and how high fees are set, they can present an unfair burden to EV drivers. They can also potentially depress EV adoption even as other policies seek to drive it up.

Background on EV Fees

Thirty-four states charge BEV drivers more than conventional vehicle drivers to annually register their vehicle. This trend extends to PHEVs in 28 of those states and to HEVs in 15. Two states (Oregon and Virginia) also charge conventional vehicles registration fees that increase with fuel economy. In some states, PHEV fees are the same as for BEVs, meaning that PHEVs pay more in tax than BEVs because they also pay gas taxes. Of the states without current BEV fees, at least 10 have had fees proposed in the legislature [74]. See Figure 5 and Appendix B for each state's fees.

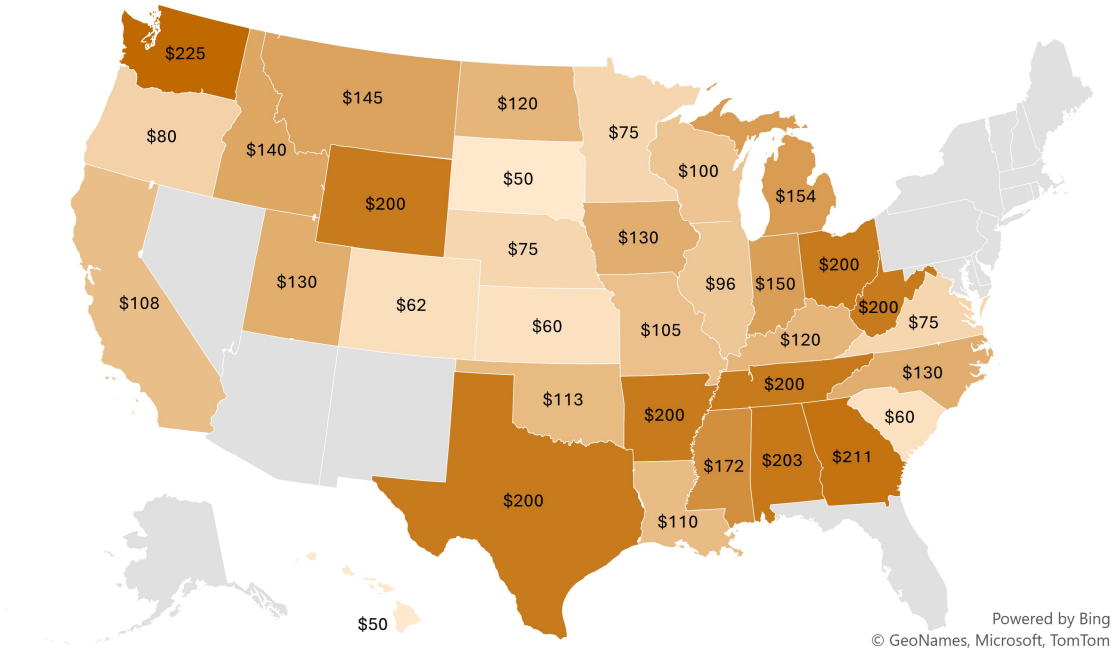
Annual BEV fees range from $50 to Hawaii and South Dakota to $225 in the state of Washington,[3] while the average BEV fee (among states with fees and weighted by BEV stock) is $126, and the median fee is $125. Given low EV penetration levels, in no state did revenue from these fees account for more than 0.4 percent of transportation spending in 2021; in 27 states they accounted for, or would have accounted for, less than 0.1 percent. While they may present a short-term fix to a very small part of the transportation funding problem, they can also discourage EV adoption if they are too high.

Researchers at the University of California, Davis analyzed sales data before and after the introduction of EV fees, controlling for other variables, and estimated an average decrease of 0.24 percent in EV sales per dollar of fee [75]. These results varied between states and may decrease in the long term given that "the enactment of registration fees into law present a stronger effect on sales than the implementation of those fees." The researchers speculate that this could be due to negative media attention to these bills around the time of their passage. Still, even if the impact is more pronounced in the short term, an average BEV fee of $126 would correspond to an average short-run decrease in EV sales of 30.2 percent according to the study's findings. Through a nationwide survey, the UC Davis researchers also asked BEV drivers how their purchase decision would have changed had

[3] BEVs weighing >8,000 lbs in Michigan pay a fee of $248.

they been subject to a $100 fee and found an 11 percent decrease in stated BEV preference, though this method is subject to sampling and response bias given that respondents were people who had decided to purchase an EV [75].

Figure 5: BEV Fees by State (2023)



This figure shows the BEV fee level as of 7/1/23 in states that have passed such fees, except in Kentucky and Texas. Texas's fee will come into effect on 9/1/23 and Kentucky's on 1/1/24. As detailed in Appendix B, several states have scheduled increases as soon as 1/1/24. For instance, Indiana's fee is expected to rise 43 percent to $214 on that date [76]. Fees in Illinois, Michigan, Montana, and Oklahoma vary by vehicle weight and the values shown are weighted averages based on BEV sales. In Kansas, data constraints precluded a weighted average and the fee shown is for vehicles >4,500 lbs. In Oregon and Virginia, conventional vehicle registration fees are based on fuel economy and "additional" fees for BEVs as displayed in this map are relative to the fee paid for the average new light-duty vehicle registered in the state.

Source: Atlas Public Policy

Considering the large difference between the results of the two research methods and the abundance of new data that has become available since the study's publication in late 2018, a validation of its findings would be valuable to characterize the effect of EV fees more accurately. For example, BEV sales in California have grown threefold since the state implemented its $100 fee in July 2020 [22], which suggests that low fee levels may not have as great an effect on adoption as the study indicated. Regardless, fees of this nature could hinder BEV adoption or be perceived as a sign that government is tempering its support for this technology at a critical point for transportation electrification.

Defining "Fairness"

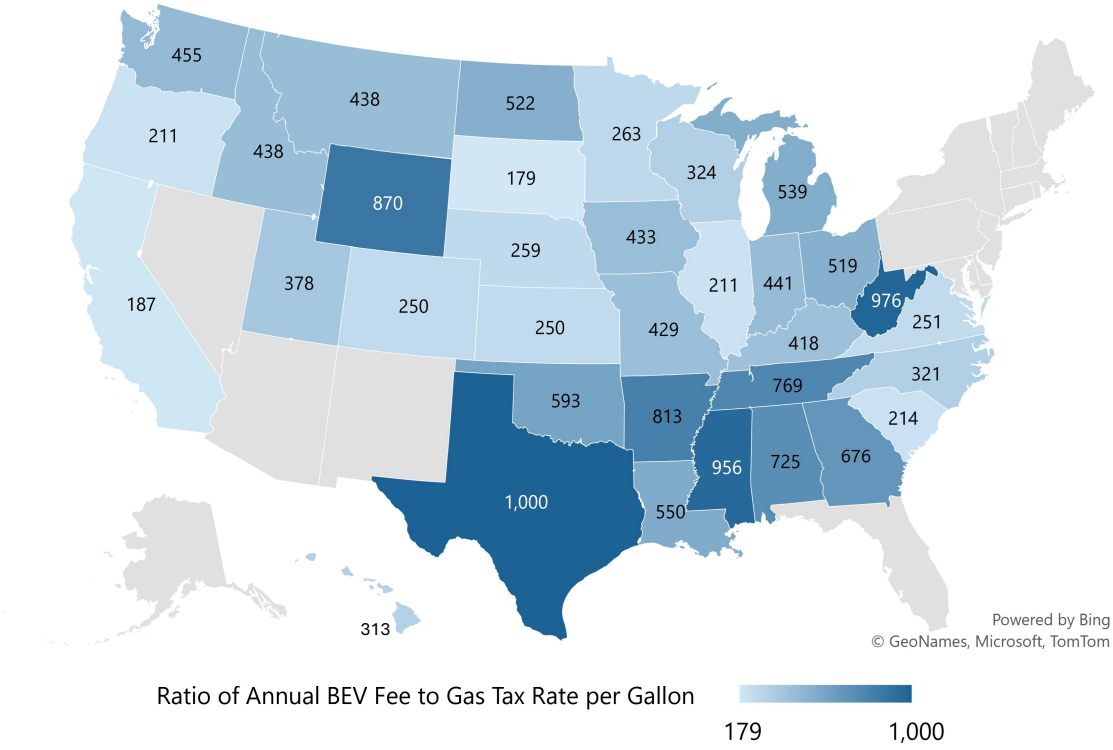
In a number of states, EV fees also result in BEV drivers paying, on average, more than their fair share. It is important to note that no flat registration fee will be as fair as a fee that is actually based on an individual's road use, but barring that, the "fair" level for an EV registration fee is a matter of perspective. EV supporters, industry groups, and road-funding advocates have set forth different definitions of what fairness should mean.

