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Costs of Battery Electric Vehicle Policy Incentives

Analysis and Results

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Executive Summary

This study analyzed the cost of battery electric vehicle (BEV) incentives to the federal government and 14 state governments. These states were chosen because they have either recently enacted incentive programs or are considering new or additional incentive programs. BEV adoption is growing across the United States and consequently so is the use of financial incentive programs. This analysis focused on policies affecting consumer level BEV adoption and considers foregone revenue through decreased fuel tax revenue, the provision of tax credits, and reduced fees charged to BEV owners, as well as the cost of incentive programs, such as rebates and grants. States examined include:

- Arizona.
- California.
- Colorado.
- Connecticut.
- Florida.
- Illinois.
- Maryland.
- Massachusetts.
- New Jersey.
- New York.
- North Carolina.
- Ohio.
- Oregon.
- Pennsylvania.

Policies

The initial purchase cost of an EV is often higher than a similar internal combustion engine vehicle, so various government programs at the federal and state levels in the U.S. have been funded to increase the sales of EVs, including tax credits, rebates, and charging infrastructure.

The federal government provides a plug-in electric vehicle (PEV)[1] credit for consumers that purchase either a BEV or a plug-in hybrid vehicle (PHEV) that operates both on electric power and gasoline. This report focuses on BEV incentives, however many of these programs incentivize all types of EVs, including BEVs. The incentives provided at the state level vary but often include a mixture of grant or rebate programs, tax incentives or credits, and fee reductions in the form of waived registration fees or toll reductions:

- Rebate programs offer a reduction in the initial purchase cost of an EV; most rebate programs include different types of vehicles, such as partially zero emission or PEVs.
- Grant programs provide funding for the purchase of EVs or for the purchase of EV infrastructure or equipment that can include charging stations or in-home chargers.
- Loans or financing assistance for the purchase of electric vehicle supply equipment (EVSE) or EVs are provided through programs in several states. Most of these programs focus on EVSE

[1] Plug-in electric vehicle refers to both fully electric (battery electric) vehicles and plug-in hybrid vehicles that operate electrically and using gasoline.

equipment for various entities, but certain states offer loans to help with the purchase of an EV. These programs are normally agreements between the state and a bank within that state to provide lower interest rates or specific loan amounts to qualified customers.

- Tax credits, similar to the federal level incentive, are where residents that have purchased an EV or EVSE will apply for a tax credit during their next tax return.
- Other tax incentives commonly include sales tax exemptions and can vary based on the price of the vehicle.

Methodology and Analysis

The objective of the analysis was to quantify the costs of BEV incentives as fully as possible, both at the U.S. federal government and the state government levels. These estimated costs include the direct cost of BEV rebates and tax credits, the amount of fuel tax revenues lost as a result of BEVs, the net effect of increased or decreased BEV registration fees, and the cost of BEV sales tax exemptions. The analysis includes a current scenario, which is an estimate of the 2018 annual costs, and three modelled scenarios, where BEV ownership has increased to 5 percent, 10 percent, and 25 percent of the total light duty vehicle fleet. The report also includes a sensitivity analysis, which estimates the modelled scenario costs with vehicle miles traveled (VMT) being equal to the current average VMT, rather than the existing lower average VMT for EVs.

Each state profile relies on reported program costs to the extent possible. The costs of each state BEV incentive program are listed in the state profiles, along with a summary of the major programs, including any rebates, tax exemptions, or registration fee changes.

BEVs and BEV incentives can impact local government revenues and expenditures through a reduction in available funding at the state level, reduction in tax revenue if a local fuel tax is levied, and the potential cost of local incentives. Although costs to local governments from BEVs exist, they were not included within the analysis.

Results

The state by state analysis examined five general types of costs resulting from BEV incentives. These were:

- Costs of BEV rebate programs.
- Foregone revenue from BEV tax credits.
- Foregone revenue from BEV sales tax exemptions.
- Foregone revenue from gasoline fuel taxes.
- Net costs of BEV registration fee policies.

Table ES 1 shows the estimated cost to the federal government for new BEVs in all 50 states was up to $1.64 billion in 2018, in addition to $44.0 million lost in fuel tax revenues due to BEVs not consuming gasoline. Together this results in $1.68 billion in lost federal tax revenue annually due to BEV ownership in the United States. This expands up to $5.16 billion annually in the 25 percent BEV penetration scenario and up to $5.93 billion annually in the increased EVMT scenario.

Table ES 1. Total Estimated Annual Federal Cost of BEVs in the United States for Current and Modeled Scenarios ($ Billions)

	Current (0.21% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$1.64	$0	$0	$0
Annual Federal Fuel Tax	$0.04	$1.03	$2.06	$5.16
Total Annual Federal Costs	**$1.68**	**$1.03**	**$2.06**	**$5.16**
Fuel Tax Cost Increased EVMT	**-**	**$1.19**	**$2.38**	**$5.93**

This also has a large impact in the states for which the analysis is conducted, especially in the higher BEV penetration scenarios. The analysis estimates California lost $62.8 million in fuel taxes in 2018, which expands to $1.940 billion in the 25 percent scenario. This results in the California total annual cost reaching $2.249 billion in the 25% BEV scenario with increased VMT, as seen in Table ES 3. Other states also experience a large growth in this cost as BEV ownership expands, with states that have a higher gasoline tax rate experiencing larger costs, relative to their size.

Table ES 2. 2018 Annual State Costs ($ Millions)

State	Total Federal Cost	Total State Cost	Total
Arizona	$42.1	$10.1	$52.2
California	$701.0	$199.7	$900.7
Colorado	$49.7	$32.9	$83.5
Connecticut	$15.8	$3.3	$19.1
Florida	$77.1	$4.5	$81.6
Illinois	$41.9	$4.4	$46.3
Maryland	$33.5	$4.4	$37.9
Massachusetts	$71.0	$16.8	$87.9
New Jersey	$51.7	$23.3	$75.0
New York	$50.5	$5.6	$56.1
North Carolina	$25.0	$0.1	$25.1
Ohio	$23.8	$1.2	$25.0
Oregon	$33.7	$13.5	$47.2
Pennsylvania	$29.2	$2.7	$31.8
14 State Total	**$1,246.0**	**$322.5**	**$1,569.4**

Table ES 3. Total Estimated Annual Cost for BEVs in 2018 and Modeled Scenarios ($ Millions)

State	2018 Actual	25% BEV Penetration	25% BEV with Increased VMT
Arizona	$52.2	$238.8	$274.7
California	$900.7	$1,870.7	$2,249.2
Colorado	$83.5	$706.5	$738.5
Connecticut	$19.1	$219.4	$247.2
Florida	$81.6	$1,046.1	$1,203.0
Illinois	$46.3	$1,001.5	$1,118.5
Maryland	$37.9	$270.4	$310.0
Massachusetts	$87.9	$243.3	$279.9
New Jersey	$75.0	$913.7	$979.0
New York	$56.1	$758.8	$872.1
North Carolina	$25.1	$204.0	$278.6
Ohio	$25.0	$613.3	$705.2
Oregon	$47.2	$116.5	$147.9
Pennsylvania	$31.8	$935.6	$1,075.9
14 State Total	**$1,569.4**	**$9,138.6**	**$10,479.6**

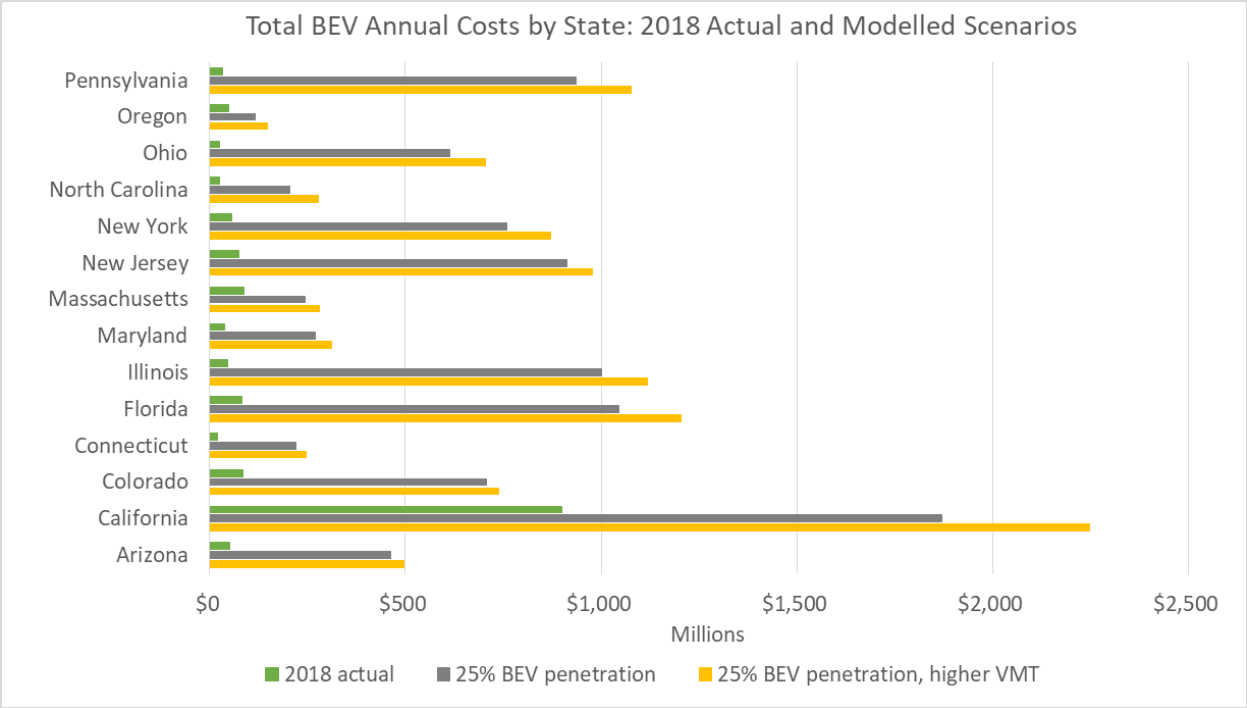

Figure ES 1. Total Annual BEV Costs by State

Figure ES 1 shows these results by state. The green bar is the 2018 annual cost, while the gray and orange bars correspond to modelled scenarios of 25% BEV penetration with 10,000 and increased EVMT

of 11,500, respectively. Estimated aggregate annual costs for the fourteen analysis states increase from approximately $1.6 billion in 2018 to $9.1 – $10.5 billion in the modelled cases of high BEV penetration, as shown in Table ES 3.

The analysis found that BEV rebate programs were generally less expensive than other types of programs, as their costs are constrained by state budgets. Policies that allow costs to grow unrestrained as BEV ownership grows, such as tax credits, sales tax exemptions, and registration fee decreases, are constrained only by BEV ownership and have the potential to impose massive costs on states as BEVs begin to make up a larger portion of the consumer vehicle fleet. Finally, fuel tax revenues will continue to decrease as BEVs increase in share, although some states have taken steps to mitigate some of these losses through increased BEV registration fees. As BEV adoption increases, states will have to determine how to offset these costs.

Introduction

Battery electric vehicle (BEV) adoption is growing across the United States and consequently so is the use of financial incentive programs. The purpose of this study is to analyze the cost of BEV incentives to the federal government and to 14 state governments. This analysis considers foregone revenue through decreased fuel tax revenue, the provision of tax credits, and reduced fees charged to BEV owners, as well as the cost of incentive programs, such as rebates and grants.[2] The report includes an overview of electric vehicle (EV) incentives, presents the methodology for the analysis, and calculates the cost to 14 states and the federal government of BEVs. The final part of the analysis examines different market penetration scenarios and their impact on fuel tax revenues and incentive costs.

TTI researchers began with a thorough review of policies at the federal level that seek to incentivize the purchase of a BEV and a review of policies in the following 14 states:

- Arizona
- California
- Colorado
- Connecticut
- Florida
- Illinois
- Maryland
- Massachusetts
- New Jersey
- New York
- North Carolina
- Ohio
- Oregon
- Pennsylvania.

Though focus was placed on policies that impacted individual consumers of BEVs, programs incentivizing the use of BEVs or EVs for heavy vehicles, fleet vehicles, and programs funding the installation and purchase of EV charging infrastructure were also explored. Data on the cost associated with the adoption of the policies and programs were collected, where possible, to assist in the analysis of the total cost of BEVs to each of the states and the federal government.

The analysis involved quantification of costs associated with BEV incentives and foregone revenue (e.g., fuel taxes) attributed to the electrification of the vehicle fleet. Vehicle registration data obtained from IHS Markit were used to determine the number of BEVs on the road at the end of 2018. The rest of the data used in the analysis were obtained from publicly available sources.

The cost to the federal government is presented by analyzing the impact of BEVs to federal fuel tax revenues and assessing the cost of the federal tax credit. The state profiles provide an overview of the available incentives, such as those that reduce the cost of BEV ownership for individual consumers; they did not include programs related to heavy vehicle or fleets. Each state's fuel tax losses, both at the federal and state level were considered, as well as the cost of rebates, tax credits, and any other

[2] This is not an exhaustive accounting of foregone revenues as local and private incentives are not included within the analysis.

applicable programs to obtain the total cost to the state in 2018. In addition to the annual cost, different market penetration scenarios are presented to understand the costs of BEV adoption and incentives at 5, 10, and 25 percent shares of total vehicle fleet.

Overview of Electric Vehicle Incentives

Both the federal and state levels of government in the U.S. incentivize the purchase of EVs through various measures, including tax credits and rebates. The initial purchase cost of an EV is often higher than a similar internal combustion engine (ICE) vehicle, so various government programs have been funded to increase the sales of EVs. Incentives are provided for various clean or cleaner vehicles, but the incentives detailed in this report focus on those that provide funding or financing for fully electric vehicles, also known as BEVs.[3] Certain programs will also provide funding for the purchase and/or installation of charging equipment or infrastructure that supports EV usage. The following incentives provide an overview of the funding available, at the federal and state level, for consumers purchasing passenger EVs and/or charging equipment and infrastructure in the 14 states analyzed. A more comprehensive list of programs and incentives, for those states, that cover vehicle electrification is provided in the Appendix.

Federal Incentives

The federal government provides a plug-in electric vehicle (PEV) credit for consumers that purchase either a BEV or a plug-in hybrid vehicle (PHEV) that operates both on electric power and gasoline. To qualify, the vehicle must have at least 5 kilowatt hours (kWh) of capacity, weigh less than 14,000 lb, use an external source to charge the battery, and meet specified emissions standards. The program began in 2008 and is available to vehicles purchased in and after 2009. The credit is processed through the Internal Revenue Service and ranges from $2,500 to $7,500. As of the end of 2018, all BEVs were eligible for the full $7,500 credit.[4] The tax credit is available until 200,000 qualified vehicles have been sold by each manufacturer; after a manufacturer has sold 200,000 qualified vehicles, the credit begins to phase out, over a period of six quarters. (*1*). In April 2019, the Driving America Forward Act was introduced in the U.S. Senate. This bill would extend the credit to an additional 400,000 vehicles per manufacturer at a reduced rate of $7,000 per vehicle. At the time of this report, this bill had not advanced out of the Senate Committee on Finance.

State Incentives

The incentives provided at the state level vary but often include a mixture of grant or rebate programs, tax incentives or credits, and fee reductions in the form of waived registration fees or toll reductions. Each state has its own combination of available options; the following details the programs that relate

[3] This report will use BEV to indicate fully electric vehicles and EV to describe the full range of electric vehicles, including plug-in hybrids.

[4] Tesla reached the 200,000-vehicle limit early in 2019; the credit has begun to phase out for consumers purchasing any Tesla model as of 1/1/2019. The credit was $3,750, which expired on 6/30/2019 and then decreased to $1,875 until the end of 2019. Chevrolet reached the 200,000-vehicle limit in 2019; the credit has begun to phase out for consumers purchasing a Chevrolet EV as of 3/31/2019. The credit was $3,750 and expired on 9/30/2019 and decreased to $1,875 on 10/1/2019 till the end of March 2020. The phase out schedule is set by the IRS.

to passenger vehicles in 14 states: Arizona, California, Colorado, Connecticut, Florida, Illinois, Maryland, Massachusetts, New Jersey, New York, North Carolina, Ohio, Oregon, and Pennsylvania.

Rebate Programs

Rebate programs offer a reduction in the initial purchase cost of an EV; most rebate programs include different types of vehicles, such as partially zero emission or PZEVs.[5] These rebates are generally provided directly to the dealership through a state administered program. Other states require customers to apply for the rebate within a set timeframe after purchase, such as Massachusetts. Certain states also operate a rebate program for the purchase of electric vehicle supply equipment (EVSE) or infrastructure. Table 1 details the states with rebate programs.

Table 1. State Rebate Programs

State	Program
California	The Clean Vehicle Rebate Project (CVRP) provides rebates for the purchase or lease of zero-emission and plug-in hybrid light-duty vehicles. An additional $2,000 rebate is available on top of the standard $5,000 for lower income households.
Connecticut	Connecticut Hydrogen and Electric Automobile Purchase Rebate Program (CHEAPR) offers rebates of up to $5,000.
Maryland	EVSE Rebate Program is available for the purchase of EV infrastructure.
Massachusetts	Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) Program provides rebates of up to $2,500 for the purchase or lease of a PEV.
New York	NY offers the Drive Clean Rebate for Plug-In Electric Cars, which offers up to $2,000 toward the lease or purchase of an EV, and the Charge Ready NY program provides rebates for EVSE.
Oregon	The Oregon Clean Vehicle Rebate Program offers up to $2,500 for the purchase or lease of an eligible EV; an extra $2,500 is available for qualified low-income buyers through the Charge Ahead program.
Pennsylvania	Alternative Fuel Vehicle Rebates are available through the Alternative Fuels Incentive Grant Program. BEVs qualify for a $1,500 rebate.

In certain states, private companies, such as utility companies, will offer a rebate or partner with a manufacturer to offer a rebate. One example of this is Maryland. Pepco, Southern Maryland Electric Cooperative, and Baltimore Gas & Electric all offer a rebate on the purchase of a Nissan Leaf when the customer shows their utility bill and the applicable flyer at purchase (*2*).

Grant Programs

Grant and rebate programs can cover both EVs and EV infrastructure or equipment; these incentives can be provided through the same program by the state but can have different requirements for qualification.

Grant programs provide funding for the purchase of EVs or for the purchase of EV infrastructure or equipment that can include charging stations or in-home chargers. These programs can include income level requirements and differ depending on whether the vehicle is purchased or leased. Grants can be

[5] Certain states use the terminology partially zero emission vehicles to refer to PHEVs. These two terms can be used interchangeably.

direct payments to the consumer or provided to the dealership to lower the initial purchase cost. Certain grant programs require that the funding be provided directly to the dealership or manufacturer to reduce the initial purchase cost. An example of this is California's Clean Vehicle Assistance Program that provides grants for low income buyers of clean vehicles.

Table 2 shows the states that have grant programs.

Table 2. State Grant Programs

State	Program
California	California operates two grant programs, both for low-income buyers; the Clean Vehicle Assistance Program and the Driving Clean Pilot Program.
Maryland	The Alternative Fuel Infrastructure Grants program provides funding to install fueling and charging infrastructure.
Massachusetts	Massachusetts Electric Vehicle Incentive Program (MassEVIP) provides grants for EVSE and EVs for public fleets.
New Jersey	It Pay$ to Plug In provides grants for the purchase of EVSE.
Pennsylvania	The Pennsylvania Department of Environmental Protection also provides grants for the installation of EVSE.

Financing Programs

Loans or financing assistance for the purchase of EVSE or EVs are provided through programs in several states. Most of these programs focus on EVSE equipment for various entities, but certain states offer loans to help with the purchase of an EV. These programs are normally agreements between the state and a bank within that state to provide lower interest rates or specific loan amounts to qualified customers. The following states offer some form of financing program:

- California
    - Residential EV Charging through Property-Assessed Clean Energy (PACE) financing.
    - Driving Clean Pilot Program is offering financing and buy-down assistance to residents in certain disadvantaged communities across the state.[6]
- Colorado—Charge Ahead Colorado provides financial support for EVs and EV charging stations.
- Ohio—Alternative Fueling Infrastructure Incentive provides financial assistance for alternative fueling stations including EVSE.[6]

Tax Credits

Certain states have opted for a tax credit, in a similar manner to the federal level incentive, where residents that have purchased an EV or EVSE will apply for a tax credit during their next tax return. The following states examined offer tax credits:

- Colorado
- Maryland

[6] These programs are not accepting new applications as of December 2018; these programs could be reopened once waitlists have cleared or further funding is made available.

- New York

Colorado's tax credit is currently in the phase-out stage; however, no definitive end date has been set for the program (*3*). The current credits differ depending on the size of the vehicle and are offered for both purchase and lease of an EV. Maryland's EV credit is only for vehicles that do not exceed $60,000 at initial purchase and are applied to the excise tax that is levied on the purchase (*4*). New York's tax credit is available to either a person or business that has invested in new alternative fuel or EV charging infrastructure on or after the tax year 2013. Qualifying infrastructure includes EVSE and the credit is set to expire in 2022 (*5*).

Tax Incentives

Beyond tax credits, states have offered various other tax incentives that include tax exclusions or exemptions. These are commonly sales tax exemptions and can vary based on the price of the vehicle. The following states have a tax exemption or exclusion:

- Arizona—Arizona exempts vehicles *converted* to operate on alternative fuels and the equipment used in converting a diesel vehicle to alternative fuels from the use tax (*6*).
- California—Advanced Transportation Tax Exclusion provides a sales tax exclusion for manufacturers of products or components that reduce pollution or energy use (*7*).
- Colorado—Lower Emission Vehicle Sales Tax Exemption exempts vehicles, vehicle power sources, or parts used for converting a vehicle power source to reduce emissions from the state sales and use tax (*8*).[7]
- New Jersey—Zero Emission Vehicle (ZEV) Tax Exemption provides a tax break for ZEVs sold, rented, or leased within the state. This exemption does vary based on the price of the vehicle (*9*).

