

Innovative Revenue Mechanisms for Alternative Fuel Vehicles

The adoption of alternative fuel vehicles, including electric and hybrid, in the U.S. has seen remarkable growth. Sales of battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs) increased dramatically, rising from 2011 to 2020 by 100-fold to reach nearly 1.7 million (Nick et al., 2021). Furthermore, the sales grew by 85 percent between 2020 and 2021 (Minos, 2022). In 2023, year-to-date sales of electric vehicles reached 71,294 units, representing a 71.5 percent increase over the same period in 2022 (Minos, 2022; Nick et al., 2021; Argonne National Laboratory, 2023).

The increased adoption of alternative fuel vehicles and the increased vehicle fuel efficiency posed challenges to the revenue-generation ability of the motor fuel tax. Unlike internal combustion engine vehicles (ICEVs) that rely on gasoline and contribute to road upkeep through gasoline tax revenues, EVs do not and hybrid vehicles only do when using fuel as the alternative to electricity. In addition, vehicle fuel efficiency has increased by 35.4 percent in the past 20 years (EPA, 2022). Therefore, the overall decrease in the use of fuel to power vehicles presents an erosion of the motor fuel tax base and impacts the revenues generated. This has implications for the maintenance and development of vital transportation infrastructure.

In response to this issue, several states have explored alternative revenue mechanisms to bridge the funding gap. One mechanism has been the introduction of special registration fees for specific hybrid and EV models. These fees are levied in addition to standard motor vehicle registration fees, with the aim of ensuring that all vehicle owners, regardless of their choice of propulsion, contribute equitably to the maintenance and expansion of the roadway system. Another mechanism is the charge per mile, also known as mileage-based user fees (MBUF), distance-based user fees (DBUF), and roadway user charges (RUC).

1 Special Registration Fees for Electric and Hybrid Vehicles

Across the U.S., 33 states have adopted a special registration fee for electric and hybrid vehicles. Of these, 20 states have fees levied on both electric vehicles (EVs) and hybrid vehicles, and 12 states have fees levied only on EVs. Figure 1 presents the distribution of states that have adopted these types of fees.