One method used to assess fairness is the annual gas tax revenue paid for the average vehicle registered in the state. This is the logic behind Pennsylvania's proposed $290 BEV fee [50], which would be the highest fee in the country, though Pennsylvania's gas tax rate is also the highest in the country. Figure 6 shows which states charge the highest BEV fees relative to their gas tax rate. The rationale behind comparing EVs to the average vehicle currently registered is based on the goal of maintaining funding close to current levels. However, it neglects the fact that conventional vehicles are becoming more efficient by the year. Thus, unless all drivers of vehicles that are more efficient than the average one registered in the state are also paying a fee, the average BEV driver is paying more in taxes than the average driver of a non-BEV, fuel-efficient vehicle. Box 2 describes how Virginia addresses this issue by charging registration fees that increase with fuel economy while maintaining an incentive for more efficient vehicles. Oregon also charges registration fees that increase based on fuel economy and 15 states charge extra fees to HEVs in addition to BEVs and PHEVs.

Another method of assessing fairness is for EV drivers to pay a registration fee equivalent to the gas taxes paid by the average new vehicle. This reflects the fact that new vehicles are overall more efficient than the average vehicle currently registered. However, it does mean that the average BEV driver, like the average new-vehicle driver overall, would pay less in transportation taxes than other drivers. Revenues would also diminish over time as the vehicle stock turns over to more efficient vehicles, barring adjustments of gasoline taxes based on revenue targets or total fuel consumption.

Yet another method is for EV drivers to pay a fee equivalent to the hypothetical gas tax they would pay for a comparable, highly efficient gasoline vehicle based on their EV's MPGe. Considering an average fuel economy of 117 MPGe [19], BEV drivers would pay far less in taxes than other drivers using this method. This approach reflects the fact that U.S. gasoline taxation policy has historically offered an incentive for driving more efficient vehicles [69]. Additionally, because of their greater energy efficiency, EVs pose fewer non-road-use external costs such as greenhouse gas emissions and air and noise pollution, bearing in mind that they still contribute to externalities such as congestion, collisions, and road damage.

Figure 6: Ratio of Annual BEV Fee to Gas Tax Rate per Gallon (2023)



This figure shows that some states, as indicated by darker shades of blue, have much higher BEV fees compared to their gasoline tax rates than other states. In general, a darker shade means that a state's fuel-taxation policies are less favorable to EVs. The value determining each state's color is the ratio of its annual BEV fee to its per-gallon gasoline tax and is only meaningful when compared across states. For instance, the map shows that the ratio of 1,000 in Texas, which has a $200 BEV fee and a tax of $0.20 per gallon of gasoline, is more than five times that of South Dakota, with a value of 179. Colorado's gas tax value includes a $0.03 per gallon "road-usage fee" in effect since July 1, 2023 [77].

Source: Atlas Public Policy, EIA

A final method is to charge BEVs a fee equivalent to the amount paid by the most efficient non-BEVs that are not charged additional fees. This would effectively ensure that BEV drivers pay as much as some non-BEVs while still encouraging energy efficiency and adoption of BEVs by comparing them to those who contribute the least on average to road funding.

Other considerations related to fairness include:

- *Avoid Overlap with EV Charging Taxes*: With the exception of Pennsylvania, all states with taxes on EV charging also charge extra registration fees for EVs. This can result in double taxation of in-state drivers that rely on public charging but have already paid an EV registration fee. Such drivers may have lower incomes on average than those with home charging.

- *Taxes on Electricity*: Some states charge sales taxes or gross receipts taxes on electricity and could consider allocating some of these revenues for transportation (if they do not already) and take them into account when evaluating the appropriate registration fee and/or EV charging tax level. From a fairness perspective, this is especially important in states that collect sales or gross receipts taxes on electricity for EV charging but exempt motor fuel from such taxes (which most states do [78]). A form of triple taxation can occur in cases where in-state drivers pay an EV registration fee, a tax on public charging, and a sales or gross receipts tax that is charged on electricity but not gasoline.
- *Avoid Recouping Lost Revenues from Federal Motor-Fuel Taxes*: Federal highway funding is largely channeled to states based on a formula,[4] not on the proportion collected in each state, meaning that lost federal revenue from EVs is unrelated to that state's lost federal highway aid. Additionally, if a state incorporates lost federal taxes into its EV fee and the federal government itself then takes action to collect revenue from EVs for the HTF, the result is double taxation for EV drivers. Still, Texas, which has the highest fee relative to its state gasoline tax, designed its BEV fee based on both federal and state taxes lost [79].
- *Avoid Double Taxation of PHEVs*: Fuel economy labeling by the EPA may overstate how much time PHEVs spend in all-electric mode [80]. This can lead to an underestimation of how much revenue PHEV drivers pay in gas taxes and result in a PHEV fee level that collects more revenue than the gas tax revenue lost.
- *Allow Payment in Installments*: Whereas gas taxes are a pay-as-you-go mechanism, charging a lump-sum payment equivalent to a year of gas taxes may present a financial barrier to some drivers. While Pennsylvania has proposed an option to pay its fee in monthly installments [51], Texas charges a $400 upfront fee which accounts for the first two years of registration [61].

Other design features could also help EV fees score higher on policy criteria other than fairness. One is using a phase-in of several years to reduce the impact on EV adoption and avoid creating a sudden extra financial burden for current EV drivers. Another is applying the fee only at the time of re-registration, not initial registration – again, to dull the impact on EV sales. California exempts EVs from its fee for the first year of ownership [81]. Charging differentiated EV fees based on vehicle weight, as several states do, would also more closely reflect the impact of a vehicle on the road, although some states already account for weight in their base registration fees.

[4] Each state's share of federal highway funds is determined by a formula with factors including interstate highway and principal arterial lane miles, VMT, state population, infrastructure improvement needs, and estimated HTF funds collected in the state [88].

Box 2: Recent Road-Funding Reforms in Virginia

Since 2020, Virginia has taken several steps to improve how it funds its roads. One was raising its state gas tax, which was well below the national average at 16 cents per gallon. This rate rose 63 percent to 26 cents per gallon and it is now indexed annually to inflation [82]. Virginia also reformed its registration fees in 2020 with the Highway Use Fee (HUF). Unlike in most states, fees for all vehicles with fuel economy greater than 25 MPG now vary based on fuel economy. BEV drivers pay a fee equal to 85 percent of the gas tax paid by a vehicle with 23.7 MPG that travels an average distance, while other drivers of fuel-efficient vehicles pay 85 percent of the difference between what they already pay in gas tax and what a 23.7-MPG vehicle pays [83]. The HUF essentially ensures that all vehicles meet a minimum revenue level while maintaining some incentive for fuel economy. However, by basing fees on the average distance traveled, it fails to follow the "user pays" principle.

To address shortcomings regarding "user pays," Virginia established an RUC program which allows drivers paying the HUF to instead pay by the mile (as tracked by a device) [84]. Charges are capped at the level of the HUF the driver would pay, but a major drawback is that the system does not currently distinguish between miles traveled in- and out-of-state. The program's uptake remains to be seen.