Vehicle Retirement Program

Of the 14 states researched, California is the only state that has a vehicle retirement program. The program offers a $1,000 incentive for the retirement of a qualified vehicle. Consumers that meet the low-income eligibility requirements (currently set at 225 percent of the federal poverty level) can receive up to $1,500 from the program. To qualify, the vehicle being retired must have failed its most recent smog check (*10*). The retirement program is available statewide, but two air quality districts, San Joaquin Valley Air Pollution Control District and the South Coast Air Quality Management Districts, also operate a scrap and replace program that uses California Air Resources Board (CARB) funds. The programs provide funding for the purchase of a more fuel-efficient vehicle, retirement of the old vehicle, and money for mobility options, such as transit passes, in lieu of another vehicle. Participants in disadvantaged communities are also eligible for the Clean Cars for All Program that extends the Enhanced Fleet Modernization Program (EFMP) to provide even greater incentives (*11*).

Fee or Toll Reductions and Incentives

Although the majority of incentives focus on reducing the cost of the initial purchase, some states also provide fee reductions and other incentives that reduce the cost of ownership and general maintenance. These include reduced registration fees, high occupancy vehicle (HOV) lane exemption

[7] Vehicles must have a gross vehicle weight rating (GVWR) over 26,000 lb to qualify. The exemption also applies to vehicles that are converting to full electric that have a GVWR of over 10,000 lb.

decals that allows an EV that does not meet HOV requirements to travel in that lane, toll reductions, and emissions inspection exemptions. The following states offer a reduced registration fee:

- Arizona[8]
- Connecticut
- Illinois

The following states offer HOV lane decals or toll reductions:

- Arizona
- California
- Colorado
- Florida
- Maryland
- New Jersey[9]
- New York
- North Carolina

The following states have an emissions inspection exemption, which provides a saving to the consumer when switching from an ICE vehicle to a BEV:

- Arizona
- Colorado
- Connecticut
- Illinois
- Maryland
- Massachusetts
- New York
- North Carolina
- Ohio

Several states are considering, or have recently introduced, an increased registration fee for EVs to account for the loss in fuel tax revenue from these vehicles (*12*). The following states have additional fees due at the time of registration for EVs:

- California[10]
- Colorado
- North Carolina
- Oregon[10]

Fleet and Heavy Vehicle Incentives

States also provide incentives for fleet conversions to EVs and for the purchase of trucks, buses, or other heavier duty vehicles that are powered by a battery. These incentives are generally provided to state and local entities and agencies, as well as businesses and nonprofits. Some of these incentives are also

[8] Arizona includes a Vehicle License Tax (VLT) as part of their registration fees; this reduction is applied to the VLT.
[9] New Jersey and New York have both a HOV lane exemption program and toll discount program.
[10] Legislation has passed introducing the fee, but the fee has not yet gone into effect.

provided for the purchase of EVSE for residential multi-unit dwellings and other properties. These additional incentives are detailed in the Appendix.

Methodology

The objective of the analysis portion of this report is to quantify the costs of BEV incentives as fully as possible, both at the U.S. federal government and state government levels. These estimated costs include the direct cost of BEV rebates and tax credits, the amount of fuel tax revenues lost as a result of BEVs, the net effect of increased or decreased BEV registration fees, and the cost of BEV sales tax exemptions. The analysis includes a current scenario, which is an estimate of the annual costs as of 2018, and three modelled scenarios, where BEV ownership has increased to 5 percent, 10 percent, and 25 percent of light duty total vehicle fleet.

The costs of each state BEV incentive program are listed in the state profiles, along with a summary of the major programs, including any rebates, tax exemptions, or registration fee changes. A full summary of all state BEV incentive programs is included in the appendix. Federal tax credit costs and foregone tax revenue from reduced fuel consumption, decreased registration fees, and sales tax exemptions were estimated for each state, using the methodology discussed below.

Assumptions

Several pieces of data were needed to estimate foregone tax revenues and federal tax credit costs, including state and federal fuel tax rates, the number of vehicle miles traveled per electric vehicle (EVMT), the average miles per gallon (MPG) for an ICE vehicle, and the number of registered BEVs on the road.

Fuel tax rates were obtained from API's July 2019 State Motor Fuel Taxes report (*13*).

Table 3 shows the fuel tax rates used for each state in the analysis. The rates shown are the total effective tax rate, which includes all state taxes and fees. These rates are used to calculate foregone fuel tax revenues, resulting from an increase in BEV ownership.

Table 3. Fuel Tax Rates

State	Fuel Tax Rate ($/Gallon)
Arizona	$0.1900
California	$0.6120
Colorado	$0.2200
Connecticut	$0.4211
Florida	$0.4199
Illinois	$0.5498
Maryland	$0.3670
Massachusetts	$0.2654
New Jersey	$0.4140
New York	$0.4596
North Carolina	$0.3645
Ohio	$0.3851
Oregon	$0.3682
Pennsylvania	$0.5870
Federal	$0.1840

This analysis assumes EVMT to be 10,000 miles per year, based on research from UC Davis Institute of Transportation Studies (*14*). MPG was assumed to be 24.9, based on the EPA Automotive Trends Report (*15*). This represents the average fuel economy of the U.S. vehicle fleet. These numbers are necessary to calculate the fuel tax losses incurred by replacing gasoline vehicles with BEVs. The final piece of data, the vehicle registration data, is discussed in detail below.

Vehicle Registration Data

The analysis makes use of U.S. vehicle registration data obtained from IHS Markit. The data set includes all vehicle registrations in the United States as of January 2019. The data report the number of registered vehicles in each U.S. state by make, model, and model year.

The first step in the analysis was to identify the number of BEVs in each state. To accomplish this, vehicle models were checked against a list of all past and current BEVs in the United States. This immediately identified the number of most BEV models in each state; however, the Fiat 500, Honda Clarity, Hyundai Ioniq, and Smart Fortwo were not split into BEV and ICE vehicle in the data set. For example, the data set reported all types of the Fiat 500 as simply, a Fiat 500, when in reality a portion of these are the battery electric Fiat 500. Therefore, it was necessary to estimate percent of these models that were actually BEVs.

The Hyundai Ioniq BEV was only available in California (*16*), the Honda Clarity BEV (*17*) and Fiat 500 BEV (*18*) were available only in California and Oregon, while the Smart Fortwo was available in all states. Researchers were able to obtain a count of BEVs on the road in California (*24*) and the total number of national sales (*19*) for each year model. This showed the true count for the Ioniq BEV as it was only available in California. The number of Clarities and 500s in Oregon were estimated by subtracting the number sold nationally by the number in California, as Oregon is the only other state in which these vehicles are available.

The Smart Fortwo BEV was more difficult to estimate as it was available in all states. First, the number of Smart Fortwo BEVs on the road in California was subtracted from the number sold nationally since 2013. This provided an estimate of the number of Fortwo BEVs in states other than California. This number was then divided by the number of Fortwos of all types (BEV, internal combustion, etc.) on the road outside California. This showed that Fortwo BEVs made up 15.43 percent of all Fortwos. Thus, to estimate the number of Fortwo BEVs in each state, the total number of Fortwos in each state was multiplied by 15.43 percent. This method likely overestimates the total number of Fortwo BEVs as it relies on sales data, meaning some of these vehicles are likely no longer on the road. However, it is unlikely this would substantially affect the overall analysis, as Fortwo BEVs comprise around 1 percent of the total BEV fleet in most states. Table 4 shows registered BEVs in each of the analysis states and the U.S. 50-state total, as well as the estimated number of BEVs in the modelled scenarios.

Table 4. Registered LDVs and BEVs by State

State	Total LDV fleet (2018)	Total BEVs (2018)	New BEVs (2018)	5% BEV Total	10% BEV Total	25% BEV Total
Arizona	6,360,817	14,447	5,465	318,041	636,082	1,590,204
California	31,570,788	255,592	90,948	1,578,539	3,157,079	7,892,697
Colorado	5,272,915	17,334	6,451	263,646	527,292	1,318,229
Connecticut	3,047,165	5,023	2,060	152,358	304,717	761,791
Florida	17,253,092	26,742	10,012	862,655	1,725,309	4,313,273
Illinois	10,591,670	14,373	5,451	529,584	1,059,167	2,647,918
Maryland	4,779,093	9,467	4,375	238,955	477,909	1,194,773
Massachusetts	5,393,445	31,651	9,165	269,672	539,345	1,348,361
New Jersey	7,252,799	13,876	6,750	362,640	725,280	1,813,200
New York	11,700,626	16,055	6,573	585,031	1,170,063	2,925,157
North Carolina	9,036,082	8,181	3,248	451,804	903,608	2,259,021
Ohio	10,731,547	7,486	3,092	536,577	1,073,155	2,682,887
Oregon	3,781,601	18,282	4,285	189,080	378,160	945,400
Pennsylvania	12,079,682	8,905	3,800	603,984	1,207,968	3,019,921
U.S. 50 State Total	279,125,765	595,271	218,623	13,956,288	27,912,577	69,781,441

Analysis

To determine the annual federal tax credit cost, the estimated number of BEVs in each state was multiplied by $7,500, which is the amount of the federal tax credit. The same was done for the number of 2018 BEVs to estimate the foregone tax revenue from the tax credit annually. The same method was used to estimate the cost of state BEV tax credits. It was not necessary to estimate the cost of state rebate programs, as these are direct costs that are reported by the states.

Foregone fuel tax revenues were calculated by first dividing EVMT by MPG to determine how many fewer gallons of gasoline were purchased by each BEV compared to an ICE vehicle. This volume was then multiplied by the fuel tax rate to determine the foregone tax revenue per BEV in each state. This was then multiplied by the total number of BEVs in each state, to estimate the annual amount of foregone state fuel tax revenue. The same process was followed using the federal fuel tax rate to estimate the foregone federal fuel tax revenue in each state.

Some states provide registration fee discounts to BEVs. These foregone revenues were estimated by simply multiplying the total number of BEVs in each state by the registration fee discount in that state. Other states are implementing registration fee increases for BEVs in the future. These were included in the modelled scenarios for those states. The future registration fee increase was multiplied by the total number of BEVs in that state, then subtracted from the total foregone revenue, since increased registration fees offset foregone revenue from other sources.

New Jersey offers a sales tax exemption for BEVs. The foregone revenue from this was calculated by multiplying the manufacturer recommended sales price (MSRP) of each model of BEV by the sales tax of 6.625 percent, then by the number of those BEVs in 2018. The foregone revenue from each model of BEV was then summed, to provide an estimate of the total annual foregone tax revenue from the sales tax exemption. The same method was used to calculate the Vehicle License Tax (VLT) reduction in Arizona.

The results of this analysis are shown as annual costs for each state and their share of federal costs. Federal costs include the annual cost of federal tax credits for new BEVs in that state and the state's share of foregone federal fuel tax revenue. While the federal fuel tax is collected by the federal government, in practice this revenue is returned to the state through the Federal Highway Trust Fund. Thus, decreases in federal fuel tax revenue in a state will result in lower allocations from the trust fund. State costs shown include the annual cost of any state programs that incentivize EV ownership and annual foregone revenue from fuel taxes, registration fees, or sales tax exemptions.

Increased BEV Ownership Scenarios

In addition to the current scenario, three modeled scenarios were evaluated, where BEV ownership has increased to 5 percent, 10 percent, and 25 percent of the total light duty vehicle fleet in each state. Currently in the states analyzed, BEVs make up between 0.07 percent and 0.81 percent of BEVs. In order to reach 5 percent BEV ownership nationally, there would need to be 14 million BEVs on the road. Because of this, researchers assumed that by the time BEV ownership reaches 5 percent of total vehicles in any state the federal tax credit will have been phased out, since it begins to phase out for each manufacturer once they have sold 200,000 vehicles nationally and phases out completely one year after reaching 200,000 vehicles. As of 2019, both Tesla and Chevrolet have reached the 200,000 vehicle phase out threshold.

Additionally, some states have passed legislation, which will increase registration fees on EVs in the next few years. Using the same reasoning used for the federal tax credit, it was assumed these increases would be in place before any state reached 5 percent BEV ownership. Therefore, in these states, registration fee increases will offset the total impact of BEV ownership in the three modelled scenarios.

In order to determine the number of BEVs for each modelled scenario, the total number of registered vehicles in each state was multiplied by 5, 10, and 25 percent, respectively. This method assumes the total number of vehicles in each state remains constant in the future, which is unlikely, meaning it likely underestimates the actual costs to some extent. The modelled number of BEVs in each scenario was then used in place of the current number of BEVs to again calculate foregone fuel tax revenues, the net effect of registration fee increases and decreases, and foregone sales tax revenue.

It was also necessary to estimate how many new BEVs would be on the road each year in the 5, 10, and 25 percent scenarios, as the Arizona VLT reduction, Colorado BEV tax credit and New Jersey BEV sales tax exemption apply to new vehicles each year. This was done by dividing the total number of all types of vehicles on the road by the average age of a vehicle in the United States. The average age was assumed to be 11.8 years, per IHS Markit (*20*). This estimated the total number of new vehicles per year in each state, which was then multiplied by 5, 10, and 25 percent for the respective scenario. This provided a rough estimate of the number of new BEVs in each state as BEV ownership grows.

Estimating the Arizona tax reduction in the modelled scenarios required extra steps. Because the tax is higher when a vehicle is newer and depreciates based on a formula laid out by Arizona, it was necessary to estimate both the tax paid by new vehicles in the future and by older vehicles. First the lost tax revenue was calculated for 2018 using the current registration data, then the ratio of the tax paid by new vehicles and vehicles over one year old was calculated. Next, the lost tax per new vehicle was estimated, then applied to the number of new vehicles in each modelled scenario. The previously calculated ratio was then used to estimate the remaining lost tax revenue for each scenario.

EVMT was again assumed to be 10,000 miles per year in the modelled scenarios. This number is an estimate of the current miles driven per year by BEVs. Currently in the United States, the average light duty vehicle is driven 11,500 (*21*) miles per year. As BEV ownership increases, and drivers who drive

more begin to replace their ICE vehicles with longer range BEVs, it is likely that EVMT will converge toward the U.S. average VMT. Rather than attempt to predict how EVMT will change in the future, the analysis includes a table showing how an increase in EVMT will affect foregone fuel tax revenues in each scenario; however, the cost numbers shown in the results summary tables use the baseline EVMT of 10,000.

Federal Profile

Currently the only program at the federal level incentivizing BEV ownership is the Plug-in Electric Vehicle Tax Credit. Our analysis estimates that this program, that began in 2009, has cost the federal government up to $4.46 billion in the period from 2009 to the end of 2018. Table 5 shows the total annual estimated costs to the U.S. federal government from BEV ownership and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 595,271 BEVs on the road in the United States making up 0.21 percent of the total consumer vehicle fleet. Of these vehicles, 218,623 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Plug-in Electric Vehicle Tax Credit currently costs the federal government up to $1,639.7 million in 2018, due to new BEVs in the United States, in addition to $44.0 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $1,683.7 million in lost federal tax revenue annually due to BEV ownership in the United States.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of BEVs. In these scenarios, it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per manufacturer. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually; however, as it is likely that EVMT will increase in the future, the analysis also calculated tax impacts with EVMT equal to the current U.S. average of 11,500 miles per year.

Table 5. Total Estimated Annual Cost of BEVs in the United States for Current and Modeled Scenarios ($ Millions)

	Current (0.21% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$1,639.7	$0	$0	$0
Annual Federal Fuel Tax	$44.0	$1,031.3	$2,062.6	$5,156.5
Total Annual Federal Costs	**$1,683.7**	**$1,031.3**	**$2,062.6**	**$5,156.5**
Fuel Tax Cost Increased EVMT	**-**	**$1,186.0**	**$2,372.0**	**$5,930.0**

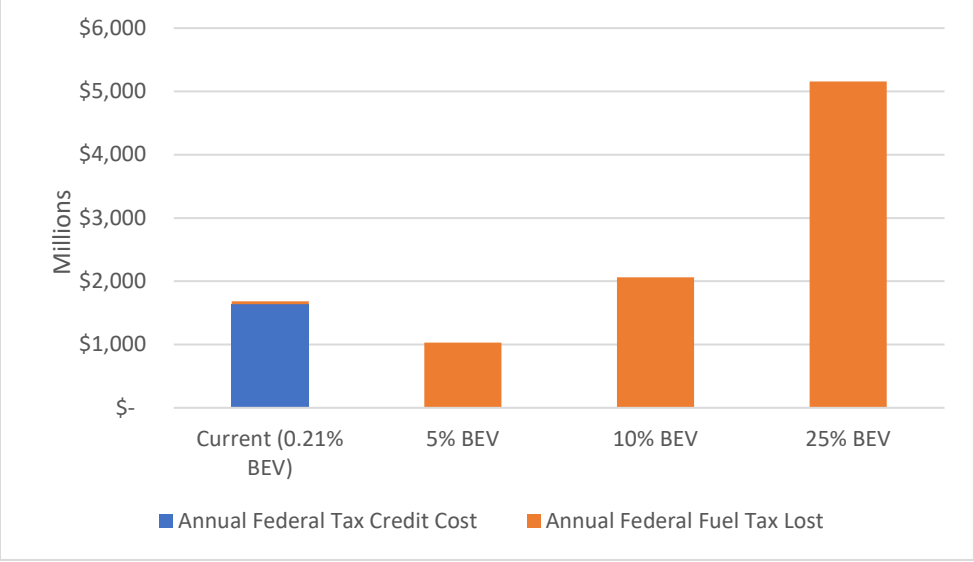

Figure 1. Total Annual Federal BEV Costs

State Profiles

Arizona

Arizona has four programs related to consumer grade EVs. Two of these programs directly reduce the cost of EV ownership. These two policies are discussed in detail below followed by an analysis of the costs of EV ownership in Arizona.

Alternative Fuel and Alternative Fuel Vehicle Use Tax Exemption

Alternative fuels and alternative fuel vehicles (AFVs) converted to operate on alternative fuels, or the equipment used to convert a diesel vehicle to an AFV, are exempt for use taxes (6).

Reduced Vehicle License Tax

Arizona assesses a VLT on all vehicles but provides a reduction for AFVs. VLT for AFVs are charged at a rate of $4 per $100 of assessed valuation; the valuation is determined using the following:

- The first year, the assessed value is one percent of the factory list price of the AFV.
- In subsequent years, the assessed value is depreciated by 15 percent each year.
- The minimum VLT for an AFV is $5 (*49*).

The license tax reduction is set to phase out and will not apply to vehicles purchased on or after December 31, 2022 (*22*). VLT for ICE vehicles is based on 60 percent of the assessed value of the manufacturer's base retail price, which is reduced by 16.25 percent for every year the vehicle has been registered in the state of Arizona. The rate is then $2.80 for new vehicles and $2.89 for used vehicles per $100 of assessed value.

Arizona Total BEV Costs

Table 6 shows the total estimated costs to the state of Arizona and to the federal government from BEV ownership in Arizona and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 14,447 BEVs on the road in Arizona making up 0.23 percent of the total consumer vehicle fleet. Of these vehicles, 5,465 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $41.0 million in 2018, due to new BEVs in Arizona, in addition to $1.1 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $42.1 million in lost federal tax revenue annually due to BEV ownership in Arizona. A reduction in federal fuel tax revenues would be a cost borne by Arizona, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of Arizona include $9.0 million for the reduced VLT and $1.1 million in lost state fuel tax revenue. Together this amounts to $10.1 million in lost revenue annually to the state of Arizona.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of EVs. In these scenarios it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per

manufacturer[11]. The VLT reduction was assumed to be phased out before 5% BEV is reached, as the reduction is currently scheduled to be phased out at the end of 2022. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

Table 6. Total Estimated Annual Cost of BEVs in Arizona for Current and Modeled Scenarios ($ Millions) [12]

	Current (0.23% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$41.0	$0	$0	$0
Annual Federal Fuel Tax	$1.1	$23.5	$47.0	$117.5
Total Annual Federal Costs	**$42.1**	**$23.5**	**$47.0**	**$117.5**
Annual State Fuel Tax	$1.1	$24.3	$48.5	$121.3
VLT Reduction Cost	$9.0	$0	$0	$0
Total Annual State Cost	**$10.1**	**$24.3**	**$48.5**	**$121.3**
Total Annual Cost	**$52.2**	**$47.8**	**$95.5**	**$238.8**

Total annual federal costs increase in the modeled higher penetration scenarios, as annual federal fuel tax losses increase from $1.1 million presently to $117.5 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the 25 percent scenario, reaching a total annual cost of $121.3 million. Figure 2 and Figure 3 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 7 shows the effects of this. Total costs increase from $47.8 million to $54.9million in the 5 percent scenario and from $238.8 million to $274.6 million in the 25 percent scenario.

Table 7. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$27.0	$54.1	$135.1
Annual Foregone State Fuel Tax	$27.9	$55.8	$139.5
Total Annual State Cost	**$27.9**	**$55.8**	**$139.5**
Total Annual Cost	**$54.9**	**$109.9**	**$274.6**

[11] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

[12] Assumes EVs travel 10,000 miles per year.