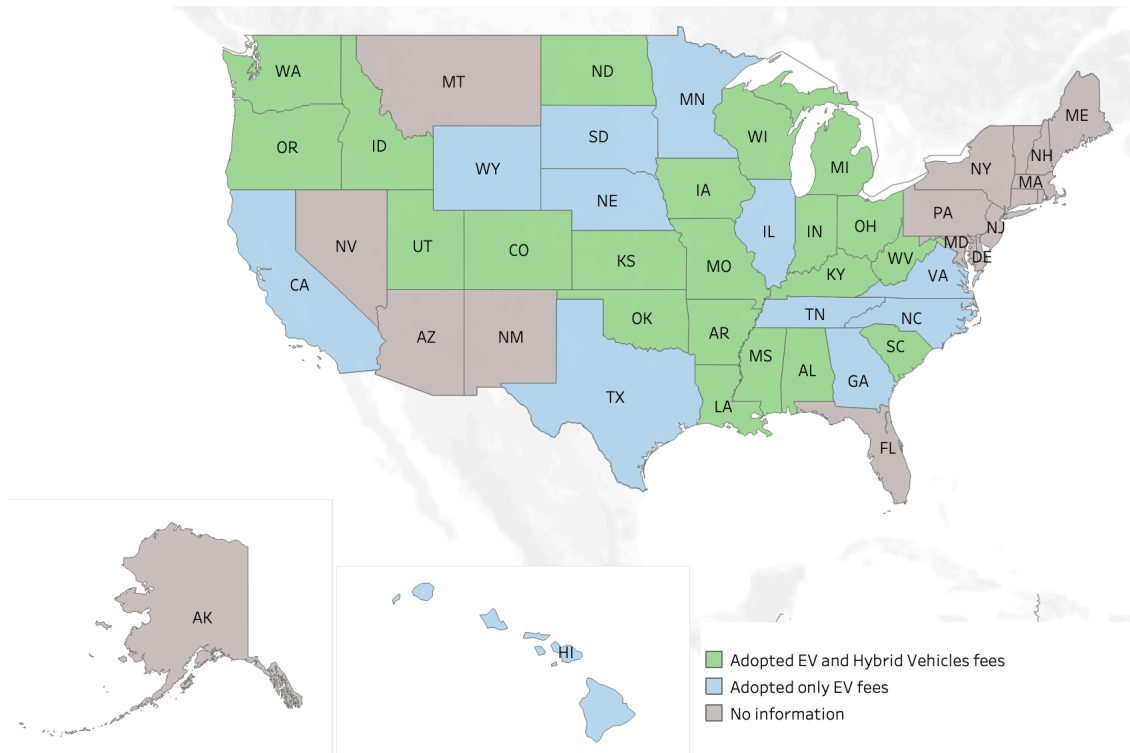


Figure 1: States adopting Special Registration Fees for Electric and Hybrid Vehicles in the U.S.

Most of the states have dedicated revenues from the special registration fees for transportation purposes and few have made adjustments to the rates. Appendix A presents a table with the revenue distribution and rate adjustments by state. Overall, revenues collected through special registration fees for electric and hybrid vehicles are mainly used to support the statewide transportation system, and in some states to support the transportation efforts of local governments (counties and cities). A few states also dedicate some funding to support EV adoption and EV infrastructure such as charging stations. Similarly, states have implemented rate adjustments to increase the fee value (and adjust for changes in prices) or differential rates based on vehicle characteristics. Fee values are mainly adjusted in accordance with price indexes (5 states) or by statute (4 states). Differential rates are based on vehicle weight (2 states), vehicle fuel efficiency or MPG (1 state), and vehicle classification (1 state).

1.1 Special Registration Fees for Electric Vehicles

Across the U.S., 33 states have adopted a special registration fee levied on EVs - specifically battery electric vehicles (BEVs), which are vehicles that run on electricity from batteries and do not use any other source of power. Figure 2 presents the annual number and the cumulative number of states adopting special registration fees for BEVs since 2011. The fee adoption started in 1998 when Missouri enabled legislation for this fee, but the fee adoption has been more seriously considered by states since 2011. In 2017, there was significant growth in the number of states adopting this type of fee.