Despite its imperfections, the way Virginia charges vehicles to fund roads relates positively to the evaluation criteria in several respects:

- Raising the gas tax and indexing it to inflation increases its sustainability.
- The HUF is effectively a revenue floor that all vehicles must meet, barring participation in the RUC, contributing to sustainability and fairness. A slightly lower floor maintains an incentive for more fuel-efficient vehicles.
- Through the RUC, Virginia provides an alternative, albeit a cumbersome one, to the HUF that more closely hews to the "user pays" principle.

These benefits do not come without tradeoffs—Virginia's system likely has high administrative costs associated both with the RUC program as well as annually recalculating and administering a different HUF for each model/model year of non-BEV, fuel-efficient vehicle. Still, it illustrates how states can improve performance along multiple road-funding criteria by combining several complementary policies.

Comparison of Current Fees to Fairness Metrics

Depending on the definition of fairness, of the BEV fees currently in place across the country, the number that charge EV drivers more than their fair share ranges from eight to all 34 (see Figure 7). Policymakers can use the following formula to calculate the "fair" level for a BEV fee based on their definition of "comparable" vehicle.

$$Gas\ Tax\ Revenue\ Paid\ by\ "Comparable"\ Vehicle = \frac{Average\ Annual\ VMT}{"Comparable"\ Vehicle\ MPG} \times State\ Gas\ Tax\ Rate$$

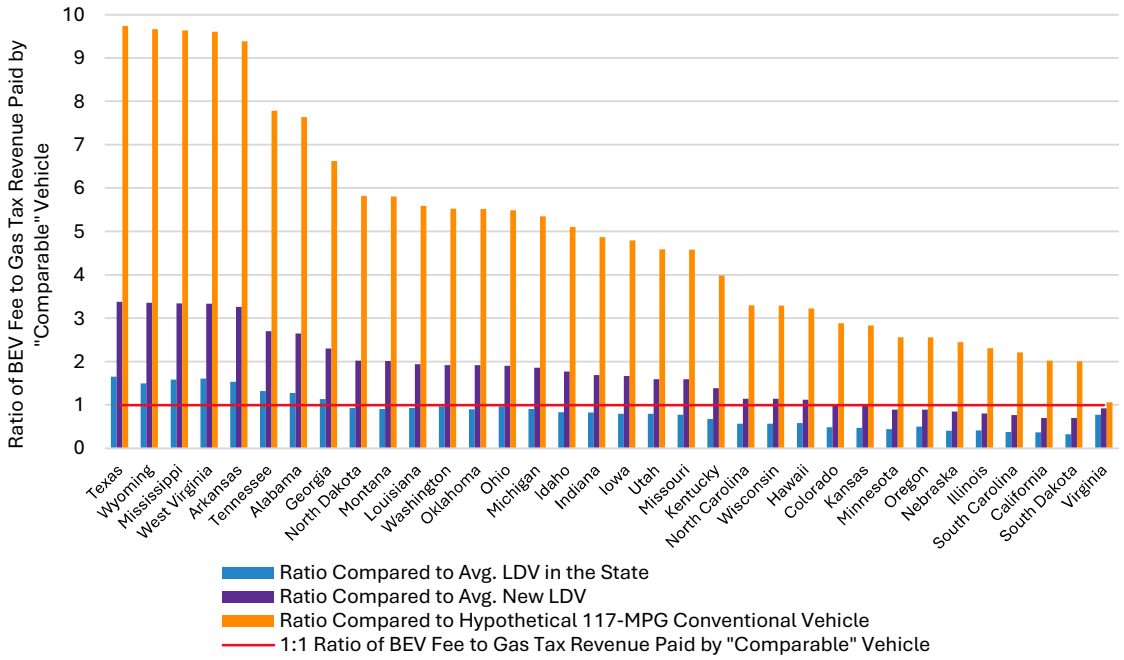
Eight states charge BEV fees more than what the average conventional vehicle driver pays in the state, as calculated by the formula above using state-specific figures on average light-duty VMT, the gas tax rate, and average LDV fuel economy [35] [36] [85] [86]. These values vary significantly among states with fees. Average VMT per passenger vehicle ranges from 8,828 in Montana to 12,565 in Oklahoma. Gas tax rates range from 16 cents per gallon in Hawaii to 58 cents in California, while data on the average fuel economy of registered light-duty vehicles show a range from 18.1 MPG (Wyoming) to 21.4 (California). This state-level fuel economy data is from 2018, meaning that it likely underestimates present-day average fuel economy to some degree, although national light-duty fuel economy in 2021, the most recent year available, was just 0.3 MPG higher than in 2018 [12].

Relative to the average conventional vehicle driver, Texas leads states with BEV fees by charging 1.65 times the average gas tax revenue in the state. Its $200 annual fee is also the highest in the country relative to its gas tax rate, among the highest in dollar terms, and the newest, having been signed into law in May 2023.

When changing the point of comparison to the average gas tax paid by new vehicles in a state, as calculated by using the estimated 2024 CAFE light-duty fleet average of 40.6 MPG [87], the number of states charging unfair fees rises to 24, with five states (Arkansas, Mississippi, Texas, West Virginia, and Wyoming) charging BEV drivers more than three times the fair level.

Finally, all 34 states with BEV fees charge more than the hypothetical gas tax a BEV driver would pay based on a fuel economy of 117 MPGe. On the low end, Virginia charges BEV drivers 1.1 times the "fair" level, while Texas charges them nearly ten times this level.

Figure 7: Comparison of Existing BEV Fees with Gas Taxes Paid by Three Definitions of “Comparable” Vehicle



This figure shows how each state’s BEV fees compare to the gas tax revenue paid by the average “comparable” vehicle in their state, represented by the red line, using three definitions of “comparable.” These are: a) the average light-duty vehicle currently registered, for which fuel economy data varies by state, b) the average new light-duty vehicle, which has an estimated 40.6 MPG based on model year 2024 CAFE standards, and c) a hypothetical conventional vehicle with a fuel economy of 117 MPG, which is the energy-basis MPGe of an average BEV. Note that states are listed in descending order according to point of comparison “c.” State-level VMT data and gas tax rates are used for each comparison.

Source: EIA, DOT, DOE, Atlas Public Policy

Oregon, Utah, and Virginia offer RUC programs as a voluntary alternative to paying a BEV fee. This could be the prevailing RUC model in the medium term given the political challenges of such programs, even though more than 30 states are considering them. While voluntary RUCs can present a fairer alternative for low-VMT BEV drivers, their existence as an option does not justify unfair BEV fees, regardless of the definition of “fair.” Depending on their design, voluntary RUC programs can have high compliance costs and generate privacy concerns, meaning that BEV drivers have the difficult choice of either paying an unfair fee or enrolling in a program that many drivers prefer to avoid.

Importantly, the figures presented above compare BEV fees only to what conventional vehicles pay in state gasoline taxes, not federal or local taxes. This is because BEV fees are charged on the state level and generally fund state-level transportation efforts. They also

exclude other taxes and fees on both gasoline and electricity because these revenues are not necessarily used for transportation. States seeking to conduct a more context-specific analysis of fairness could incorporate all state and local transportation-specific revenues as well as revenues that could be re-dedicated to transportation, such as sales tax on gasoline for conventional vehicles and electricity for BEVs.

Additionally, these figures merely present a snapshot of the current situation—all the variables in the calculation will change over time as BEV fees and gas tax rates change, trends in VMT evolve, and the LDV fleet turns over and becomes more fuel-efficient.

Conclusion

The questions of who should pay for roads, and how much they should pay, are essential to several facets of U.S. policy including quality of life, economic well-being, environmental sustainability, and global competitiveness. A review of federal and state road-funding trends, the policy options available, and the current debate over EV fees yields several key considerations.