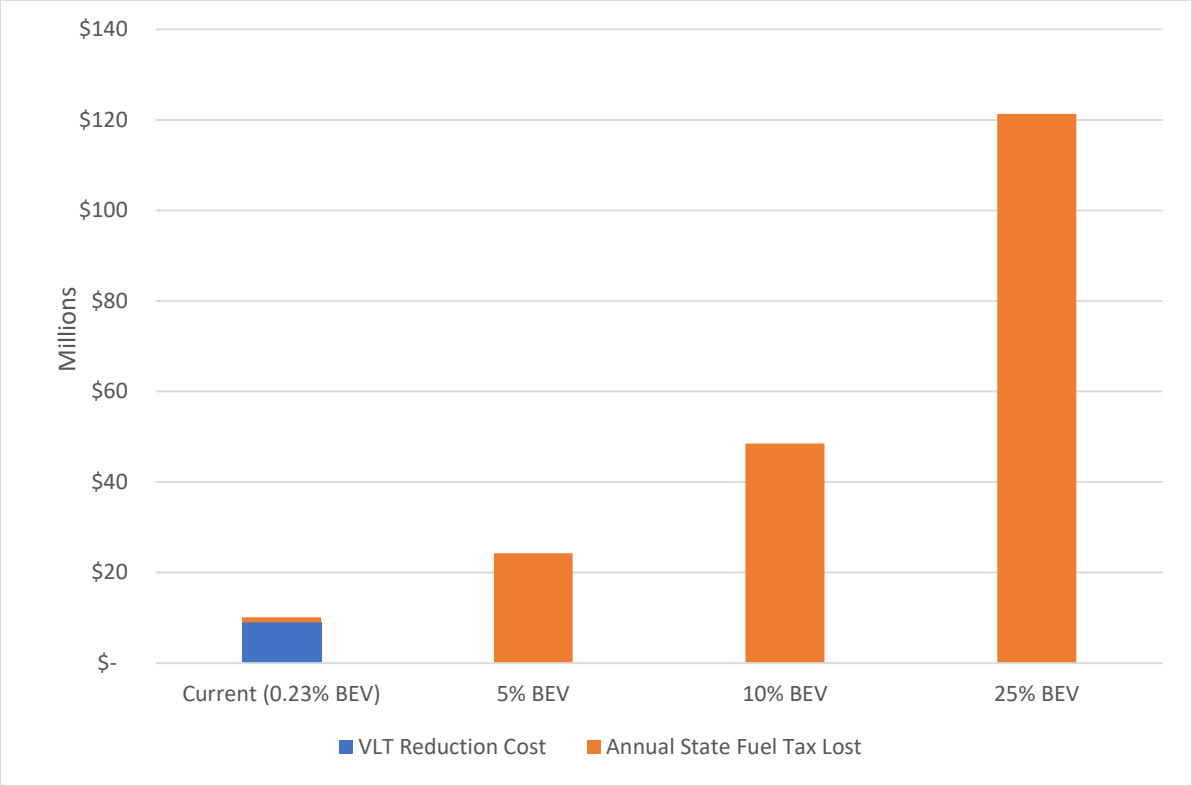

Figure 2. Arizona Annual BEV Estimated Costs

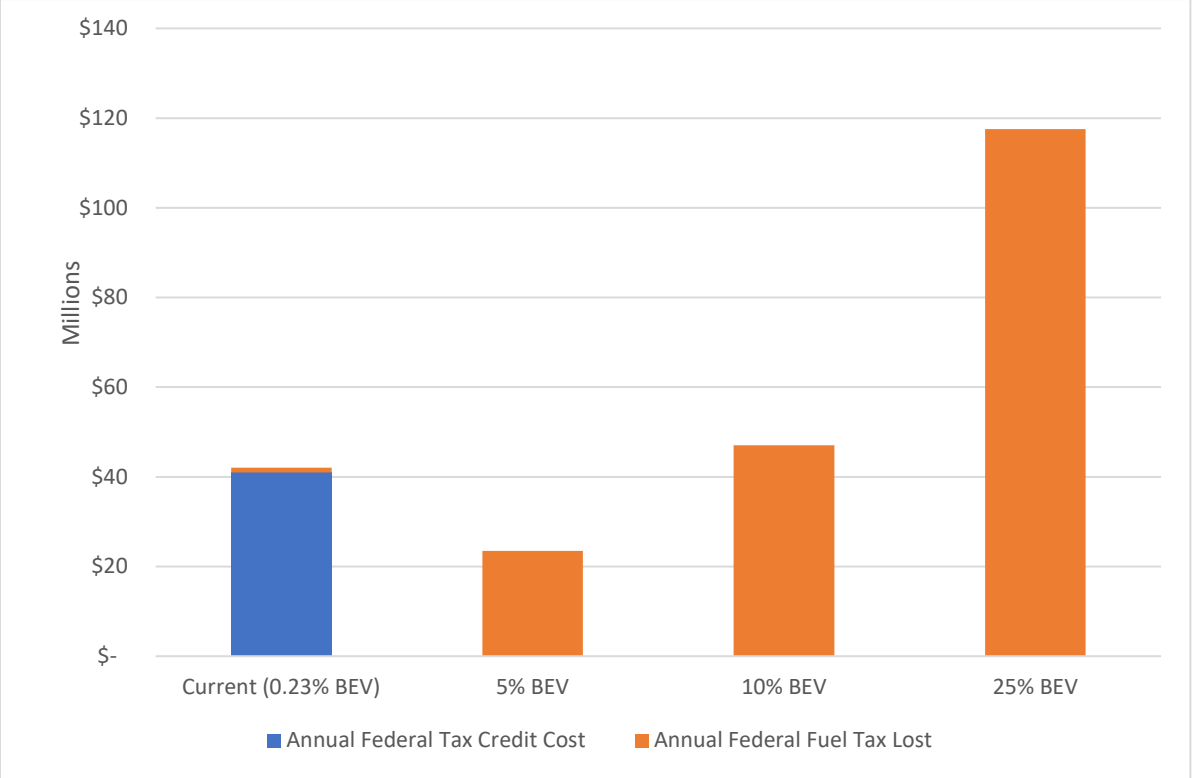

Figure 3. Arizona's Estimated Share of Annual Federal BEV Costs

California

California currently has seven programs related to consumer grade EVs. The CVRP and the Clean Vehicle Assistance Program both directly incentivize EVs at a cost to the state. These two policies are discussed in detail below, as well as a future registration fee, followed by an analysis of the costs of BEV ownership in California.

Clean Vehicle Rebate Project

The CVRP program offers rebates up to $5,000 for the purchase or lease of zero-emission and plug-in hybrid light-duty vehicles. An additional $2,000 rebate is available for lower income households whose total income is at 300 percent or less of the federal poverty level.[13] Approved vehicles are selected by the CARB. The rebates are provided on a first come, first served basis to individuals, businesses, and government entities in California that purchase or lease new vehicles. The following details the rebate amounts:

- $5,000 for fuel cell electric vehicles (FCEVs).
- $2,500 for BEVs.
- $1,500 for plug-in hybrid electric vehicles (PHEVs).

Additional income restrictions apply; if an individual has a gross annual income above the following:

- $150,000 for single filers.
- $204,000 for head-of-household filers.
- $300,000 for joint filers.

Individuals over these income limits are only eligible to receive a rebate for the purchase of an FCEV, not a BEV. The program is administered by the Center for Sustainable Energy for the CARB, which has been instructed to prioritize low income applicants until January 1, 2022. The CARB determines annual funding amounts for the CVRP, and it is expected that the program will continue through 2023 (*23*). In 2018, $130 million in rebates were approved for BEVs through this program (*24*).

The CVRP instituted income criteria in March 2016 and then alterations were made to the criteria in November 2016. Table 8 details the percentage of funding directed toward low-income individuals and disadvantaged communities for the program (*24*).

[13] The federal poverty level was set at $12,140 for an individual and $25,100 for a family of four in 2018. In order to be eligible for the additional rebate, individuals would have to earn less than $36,420 per year and less than $75,000 for a family of four.

Table 8. Rebates to Equity Groups[14] by Percent of Funding

Timeframe	Percent of Funding Directed to Equity Groups
Life of the Program	24.6
Since Income Criteria (3/29/2016–Present)	30.3
Under Current Income Criteria (11/1/2016–Present)	31.1

CARB recently approved further changes to the rebate program that went into effect on December 3, 2019. The new rules limited rebates to one per consumer (either individual or business) as well as setting new income eligibility and purchase requirements. Customers with income less than or equal to 300 percent of the federal poverty level are eligible for an increased rebate of $2,500; this keeps the rebates to equity groups at the same amount as before the December changes. The standard rebate amounts have also decreased; the fuel cell rebate is now $4,500, the BEV rebate is $2,000, and the PHEV rebate is $1,000. The list of qualified vehicles was altered to institute an MSRP cap of $60,000 on all vehicles except fuel cell electric vehicles, and the PHEV electric range requirement was increased from 20 miles to 35 miles in order to qualify for a rebate (*25*).

Clean Vehicle Assistance Program

The Clean Vehicle Assistance Program provides grants for lower income buyers of either new or used clean vehicles. The grant is up to $5,000 for PHEVs or BEVs. BEV grants can also be used for a charging unit and its home installation. Table 9 shows the income qualification requirements:

Table 9. Clean Vehicle Assistance Program Qualifications

Number of People[15]	Maximum Annual Income[16]
1	$48,560
2	$65,840
3	$83,120
4	$100,400
5	$117,680
6	$134,960
7	$152,240
8	$169,520

[14] California defines equity groups as either Disadvantaged Communities, based on exposure and vulnerability to pollution using the CalEnviroScreen, or Low-Income Communities, Low income communities are census tracts that are either at or below 80 percent of the statewide median income, or at or below the threshold designated by the California Department of Housing and Community Development. A third group is low income communities that are within a half mile of a disadvantaged community.

[15] Head of household, plus spouse and dependents.

[16] Income calculation based on 400 percent of the Federal Poverty Level (2018).

Grants provided through the Clean Vehicle Assistance Program are paid directly to the dealership to lower the initial purchase cost of a vehicle (*26*). The program launched in 2018 with a grant of $5 million. (*27*).

Registration Fee

Beginning on July 1, 2020, California will assess an additional fee on BEVs with a model year 2020 or later at the time of registration or renewal. This road improvement fee is set at $100 per vehicle per year and will be indexed to the California Consumer Price Index starting on January 1, 2021 (*28*).

Table 10 shows program costs related to vehicle electrification; more information on these programs is provided in the Appendix. Revenue lost refers to the tax exclusion that excludes manufacturers from sales and use taxes for products, systems, and components that reduce energy usage and support advanced transportation. This is represented as a negative amount as it does not represent a cost but foregone tax revenue. Where possible, the amount expended on BEVs is split out from the total program cost.

Table 10. California Vehicle Electrification Program Costs ($ Millions)

Program	Total Amount Expended	Amount Expended on BEVs	FY2018 Amount Expended (BEVs)
Clean Vehicle Rebate Program	$720.4	$501.1	$140.3[17]
Clean Vehicle Assistance Program[18]	$5	-	$5
Enhanced Fleet Modernization Program[19]	$26.3	$5.7	$1.5
Driving Clean Pilot Program	$0.9	-	-
Clean Transportation Program	$94.9	-	$94.2
HVIP[20]	$359.7	$243.3	-
EV Charging Station Financing Program[21]	$2	-	-
Advanced Transportation Tax Exclusion	$(700)	-	$(100)
Total Costs	**$1208.3**	**$705.1**	**$246.8**
Total Revenue Lost	**$(700)**	**-**	**$(100)**

California Total BEV Costs

Table 11 shows the total estimated costs to the state of California and to the federal government from BEV ownership in California and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 255,592 EVs on the road in California making up 0.81 percent of the total consumer

[17] Program costs from March 2018–March 2019.
[18] Grants are available for hybrid vehicles, PHEVs, and BEVs.
[19] Total Amount Expended includes PHEV and BEV incentives provided through states funds.
[20] The program provides vouchers to reduce emissions; the total amount expended represents vouchers provided for hybrids and ZEVs.
[21] Total represents total funds allocated; as of August 2019, only two loans have been secured through the program.

vehicle fleet. Of these vehicles, 90,948 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $682.1 million in 2018, due to new BEVs in California, in addition to $18.9 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $701.0 million in lost federal tax revenue annually due to BEV ownership in California. A reduction in federal fuel tax revenues would be a cost borne by California, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of California include $130.4 million for the Clean Vehicle Rebate Program, $5.0 million for the Clean Vehicle Assistance Program, and $62.8 million in lost state fuel tax revenue. Together this amounts to $199.7 million in costs or lost revenue annually to the state of California.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of BEVs. In these scenarios it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per manufacturer[22]. The state programs were assumed to remain constant, as this would represent continued funding at the current level. It was also assumed that California will reach 5 percent BEVs after January 2021, at which time a $100 per EV registration fee will come into effect. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

Table 11. Total Estimated Annual Cost of BEVs in California for Current and Modeled Scenarios ($ Millions) [23]

	Current (0.81% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$682.1	$0	$0	$0
Annual Federal Fuel Tax	$18.9	$116.6	$233.3	$583.2
Total Annual Federal Costs	**$701.0**	**$116.6**	**$233.3**	**$583.2**
Clean Vehicle Rebate Program	$130.4	$130.4	$130.4	$130.4
Clean Vehicle Assistance Program	$5.0	$5.0	$5.0	$5.0
Enhanced Fleet Modernization Program	$1.5	$1.5	$1.5	$1.5
Annual State Fuel Tax	$62.8	$388.0	$776.0	$1,939.9
Annual Registration Fee Revenue	$0	−$157.8	−$315.7	−$789.3
Total Annual State Cost	**$199.7**	**$367.1**	**$597.2**	**$1,287.5**
Total Annual Cost	**$900.7**	**$483.7**	**$830.5**	**$1,870.7**

Total annual federal costs decrease in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $22.5 million presently to $583.2 million in the 25 percent BEV scenario. Direct costs to the state increase six-fold from the present to the 25 percent scenario, reaching a total annual cost of $1,288 million. This is driven by increasing losses in state fuel tax revenues, although this is offset some by increased revenue from BEV registrations. Figure 4 and Figure 5 display these results by each scenario.

[22] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

[23] Assumes EVs travel 10,000 miles per year.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 12 shows the effects of this. Total costs increase from $483.7 million to $559.4 million in the 5 percent scenario and from $1.871 billion to $2.249 billion in the 25 percent scenario.

Table 12. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$134.1	$268.3	$670.7
Annual Foregone State Fuel Tax	$446.2	$892.4	$2,230.9
Total Annual State Cost	**$425.3**	**$713.6**	**$1,578.5**
Total Annual Cost	**$559.4**	**$981.9**	**$2,249.2**

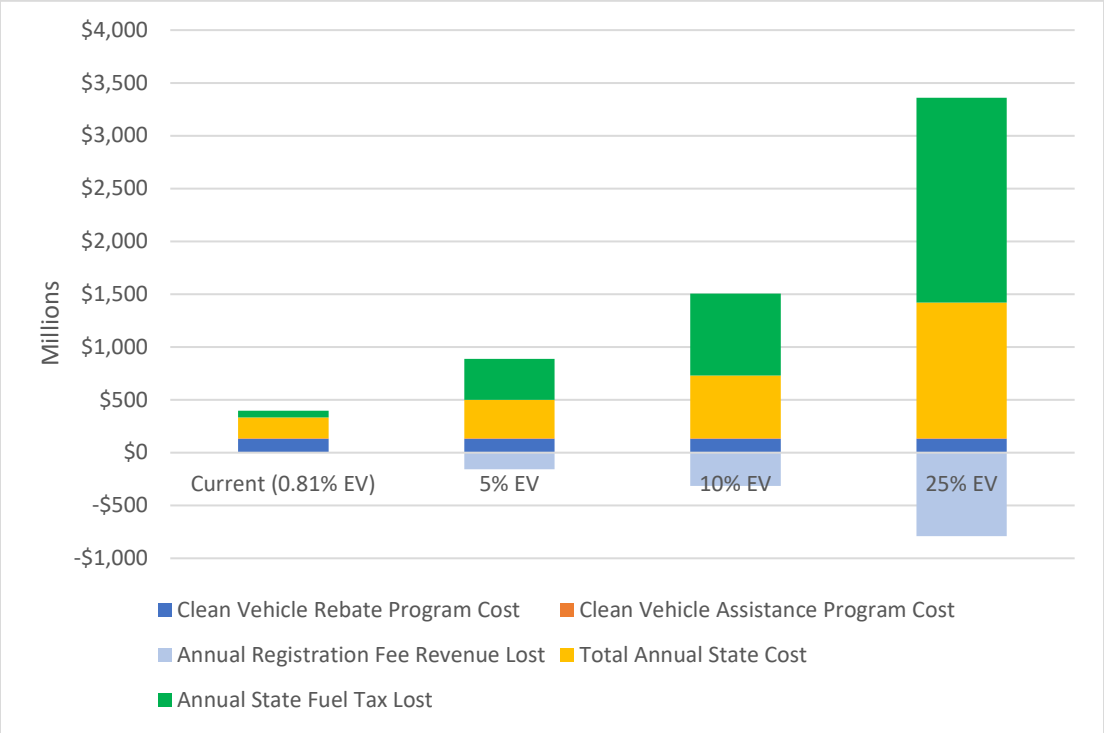

Figure 4. Estimated Annual Costs for California BEVs

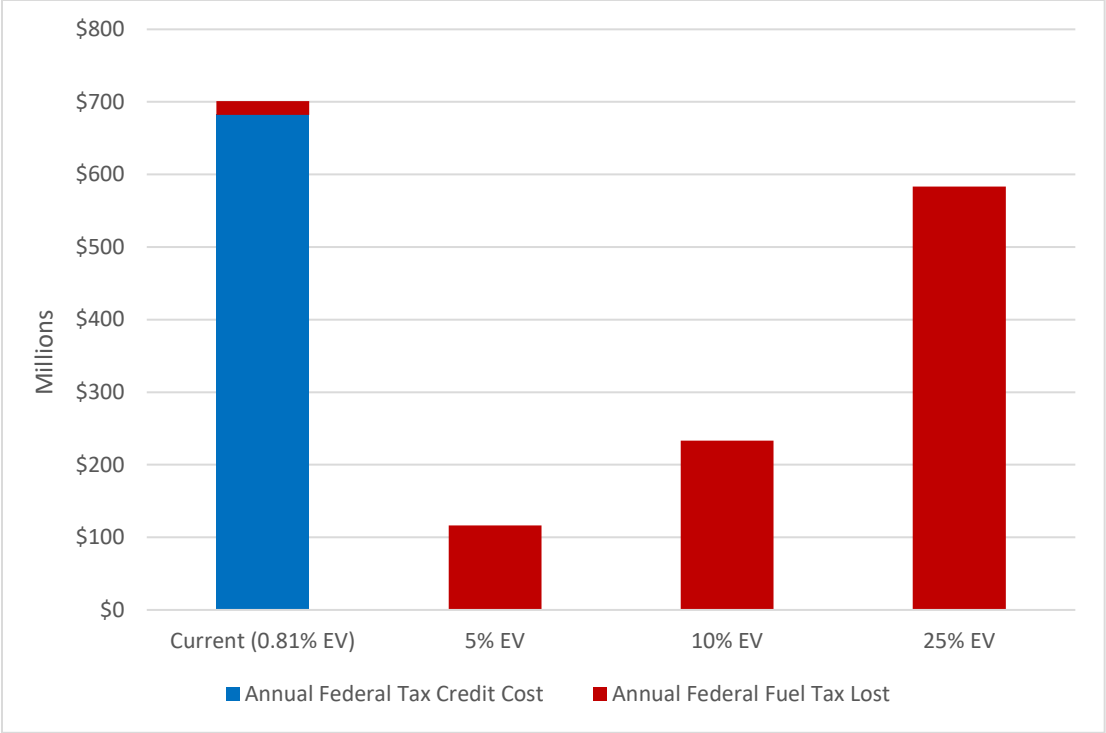

Figure 5. California's Estimated Share of Annual Federal BEV Costs

Colorado

Colorado currently has five programs related to consumer grade BEVs. The Alternative Fuel Vehicle and EV Tax Credit directly incentivize BEVs at a cost to the state. These two policies are discussed in detail below, as well as an increased BEV registration fee, followed by an analysis of the costs of BEV ownership in Colorado.

AFV and EV Tax Credit

Colorado residents are eligible for up to a $5,000 tax credit for purchase, lease and conversion of light, medium, and heavy duty alternative fueled vehicles, such as BEV, PHEV, compressed natural gas, liquefied natural gas, or hydrogen vehicles. In 2017, the program stopped providing credits for used vehicles (*29*). The program is currently phasing out, but there is no definitive end date set as of June 2019. Table 13 details the phase out process for PHEVs and BEVs.

Table 13. Plug-In Electric Vehicle Tax Credit Amounts (3)

Category	2017–2019	2020	2021
Light-duty EV or PHEV	$5,000 for purchase or conversion; $2,500 for lease	$4,000 for purchase or conversion; $2,000 for lease	$2,500 for purchase or conversion; $1,500 for lease
Light-duty electric truck	$7,000 for purchase or conversion; $3,500 for lease	$5,500 for purchase or conversion; $2,750 for lease	$3,500 for purchase or conversion; $1,750 for lease
Medium-duty electric truck	$10,000 for purchase or conversion; $5,000 for lease	$8,000 for purchase or conversion; $4,000 for lease	$5,000 for purchase or conversion; $2,500 for lease
Heavy-duty electric truck	$20,000 for purchase or conversion; $10,000 for lease	$16,000 for purchase or conversion; $8,000 for lease	$10,000 for purchase or conversion; $5,000 for lease

Registration Fee Increase

Colorado assesses a $50 fee annually on vehicles classified as a plug-in electric motor vehicle; this includes both BEVs and PHEVs (*30*).