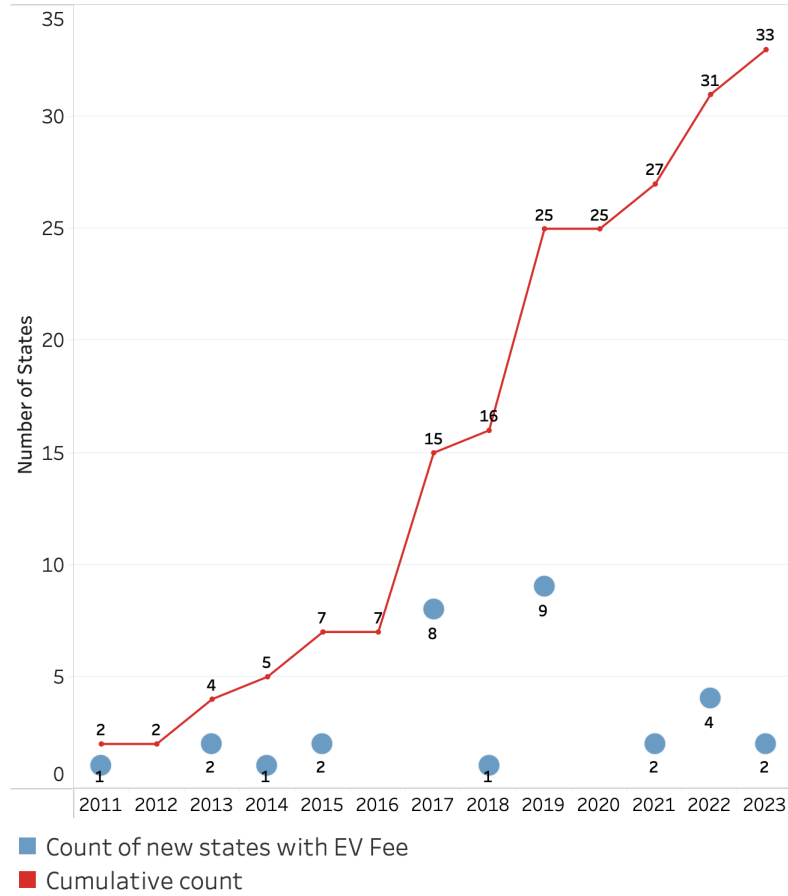


Figure 2: Adoption of EV fees by states over time

Notes: Missouri enabled legislation in 1998.

Figure 3 presents the registration fee rate for EVs in 2023 by state. Overall, the annual rate levied varies from \$50 (in states like Colorado, Hawaii, and South Dakota) to \$210 (in Georgia), with an average of \$126.52.¹

¹In Texas, owners of EVs pay a first-time registration fee of \$400. After that, there is a \$200 fee for EV registration renewal.

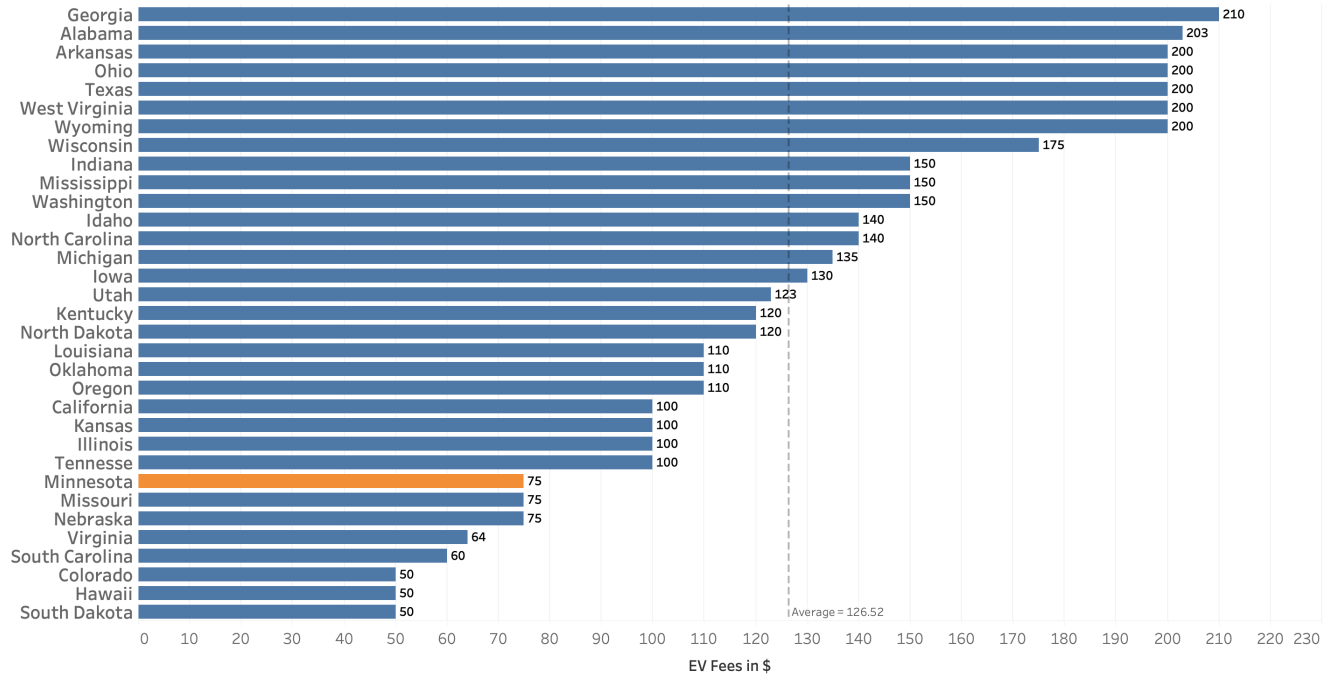


Figure 3: Special registration fees levied on EVs across the U.S.