Roads have been underfunded for years due to inflation, stagnant gas tax rates, increasing fuel economy, and slow VMT growth. On the federal level, and in most states, taxes on motor fuel have not increased nearly fast enough to counteract these trends. This has eroded the purchasing power of revenues from user fees and led to an unsustainable dependence on ad hoc transfers of federal general funds. However, on the state level, the impact of these factors should not be overstated; on average, roughly two thirds of state funding for roads comes from sources other than motor-fuel taxes.

Road-funding policies should focus on ensuring that all drivers equitably and sustainably fund roads. EV drivers will continue to contribute only marginally to the funding gap in most states for some time. Lost state tax revenue from light-duty BEVs compared to the average new light-duty vehicle was equivalent to 0.09 percent of state highway spending in 2021. Although this share will grow as EV adoption rises, it will remain marginal for years to come. Ensuring that EV drivers pay their fair share should be part of a holistic solution that ensures that everybody does.

Policymakers have a range of options for funding transportation, all of which have pros and cons. Enacting a suite of complementary policies based on a state's specific context, while avoiding overlapping policies and double taxation, is more likely to meet a state's criteria for success. Raising gas taxes, using tolls and RUCs, taxing commercial road use, adding extra fees for EV registration and charging, and permanently dedicating general revenues to transportation all entail tradeoffs along the criteria of

revenue sustainability, fairness, equity, cost-effectiveness, political viability, and advancing environmental and electrification goals. Policymakers can combine these policies and others based on their state's transportation funding sources and needs and on the priorities, demographics, and economic realities of their constituents. However, it is important to ensure that policies are truly complementary rather than overlapping and resulting in double taxation. As detailed in Box 2, Virginia has sought to do this through raising gas taxes while also implementing higher registration fees for more efficient vehicles and providing the option for drivers of such vehicles to instead participate in an RUC program.

Further research is needed to evaluate the performance of policy options along key criteria. For example, the UC Davis study on the impact of fees on EV adoption, which is likely the most frequently cited, was written in fall 2018, when only 19 states had passed EV fees. Data points are now available over longer periods and in 15 new states, where impacts may differ. More states are also beginning to implement EV charging taxes, and it will be important to monitor the implementation costs of these taxes and their effect on public charging availability and EV uptake. More research is also needed into the equity implications of different mechanisms and how they will evolve as the composition of the vehicle fleet changes. For instance, there are uncertainties about the distributional impacts of RUC programs, especially vis-à-vis gas taxes, given questions about how long EV drivers will be disproportionately high-income and whether EV drivers tend to drive less on average [60]. The incidence of taxes on public charging is another question. For instance, how much do these taxes affect in-state drivers that may already be paying extra EV registration fees, and are affected drivers disproportionately lower-income? Another important area for research is how to design and communicate RUC programs in a way that minimizes privacy concerns and administrative costs while maintaining accuracy and fairness. More than half of states are asking such questions through research and pilot programs.

Of 34 states with additional registration fees for BEVs, at least eight and up to all 34 charge BEV fees that are unfair, depending on how "fairness" is defined. Some states are charging many times the "fair" level, depending on the point of comparison. These fees can dissuade drivers from purchasing EVs and slow the decarbonization of the transportation sector. Under a definition of fairness more generous to conventional vehicles, EV drivers should not pay more than the annual gas tax revenue collected from the average vehicle currently registered, but under other definitions, they should pay much less than that. States could also consider other taxes, such as sales or gross receipts taxes on electricity, that EV drivers already pay, and whether this revenue can be redirected to transportation if it is not already. This is particularly relevant in states that charge such taxes on EV charging but not on gasoline. States could also seek ways to blunt the impact of EV fees on adoption and lower-income drivers, such as through phase-ins, installment payments, or waiving the initial registration fee, and avoid double taxation pitfalls, such as seeking to recover lost

federal gas tax revenues through state EV fees and charging fees for PHEVs that underestimate how much these vehicles pay in gas tax. Overall, if states choose to use EV fees to collect transportation revenue as part of their policy package, they should do so in a way that does not disproportionately burden EV drivers, particularly as they seek to encourage EVs with other policies.

Appendix A: State Revenues for Highways (2017–2021)

State	State Motor-Fuel Tax	Reg. Fees	Tolls	State General Funds	Bond Pro-ceeds	Other State Funds	Federal Motor-Fuel Tax	Other Federal Funds
AL	28.5%	6.5%	0.0%	4.4%	10.4%	7.0%	28.5%	14.7%
AK	2.6%	3.3%	3.5%	20.5%	4.9%	12.9%	35.2%	17.1%
AZ	20.4%	10.6%	0.0%	0.3%	9.8%	35.6%	15.4%	8.0%
AR	24.0%	9.5%	0.0%	3.4%	3.1%	24.1%	22.9%	13.0%
CA	29.2%	35.9%	2.4%	0.0%	2.0%	9.8%	13.4%	7.2%
CO	17.8%	35.0%	0.5%	6.2%	8.9%	3.9%	15.5%	12.3%
CT	14.0%	6.8%	0.0%	0.8%	32.4%	20.6%	16.2%	9.2%
DE	5.6%	7.5%	26.1%	4.8%	22.1%	23.4%	6.9%	3.6%
DC	2.1%	8.6%	0.0%	26.0%	27.3%	0.7%	23.4%	11.8%
FL	17.6%	13.3%	16.4%	0.0%	16.6%	17.3%	12.5%	6.3%
GA	35.0%	2.0%	0.4%	10.0%	9.2%	9.2%	20.9%	13.2%
HI	14.5%	34.4%	0.0%	0.0%	13.1%	0.4%	24.8%	12.8%
ID	29.2%	20.1%	0.0%	2.3%	8.9%	7.5%	21.2%	10.8%
IL	17.2%	17.7%	19.8%	8.1%	14.5%	1.7%	14.1%	7.1%
IN	41.7%	9.4%	0.0%	3.0%	7.7%	6.8%	21.0%	10.4%
IA	27.0%	44.3%	0.0%	2.5%	0.0%	1.4%	14.3%	10.5%
KS	13.3%	6.6%	7.4%	0.6%	6.1%	39.8%	17.3%	8.8%
KY	26.2%	27.6%	0.0%	0.4%	2.3%	9.9%	22.5%	11.1%
LA	23.1%	5.9%	1.0%	1.7%	30.0%	3.9%	22.8%	11.6%
ME	16.0%	7.9%	13.5%	0.0%	5.4%	37.4%	13.0%	6.8%
MD	9.2%	11.6%	22.0%	10.2%	22.0%	10.8%	9.6%	4.8%
MA	7.6%	6.2%	8.9%	3.5%	51.6%	6.7%	10.0%	5.6%
MI	26.6%	26.4%	0.9%	11.8%	9.7%	3.8%	13.9%	7.0%
MN	16.1%	16.1%	0.0%	3.5%	9.5%	35.3%	12.8%	6.6%