Colorado Total BEV Costs

Table 14 shows the total estimated costs to the state of Colorado and to the federal government from BEV ownership in Colorado and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 17,334 BEVs on the road in Colorado making up 0.33 percent of the total consumer vehicle fleet. Of these vehicles, 6,451 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $48.4 million in 2018, due to new BEVs in Colorado, in addition to $1.3 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $49.7 million in lost federal tax revenue annually due to BEV ownership in Colorado. A reduction in federal fuel tax revenues would be a cost borne by Colorado, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of Colorado include $32.3 million for the Plug-In Electric Vehicle Tax Credit and $1.5 million in lost state fuel tax revenue. Additionally, the state receives $0.9 annually in increased

registration fee revenues. Together, this amounts to $32.9 million in costs or lost revenue annually to the state of Colorado.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of BEVs. In these scenarios, it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per manufacturer[24]. The state programs were assumed to remain constant. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

Table 14. Total Estimated Annual Cost of BEVs in Colorado for Current and Modeled Scenarios ($ Millions)[25]

	Current (0.33% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$48.4	$0	$0	$0
Annual Federal Fuel Tax	$1.3	$19.5	$39.0	$97.4
Total Annual Federal Costs	**$49.7**	**$19.5**	**$39.0**	**$97.4**
Annual Tax Credit Cost	$32.3	$111.7	$223.4	$558.6
Annual State Fuel Tax	$1.5	$23.3	$46.6	$116.5
Annual Registration Fee Revenue	−$0.9	−$13.2	−$26.4	−$65.9
Total Annual State Cost	**$32.9**	**$121.8**	**$243.7**	**$609.1**
Total Annual Cost	**$83.5**	**$141.3**	**$282.7**	**$706.5**

Total annual federal costs decrease in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $1.3 million presently to $97.4 million in the 25 percent BEV scenario. Direct costs to the state increase 18-fold from the present to the 25 percent scenario, reaching a total annual cost of $609.1 million. This is driven primarily by increasing foregone revenue from the Plug-In Electric Vehicle Tax credit, although this is offset some by increased revenue from BEV registrations. Figure 6 and Figure 7 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 15 shows the effects of this. Total costs increase from $141.3 million to $147.7 million in the 5 percent scenario and from $706.5 million to $738.5 million in the 25 percent scenario.

Table 15. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$22.4	$44.8	$112.0
Annual Foregone State Fuel Tax	$26.8	$53.6	$133.9
Total Annual State Cost	**$125.3**	**$250.7**	**$626.5**
Total Annual Cost	**$147.7**	**$295.5**	**$738.5**

[24] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

[25] Assumes EVs travel 10,000 miles per year.

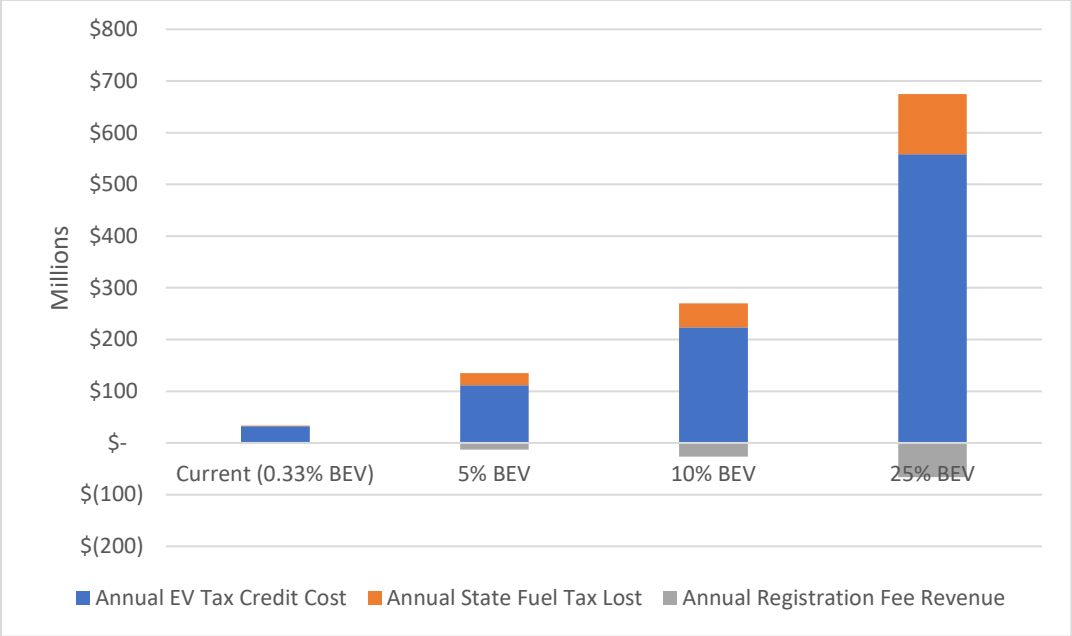

Figure 6. Estimated Annual Costs for Colorado BEVs

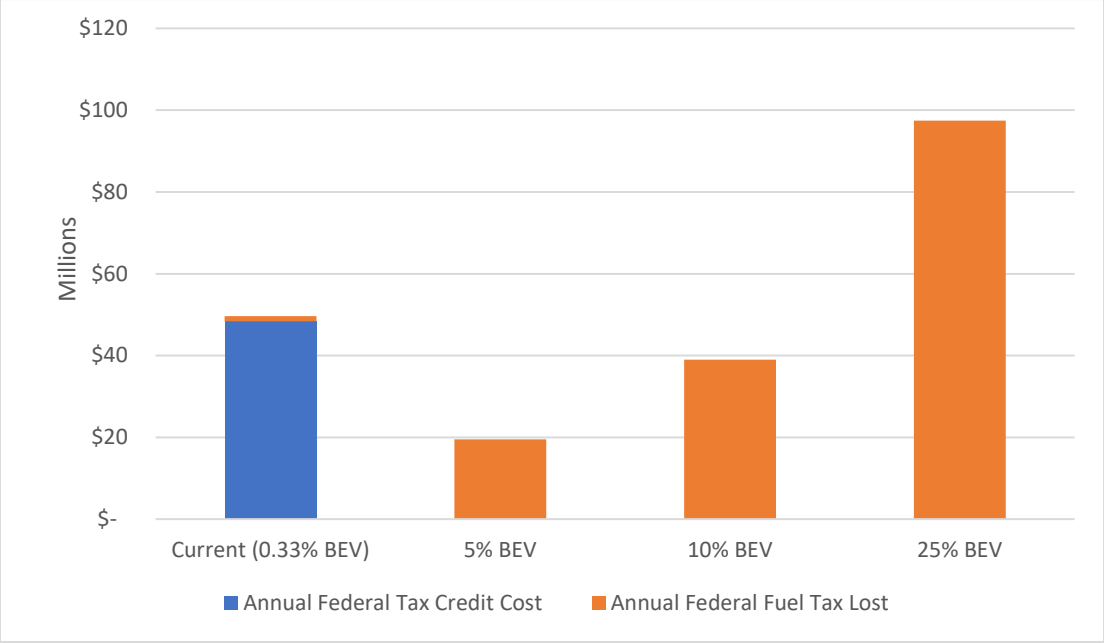

Figure 7. Colorado's Estimated Share of Annual Federal BEV Costs

Connecticut

Connecticut currently has three programs related to consumer grade BEVs. Of these, CHEAPR and the reduced registration fee directly incentivize BEVs at a cost to the state. These policies are discussed in detail below, followed by an analysis of the costs of BEV ownership in Connecticut.

CHEAPR

The CHEAPR programs offers rebates up to $5,000 for the purchase of an EV, FCEV, or PHEV. Rebates are offered based on battery range.

Table 16. Incentive Structure (31)

Incentive Amount	EPA Rated Electric Range
$5,000	Any fuel cell EV
$2,000	BEV: 200 Miles or Greater
$1,500	BEV: 120-199 Miles
$1,000	PHEV: 45 Miles or Greater
$500	BEV: Less 120 Miles PHEV: Less than 45 Miles

Rebates are offered on a first come, first served basis until the funding has been depleted. The remaining available funds, as of August 2019, are $267,500; funds considered issued and reserved total $10,028,500. Fifty-eight percent of issued funding went to PHEVs with the remaining 42 percent issued to BEV owners (*31*).

Registration Fee Reduction

BEVs pay a reduced vehicle registration fee of $38, as opposed to $80 for an ICE vehicle.

Connecticut Total BEV Costs

Table 17 shows the total estimated costs to the state of Connecticut and to the federal government from BEV ownership in Connecticut and future cost estimates as BEV ownership grows. As of early 2019, there were 5,023 BEVs on the road in Connecticut making up 0.16 percent of the total consumer vehicle fleet. Of these vehicles, 2,060 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $15.4 million in 2018, due to new BEVs in Connecticut, in addition to $0.4 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $15.8 million in lost federal tax revenue annually due to BEV ownership in Connecticut. A reduction in federal fuel tax revenues would be a cost borne by Connecticut, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of Connecticut include $2.3 million for CHEAPR, $0.8 million in lost state fuel tax revenue, and $0.2 million in lost registration fees. Together this amounts to $3.3 million in costs or lost revenue annually to the state of Connecticut.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of BEVs. In these scenarios, it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per

manufacturer[26]. The state programs were assumed to remain constant at 2018 funding levels. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

Table 17. Total Estimated Annual Cost of BEVs in Connecticut for Current and Modeled Scenarios ($ Millions) [27]

	Current (0.16% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$15.4	$0	$0	$0
Annual Federal Fuel Tax	$0.4	$11.3	$22.5	$56.3
Total Annual Federal Costs	**$15.8**	**$11.3**	**$22.5**	**$56.3**
CHEAPR Cost	$2.3	$2.3	$2.3	$2.3
Annual State Fuel Tax	$0.8	$25.8	$51.5	$128.8
Annual Registration Fee Revenue	$0.2	$6.4	$12.8	$32.0
Total Annual State Cost	**$3.3**	**$34.4**	**$66.6**	**$163.1**
Total Annual Cost	**$19.1**	**$45.7**	**$89.1**	**$219.4**

Total annual federal costs increase in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $0.4 million presently to $56.3 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the 25 percent scenario, reaching a total annual cost of $163.1 million. This is driven by increasing foregone revenue from the state fuel tax and vehicle registration fees. Figure 8 and Figure 9 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 18 shows the effects of this. Total costs increase from $45.7 million to $51.1 million in the 5 percent scenario and from $219.4 million to $247.2 million in the 25 percent scenario.

Table 18. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$12.9	$25.9	$64.7
Annual Foregone State Fuel Tax	$29.6	$59.3	$148.2
Total Annual State Cost	**$38.2**	**$74.4**	**$182.5**
Total Annual Cost	**$51.1**	**$100.3**	**$247.2**

[26] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

[27] Assumes EVs travel 10,000 miles per year.

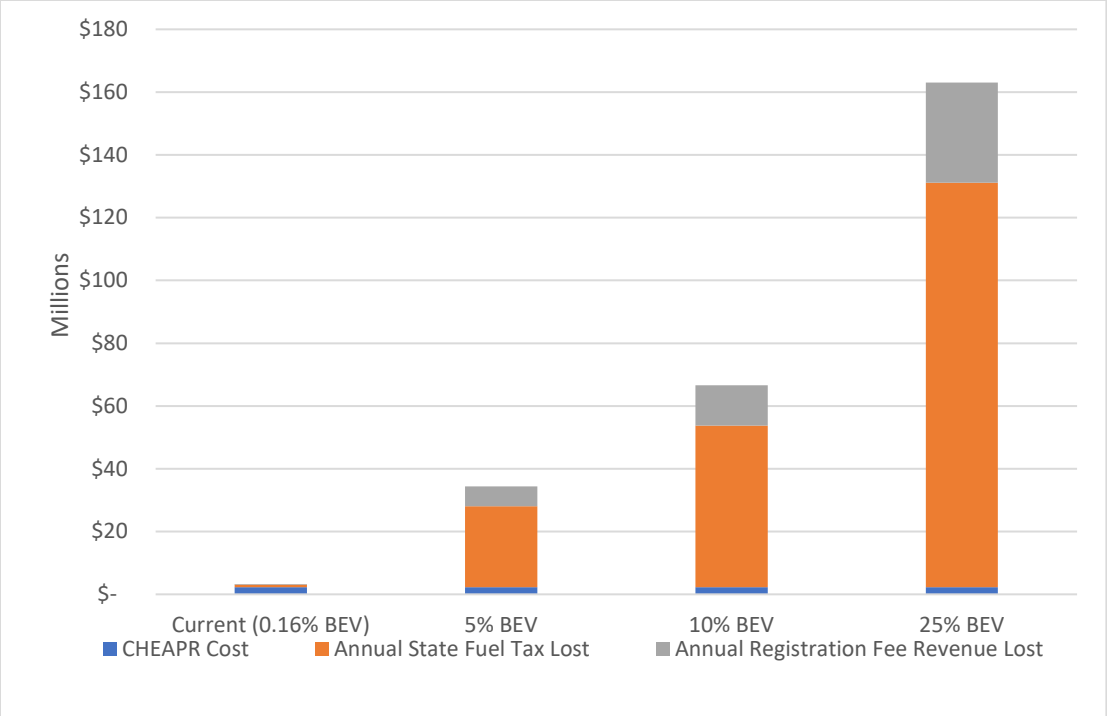

Figure 8. Estimated Annual Costs for Connecticut BEVs

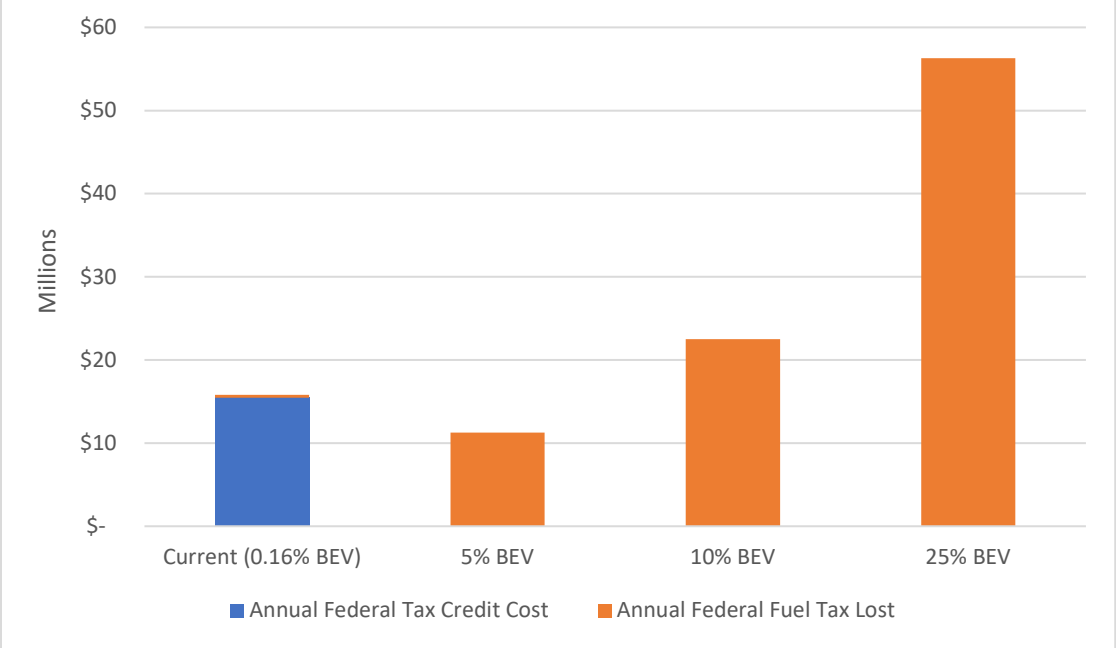

Figure 9. Connecticut's Estimated Share of Annual Federal BEV Costs

Florida

Florida has two policies related to BEVs: an HOV/high-occupancy toll (HOT) lane exemption and a policy allowing local governments to finance private property owner's EVSE installation; however, neither of these policies are included in this analysis. These policies are discussed in more detail in the appendix. While Florida does not have any policies that directly incentivize BEV ownership, the state does still feel impacts from federal policies and foregone state fuel tax revenue.

Florida Total BEV Costs

Table 19 shows the total estimated costs to the state of Florida and to the federal government from BEV ownership in Florida and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 26,742 BEVs on the road in Florida making up 0.15 percent of the total consumer vehicle fleet. Of these vehicles, 10,012 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $75.1 million in 2018, due to new BEVs in Florida, in addition to $2.0 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $15.8 million in lost federal tax revenue annually due to BEV ownership in Florida. A reduction in federal fuel tax revenues would be a cost borne by Florida, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund. Additionally, annual costs to the state of Florida are $4.5 million in lost state fuel tax revenue.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of BEVs. In these scenarios, it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per manufacturer[28]. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

Table 19. Total Estimated Annual Cost of BEVs in Florida for Current and Modeled Scenarios ($ Millions) [29]

	Current (0.15% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$75.1	$0	$0	$0
Annual Federal Fuel Tax	$2.0	$63.7	$127.5	$318.7
Total Annual Federal Costs	**$77.1**	**$63.7**	**$127.5**	**$318.7**
Annual State Fuel Tax	$4.5	$145.5	$290.9	$727.4
Total Annual State Cost	**$4.5**	**$145.5**	**$290.9**	**$727.4**
Total Annual Cost	**$81.6**	**$209.2**	**$418.4**	**$1,046.1**

Total annual federal costs increase in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $2.0 million presently to $318.7 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the

[28] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

[29] Assumes EVs travel 10,000 miles per year.

25 percent scenario, reaching a total annual cost of $727.4 million. This is driven by increasing foregone revenue from the state fuel tax. Figure 10 and Figure 11 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 20 shows the effects of this. Total costs increase from $209.2 million to $240.6 million in the 5 percent scenario and from $1,046.1 million to $1,203.0 million in the 25 percent scenario.

Table 20. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$73.3	$146.6	$366.5
Annual Foregone State Fuel Tax	$167.3	$334.6	$836.5
Total Annual State Cost	**$167.3**	**$334.6**	**$836.5**
Total Annual Cost	**$240.6**	**$481.2**	**$1,203.0**

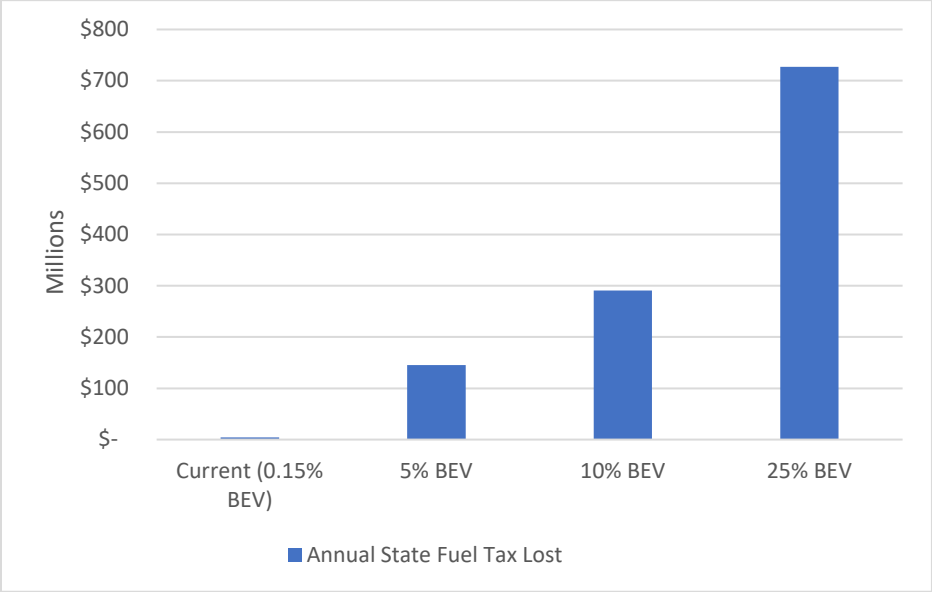

Figure 10. Estimated Annual Costs for Florida BEVs

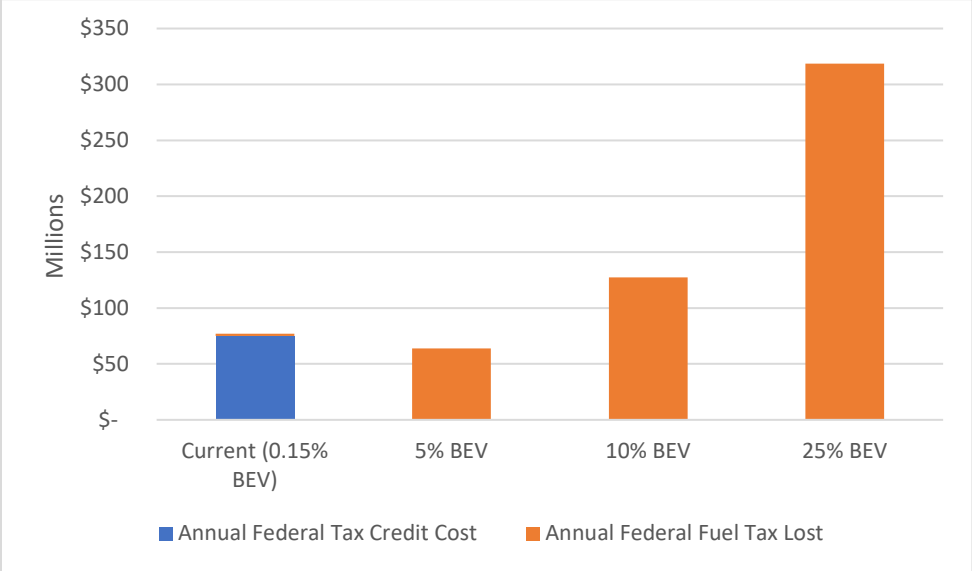

Figure 11. Florida's Estimated Share of Annual Federal BEV Costs

Illinois

Illinois currently only has one policy incentivizing BEV ownership: a registration fee reduction. EVs pay $35 registration fee every two years, as opposed to the $101 yearly charge for ICE passenger vehicles (*32*). State statute prohibits the fee from exceeding $18 per year (*33*):

> Definition (625 ILCS 5/12-805): "The owner of a motor vehicle of the first division or a motor vehicle of the second division weighing 8,000 pounds or less propelled by an electric engine and not utilizing motor fuel, may register such vehicle for a fee not to exceed $35 for a 2-year registration period. The Secretary may, in his discretion, prescribe that EV registration plates be issued for an indefinite term, such term to correspond to the term of registration plates issued generally, as provided in Section 3-414.1 (625 ILCS 5/3-414.1). In no event may the registration fee for EVs exceed $18 per registration year. EV license plates are prorated and have a registration period that begins January 1st of even-numbered years and ends December 31st of odd-numbered years."