Notes: Annual fee rate in dollars, amount effective in 2023. In South Carolina, the fee is divided by 2 to reflect that it is biannual.

1.2 Special Registration Fees for Hybrid Vehicles

Across the U.S., 21 states have adopted a special registration fee levied on hybrid vehicles, which are vehicles that use batteries to power an electric motor and another fuel, such as gasoline or diesel, to power an internal combustion engine or other propulsion source. While 9 states have implemented these fees on hybrid vehicles in general, other 9 states have implemented these fees specifically on plug-in hybrid electric vehicles (PHEVs) -which are vehicles whose battery is recharged by plugging it into an electric power source. Two states, Utah and Kansas, specifically refer to both types of vehicles.

Figure 4 presents the cumulative number of states adopting special registration fees for hybrid vehicles. Similar to EV fees, the adoption of hybrid vehicle fees started in 1998 with Missouri and has been more seriously considered by states since 2011. In 2019, there was significant growth in the number of states adopting this type of fee. Generally, states have implemented special registration fees for both electric and hybrid vehicles at the same time. However, in recent years states such as North Carolina are considering the option of levying the special registration fee on hybrid vehicles years after starting fees on EVs (General Assembly of North Carolina, 2023).

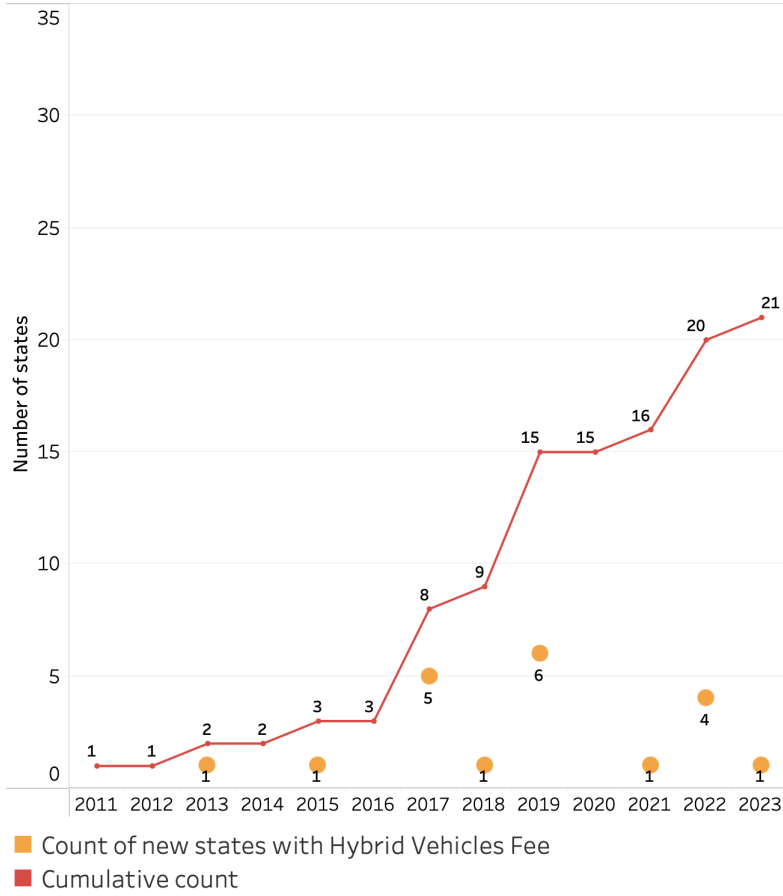


Figure 4: Adoption of hybrid vehicle fees by states over time

Notes: Missouri enabled legislation in 1998.

Figure 5 presents the registration fee rate for hybrid vehicles in 2023 by state. Overall, the annual rate levied varies from \$30 (in South Carolina) to \$150 (in Washington), with an average of \$68.81.