State	State Motor-Fuel Tax	Reg. Fees	Tolls	State General Funds	Bond Pro-ceeds	Other State Funds	Federal Motor-Fuel Tax	Other Federal Funds
MS	29.1%	13.3%	0.0%	0.0%	4.8%	8.3%	29.5%	15.0%
MO	26.6%	12.5%	0.0%	0.9%	2.4%	19.1%	25.5%	13.0%
MT	15.6%	16.3%	0.0%	0.1%	0.0%	8.2%	39.7%	20.2%
NE	22.6%	6.4%	0.0%	2.8%	0.0%	46.1%	14.6%	7.6%
NV	26.3%	21.7%	0.1%	0.0%	8.3%	15.5%	18.7%	9.4%
NH	24.5%	12.0%	19.2%	1.7%	2.4%	7.6%	18.7%	13.9%
NJ	2.7%	6.6%	15.8%	0.4%	41.2%	22.1%	7.1%	4.0%
NM	16.6%	22.6%	0.0%	16.4%	8.7%	5.0%	20.2%	10.6%
NY	4.9%	5.3%	26.4%	7.3%	10.8%	32.5%	8.3%	4.6%
NC	28.8%	14.2%	0.6%	0.0%	14.2%	19.8%	14.3%	8.1%
ND	25.6%	15.0%	0.0%	9.3%	0.0%	4.8%	30.0%	15.4%
OH	34.8%	10.6%	3.4%	7.3%	9.6%	8.2%	16.8%	9.3%
OK	6.4%	9.6%	8.4%	0.0%	14.7%	38.2%	15.2%	7.7%
OR	16.9%	18.9%	0.0%	2.0%	27.1%	18.8%	10.5%	5.9%
PA	23.4%	7.0%	15.9%	10.5%	20.0%	5.1%	12.0%	6.1%
RI	10.7%	6.8%	4.0%	9.8%	8.7%	18.2%	27.3%	14.4%
SC	27.8%	28.9%	0.7%	1.5%	0.0%	7.7%	22.1%	11.4%
SD	23.1%	0.6%	0.0%	0.0%	0.0%	26.4%	33.2%	16.7%
TN	39.3%	16.3%	0.0%	0.0%	0.0%	4.8%	25.4%	14.1%
TX	8.6%	16.9%	6.7%	3.1%	9.0%	30.8%	16.5%	8.5%
UT	20.8%	10.3%	0.1%	3.4%	12.3%	33.1%	11.8%	8.3%
VT	14.2%	26.7%	0.0%	10.0%	0.0%	4.9%	28.6%	15.6%
VA	11.2%	15.6%	1.0%	3.0%	12.6%	40.1%	10.9%	5.6%
WA	26.5%	14.3%	6.7%	0.0%	16.9%	15.4%	13.2%	7.0%
WV	21.8%	21.6%	0.5%	2.4%	25.4%	4.2%	15.7%	8.3%
WI	26.2%	19.1%	0.0%	3.3%	13.7%	6.7%	13.3%	17.6%
WY	13.9%	11.0%	0.0%	5.6%	0.0%	12.0%	35.0%	22.5%
Total	19.2%	15.7%	7.5%	3.8%	13.2%	17.4%	15.0%	8.2%

Source: FHWA

Appendix B: Annual Additional Registration Fees for EVs and Public EV Charging Taxes (2023)

State	BEV	PHEV	HEV	Public EV Charging	Notes
AL*	$203	$103	$0	$0	Increase of $3 every four years.
AK	$0	$0	$0	$0	
AZ	$0	$0	$0	$0	
AR	$200	$100	$50	$0	
CA*	$108	$0	$0	$0	Indexed annually to inflation.
CO*	$62.47	$59.57	$0	$0	Indexed annually to NHCCI, plus additional scheduled increases until 2032.
CT	$0	$0	$0	$0	
DE	$0	$0	$0	$0	
DC	$0	$0	$0	$0	
FL	$0	$0	$0	$0	
GA*	$210.87	$0	$0	$0.028/ kWh	Registration fee adjusted annually based on average fuel economy and inflation. EV charging tax effective 1/1/25 and indexed to gasoline tax rate.
HI	$50	$50	$0	$0	
ID	$140	$75	$0	$0	
IL	$95.68	$0	$0	$0	Estimated weighted average fee based on EV sales. $100 fee excludes vehicles weighing >8,000 lbs.
IN*	$150	$50	$50	$0	Indexed annually to inflation.
IA	$130	$65	$0	$0.026/ kWh	

State	BEV	PHEV	HEV	Public EV Charging	Notes
KS	$60	$10	$10	$0	Flat fee of $100 for BEVs and $50 for PHEVs/HEVs compared to fees of $40/$30 for conventional vehicles over/under 4,500 lbs. Figures shown are the fee difference for an EV over 4,500 lbs compared to a conventional counterpart of the same weight.
KY*	$120	$120	$60	$0.03/ kWh	All effective 1/1/24 and indexed annually to NHCCI. EV charging tax is $0.06/kWh when on state property.
LA	$110	$60	$60	$0	
ME	$0	$0	$0	$0	
MD	$0	$0	$0	$0	
MA	$0	$0	$0	$0	
MI*	$154.25	$54	$0	$0	Estimated weighted average fees based on EV sales. BEV fees are $248/$148 for vehicles over/under 8,000 lbs. PHEV fees are $124/$54 for vehicles over/under 8,000 lbs. Indexed annually to motor-fuel tax, which is indexed to inflation.
MN	$75	$0	$0	$0	
MS*	$172	$85	$85	$0	Indexed annually to inflation.
MO*	$105	$52.50	$0	$0	Fees increase 20% annually until 2026.
MT	$144.53	$85.55	$0	$0.03/ kWh	Estimated weighted average registration fees based on EV sales. BEV/PHEV fees are $130/$70 for vehicles under 6,000 lbs and $190/$100 for vehicles 6,000-10,000 lbs. EV charging tax effective 1/1/23 for charging stations installed after 1/1/23 and effective 1/1/25 for charging stations installed before 1/1/23.

State	BEV	PHEV	HEV	Public EV Charging	Notes
NE	$75	$75	$0	$0	
NV	$0	$0	$0	$0	
NH	$0	$0	$0	$0	
NJ	$0	$0	$0	$0	
NM	$0	$0	$0	$0	
NY	$0	$0	$0	$0	
NC	$130	$0	$0	$0	
ND	$120	$50	$0	$0	
OH	$200	$150	$100	$0	
OK	$112.61	$113.68	$0	$0.03/ kWh	Estimated weighted average registration fees based on EV sales. BEV fees are $158/$110 for vehicles over/under 6,000 lbs. PHEV fees are $118/$82 for vehicles over/under 6,000 lbs. EV charging tax effective 1/1/24.
OR*†	$90	$10	$10	$0	Extra fees relative to those paid for the average vehicle currently registered in the state. Conventional and hybrid vehicle fees are determined based on fuel economy (values shown for PHEVs/HEVs are for all vehicles >40 MPG). All fees are scheduled to increase in 2024. Optional RUC program as alternative to fee.
PA	$0	$0	$0	$0.0183/ kWh	Indexed to gasoline tax. Applies to private charging as well but compliance is low.
RI	$0	$0	$0	$0	
SC	$60	$30	$30	$0	
SD	$50	$50	$0	$0	

State	BEV	PHEV	HEV	Public EV Charging	Notes
TN*	$200	$100	$100	$0	BEV fee increases to $274 in 2027, and both fees are annually indexed to inflation beginning in 2028.
TX	$200	$0	$0	$0	Effective 9/1/23. $400 for initial two-year registration of a new vehicle.
UT*	$130.25	$56.50	$21.75	12.5% of retail cost	Registration fees are indexed annually to inflation. Optional RUC program for BEVs as alternative to fee. EV charging tax effective 1/1/24.
VT	$0	$0	$0	$0	
VA*†	$123.98	Varies	Varies	$0	All vehicles with >25 MPG pay a highway use fee based on their fuel economy. BEVs specifically pay a fee of 85% of the average fuel taxes paid by a vehicle with 23.7 MPG. Effective 7/1/23 this is $123.98. No specific PHEV or HEV fee. Optional RUC program as alternative to fee.
WA	$225	$225	$75	$0	
WV	$200	$100	$100	$0	
WI	$100	$75	$75	$0	
WY	$200	$200	$0	$0	

* States with future adjustments based on inflation, gasoline tax rate, average fuel economy, or other scheduled changes.

† States which charge conventional vehicles higher fees based on higher fuel economy.

Registration fees and public EV charging tax rates are in effect and current as of 7/1/23 unless otherwise indicated.

References

[1] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2021: Total Disbursements for Highways, All Units of Government - 2020," February 2023. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2021/hf2.cfm. [Accessed 27 July 2023].

[2] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2021: Status of The Federal Highway Trust Fund, October 1, 2020 - September 30, 2021," October 2022. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2021/fe10.cfm. [Accessed 27 July 2023].