Illinois Total BEV Costs

Table 21 shows the total estimated costs to the state of Illinois and to the federal government from BEV ownership in Illinois and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 14,373 BEVs on the road in Illinois making up 0.14 percent of the total consumer vehicle fleet. Of these vehicles, 5,451 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $40.9 million in 2018, due to new BEVs in Illinois, in addition to $1.1 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $41.9 million in lost federal tax revenue annually due to BEV ownership in Illinois. A reduction in federal fuel tax revenues would be a cost borne by Illinois, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of Illinois include $1.2 million in lost registration fee revenue and $3.2 million in lost state fuel tax revenue. Together this amounts to $4.4 million in lost revenue annually to the state of Illinois.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of EVs. In these scenarios it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per manufacturer[30]. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

[30] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

Table 21. Total Estimated Annual Cost of BEVs in Illinois for Current and Modeled Scenarios ($ Millions) [31]

	Current (0.14% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$40.9	$0	$0	$0
Annual Federal Fuel Tax	$1.1	$39.1	$78.3	$195.7
Total Annual Federal Costs	**$41.9**	**$39.1**	**$78.3**	**$195.7**
Annual State Fuel Tax	$3.2	$116.9	$233.9	$584.7
Annual Registration Fee Revenue	$1.2	$44.2	$88.4	$221.1
Total Annual State Cost	**$4.4**	**$161.2**	**$322.3**	**$805.8**
Total Annual Cost	**$46.3**	**$200.3**	**$400.6**	**$1,001.5**

Total annual federal costs increase in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $1.1 million presently to $195.7 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the 25 percent scenario, reaching a total annual cost of $805.8 million. This is driven by increasing foregone revenue from the state fuel tax and reduced registration fee revenue. Figure 12 and Figure 13 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 22 shows the effects of this. Total costs increase from $200.3 million to $267.9 million in the 5 percent scenario and from $1,001.5 million to $1,118.5 million in the 25 percent scenario.

Table 22. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$45.0	$90.0	$225.0
Annual Foregone State Fuel Tax	$134.5	$268.9	$672.4
Total Annual State Cost	**$222.9**	**$357.4**	**$893.5**
Total Annual Cost	**$267.9**	**$447.4**	**$1,118.5**

[31] Assumes EVs travel 10,000 miles per year.

Figure 12. Estimated Annual Costs for Illinois BEVs

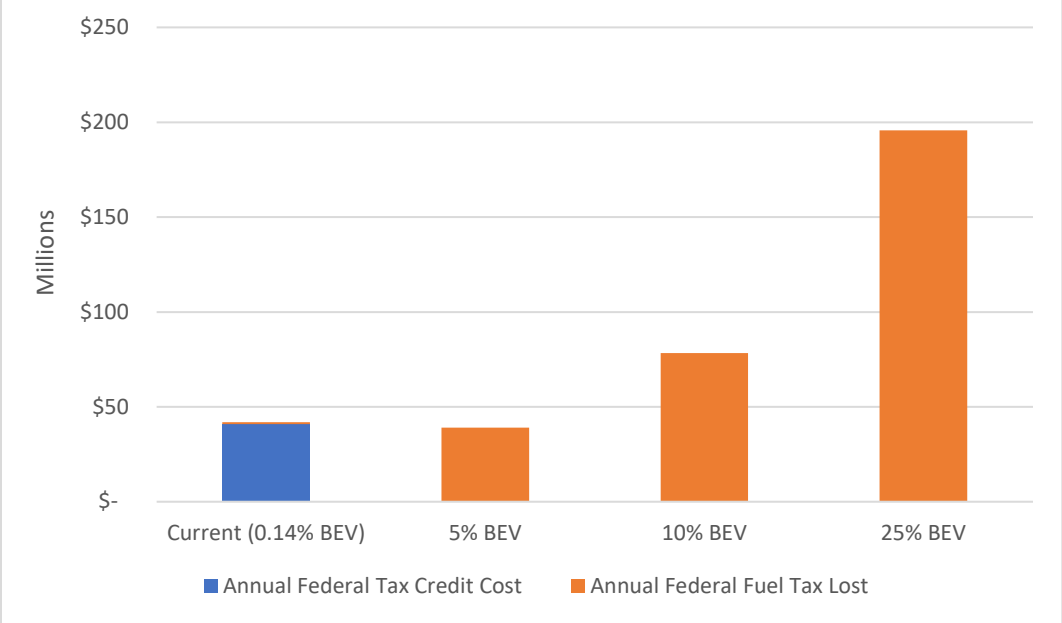

Figure 13. Illinois' Estimated Share of Annual Federal BEV Costs

Maryland

Currently the only policy in Maryland incentivizing private BEV ownership is an EV Tax Credit.

EV Tax Credit

Maryland offer an EV tax credit of up to $3,000 tax on the purchase of a new EV, which does not exceed $60,000; this is applied to the excise tax on the vehicle. Additional criteria include:

- Be propelled to a significant extent by an electric motor that draws electricity from a battery with a capacity of at least five kWh.
- Have not been modified from original manufacturer specifications.
- Be purchased on or after July 1, 2017.

The credit is calculated based on $100 per kWh of battery capacity. Vehicles with over 30 kWh of battery capacity will only qualify for the maximum $3,000 credit. Vehicles must be new and being titled for the first time; vehicles purchased between July 1, 2017, and July 1, 2020, are eligible. There is $3,000,000 allocated for each fiscal year, and the funding has been depleted, as of June 2019, for the current fiscal year. Additional funding becomes available on July 1, 2019, as the state enters fiscal year 2020 (*4*). The allocation was increased to $6,000,000 for the fiscal year starting on July 1, 2019 (*34*).

Maryland does have programs that incentivize infrastructure and fleet vehicles. Table 23 provides the program costs for these incentives and splits out the money expended on BEVs where possible.

Table 23. Maryland Vehicle Electrification Program Costs (in $Millions)

Program	Total Amount Expended	FY2018 Amount Expended (BEVs)
EVSE Rebate Program 2.0[32]	$3.6	$1.2
Alternative Fuel Infrastructure Grants[33]	$3	$0.8
Freedom Fleet Voucher Program[34]	$4.1	-
Total	**$10.7**	**$2**

Maryland Total BEV Costs

Table 24 shows the total estimated costs to the state of Maryland and to the federal government from EV ownership in Maryland and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 9,467 BEVs on the road in Maryland making up 0.20 percent of the total consumer vehicle fleet. Of these vehicles, 4,375 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $32.8 million in 2018, due to new BEVs in Maryland, in addition to $0.7 million lost in fuel tax revenues, due to EVs not consuming gasoline. Together this results in $33.5 million in lost federal tax revenue annually due to BEV ownership in Maryland. A reduction in federal fuel tax revenues would be

[32] This program runs between 2017–2020.
[33] Only funds expended on EV charging stations are included.
[34] The dollar total represents funds expended from FY2015–2017; the program ended in 2018.

a cost borne by Maryland, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of Maryland include $3.0 million lost to the EV Tax Credit and $1.4 million in lost state fuel tax revenue. Together this amounts to $4.4 million in lost revenue annually to the state of Illinois.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of EVs. In these scenarios it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per manufacturer[35]. Additionally, the EV tax credit cost was assumed to be $6.0 million per year, as this is the new funding level as of 2019. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

Table 24. Total Estimated Annual Cost of BEVs in Maryland for Current and Modeled Scenarios ($ Millions) [36]

	Current (0.20% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$32.8	$0	$0	$0
Annual Federal Fuel Tax	$0.7	$17.7	$35.3	$88.3
Total Annual Federal Costs	**$33.5**	**$17.7**	**$35.3**	**$88.3**
Annual State Fuel Tax	$1.4	$35.2	$70.4	$176.1
EV Tax Credit Cost	$3.0	$6.0	$6.0	$6.0
Total Annual State Cost	**$4.4**	**$41.2**	**$76.4**	**$182.1**
Total Annual Cost	**$37.9**	**$58.9**	**$111.7**	**$270.4**

Total annual federal costs increase in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $0.7 million presently to $88.3 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the 25 percent scenario, reaching a total annual cost of $182.1 million. This is driven by increasing foregone revenue from the state fuel tax. Figure 14 and Figure 15 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 25 shows the effects of this. Total costs increase from $58.9 million to $66.8 million in the 5 percent scenario and from $270.4 million to $310.0 million in the 25 percent scenario.

Table 25. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$20.3	$40.6	$101.5
Annual Foregone State Fuel Tax	$40.5	$81.0	$202.5
Total Annual State Cost	**$46.5**	**$87.0**	**$208.5**
Total Annual Cost	**$66.8**	**$127.6**	**$310.0**

[35] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

[36] Assumes EVs travel 10,000 miles per year.

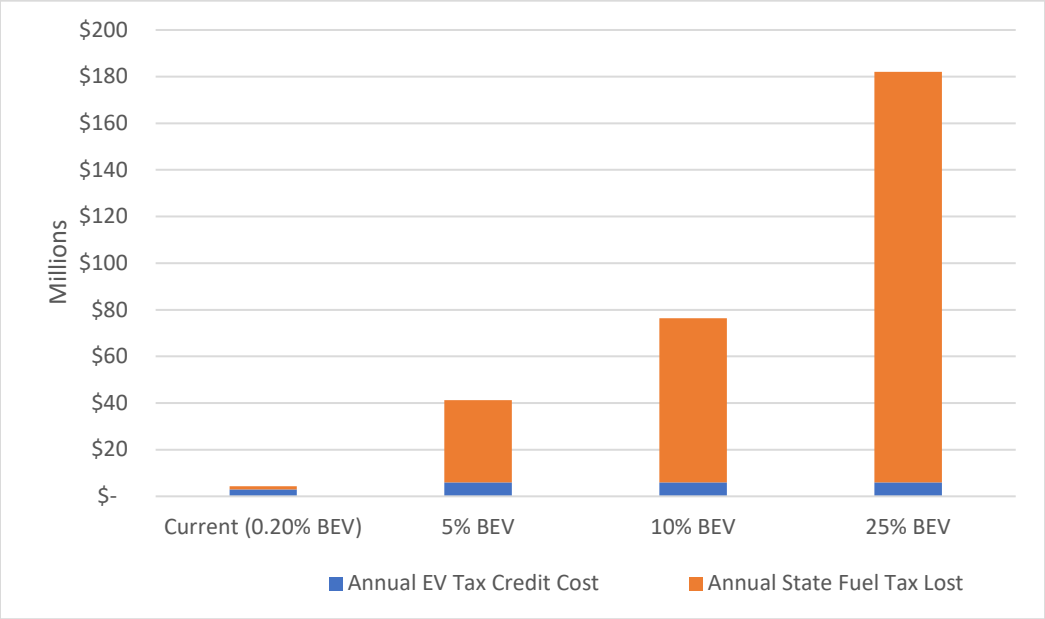

Figure 14. Estimated Annual Costs for Maryland BEVs

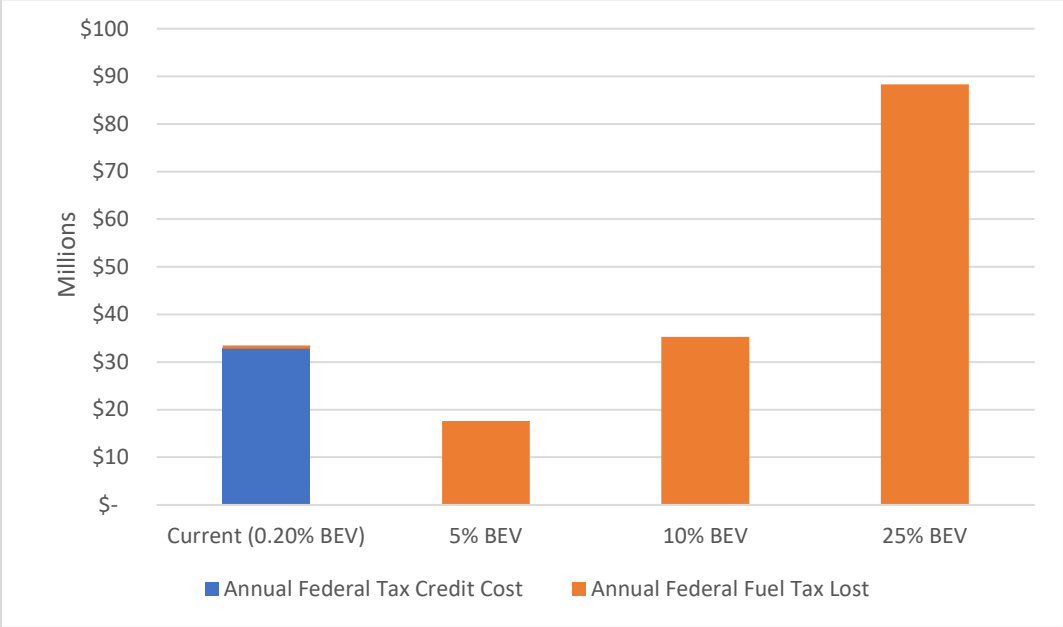

Figure 15. Maryland's Estimated Share of Annual Federal BEV Costs

Massachusetts

Currently the only policy in Massachusetts incentivizing BEV ownership is an EV rebate program.

MOR-EV Program

MOR-EV is run by the Massachusetts Department of Energy Resources and offers rebates of up to $2,500 for customers purchasing or leasing a PEV or zero emission motorcycle through the end of 2018. Starting January 1, 2019, the maximum rebate drops to $1,500 toward the purchase or lease of eligible BEVs and FCEVs and to $450 for zero emission motorcycles. Applications must be submitted within three months of the purchase or lease date. In addition, applicants are required to retain ownership of the vehicle for at least 36 months. The program is set to end on September 30, 2019 (*35*).

Massachusetts does provide incentives for both EV infrastructure and fleet vehicles. The program costs are shown in Table 26; where possible, the amount spent on BEVs is split out.

Table 26. Massachusetts Vehicle Electrification Program Costs (in $Millions)

Program	Total Amount Expended	Amount Expended on BEVs	FY2018 Amount Expended (BEVs)
MOR-EV	$30.5	$18	$9.6
MassEVIP[37]	$0.8	-	-
EV Grants for Public Fleets	$2.7	$1.6	-
Total	**$33.9**	**$19.6**	**$9.6**

Massachusetts Total BEV Costs

Table 27 shows the total estimated costs to the state of Massachusetts and to the federal government from EV ownership in Massachusetts and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 31,651 BEVs on the road in Massachusetts making up 0.59 percent of the total consumer vehicle fleet. Of these vehicles, 9,165 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $68.7 million in 2018, due to new BEVs in Massachusetts, in addition to $2.3 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $71.0 million in lost federal tax revenue annually due to BEV ownership in Massachusetts. A reduction in federal fuel tax revenues would be a cost borne by Massachusetts, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of Massachusetts include a cost $13.4 million for the MOR-EV Program and $3.4 million in lost state fuel tax revenue. Together this amounts to $16.8 million in lost revenue annually to the state of Massachusetts.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of EVs. In these scenarios, it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per

[37] Includes funding provided for multi-unit dwellings, individuals, and workplaces.

manufacturer[38]. Additionally, the MOR-EV cost was assumed to be zero, as this program ends in 2019. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

Table 27. Total Annual Estimated Cost of BEVs in Massachusetts for Current and Modeled Scenarios ($ Millions) [39]

	Current (0.59% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$68.7	$0	$0	$0
Annual Federal Fuel Tax	$2.3	$19.9	$39.9	$99.6
Total Annual Federal Costs	**$71.0**	**$19.9**	**$39.9**	**$99.6**
Annual State Fuel Tax	$3.4	$28.7	$57.5	$143.7
MOR-EV Cost	$13.4	$0	$0	$0
Total Annual State Cost	**$16.8**	**$28.7**	**$57.5**	**$143.7**
Total Annual Cost	**$87.9**	**$48.6**	**$97.4**	**$243.3**

Total annual federal costs increase in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $2.3 million presently to $99.6 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the 25 percent scenario, reaching a total annual cost of $143.7 million. This is driven by increasing foregone revenue from the state fuel tax. Figure 16 and Figure 17 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 28 shows the effects of this. Total costs increase from $48.6 million to $56.0 million in the 5 percent scenario and from $243.3 million to $279.9 million in the 25 percent scenario.

Table 28. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$22.9	$45.8	$114.6
Annual Foregone State Fuel Tax	$33.1	$66.1	$165.3
Total Annual State Cost	**$33.1**	**$66.1**	**$165.3**
Total Annual Cost	**$56.0**	**$111.9**	**$279.9**

[38] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

[39] Assumes EVs travel 10,000 miles per year.

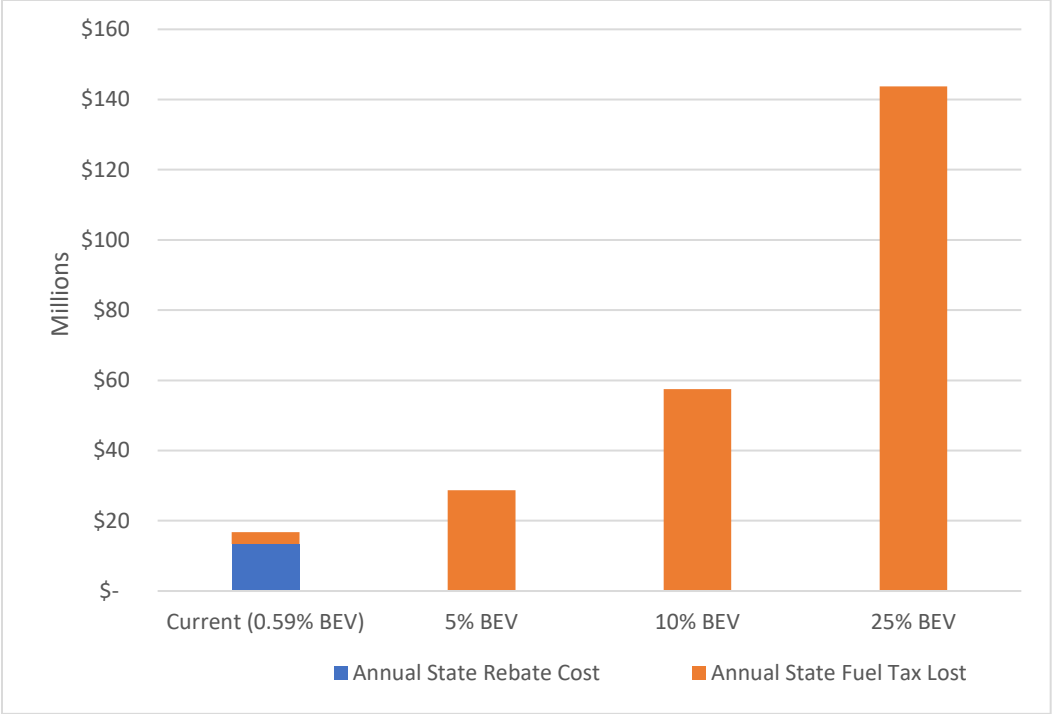

Figure 16. Estimated Annual Costs for Massachusetts BEVs

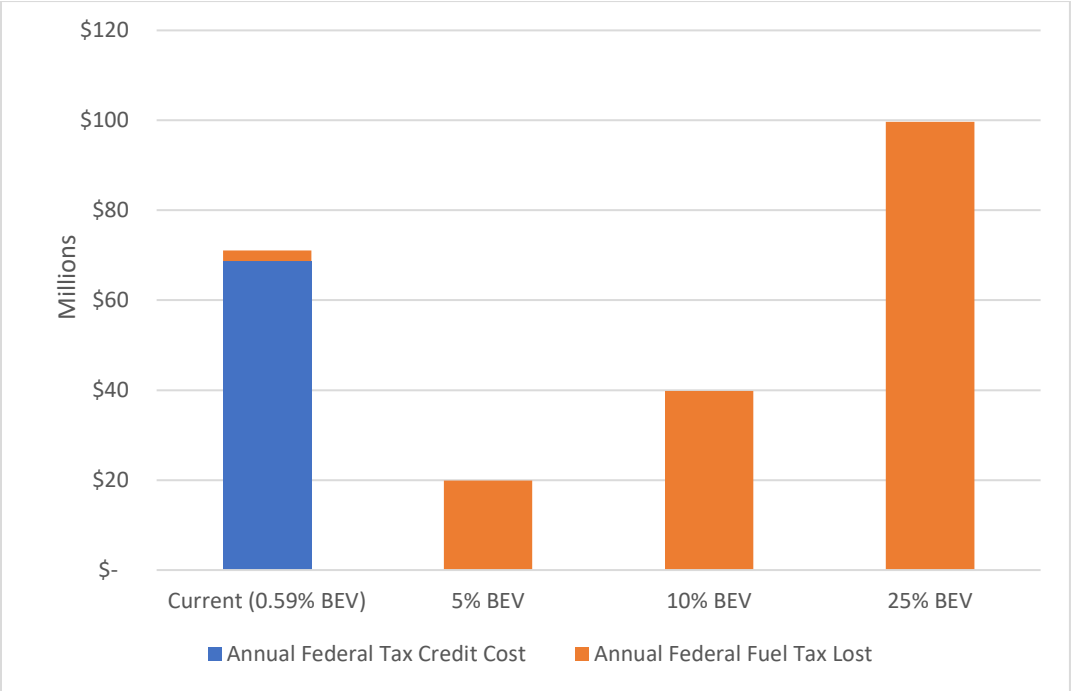

Figure 17. Massachusetts' Estimated Share of Annual Federal BEV Costs

New Jersey

New Jersey has one program that incentivizes BEV ownership by exempting their purchase from the sales and use tax.