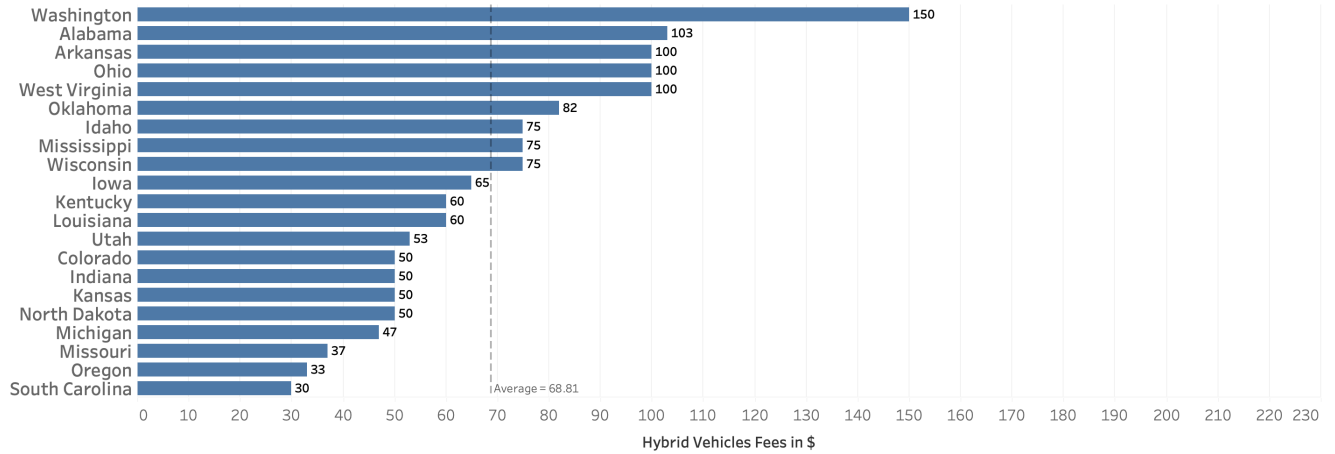


Figure 5: Special registration fees levied on hybrid vehicles across the U.S.

Notes: Annual fee rate in dollars, amount effective in 2023. In South Carolina, the fee is divided by 2 to reflect that it is biannual.

When states implement registration fees on EVs and hybrid vehicles, the registration fee rate for hybrid vehicles tends to be lower than the registration fee rate for EVs. As of 2023, the average registration fee rate for hybrid vehicles is 60 percent of the average registration fee rate for EVs.

The implementation of the hybrid fee varies across states. On the one hand, states can implement a registration fee for EVs and apply it to hybrid vehicles under special circumstances. In Georgia, for instance, the EV fee applies to PHEVs only if they have an alternative fuel vehicle (AFV) license plate (Georgia Department of Revenue, 2023). On the other hand, it is possible to have a different fee rate for hybrid vehicles and PHEVs. In Utah, for instance, PHEVs pay a \$52 annual fee, while hybrid vehicles pay a \$20 annual fee (Utah Code § 41-1a-1206).

2 Roadway User Charges (RUCs)

Across the U.S. states have also considered RUCs as a revenue-generation strategy for the transportation system that could replace the motor fuel tax. This type of charge links taxation to the actual use of the roadway by a driver. As of 2023, three states have enacted legislation and currently collect revenues from per-mile charges (see Table 1).² Other states such as California, Colorado, Minnesota, Pennsylvania, and Washington have tested or demonstrated these per-mile charges; while states such as Alaska, Arizona, Idaho, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming have explored or researched these charges (RUC America, 2023).

²The RUC for EVs in Hawaii will go into effect beginning July 1, 2025. Hawaii DOT will prepare and submit a plan to the legislature by the end of 2025 to transition all vehicles to RUC by 2033 (including ICEV, hybrid vehicles, or other renewable fuel-powered vehicle) (HDOT, 2023).