[3] J. Kile, "Testimony Before the Committee on Finance, United States Senate: Options for Funding and Financing Highway Spending," Congressional Budget Office, 18 May 2021. [Online]. Available: https://www.cbo.gov/publication/57138. [Accessed 27 July 2023].

[4] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2021: Status of the Highway Trust Fund, Fiscal Years 1957-2021," April 2023. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2021/fe210.cfm. [Accessed 27 July 2023].

[5] N. Nigro and C. Burbank, "A Primer on Federal Surface Transportation Reauthorization and the Highway Trust Fund," Center for Climate and Energy Solutions, January 2014. [Online]. Available: https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/ser/a-primer-on-federal-surface-transportation-reauthorization-a11y.pdf. [Accessed July 27 2023].

[6] Committee for a Responsible Federal Budget, "The Infrastructure Bill's Impact on the Highway Trust Fund," 3 February 2022. [Online]. Available: https://www.crfb.org/blogs/infrastructure-bills-impact-highway-trust-fund. [Accessed 27 July 2023].

[7] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2021: Federal Tax Rates on Motor Fuels and Lubricating Oil," November 2022. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2021/fe101a.cfm. [Accessed 27 July 2023].

[8] U.S. Department of Labor, Bureau of Labor Statistics, "CPI Inflation Calculator," [Online]. Available: https://www.bls.gov/data/inflation_calculator.htm. [Accessed 27 July 2023].

[9] U.S. Department of Transportation, Federal Highway Administration, "National Highway Construction Cost Index (NHCCI)," [Online]. Available: https://explore.dot.gov/views/NHIInflationDashboard/NHCCI. [Accessed 27 July 2023].

[10] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, Alternative Fuels Data Center, "Vehicle Fuel Efficiency (CAFE) Requirements by Year," September 2013. [Online]. Available: https://afdc.energy.gov/data/10562. [Accessed 27 July 2023].

[11] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, Vehicle Technologies Office, "FOTW# 1177, March 15, 2021: Preliminary Data Show Average Fuel Economy of New Light-Duty Vehicles Reached a Record High of 25.7 MPG in 2020," 15 March 2021. [Online]. Available: https://www.energy.gov/eere/vehicles/articles/fotw-1177-march-15-2021-preliminary-data-show-average-fuel-economy-new-light. [Accessed 27 July 2023].

[12] U.S. Department of Transportation, Bureau of Transportation Statistics, "Average Fuel Efficiency of U.S. Light Duty Vehicles," [Online]. Available: https://www.bts.gov/content/average-fuel-efficiency-us-light-duty-vehicles. [Accessed 27 July 2023].

[13] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2021: Licensed Drivers, Vehicle Registrations, and Resident Population," March 2023. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2021/dv1c.cfm. [Accessed 27 July 2023].

[14] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2021: Net Motor-Fuel Volume Taxed by State, 1950-2021," [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2021/mf202.cfm. [Accessed 27 July 2023].

[15] U.S. Department of Transportation, National Highway Traffic Safety Administration, "USDOT Proposes Updated Fuel Economy Standards to Strengthen Energy Security, Save Americans Hundreds of Dollars at the Gas Pump," 28 July 2023. [Online]. Available: https://www.nhtsa.gov/press-releases/usdot-proposal-updated-cafe-hdpuv-standards. [Accessed 8 August 2023].

[16] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2020: Annual Vehicle-Miles of Travel, 1980-2020," October 2021. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2020/vm202.cfm. [Accessed 27 July 2023].

[17] J.-P. Rodrigue, "Annual Vehicle-Miles Traveled in the United States and Year-over-Year Changes, 1971-2022," The Geography of Transport Systems, [Online]. Available: https://transportgeography.org/contents/chapter5/road-transportation/vehicle-miles-united-states/. [Accessed 27 July 2023].

[18] U.S. Department of Energy, Energy Information Administration, "Annual Energy Outlook 2023: Table 7. Transportation Sector Key Indicators and Delivered Energy Consumption," 16 March 2023. [Online]. Available: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=7-AEO2023&cases=ref2023&sourcekey=0. [Accessed 27 July 2023].

[19] M. Singer, C. Johnson, E. Rose, E. Nobler and L. Hoopes, "Electric Vehicle Efficiency Ratios for Light-Duty Vehicles Registered in the United States," U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, National Renewable Energy Laboratory, March 2023. [Online]. Available: https://www.nrel.gov/docs/fy23osti/84631.pdf. [Accessed 26 July 2023].

[20] Atlas Public Policy, "Q1 2023: EV Market Overview," May 2023. [Online]. Available: https://atlaspp.sharepoint.com/:p:/r/sites/evhub/_layouts/15/Doc.aspx?sourcedoc=%7BC119CCA2-C77F-4A56-963C-C1A708CB7252%7D&file=2023_EV_Hub_Q1_Review.pptx&action=edit&mobileredirect=true. [Accessed 27 July 2023].

[21] D. R. Keith, S. Houston and S. Naumov, "Vehicle fleet turnover and the future of fuel economy," Environmental Research Letters, 15 February 2019. [Online]. Available: https://iopscience.iop.org/article/10.1088/1748-9326/aaf4d2/pdf. [Accessed 27 July 2023].

[22] Atlas Public Policy, "Automakers Dashboard," [Online]. Available: https://www.atlasevhub.com/materials/automakers-dashboard/. [Accessed 27 July 2023].

[23] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2021: Annual Vehicle Distance Traveled in Miles and Related Data - 2021," May 2023. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2021/vm1.cfm. [Accessed 27 July 2023].

[24] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, Alternative Fuels Data Center, "Vehicle Registration Counts by State," [Online]. Available: https://afdc.energy.gov/vehicle-registration. [Accessed 26 July 2023].

[25] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2017: Revenues Used by States for Highways - 2017," March 2019. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2017/sf1.cfm. [Accessed 27 July 2023].

[26] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2018: Revenues Used By States for Highways - 2018," January 2020. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2018/sf1.cfm. [Accessed 27 July 2023].

[27] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2019: Revenues Used By States for Highways - 2019," November 2020. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2019/sf1.cfm. [Accessed 27 July 2023].

[28] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2020: Revenues Used By States for Highways - 2020," December 2021. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2020/sf1.cfm. [Accessed 27 July 2023].

[29] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2021: Revenues Used By States for Highways - 2021," December 2022. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2021/sf1.cfm. [Accessed 27 July 2023].

[30] U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics 2021: State Motor-Fuel Tax Rates, 2000-2021," October 2022. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2021/mf205.cfm. [Accessed 27 July 2023].

[31] U.S. Department of Energy & U.S. Environmental Protection Agency, "Compare Side-by-Side: 2018 Ford F150 Pickup 2WD x 2011 Ford F150 Pickup 2WD," fueleconomy.gov, [Online]. Available: https://fueleconomy.gov/feg/Find.do?action=sbs&id=39244&id=31031. [Accessed 27 July 2023].

[32] J. Larsen, B. King, H. Kolus, N. Dasari, G. Hiltbrand and W. Jones, "A Turning Point for US Climate Progress: Assessing the Climate and Clean Energy Provisions in the Inflation Reduction Act," Rhodium Group, 12 August 2022. [Online]. Available: https://rhg.com/research/climate-clean-energy-inflation-reduction-act/. [Accessed 27 July 2023].

[33] International Energy Agency, "Global EV Data Explorer," 26 April 2023. [Online]. Available: https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer. [Accessed 27 July 2023].

[34] P. K. Rahn, "Opinion | The Gas Tax is Obsolete. Here's a Better Idea.," Politico, 23 June 2021. [Online]. Available: https://www.politico.com/news/agenda/2021/06/23/gas-tax-better-idea-495572. [Accessed 27 July 2023].

[35] U.S. Department of Energy, Energy Information Administration, "State tax rates for retail gasoline and diesel increased in 13 states in 2023," 23 February 2023. [Online]. Available: https://www.eia.gov/todayinenergy/detail.php?id=55619. [Accessed 31 July 2023].