Zero Emissions Vehicle Tax Exemption

New and used ZEVs are exempt from sales and use tax at the time of sale. The exemption applies to ZEVs sold, rented, or leased in the state of New Jersey. The exemption does not apply to partial ZEVs, such as hybrids (*9*).

New Jersey Total BEV Costs

Table 29 shows the total estimated costs to the state of New Jersey and to the federal government from EV ownership in New Jersey and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 13,876 BEVs on the road in New Jersey making up 0.19 percent of the total consumer vehicle fleet. Of these vehicles, 6,750 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $50.6 million in 2018, due to new BEVs in New Jersey, in addition to $1.0 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $51.7 million in lost federal tax revenue annually due to BEV ownership in New Jersey. A reduction in federal fuel tax revenues would be a cost borne by New Jersey, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of New Jersey include a cost $21.0 million for the Zero Emissions Vehicle Tax Exemption and $2.3 million in lost state fuel tax revenue. Together this amounts to $23.3 million in lost revenue annually to the state of New Jersey.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of BEVs. In these scenarios it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per manufacturer[40]. New vehicle sales were assumed to scale up at the rate described previously in the methodology sections, which impacts the effect of the sales tax exemption. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

[40] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

Table 29. Total Estimated Annual Cost of BEVs in New Jersey for Current and Modeled Scenarios ($ Millions) [41]

	Current (0.19% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$50.6	$0	$0	$0
Annual Federal Fuel Tax	$1.0	$26.8	$53.6	$134.0
Total Annual Federal Costs	**$51.7**	**$26.8**	**$53.6**	**$134.0**
Annual State Fuel Tax	$2.3	$60.3	$120.6	$301.5
Sales Tax Exemption Cost	$21.0	$95.6	$191.3	$478.2
Total Annual State Cost	**$23.3**	**$155.9**	**$311.9**	**$779.7**
Total Annual Cost	**$75.0**	**$182.7**	**$365.5**	**$913.7**

Total annual federal costs increase in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $1.0 million presently to $134.0 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the 25 percent scenario, reaching a total annual cost of $779.7 million. This is driven by increasing foregone revenue from the BEV sales tax exemption and the state fuel tax. Figure 18 and Figure 19 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 30 shows the effects of this. Total costs increase from $182.7 million to $195.7 million in the 5 percent scenario and from $913.7 million to $979.0 million in the 25 percent scenario.

Table 30. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$30.8	$61.6	$154.1
Annual Foregone State Fuel Tax	$69.3	$138.7	$346.7
Total Annual State Cost	**$164.9**	**$330.0**	**$824.9**
Total Annual Cost	**$195.7**	**$391.6**	**$979.0**

[41] Assumes EVs travel 10,000 miles per year.

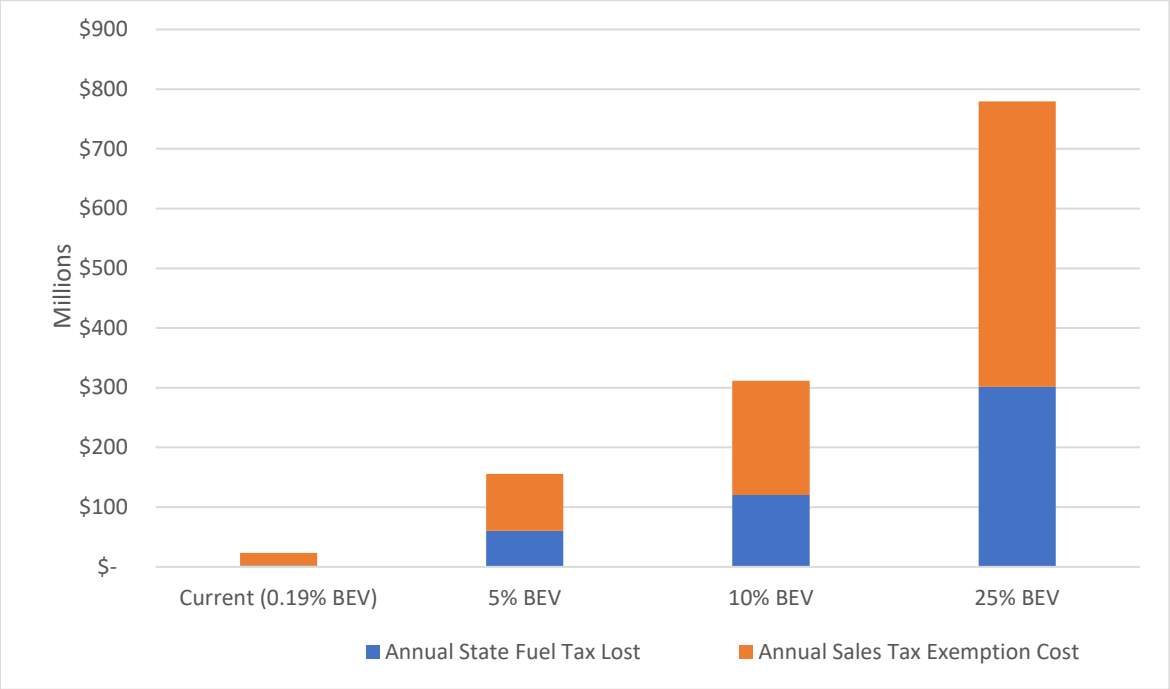

Figure 18. Estimated Annual Costs for New Jersey BEVs

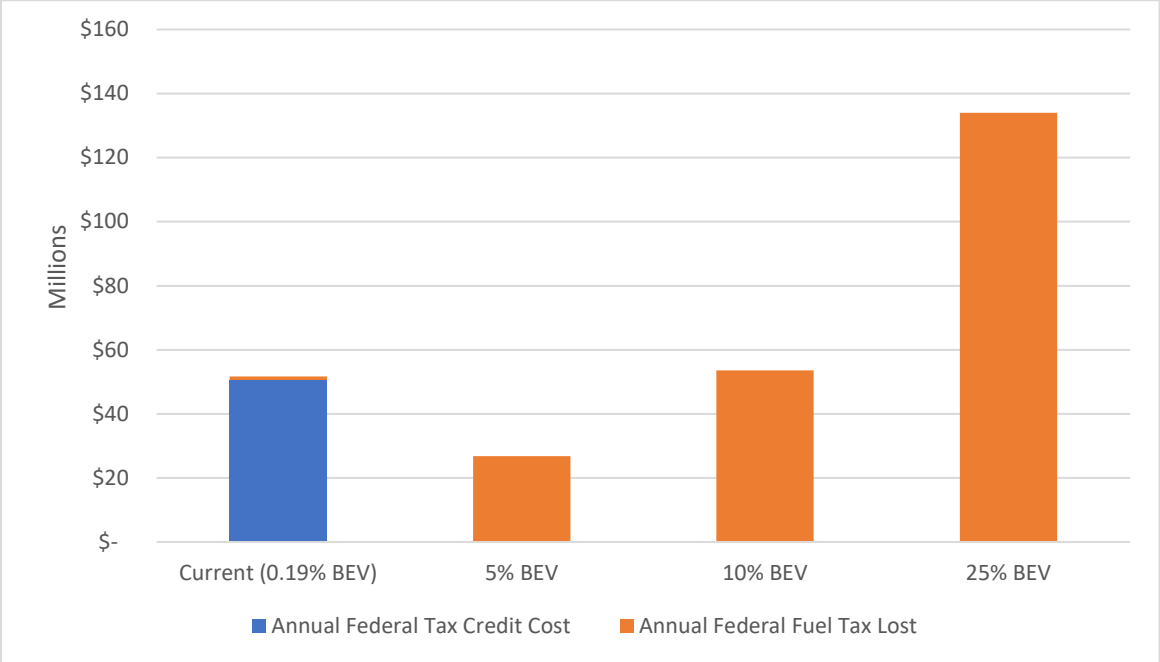

Figure 19. New Jersey's Estimated Share of Annual Federal BEV Costs

New York

New York has one program that directly incentivizes BEV ownership. The Plug-In Electric Vehicle Rebate program provides a rebate for the purchase of eligible Evs.

Plug-In Electric Vehicle Rebate Program

The New York State Energy Research and Development Authority (NYSERDA) provides rebates of up to $2,000 for the purchase or lease of an eligible EV. The vehicle must comply with the following requirements:

- Be a four-wheeled motor vehicle manufactured for use on public streets, roads, and highways.
- Have a gross vehicle weight rating of not more than 8,500 lb.
- Have a maximum speed of at least 55 mph.
- Be propelled at least in part by an electric motor and associated power electronics that draw electricity from a hydrogen fuel cell or from a battery that has a capacity of at least 4 kWh, and is capable of being charged from an external source of electricity (*36*).

Vehicles with a MSRP of over $60,000 are eligible for a $500 rebate only (*37*).

New York also has incentives that support EV charging infrastructure and fleet or transit vehicle electrification. Table 31 shows the costs for these programs.

Table 31. New York Vehicle Electrification Program Costs (in $Millions)

Program	Total Amount Expended	Amount Expended on BEVs	FY2018 Amount Expended (BEVs)
Clean Vehicle Rebate Program	$23.2	$8.4	$2.6
Charge Ready NY[42]	$2.9	-	-
Public Transit Technology and Innovation Program	$5	-	-
Municipal ZEV Clean Vehicle Rebate Program[43]	$2.3	-	-
Charge to Work NY Program	$0.8	-	-
Total	**$34.1**	**$8.4**	**$2.6**

New York Total BEV Costs

Table 32 shows the total estimated costs to the state of New York and to the federal government from BEV ownership in New York and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 16,055 BEVs on the road in New York making up 0.14 percent of the total consumer vehicle fleet. Of these vehicles, 6,573 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $49.3 million in 2018, due to new BEVs in New York, in addition to $1.2 million lost in fuel tax

[42] A total of $5,000,000 is available for the program.
[43] $2,000,000 to support EV infrastructure for municipalities and $300,000 for clean vehicle purchases by municipalities.

revenues, due to BEVs not consuming gasoline. Together this results in $50.5 million in lost federal tax revenue annually due to BEV ownership in New York. A reduction in federal fuel tax revenues would be a cost borne by New York, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of New York include a cost of $3.0 million in lost state fuel tax revenue and $2.6 million to the Plug-In Electric Vehicle Rebate. Together this amounts to $5.6 million in lost revenue annually to the state of New York.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of EVs. In these scenarios, it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per manufacturer[44]. This analysis assumes the Plug-in Electric Vehicle Rebate will continue to cost $2.6 million per year. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

Table 32. Total Estimated Annual Cost of BEVs in New York for Current and Modeled Scenarios ($ Millions) [45]

	Current (0.14% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$49.3	$0	$0	$0
Annual Federal Fuel Tax	$1.2	$43.2	$86.5	$216.2
Total Annual Federal Costs	**$50.5**	**$43.2**	**$86.5**	**$216.2**
Annual State Fuel Tax	$3.0	$108.0	$216.0	$540.0
EV Rebate Program	$2.6	$2.6	$2.6	$2.6
Total Annual State Cost	**$5.6**	**$110.6**	**$218.6**	**$542.6**
Total Annual Cost	**$56.1**	**$153.8**	**$305.1**	**$758.8**

Total annual federal costs increase in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $1.2 million presently to $216.2 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the 25 percent scenario, reaching a total annual cost of $542.6 million. This is driven by increasing foregone revenue from the state fuel tax. Figure 20 and Figure 21 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 33 shows the effects of this. Total costs increase from $153.8 million to $176.5 million in the 5 percent scenario and from $758.8 million to $872.1 million in the 25 percent scenario.

[44] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

[45] Assumes EVs travel 10,000 miles per year.

Table 33. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$49.7	$99.4	$248.6
Annual Foregone State Fuel Tax	$124.2	$248.4	$620.9
Total Annual State Cost	**$126.8**	**$251.0**	**$623.5**
Total Annual Cost	**$176.5**	**$350.4**	**$872.1**

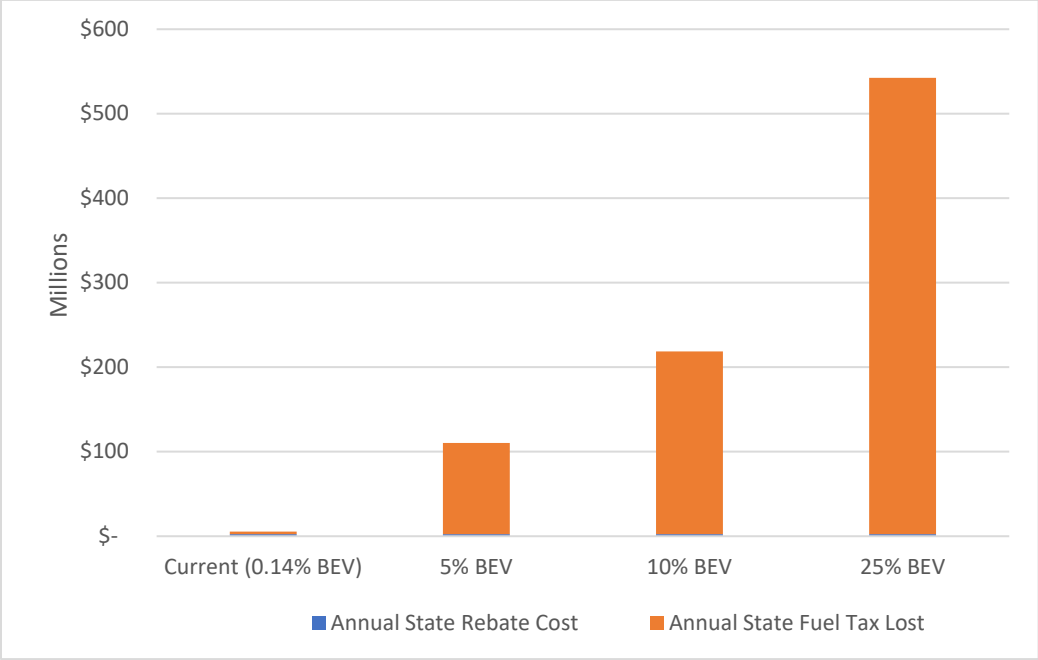

Figure 20. Estimated Annual Costs for New York BEVs

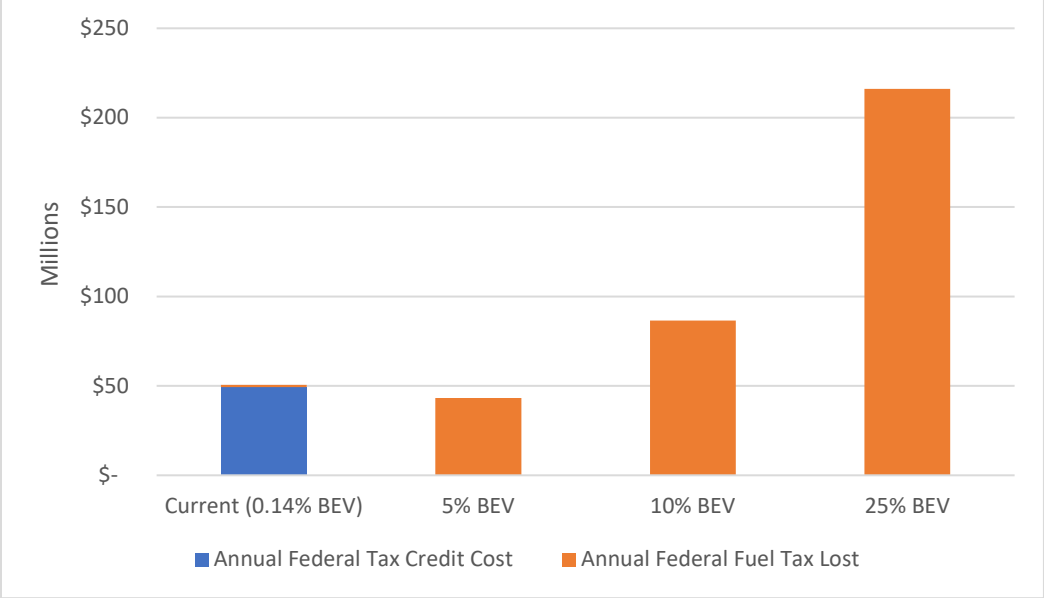

Figure 21. New York's Estimated Share of Annual Federal BEV Costs

North Carolina

North Carolina does not have any programs directly incentivizing BEV ownership; however it does have an increased registration fee for BEVs.

Registration Fee Increase

North Carolina first instituted an increased registration fee for EVs in 2013; it was set at $100 annually due at the time of registration or renewal (*38*). In 2015, the fee was increased to $130 (*39*).

North Carolina does have incentives that support heavy vehicle and bus conversion to cleaner fuels; more information can be found about these programs in the appendix. Table 34 details the program costs.

Table 34. North Carolina Program Costs (in $Millions)

Program	Total Amount Expended
DC Infrastructure Program[46]	$3.5
Diesel Bus and Vehicle Program[46]	$24.5
Alt Fuel and Idle Reduction Grants	$0.7
Total	**$28.7**

North Carolina Total BEV Costs

Table 35 shows the total estimated costs to the state of North Carolina and to the federal government from BEV ownership in North Carolina and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 8,181 BEVs on the road in North Carolina making up 0.09 percent of the total consumer vehicle fleet. Of these vehicles, 3,248 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $24.4 million in 2018, due to new BEVs in North Carolina, in addition to $0.6 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $25.0 million in lost federal tax revenue annually due to BEV ownership in North Carolina. A reduction in federal fuel tax revenues would be a cost borne by North Carolina, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of North Carolina include a cost of $1.2 million in lost state fuel tax revenue; however, this is offset by $1.1 million in increased BEV registration fees. Together this amounts to only $0.1 million in lost revenue annually to the state of North Carolina.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of EVs. In these scenarios, it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per

[46] The program is funded through the Volkswagen Settlement. The amount represents Phase 1 Funding that is allocated for 2018–2020.

manufacturer[47]. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

Table 35. Total Estimated Annual Cost of BEVs in North Carolina for Current and Modeled Scenarios ($ Millions) [48]

	Current (0.09% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$24.4	$0	$0	$0
Annual Federal Fuel Tax	$0.6	$33.4	$66.8	$167.0
Total Annual Federal Costs	**$25.0**	**$33.4**	**$66.8**	**$167.0**
Annual State Fuel Tax	$1.2	$66.1	$132.3	$330.7
Registration Fee Cost	−$1.1	−$58.7	−$117.5	−$293.7
Total Annual State Cost	**$0.1**	**$7.4**	**$14.8**	**$37.0**
Total Annual Cost	**$25.1**	**$40.8**	**$81.6**	**$204.0**

Total annual federal costs increase in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $0.6 million presently to $167.0 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the 25 percent scenario, reaching a total annual cost of $37.0 million. This is driven by increasing foregone revenue from the state fuel tax but is largely offset by increased registration fee revenues. Figure 22 and Figure 23 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 36 shows the effects of this. Total costs increase from $40.8 million to $55.8 million in the 5 percent scenario and from $204.0 million to $278.6 million in the 25 percent scenario.

Table 36. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$38.4	$78.8	$192.0
Annual Foregone State Fuel Tax	$76.1	$152.1	$380.3
Total Annual State Cost	**$17.4**	**$34.6**	**$86.6**
Total Annual Cost	**$55.8**	**$113.4**	**$278.6**

[47] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

[48] Assumes EVs travel 10,000 miles per year.