Table 1: Characteristics of RUC programs

State	Rate	Program Characteristics	Fee Adjustments
Oregon (SB 810)	1.9 cents per mile (2023)	*Voluntary for light-duty passenger vehicle owners *Credit fuel tax paid *Select account manager	Annual adjustment (HB 2881): indexed to the fuel tax
Utah (SB 72)	1.0 cents per mile (2023)	*Voluntary for electric vehicle owners *Alternative fuel vehicle owners choose to pay the RUC in lieu of paying the surcharge *Participants will not pay more than the surcharge *Uses DriveSync® app	By law (HB 186): *1.00 c/m in 2023 *1.25 c/m in 2026 *1.50 c/m in 2032 Annual adjustment - beginning in 2024: change in Consumer Price Index
Hawaii (Act 222)	0.8 cents per mile (2025)	*EV owners choose to pay the RUC in lieu of paying the surcharge *Beginning July 1, 2025	

At the national level, the Bipartisan Infrastructure Law (BIL) requires the U.S. Department of Transportation to conduct a national RUC pilot. BIL authorized \$10 million per year for fiscal years 2022 to 2026 (Kim, 2023).

Outside of the U.S., some countries have implemented or are considering RUCs as a mechanism to fund their roadway system. New Zealand, for instance, introduced the RUC program in 1978. The program applies to all heavy vehicles and all diesel-powered light vehicles (New Zealand Ministry of Transport, 2023).³ Revenues from the RUC are used to fund the operation, maintenance, and improvement of the transport system. As of 2023, distance licenses are provided in units of 1,000 km (621 miles), and the unit cost depends on the vehicle type (powered vehicles, unpowered vehicles, all-terrain cranes, vintage vehicles, motor caravans, overweight specialist RUC vehicles, and for type H vehicles) and vehicle weight. The unit cost as of 2023 ranges from NZD\$41 to NZD\$1087 (USD\$24.6 to \$651.3) (NZ Transport Agency, 2023).⁴ In addition, there is an administrative fee applicable to all RUC license types, which varies depending on the purchasing method (NZD\$12.4/USD\$7.44 for online purchases and NZD\$13.7/USD\$8.21 for counter sales agents).

New Zealand set a goal of having 64,000 electric cars on the roads by the end of 2021 and introduced the Electric Vehicles Programme in 2016 to encourage the wider use of EVs. In 2012, the RUC legislation was updated and changes made the system easier to understand and fairer for RUC payers. In 2021, the legislation extended the exemption of light EVs from road charges until 2024 and waived road charges for heavy EVs based on the type of vehicle and distance driven until these vehicles make up 2 percent of all heavy vehicles.

Similarly, some European countries such as Germany and Belgium have launched RUC systems through tolls aimed at Heavy Goods Vehicles (HGV). Factors driving the adoption of this system in Europe include

³All non-petrol powered vehicles, excluding vehicles powered by CNG or LPG, are subject to RUC. In addition, if the vehicle is designed for special purposes and is not meant for regular road use, it might not have to pay road charges (including certain off-road diesel vehicles weighing less than 3.5 tonnes).

⁴The currency conversion rate is 1 NZD = 0.6 USD.

the EU-wide legislation that facilitates the interoperability of tolling across countries, and the European Electronic Toll Service (EETS) (Ptolemus Consulting Group, 2022). The German RUC, for instance, was introduced in 2005 and it is known as LKW-Maut (Perera & Thompson, 2020; Road Traffic Technology, 2022). Germany expanded the systems in phases to cover approximately 40,000 km of federal highways by 2018. On January 1, 2023, a draft amendment differentiated toll rates based on weight and axle class. Currently, the toll rate varies with the number of axes, emission class, and total weight ranging from EUR€0.13 (USD\$0.14) to EUR€0.516 (USD\$0.56) per kilometer (Freight Connections, 2023).⁵ In 2018, the Ministry of Transport anticipated to collect an average annual revenue of EUR€7.4 billion (USD\$8.1 billion) from the tolling system between 2018 and 2022 for transport infrastructure investments.

Germany plans to continue adjusting the tolling program reflecting the broader landscape of toll adjustments across European countries (Freight Connections, 2023; TransInfo, 2023). These adjustments are driven mainly by environmental concerns, emission reduction goals, the growing emphasis on stricter EU regulations, and climate change mitigation targets. In particular, starting July 1, 2024, the toll is proposed to expand to vehicles over 3.5 tonnes, and the rate is set to nearly double. These changes also include a CO2 emissions surcharge of EUR€200 (USD\$218.3) per tonne added to road tolls for heavy vehicles effective December 1, 2023, under the "Third Amendment to Road Toll Regulations" project.