[36] C. Weiner, "Gas Taxes Just Went Up In These States. See If Your State Is On The List," Forbes, 1 July 2023. [Online]. Available: https://www.forbes.com/advisor/personal-finance/gas-tax-increases/. [Accessed 31 July 2023].

[37] C. Davis, "Most Americans Live in States with Variable-Rate Gas Taxes," Institute on Taxation and Economic Policy, 27 June 2019. [Online]. Available: https://itep.org/most-americans-live-in-states-with-variable-rate-gas-taxes-0419/. [Accessed 31 July 2023].

[38] Virginia Department of Transportation, "Congestion Pricing," [Online]. Available: https://www.virginiadot.org/info/congestion_pricing.asp. [Accessed 27 July 2023].

[39] L. Wamsley, "New York Is Set To Be First U.S. City To Impose Congestion Pricing," National Public Radio, 2 April 2019. [Online]. Available: https://www.npr.org/2019/04/02/709243878/new-york-is-set-to-be-first-u-s-city-to-impose-congestion-pricing. [Accessed 27 July 2023].

[40] U.S. Government Accountability Office, "Highway Trust Fund: Federal Highway Administration Should Develop and Apply Criteria to Assess How Pilot Projects Could Inform Expanded Use of Mileage Fee Systems," January 2022. [Online]. Available: https://www.gao.gov/assets/gao-22-104299.pdf. [Accessed 31 July 2023].

[41] The Eastern Transportation Coalition, "Mileage Based User Fees: What They Are & Why We Care," June 2023. [Online]. Available: https://tetcoalitionmbuf.org/wp-content/uploads/2023/06/TETC_P4_MBUF-One-Pager-062323.pdf. [Accessed 31 July 2023].

[42] RUC America, "Who We Are," [Online]. Available: https://www.rucwest.org/about/. [Accessed 31 July 2023].

[43] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, Alternative Fuels Data Center, "Federal System Alternative Funding Pilot," [Online]. Available: https://afdc.energy.gov/laws/12737. [Accessed 27 July 2023].

[44] Tollsmart, "Truckers Toll Survival Guide," [Online]. Available: https://www.tollsmart.com/truckers-toll-survival-guide/. [Accessed 27 July 2023].

[45] Maine Motor Transport Association, "UPDATE: Connecticut Passes Onerous Weight Distance Tax – Implementation Date January 1, 2023," [Online]. Available: https://www.mmta.com/connecticut-passes-onerous-weight-distance-tax-implementation-date-january-1-2023/. [Accessed 27 July 2023].

[46] A. Kenney, "Gas And Delivery Fees Will Increase In 2022 As Colorado Approves Billions For Transportation," Colorado Public Radio, 17 June 2021. [Online]. Available: https://www.cpr.org/2021/06/17/transportation-funding-law-gas-delivery-fees-increase/. [Accessed 27 July 2023].

[47] PwC, "Minnesota enacts retail delivery fee, effective July 1, 2024," May 2023. [Online]. Available: https://www.pwc.com/us/en/services/tax/library/minnesota-enacts-retail-delivery-fee-effective-july-1-2024.html. [Accessed 27 July 2023].

[48] M. Lindblom, "Gas taxes, food delivery fees and more: Washington lawmakers eye 33 fees, taxes to pay for transportation," 12 April 2021. [Online]. Available: https://www.seattletimes.com/seattle-news/transportation/33-transportation-fees-and-taxes-on-the-menu-in-washington-legislature/. [Accessed 27 July 2023].

[49] N. Reisman, "New York lawmakers eye digital streaming media tax, delivery fee," Spectrum News 1, 16 March 2023. [Online]. Available: https://spectrumlocalnews.com/nys/central-ny/ny-state-of-politics/2023/03/16/new-york-lawmakers-eye-streaming-tax--delivery-fee. [Accessed 27 July 2023].

[50] J. Murphy, "Pa. looking to charge electric vehicle owners a $290 annual fee," PennLive, 7 June 2023. [Online]. Available: https://www.pennlive.com/politics/2023/06/pa-looking-to-charge-electric-vehicle-owners-a-290-annual-fee.html. [Accessed 27 July 2023].

[51] Idaho State Legislature, "ID H0362 | 2021 | Regular Session | Introduced," LegiScan, 5 May 2021. [Online]. Available: https://legiscan.com/ID/text/H0362/id/2359223. [Accessed 30 July 2023].

[52] D. Jacobs, "Legislature shifts vehicle tax revenue from general spending to Louisiana roads," The Center Square, 10 June 2021. [Online]. Available: https://www.thecentersquare.com/louisiana/article_809ccb9e-ca3e-11eb-9ab9-0739c377650c.html. [Accessed 30 July 2023].

[53] L. Leslie, "NC lawmakers turn to sales taxes to boost road funding," WRAL, 12 July 2022. [Online]. Available: https://www.wral.com/nc-lawmakers-turn-to-sales-taxes-to-boost-road-funding/20371326/. [Accessed 30 July 2023].

[54] C. H. Rossell, "Using Multiple Criteria to Evaluate Public Policies: The Case of School Desegregation," American Politics Quarterly, April 1993. [Online]. Available: https://www.bu.edu/polisci/files/people/faculty/rossell/papers/UsingMultCriteriaAPQ1993.PDF. [Accessed 27 July 2023].

[55] M. Baumhefner, "A Simple Way to Fix the Gas Tax Forever," National Resources Defense Council, 2 August 2019. [Online]. Available: https://www.nrdc.org/bio/max-baumhefner/simple-way-fix-gas-tax-forever. [Accessed 27 July 2023].

[56] J. Dowds and D. Rowangould, "Vermont Transportation Energy Profile 2021," The University of Vermont Transportation Research Center, March 2022. [Online]. Available: https://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/2021%20Vermont%20Transportation%20Energy%20Profile.pdf. [Accessed 28 July 2023].

[57] M. Soellner, "Would out-of-state drivers really pay $73 million under Evers' gas tax plan?," PolitiFact, 28 June 2019. [Online]. Available: https://www.politifact.com/factchecks/2019/jun/28/jon-erpenbach/state-lawmakers-gas-tax-claim-gets-green-light/. [Accessed 27 July 2023].

[58] Congressional Budget Office, "Alternative Approaches to Funding Highways," March 2011. [Online]. Available: https://www.cbo.gov/sites/default/files/112th-congress-2011-2012/reports/03-23-highwayfunding.pdf. [Accessed 28 July 2023].

[59] G. Bauer, C.-W. Hsu and N. Lutsey, "When might lower-income drivers benefit from electric vehicles? Quantifying the economic equity implications of electric vehicle adoption," International Council on Clean Transportation, February 2021. [Online]. Available: https://theicct.org/sites/default/files/publications/EV-equity-feb2021.pdf. [Accessed 28 July 2023].

[60] E. L. Glaeser, C. S. Gorback and J. M. Poterba, "How Regressive are Mobility-Related User Fees and Gasoline Taxes?," National Bureau of Economic Research, December 2022. [Online]. Available: https://www.nber.org/system/files/working_papers/w30746/w30746.pdf. [Accessed 28 July 2023].

[61] A. Gonzalez, "Own an electric vehicle in Texas? You'll need to pay an additional fee when renewing your registration starting Sept. 1," Click2Houston.com, 25 July 2023. [Online]. Available: https://www.click2houston.com/news/local/2023/07/25/own-an-electric-vehicle-in-texas-youll-need-to-pay-an-additional-fee-when-renewing-your-registration-starting-sept-1/. [Accessed 2 August 2023].

[62] Board of Governors of the Federal Reserve, "Changes in U.S. Family Finances from 2016 to 2019: Evidence from the Survey of Consumer Finances," September 2020. [Online]. Available: https://www.federalreserve.gov/publications/files/scf20.pdf. [Accessed 28 July 2023].