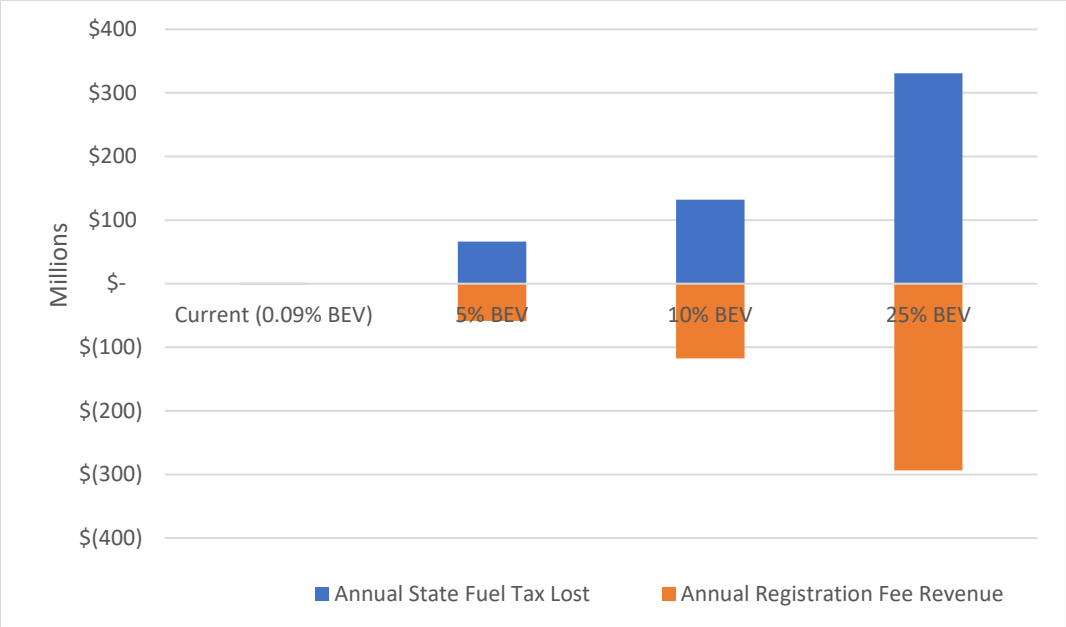

Figure 22. Estimated Annual Costs for North Carolina BEVs

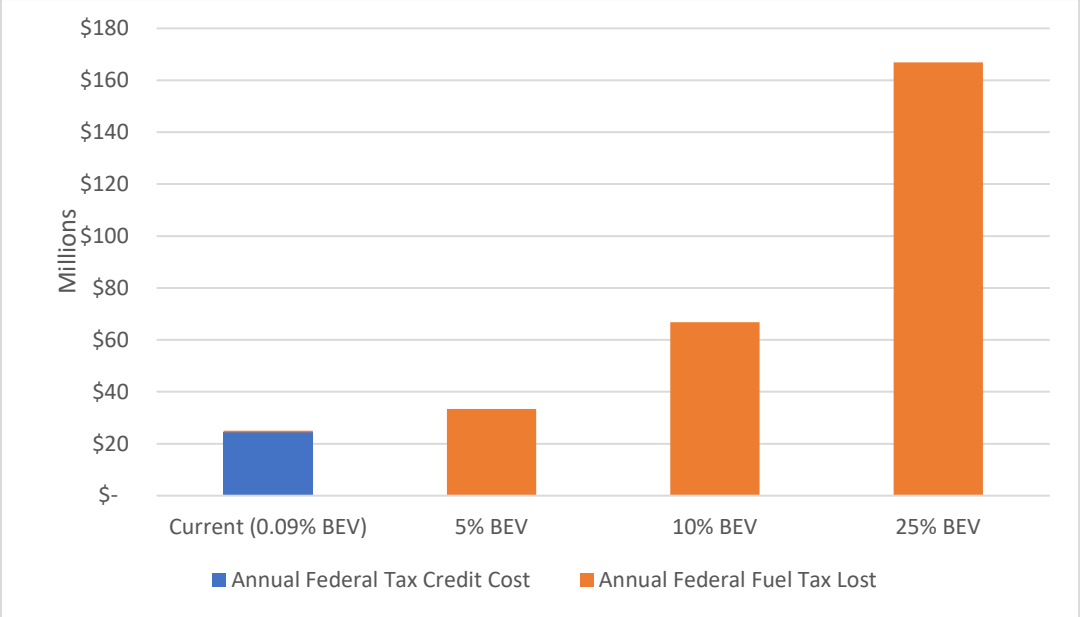

Figure 23. North Carolina's Estimated Share of Annual Federal BEV Costs

Ohio

Currently, Ohio does not have any programs that directly incentivize BEV ownership. However, the state does have programs that incentivize the conversion or replacement of heavy vehicles to cleaner fuels, including BEVs. Table 37 details these program costs.

Table 37. Ohio Program Costs (in $Millions)

Program	Total Costs	Total BEV Costs
Medium and Heavy-Duty Emission Reduction Grants[49]	$11.9	$3
Diesel Emission Reduction Grant[50]	$8.1	$2.2
Total	**$19.9**	**$5.2**

Ohio Total BEV Costs

Table 38 shows the total estimated costs to the state of Ohio and to the federal government from BEV ownership in Ohio and future cost estimates as BEV ownership grows. As of early 2019, there were 7,486 BEVs on the road in Ohio making up 0.09 percent of the total consumer vehicle fleet. Of these vehicles, 3,092 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $23.2 million in 2018, due to new BEVs in Ohio, in addition to $0.6 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $23.8 million in lost federal tax revenue annually due to BEV ownership in Ohio. A reduction in federal fuel tax revenues would be a cost borne by Ohio, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund. Annual costs to the state of Ohio include a cost of $1.2 million in lost state fuel tax revenue.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of EVs. In these scenarios it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per manufacturer[51]. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

[49] The program is funded through the Volkswagen Settlement and has allocated $15,000,000 for each of the first three years of the program.
[50] Amounts represent 2018 costs.
[51] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

Table 38. Total Estimated Annual Cost of BEVs in Ohio for Current and Modeled Scenarios ($ Millions) [52]

	Current (0.07% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$23.2	$0	$0	$0
Annual Federal Fuel Tax	$0.6	$39.7	$79.3	$198.3
Total Annual Federal Costs	**$23.8**	**$39.7**	**$79.3**	**$198.3**
Annual State Fuel Tax	$1.2	$83.0	$166.0	$415.0
Total Annual State Cost	**$1.2**	**$83.0**	**$166.0**	**$415.0**
Total Annual Cost	**$25.0**	**$122.7**	**$245.3**	**$613.3**

Total annual federal costs increase in the modeled higher penetration scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $0.6 million presently to $198.3 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the 25 percent scenario, reaching a total annual cost of $415.0 million. This is driven by increasing foregone revenue from the state fuel tax. Figure 24 and Figure 25 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 39 shows the effects of this. Total costs increase from $122.7 million to $141.0 million in the 5 percent scenario and from $613.3 million to $705.2 million in the 25 percent scenario.

Table 39. Estimated Annual Cost with Increased EVMT to 11,500 miles/yr ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$45.6	$91.2	$228.0
Annual Foregone State Fuel Tax	$95.4	$190.9	$477.2
Total Annual State Cost	**$95.4**	**$190.9**	**$477.2**
Total Annual Cost	**$141.0**	**$282.1**	**$705.2**

[52] Assumes EVs travel 10,000 miles per year.

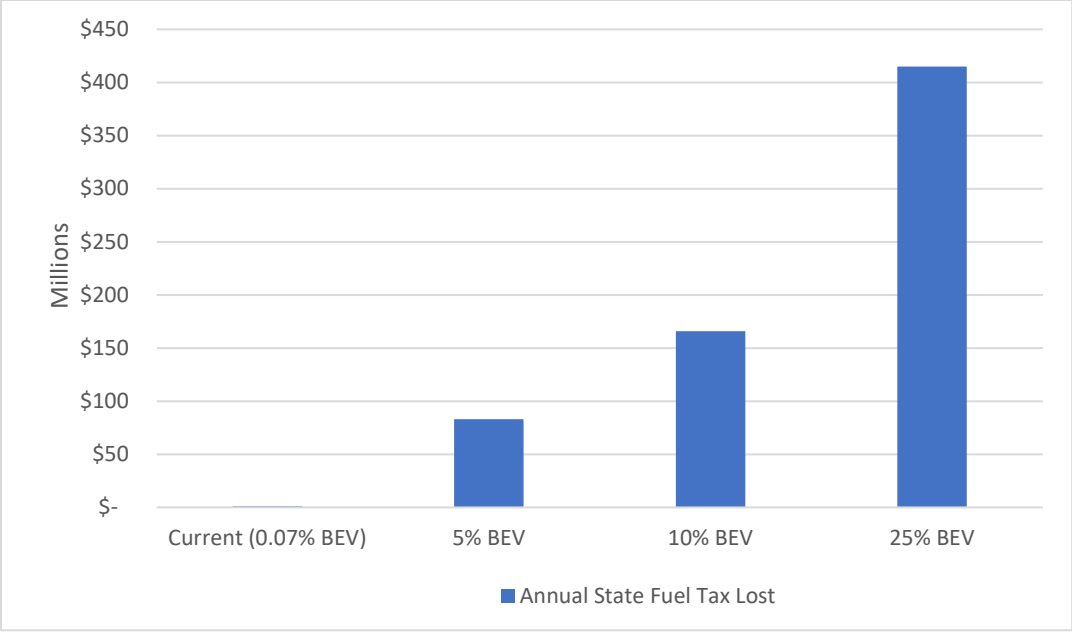

Figure 24. Estimated Annual Costs for Ohio BEVs

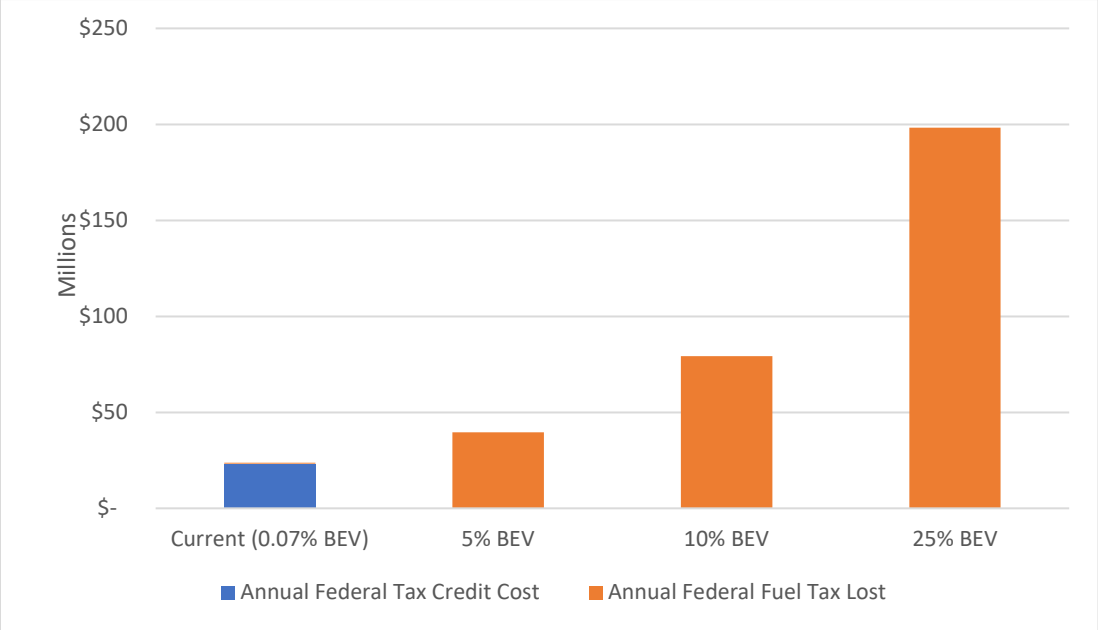

Figure 25. Ohio's Estimated Share of Annual Federal BEV Costs

Oregon

Oregon has one program incentivizing consumer grade EV ownership. The Plug-In Electric Vehicle Program provides a rebate for BEVs and PHEVs. This program and a newly enacted registration fee are discussed below in detail, followed by an analysis of the costs of BEV ownership in Oregon.

Plug-In Electric Vehicle Rebate Program

The rebate program is open to individuals, businesses, government agencies, and non-profits. The Oregon Clean Vehicle Rebate Program offers a cash rebate for purchases or leases of eligible EVs, including PHEVs and BEVs, through two programs: the standard rebate based on battery capacity and the Charge Ahead rebate based on income level (*40*). New PHEVs and BEVs with a battery capacity less than 10 kWh are eligible for a rebate of $1,500 and those with a battery capacity greater than 10 kWh are eligible for a rebate of $2,500 (*41*). Oregon residents that meet the low-income threshold are eligible for the Charge Ahead program that offers rebates of $2,500, which can be used toward the purchase of a new or used BEV only. The vehicle must be registered and remain with the individual for at least 24 months for both programs (*42*). Some applicants may be eligible for both programs (*41*). As of 2019, this program is authorized to distribute $10.8 million per year in rebates (*43*). The program is currently set to end in 2023 (*44*).

Registration Fee

Beginning on January 1, 2020, Oregon will assess an additional fee on EVs at the time of registration or renewal. This fee is set at $110 per vehicle for 2020–2021 (*45*). However, EV owners can opt into OReGO,[53] the road usage charge system, and waive the increased registration fee (*46*).[54]

Table 40 presents the program costs for Oregon's electrification incentives. The Electric Vehicle Rebate Program began in 2018 and has spent the yearly allocation of $10.8 million so far. The Clean Bus School Grants program is funded through the Volkswagen Environmental Mitigation Trust Fund allocation for Oregon so does not represent spending of state funds (*47*).

Table 40. Oregon Program Costs (in $Millions)

Program	Total Costs
EV Rebate Program	$10.8
Clean School Bus Grants	$18
Total	**$28.8**

Oregon EV Costs

Table 41 shows the total estimated costs to the state of Oregon and to the federal government from BEV ownership in Oregon and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 18,282 BEVs on the road in Oregon making up 0.48 percent of the total consumer vehicle fleet. Of these vehicles, 4,285 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

[53] OReGO is a road usage charge program where individuals pay 1.7 cents per mile in lieu of paying state gas taxes. Individuals receive a tax credit for money spent on state gas taxes.
[54] This analysis assumes that all EV owners choose to pay the additional registration fee.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $32.1 million in 2018, due to new BEVs in Oregon, in addition to $1.6 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $33.7 million in lost federal tax revenue annually due to BEV ownership in Oregon. A reduction in federal fuel tax revenues would be a cost borne by Oregon, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of Oregon include $10.8 million for the Plug-in EV Rebate Program and $2.7 million in lost state fuel tax revenue. Together this amounts to $13.5 million in costs or lost revenue annually to the state of Oregon.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of EVs. In these scenarios it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of EVs, as the credit is limited to 200,000 vehicles per manufacturer[55]. The Plug-In EV Rebate Program was assumed to remain constant at $10.8 million, as this would represent continued funding at the current level. Finally, it was assumed that Oregon will reach 5 percent BEVs after January 2020, at which time a $110 per EV registration fee will come into effect.

Table 41. Estimated Annual Cost of BEVs in Oregon ($ Millions) [56]

Scenario	Current (0.48% EV)	5% EV	10% EV	25% EV
Annual Federal Tax Credit Cost	$32.1	$0	$0	$0
Annual Federal Fuel Tax Lost	$1.6	$14.0	$27.9	$69.9
Total Annual Federal Cost	**$33.7**	**$14.0**	**$27.9**	**$69.9**
Plug-In EV Rebate Program	$10.8	$10.8	$10.8	$10.8
Annual State Fuel Tax Lost	$2.7	$28.0	$55.9	$139.8
Annual Registration Fee Revenue Lost	$0	−$20.8	−$41.6	−$104.0
Total Annual State Cost	**$13.5**	**$18.0**	**$25.1**	**$46.6**
Total Annual Cost	**$47.2**	**$32.0**	**$53.0**	**$116.5**

Total annual federal costs increase in the modelled scenarios, as the federal tax credit is phased out; however, annual federal fuel tax losses increase from $1.6 million presently to $69.9 million in the 25 percent BEV scenario. Direct costs to the state annually increase from $13.5 million currently to $46.6 million in the 25 percent scenario. This is driven by increasing losses in state fuel tax revenues, although about 74 percent of this increase is offset by increased revenue from BEV registrations. Figure 26 and Figure 27 display these results by each scenario.

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year.

[55] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

[56] Assumes EVs travel 10,000 miles per year.

Table 42 shows the effects of this. Total costs increase from $32.0 million to $38.3 million in the 5 percent scenario and from $116.5 million to $147.9 million in the 25 percent scenario.

Table 42. Estimated Annual Cost with Increased EVMT ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Federal Fuel Tax	$16.1	$32.1	$80.3
Annual State Fuel Tax	$32.2	$64.3	$160.8
Total Annual State Cost	**$22.2**	**$33.5**	**$67.6**
Total Annual Cost	**$38.3**	**$65.6**	**$147.9**

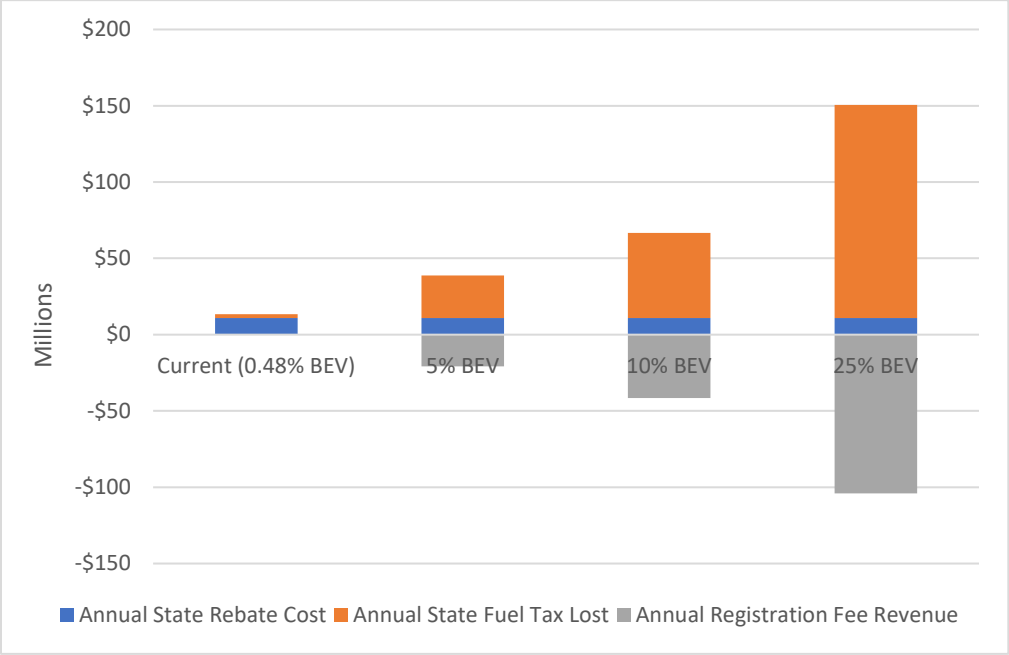

Figure 26. Estimated Annual Costs of BEVs in Oregon

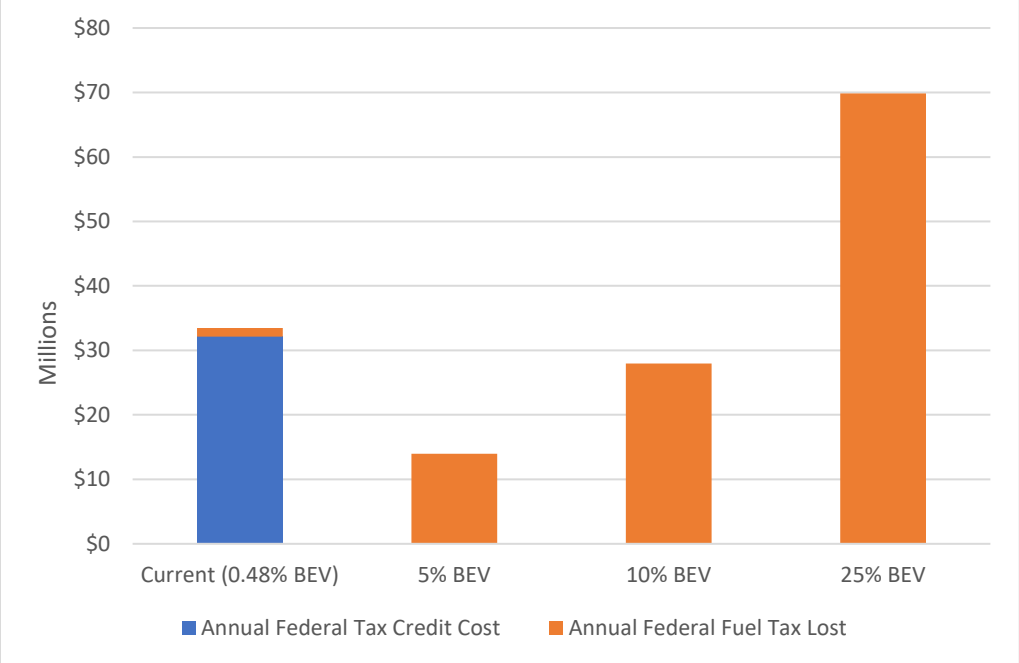

Figure 27. Oregon's Estimated Share of Annual Federal BEV Costs

Pennsylvania

Pennsylvania has one program incentivizing consumer grade EV ownership. The Alternative Fuel Vehicle Rebate Program provides a rebate for AFVs. This program is discussed below in detail, followed by an analysis of the costs of EV ownership in Pennsylvania.

Alternative Fuel Vehicle Rebate

The Pennsylvania Department of Environmental Protection administers the rebate program for alternatively fueled vehicles. Current program requirements and guidelines are valid until December 31, 2019, and then the program will be reassessed. The rebate is available for the purchase or lease of a new AFV or the purchase of a leased AFV. New AFVs must have a final purchase price of less than $50,000 to qualify; hydrogen or fuel cell vehicles must have a final purchase price of less than $75,000. Used AFVs must have less than 75,000 miles with a market value of less than $50,000 and only one previous owner to qualify; the purchase must be made at a registered dealer.

The rebate amount for BEVs is set at $1,500. Low income households, household federal taxable income of below 200 percent of the federal poverty level, are eligible for an additional $1,000 rebate (*48*).

Pennsylvania has several programs that incentivize vehicle electrification for non-consumer grade vehicles and infrastructure that supports electrification. All the programs are supported by Volkswagen Mitigation Funds. Table 43 shows these program costs; more information on these programs is provided in the Appendix. Where possible, the amount expended on BEVs is split out from the total program cost.