Lastly, Norway is currently exploring RUCs. With the increased number of EVs in Norway, the country is experiencing more pressure on the current roadway funding approach (Kosche, 2020). Similar to the U.S., the Norwegian government charges taxes on fuel purchases, vehicle registrations, and toll road fees; but the first two are not earmarked for the construction and maintenance of the roadway system. Many cities and counties have introduced or increased toll road fees as a way to increase funding for road construction, which has spawned protest marches. As of 2023, the county is exploring RUCs as a sustainable mechanism to generate revenue for the roadway system that reflects the external costs of a vehicle using the roadway network (Foss, 2023).

⁵The currency conversion rate is 1 EUR = 1.09 USD.

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A Distribution of Revenues from Special Registration Fees for Electric and Hybrid Vehicles

Table 2: Revenue distribution and fee adjustments

State	State Transportation Funding	Local Transportation Funding	Other Funding	Adjustments
Alabama	66.67% of the initial \$150 from BEV fees and \$75 from PHEV fees	<p>Counties: 25% of the initial \$150 from BEV fees and \$75 from PHEV fees</p> <p>Cities: 8.33% of the initial \$150 from BEV fees and \$75 from PHEV fees</p>	Remaining to the Rebuild Alabama Fund (supports EV charging infrastructure)	<p>Starting 2023: Increases \$3 every four years.</p> <p>Annual fees drop to \$150 for BEVs and \$75 for PHEVs when these vehicle registrations exceed 4% of total vehicle registrations (revenues used for road and bridge construction, maintenance, and other lawful purposes).</p> <p>EV fees will decrease by up to \$50 for BEVs and \$25 for PHEVs per year if used for state highway transportation, offsetting federal fees.</p>
Arkansas	Deposited in the State Highway and Transportation Department Fund			
California	Deposited into the Road Maintenance and Rehabilitation Account after deducting DMV administrative costs			Starting 2021: Expected fee adjustment with the consumer price index
Colorado	60% to the Highway Users Tax Fund		40% to the Electric Vehicle Grant Fund (grants to install charging stations and to offset station operating costs)	

Table 2: Revenue distribution and fee adjustments

State	State Transportation Funding	Local Transportation Funding	Other Funding	Adjustments
Georgia	Exclusively for “transportation purposes” (roads, bridges, public transit, rails, airports, buses, seaports); accompanying infrastructure and services necessary to provide access to facilities; and paying general obligation debt and other multiyear financing obligations.			Effective 2016: Statutory base fee automatically adjusted by statutory formula Fee applicable to vehicles registered July 1, 2019, and after Commercial vehicles: \$316.40; Non-commercial vehicles: \$210.87
Hawaii	Deposited into the State Highway Fund			
Idaho	To the Highway Distribution Account (allocation: 60% - state highway account for highway construction and improvement; 40% - localities for highway and bridge construction and maintenance and to fund unpaid bonds requirements)			
Illinois	Deposited into the Road Fund		\$1 of the fee is allocated to the Secretary of State Special Services Fund	
Indiana		Deposited into the Local Road and Bridge Matching Grant Fund for projects undertaken by localities to repair/increase road and/or bridge capacity		Indexed to the same inflation mechanism as the motor fuel tax.