[63] L. Davis, "Evidence of a Homeowner-Renter Gap for Electric Vehicles," Energy Institute at Haas, July 2018. [Online]. Available: https://haas.berkeley.edu/wp-content/uploads/WP291.pdf. [Accessed 28 July 2023].

[64] National Conference of State Legislatures, "Vehicle Registration Fees by State," 4 February 2020. [Online]. Available: https://www.ncsl.org/transportation/vehicle-registration-fees-by-state. [Accessed 28 July 2023].

[65] Ernst & Young LLP, "Colorado makes Retail Delivery Fee collection optional for retailers, increases small-seller threshold," 5 May 2023. [Online]. Available: https://taxnews.ey.com/news/2023-0832-colorado-makes-retail-delivery-fee-collection-optional-for-retailers-increases-small-seller-threshold. [Accessed 27 July 2023].

[66] A. Weinstein Agrawal and H. Nixon, "What Do Americans Think about Federal Tax Options to Support Transportation? Topline Results from Year Thirteen of a National Survey," San José State University, Mineta Transportation Institute, April 2022. [Online]. Available: https://transweb.sjsu.edu/sites/default/files/2208A-Agrawal-Nixon-Public-Opinion-Federal-Tax-Options-Transportation-Survey-Toplines.pdf. [Accessed 31 July 2023].

[67] Montana Legislature, "HB 55," 4 May 2023. [Online]. Available: http://laws.leg.mt.gov/legprd/LAW0203W$BSRV.ActionQuery?P_SESS=20231&P_BLTP_BILL_TYP_CD=HB&P_BILL_NO=55&P_BILL_DFT_NO=&P_CHPT_NO=&Z_ACTION=Find&. [Accessed 30 July 2023].

[68] M. Blonsky, P. Munankarmi and S. Balamurugan, "Incorporating Residential Smart Electric Vehicle Charging in Home Energy Management Systems," U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, National Renewable Energy Laboratory, April 2021. [Online]. Available: https://www.nrel.gov/docs/fy21osti/78540.pdf. [Accessed 31 July 2023].

[69] D. L. Greene, J. M. Greenwald and R. E. Ciez, "U.S. fuel economy and greenhouse gas standards: What have they achieved and what have we learned?," Energy Policy, November 2020. [Online]. Available: https://doi.org/10.1016/j.enpol.2020.111783. [Accessed 30 July 2023].

[70] International Energy Agency, "CO2 Emissions in 2022," March 2023. [Online]. Available: https://www.iea.org/reports/co2-emissions-in-2022. [Accessed 30 July 2023].

[71] U.S. Department of Energy, Energy Information Administration, "What is U.S. electricity generation by energy source?," 2 March 2023. [Online]. Available: https://www.eia.gov/tools/faqs/faq.php?id=427&t=3. [Accessed 30 July 2023].

[72] North Carolina Clean Energy Technology Center, "The 50 States of Electric Vehicles: 2022 Review and Q4 2022 Report," February 2023. [Online]. Available: https://nccleantech.ncsu.edu/wp-content/uploads/2023/02/Q4-22_EV_execsummary_Final.pdf. [Accessed 30 July 2023].

[73] U.S. Department of Transportation, "Historic Step: All Fifty States Plus D.C. and Puerto Rico Greenlit to Move EV Charging Networks Forward, Covering 75,000 Miles of Highway," 27 September 2022. [Online]. Available: https://www.transportation.gov/briefing-room/historic-step-all-fifty-states-plus-dc-and-puerto-rico-greenlit-move-ev-charging. [Accessed 30 July 2023].

[74] Plug In America, "EV Road Usage Fees: A 3-Step Guide for States," 24 July 2023. [Online]. Available: https://pluginamerica.org/policy/ev-road-usage-fees/. [Accessed 31 July 2023].

[75] A. Jenn, "Assessing Alternatives to California's Electric Vehicle Registration Fee," University of California Institute of Transportation Studies, December 2018. [Online]. Available: https://escholarship.org/content/qt62f72449/qt62f72449_noSplash_be2fd111c6e464f7dd4c71ae46512dbe.pdf?t=pkyia0. [Accessed 27 July 2023].

[76] Indiana Legislative Services Agency, Office of Fiscal and Management Analysis, "Fiscal Impact Statement, HB 1050," 1 May 2023. [Online]. Available: https://iga.in.gov/pdf-documents/123/2023/house/bills/HB1050/fiscal-notes/HB1050.07.ENRS.FN001.pdf. [Accessed 2 August 2023].

[77] Colorado Department of Revenue, Taxation Division, "Fuel Tax & Fee Rates," [Online]. Available: https://tax.colorado.gov/fuel-tax-and-fee-rates. [Accessed 31 July 2023].

[78] Urban Institute, "State and Local Backgrounders: Motor Fuel Taxes," [Online]. Available: https://www.urban.org/policy-centers/cross-center-initiatives/state-and-local-finance-initiative/state-and-local-backgrounders/motor-fuel-taxes. [Accessed 1 August 2023].

[79] K. Carlson, "Texas EV owners face a new tax. Find out why, and how much it will cost drivers here," Austin American-Statesman, 16 May 2023. [Online]. Available: https://www.statesman.com/story/business/technology/2023/05/16/ev-register-car-texas-law-vehicle-registration-fees-2023/70222662007/. [Accessed 28 July 2023].

[80] J. Dow, "Plug-in hybrids use more gas than estimated, dieselgate whistleblower says," Electrek, 22 December 2022. [Online]. Available: https://electrek.co/2022/12/22/plug-in-hybrids-use-more-gas-than-estimated-dieselgate-whistleblower-says/. [Accessed 28 July 2023].

[81] State of California, Department of Motor Vehicles, "Registration Fees," [Online]. Available: https://www.dmv.ca.gov/portal/vehicle-registration/registration-fees/. [Accessed 30 July 28].

[82] J. Williamson, "Say hello to a higher gas tax in Virginia," WSLS 10 News, 1 July 2020. [Online]. Available: https://www.wsls.com/news/virginia/2020/07/01/say-hello-to-a-higher-gas-tax-in-virginia/. [Accessed 28 July 2023].

[83] "Code of Virginia § 46.2-772. Highway Use Fee.," Virginia Law Library, [Online]. Available: https://law.lis.virginia.gov/vacode/46.2-772/. [Accessed 28 July 2023].

[84] Virginia Department of Motor Vehicles, "Virginia's Mileage Choice Program," [Online]. Available: https://www.dmv.virginia.gov/general/#va_mileage_choice.asp. [Accessed 28 July 2023].

[85] Atlas Public Policy, "Road Network Funding," [Online]. Available: https://www.atlasevhub.com/materials/road-networking-funding/. [Accessed 28 July 2023].

[86] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, Vehicle Technologies Office, "FOTW# 1175: Vehicles Registered in the District of Columbia Averaged 22 Miles per Gallon in 2018," 1 March 2021. [Online]. Available: https://www.energy.gov/eere/vehicles/articles/fotw-1175-march-1-2021-vehicles-registered-district-columbia-averaged-22. [Accessed 28 July 2023].

[87] National Highway Traffic Safety Administration, "Corporate Average Fuel Economy Standards for Model Years 2024-2026 Passenger Cars and Light Trucks," Federal Register, 2 May 2022. [Online]. Available: https://www.federalregister.gov/documents/2022/05/02/2022-07200/corporate-average-fuel-economy-standards-for-model-years-2024-2026-passenger-cars-and-light-trucks. [Accessed 30 July 2023].

[88] P. Lewis, J. Davis and A. Grossman, "Refreshing the Status Quo: Federal Highway Programs and Funding Distribution," Eno Center for Transportation, December 2019. [Online]. Available: https://enotrans.org/wp-content/uploads/2023/02/Refreshing-the-Status-Quo-Eno-Center-for-Transportation.pdf. [Accessed 3 August 2023].

ATLAS
PUBLIC POLICY

WWW.ATLASPOLICY.COM