Table 2: Revenue distribution and fee adjustments

State	State Transportation Funding	Local Transportation Funding	Other Funding	Adjustments
Iowa	Deposited into the Road Use Tax Fund			Statutory adjustment: 2019: \$65 for BEVs and \$32 for PHEVs 2021: \$97 for BEVs and \$48.75 for PHEVs 2022: \$130 for BEVs and \$65 for PHEVs
Kansas (1)	Deposited into the State Highway Fund after deductions			
Kentucky	50% in the state's road maintenance fund		50% in the general fund	
Louisiana	70% for road and bridge projects in DOT's Highway Priority Program	30% to the Parish Transportation Fund for use of local governments		
Michigan	Some revenues deposited into the Michigan Transportation Fund for road maintenance carried out by cities, villages and counties.		Other revenues are deposited into the Scrap Tire Regulation Fund.	Indexed to the motor vehicle fuel tax. Each 1 cent increase in fuel tax above 19 cents, increases the BEV annual fee by \$5 and the PHEV annual fee by \$2.50. By weight: Vehicles up to 8,000 pounds: \$135 BEVs and \$47.50 for PHEVs Vehicles over 8,000 pounds: \$235 for BEVs and \$117.50 for PHEVs
Minnesota	Deposited into the Highway User Tax Distribution Fund			

Table 2: Revenue distribution and fee adjustments

State	State Transportation Funding	Local Transportation Funding	Other Funding	Adjustments
Mississippi	Revenues apportioned for the same purposes and in the same proportion as for fuel taxes during the previous fiscal year. Funds used solely for the repair and maintenance of roads, streets, and bridges			Starting in 2021: fees indexed to inflation
Missouri	Deposited into the State Highway Fund			\$75 additional annual fuel decal fee for alternative fueled passenger motor vehicles up to 18,000 lbs.
Nebraska	Deposited into the Highway Trust Fund			
North Carolina (2)	85% to the Highway Fund to support the existing transportation system (resurfacing highways, replacing bridges, paving secondary roads). 15% to the Highway Trust Fund			
North Dakota	Deposited into the highway tax distribution fund			
Ohio	55% to the highway operating fund 45% to the gasoline excise tax fund (allocation: 19.3% to municipalities; 16.7% to counties; 9% to townships)			

Table 2: Revenue distribution and fee adjustments

State	State Transportation Funding	Local Transportation Funding	Other Funding	Adjustments
Oklahoma			100% to a new Driving on Road Infrastructure with Vehicles of Electricity (DRIVE) Revolving Fund until July 1, 2027. After this date: 85% to revolving fund; 15% to counties	By weight: Under 6,000 lbs: \$110 for EVs, \$82 for PHEVs. 6,000-10,000 lbs: \$158 for EVs, \$118 for PHEVs. 10,000-26,000 lbs: \$363 for EVs, \$272 for PHEVs. Over 26,000 lbs: \$2,250 for EVs, \$1,687 for PHEVs.
Oregon			Revenues support state and local transportation systems (road and bridge improvements, enhanced safety measures, and increased transit options).	By MPG: 0-19 mpg - \$18 23-29 mpg - \$23 0 mpg or greater - \$33 EVs - \$ 110
South Carolina	Deposited into the Infrastructure Maintenance Trust Fund (for repairs, maintenance, and improvements to the existing transportation system)			
South Dakota	Deposited into the state highway fund			
Tennessee	Deposited into the highway fund			
Texas	Deposited into the state highway fund			
Utah	Deposited in the Transportation Fund			Starting in 2022: Indexed to consumer price index

Table 2: Revenue distribution and fee adjustments

State	State Transportation Funding	Local Transportation Funding	Other Funding	Adjustments
Virginia	Deposited into the Highway Maintenance and Operating Fund. Funds used for district transportation purposes			Fee can decrease to \$50 if the receiving jurisdiction does not use revenues for transportation purposes.
Washington	70% to motor vehicle fund 15% to the transportation improvement account 15% to the rural arterial trust account		**Additional transportation electrification fee (\$75) to support EV charging stations	
West Virginia	PHEV fee: To the State Road Fund (pays principal and interest on state bonds for state road maintenance, construction, and improvement). EV fee: To the state's Transportation Fund.			
Wisconsin	Deposited to the state's Transportation Fund			
Wyoming (1)	Deposited into the state highway fund			By legislation: Increased in 2019

Notes: (1) In Kansas and Wyoming the fee is total, not in addition to the annual registration fee. (2) South Carolina charges a biennial fee. **Source:** National Conference of State Legislatures (2023)