Table 43. Pennsylvania Vehicle Electrification Program Costs (in $Millions) change to $ Millions

Program	Total Amount Available	FY2018 Amount Expended (BEVs)
Alternative Fuel Vehicle Rebate	-	$0.6
DC Fast Charging and Hydrogen Fueling Grant Program	$10	-
Class 8 Heavy Duty Truck and Transit Bus Grants	$16	-
Level 2 EV Charging Rebate Program	$7.7	-
Onroad Rebate Program	$30	-
Total	**$63.7**	**$0.6**

Pennsylvania Total BEV Costs

Table 44 shows the total estimated costs to the state of Pennsylvania and to the federal government from BEV ownership in Pennsylvania and modelled scenario cost estimates as BEV ownership grows. As of early 2019, there were 8,905 BEVs on the road in Pennsylvania making up 0.07 percent of the total consumer vehicle fleet. Of these vehicles, 3,800 were 2018 models, which this analysis uses as an estimate for the total number of new BEVs in 2018.

This analysis estimates the Federal Electric Vehicle Tax Credit currently costs the federal government up to $28.5 million in 2018, due to new BEVs in Pennsylvania, in addition to $0.7 million lost in fuel tax revenues, due to BEVs not consuming gasoline. Together this results in $29.2 million in lost federal tax revenue annually due to BEV ownership in Pennsylvania. A reduction in federal fuel tax revenues would be a cost borne by Pennsylvania, rather than the federal government, as the federal fuel tax revenues are simply returned to the state in the form of the Highway Trust Fund.

Annual costs to the state of Pennsylvania include $0.6 million for the AFV Rebate, and $2.1 million in lost state fuel tax revenue. Together this amounts to $2.1 million in costs or lost revenue annually to the state of Pennsylvania.

Costs were also estimated for modelled scenarios where 5 percent, 10 percent, and 25 percent of the total vehicle fleet is made up of BEVs. In these scenarios it was assumed that the federal tax credit will expire before 5 percent of the fleet is made up of BEVs, as the credit is limited to 200,000 vehicles per manufacturer[57]. The state programs were assumed to remain constant, as this would represent continued funding at the current level. Finally, this analysis assumes that EVMT remains constant at 10,000 miles per vehicle annually.

Table 44. Estimated Annual Cost of BEVs in Pennsylvania ($ Millions)

	Current (0.07% BEV)	5% BEV	10% BEV	25% BEV
Annual Federal Tax Credit	$28.5	$0	$0	$0
Annual Federal Fuel Tax	$0.7	$44.6	$89.3	$223.2
Total Annual Federal Costs	**$29.2**	**$44.6**	**$89.3**	**$223.2**
AFV Rebate Program	$0.6	$0.6	$0.6	$0.6
Annual State Fuel Tax	$2.1	$142.4	$284.8	$711.9
Total Annual State Cost	**$2.7**	**$143.0**	**$285.3**	**$712.5**
Total Annual Cost	**$31.8**	**$187.6**	**$374.6**	**$935.6**

Total annual federal costs increase in the modeled higher penetration scenarios, as annual federal fuel tax losses increase from $0.7 million presently to $223.2 million in the 25 percent BEV scenario. Direct costs to the state increase from the present to the 25 percent scenario, reaching a total annual cost of $712.5 million. Figure 28 and Figure 29 display these results by each scenario.

EVMT Sensitivity Analysis

As it is likely that EVMT will increase in the future, the analysis was conducted again assuming EVMT increases from 10,000 miles per year to the current U.S. average of 11,500 miles per year. Table 45 shows the effects of this. Total costs increase from $143.0 million to $164.3 million in the 5 percent scenario and from $712.5 million to $819.3 million in the 25 percent scenario.

Table 45. Estimated Annual Cost with Increased EVMT ($ Millions)

	5% BEV	10% BEV	25% BEV
Annual Foregone Federal Fuel Tax	$51.3	$102.7	$256.6
Annual Foregone State Fuel Tax	$163.7	$327.5	$818.7
Total Annual State Cost	**$164.3**	**$328.1**	**$819.3**
Total Annual Cost	**$215.6**	**$430.8**	**$1075.9**

[57] Should the Driving America Forward Act or other similar bills be enacted, the federal tax credit could extend into the modelled scenarios.

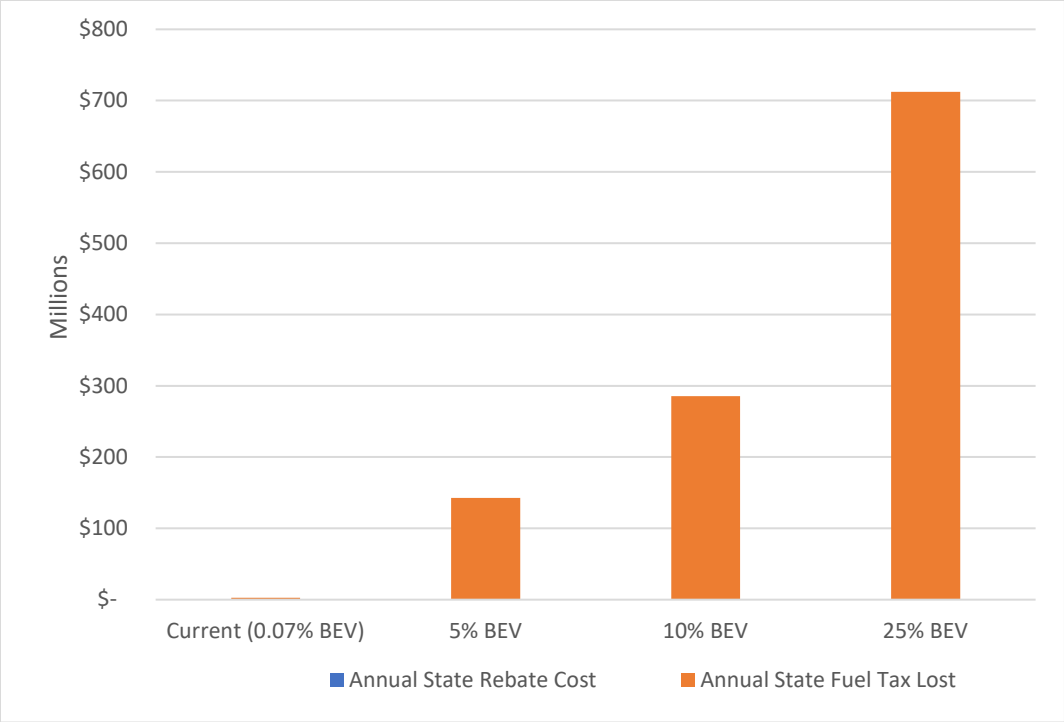

Figure 28. Estimated Annual Costs of BEVs in Pennsylvania

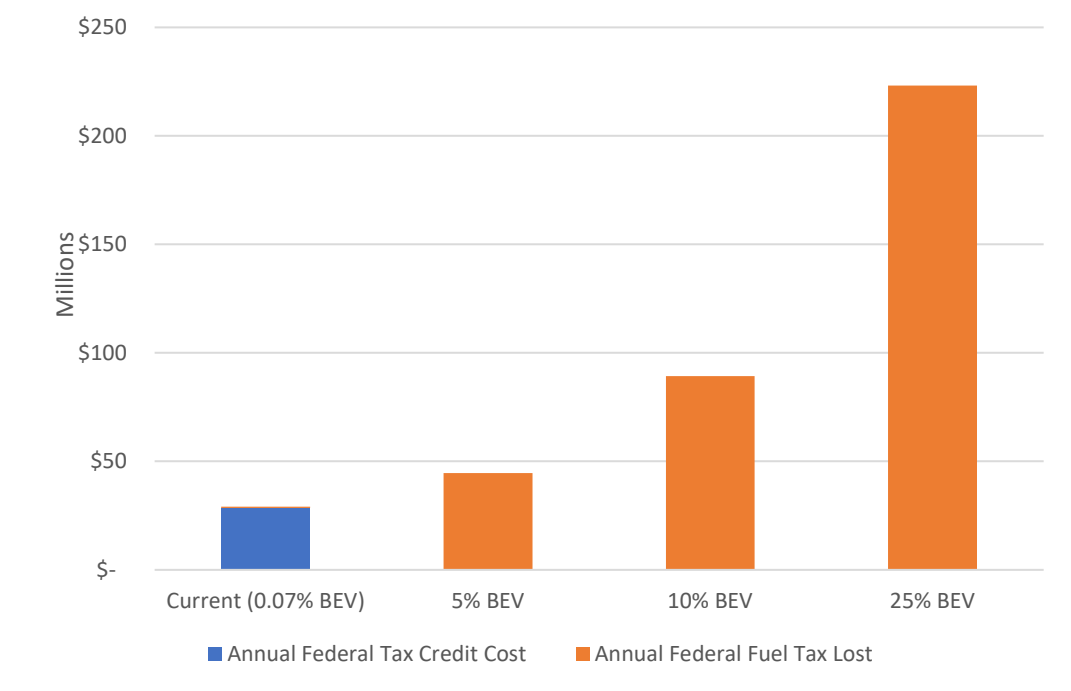

Figure 29. Pennsylvania's Estimated Share of Annual Federal BEV Costs

Conclusion

The state by state analysis examined five general types of costs resulting from BEV incentives. These were:

- Costs of BEV rebate programs
- Foregone revenue from BEV tax credits
- Foregone revenue from BEV sales tax exemptions
- Foregone revenue from gasoline fuel taxes
- Net costs of BEV registration fee policies

BEV rebate programs were present in 7 of the 14 states in the analysis. The most expensive of these programs were in California, which spent $136.9 million annually combined on three BEV rebate type programs. The remaining BEV rebate program costs ranged from $0.9 million in Pennsylvania to $13.4 million per year in Massachusetts. While these costs are substantial, even in California they do not represent a large budgetary risk to the states as these programs have a set amount of money allocated to them each year. Our analysis assumed that these programs would continue to be funded at the same level in the future, so their costs do not grow as BEV ownership increases.

The next type of cost, foregone revenue from BEV tax credits, does expand as BEV ownership increases. This means that this type of policy has the potential to impose very large costs on a state as BEVs make up a larger share of the state's vehicle fleet. The federal government provides a $7,500 tax credit for each new BEV annually, amounting to an estimated $1.6 billion in 2018. However, this cost is unlikely to increase, as the program begins to phase out. As of 2019, Tesla and Chevrolet have already reached the phase out threshold.

Colorado has a similar program that provides a tax credit of up to $5,000 per new BEV. The analysis estimated that this program cost Colorado up to $32.3 million in foregone tax revenue in 2018. This cost expands to $111.7 million per year in the 5 percent scenario and $558.6 million per year in the 25 percent scenario. Because this type of program provides a tax credit and results in foregone revenue, rather than an explicit program cost in the state budget that requires funding, and because the revenue lost directly scales with the number of new BEVs, the costs can expand infinitely as BEV ownership grows.

Likewise, the New Jersey Zero Emissions Vehicle Sales Tax Exemption, which exempts new BEVs from the 6.625 percent state sales tax, has the potential to massively expand in cost as BEV ownership grows. The analysis estimated that in 2018 the program cost $21.0 million annually. This expands to $95.6 million per year in the 5 percent scenario and $478.2 million per year in the 25 percent scenario. Both this program and the Colorado BEV tax credit represent massive potential costs in the future for their respective states.

The major uncapped cost, which affects every state, is the reduction in fuel tax revenues resulting from increased BEV ownership. The estimated costs as of 2018 were $44.0 million annually in federal fuel tax revenue. This expands up to $5.157 billion annually in the 25 percent modelled scenario. Similar large impact is observed in the states analyses, especially in the higher ownership scenarios. For example, for California a loss of $62.8 million in fuel taxes is estimated in 2018, expanding to $1.94 billion in the 25 percent modelled scenario. Other states also experience a large growth in this cost as BEV ownership expands, with states that have a higher gasoline tax rate experiencing larger costs, relative to their size.

Two states in the analysis, Connecticut and Illinois, provide a registration fee exemption for BEVs, further increasing their costs. In Illinois, this policy adds another $221.1 million onto the already

$584.7 million in foregone state fuel tax revenues estimated in the 25 percent scenario. In Connecticut, this policy adds an additional $32.0 million to the $128.8 million foregone state fuel tax revenues estimated in the 25 percent scenario. Like the previous programs, the cost of these fee reductions will continue to grow at a rate proportional to the rate of BEV ownership.

Four states; California, Colorado, North Carolina and Oregon; in the analysis have taken the opposite approach and have implemented, or plan to implement soon, registration fee increases for BEVs to offset the costs of foregone fuel tax revenues. California will soon require an additional $100 per year registration fee for BEVs. In the 25 percent scenario, this policy raises $789.3 million in additional revenue, offsetting some of the $1.940 billion in foregone state fuel taxes. The analysis estimates that these increased fees will not totally offset the estimated foregone state fuel taxes in any of these states, as they are currently implemented, although they do offer these states a mechanism in which they could offset the costs in the future by further increasing the registration fee.

This analysis examined five types of costs resulting from programs that incentivize BEV ownership. BEV rebate programs were generally less expensive than other types of programs, as their costs are constrained by state budgets. Policies that allow costs to grow unrestrained as BEV ownership grows, such as tax credits, sales tax exemptions, and registration fee decreases, are constrained only by BEV ownership and have the potential to impose massive costs on states as BEVs begin to make up a larger portion of the consumer vehicle fleet. Finally, fuel tax revenues will continue to decrease as BEVs increase in share, although some states have taken steps to mitigate some of these losses through increased BEV registration fees.

Appendix: Policies by State

Arizona

Alternative Fuel and AFV Use Tax Exemption

Alternative fuels and AFVs converted to operate on alternative fuels, or the equipment used to convert a diesel vehicle to an AFV, are exempt for use taxes (*6*).

AFV and Energy Efficient Plate Programs

AFVs are eligible for special license plate; this license plate provides HOV lane privileges to those vehicles regardless of the number of passengers. Alternative fuels include electric, natural gas, hydrogen, and solar (*49*). The AFV plate program has no limit but the Energy Efficient Plate Program, for PHEV, has a limit of 10,000 vehicles, which has been reached (*50*).

Reduced VLT

Arizona assesses a VLT on all vehicles but provides a reduction for AFVs. VLT for AFVs are charged at a rate of $4 per $100 of assessed valuation; the valuation is determined using the following:

- The first year, the assessed value is 1 percent of the factory list price of the AFV.
- In subsequent years, the assessed value is depreciated by 15 percent each year.
- The minimum VLT for an AFV is $5 (*22*).

The license tax reduction is set to phase out and will not apply to vehicles purchased on or after December 31, 2022 (*22*).

AFV Emissions Test Exemption

Electrically powered vehicles and exempt from the emissions inspection requirement (*51*).

California

Clean Vehicle Rebate Project

The CVRP program offers rebates up to $5,000 for the purchase or lease of zero-emission and plug-in hybrid light-duty vehicles. An additional $2,000 rebate is available for lower income households whose total income is at 300 percent or less of the federal poverty level.[58] Approved vehicles are selected by the CARB. The rebates are provided on a first come, first served basis to individuals, businesses, and government entities in California that purchase or lease new vehicles. The following details the rebate amounts:

- $5,000 for FCEVs.
- $2,500 for BEVs.
- $1,500 for PHEVs.
- $900 for a zero-emission motorcycle.

[58] The federal poverty level was set at $12,140 for an individual and $25,100 for a family of four in 2018. In order to be eligible for the additional rebate, individuals would have to earn less than $36, 420 per year and less than $75,00 for a family of four.

Additional income restrictions apply; if an individual has a gross annual income above the following:

- $150,000 for single filers.
- $204,000 for head-of-household filers.
- $300,000 for joint filers.

Individuals over these income limits are only eligible to receive a rebate for the purchase of an FCEV not a BEV. The program is administered by the Center for Sustainable Energy for the CARB, which has been instructed to prioritize low income applicants until January 1, 2022. The CARB determines annual funding amounts for the CVRP, and it is expected that the program will continue through 2023 (*23*). In 2018, $130 million in rebates were approved for BEVs through this program (*24*).

The CVRP also provides incentives for public fleets; public agencies are eligible for 30 rebates annually for the purchase of zero emission and plug-in hybrid light-duty vehicles. Fleets that operate in disadvantaged communities are eligible for increased rebates. The rebate schedule for fleets is the same as for individuals (*52*).

Clean Vehicle Assistance Program

The Clean Vehicle Assistance Program provides grants for lower income buyers of either new or used clean vehicles. The grant is up to $5,000 for PHEVs or BEVs. BEV grants can also be used for a charging unit and its home installation. Table 46 shows the income qualification requirements.

Table 46. Clean Vehicle Assistance Program Qualifications

Number of People[59]	Maximum Annual Income[60]
1	$48,560
2	$65,840
3	$83,120
4	$100,400
5	$117,680
6	$134,960
7	$152,240
8	$169,520

Grants provided through the Clean Vehicle Assistance Program are paid directly to the dealership to lower the initial purchase cost of a vehicle (*26*). The program launched, in 2018, with a grant of $5 million, which has been depleted (*27*).

Driving Clean Pilot Program

The Driving Clean Pilot Program is a newer incentive developed as a joint effort between the ARB and the Community Housing Development Corporation. This program is offering buy-down grants and loans for certain disadvantaged communities across the state. It is available for residents living in eligible zip codes in the following counties: Alameda, Contra Costa, Santa Clara, Santa Cruz, Solano, and San Francisco. In order to qualify, individuals are required to have verifiable income up to 400 percent of the federal poverty level. The buy-down program offers grants of $5,000 for plug-in hybrid and zero-

[59] Head of household, plus spouse and dependents.
[60] Income calculation based on 400 percent of the Federal Poverty Level (2018).

emission vehicles. Loans are limited to a maximum of $15,000 and can be applied to both new and used vehicles. Loan participants must be able to provide a minimum down payment of $1,000 and provide proof of their ability to repay the loan. The program also provides financial education services when a loan is provided (*53*). Eligible vehicles include hybrid-electric vehicles, PHEVs, BEVs, and FCEVs; used vehicles must be eight years old or newer and have a combined fuel economy of a least 20 MPG of fuel or more, depending on the model year.

Residential EV Charging – Financing Program

PACE financing allows property owners to borrow funds to pay for energy improvements, including purchasing and installing EVSE. The borrower repays over a defined period of time through a special assessment on the property. Property owners must agree to a contractual assessment on the property tax bill, have a clean property title, and be current on property taxes and mortgages (*54*).

Advanced Transportation Tax Exclusion

The Sales and Use Tax Exclusion Program offers California manufacturers a tax exclusion on purchased products, components, or systems. The California Alternative Energy and Advanced Transportation Financing Authority supports the Sales and Use Tax Exclusion for manufacturers that promote alternative energy and advanced transportation. The program is currently authorized through 2020 and has a yearly cap of $100 million; the cap has been reached for the 2019 calendar year (*7*).

Enhanced Fleet Modernization Program

EFMP has two components: a statewide vehicle retirement program and a retire and replace program that operates in certain parts of the state.

The Consumer Assistance Program administered by the Bureau of Automotive Repair offers a $1,000 rebate for the retirement of a qualified vehicle. Consumers meeting low income eligibility requirements (225 percent of the federal poverty level) may receive up to $1,500. In addition, CAP provides qualified consumers with financial assistance up to $500 to help with emissions related repairs for vehicles that cannot pass their Smog Check inspection (*10*).

While the retirement program is available statewide, two air quality districts, San Joaquin Valley Air Pollution Control District and the South Coast Air Quality Management Districts, also operate a scrap and replace program that uses CARB funds. The programs provide funding for the purchase of a more fuel-efficient vehicle, retirement of the old vehicle, and money for mobility options, such as transit passes, in lieu of another vehicle. Participants in disadvantaged communities are also eligible for the Clean Cars for All Program that extends the EFMP to provide even greater incentives (*11*).

HOV Lane Exemption

California operated a decal program that provided HOV Lane exemption (allowing vehicles to operate within a HOV lane that did not meet the occupancy requirements) for both hybrid and zero-emission vehicles that was set to expire on January 1, 2019. The state decided to offer an extension to the program until 2022 but changed some of the decal requirements. The previous decals were white for inherently low emission vehicles such as BEVs and FCEVS, and green for transitional ZEVs and partial ZEVs, which included PHEVs. Individuals that have been issued a decal between January 1, 2017, and December 31, 2018, could apply for a new decal before the program expires (*55*). The current decals in operation are listed below:

- Red Decal—These were issued between 2017–2018 to replace a white or green decal. The eligible vehicle list can be found here: https://ww2.arb.ca.gov/eligible-carpool-sticker-list.
- Purple Decal—These are the current decals being issued for first-time applications in 2019.

The decal program was essentially reauthorized by AB544, which was signed into law in October 2017. This is considered a new program by the ARB and the decals will change color every year from now on. The decals expire on January 1st of the fourth year after the year they are issued, and the program is set to expire on September 30, 2025 (*56*).

Income eligibility requirements do apply for those wishing to take advantage of both the CVRP and the decal program. Table 47 details the requirements.

Table 47. Income Eligibility Requirements (56)

Gross Annual Income:	Battery or Plug-in Hybrid	Fuel Cell
At or Above: $150,000 for single filers $204,000 for head-of-household $300,000 for joint filers	Clean Air Vehicle decal **Only**	Clean Air Vehicle decal **OR** CVRP rebate (New owner has 60 days from date of purchase to choose between the two programs)
Under: $150,000 for single filers $204,000 for head-of-household $300,000 for joint filers	Clean Air Vehicle decal **AND** CVRP rebate	Clean Air Vehicle decal **AND** CVRP rebate

Registration Fee Increase

Beginning on July 1, 2020, California will assess an additional fee on BEVs with a model year 2020 or later at the time of registration or renewal. This road improvement fee is set at $100 per vehicle per year and will be indexed to the California Consumer Price Index starting on January 1, 2021 (*28*).

Other Incentives

The following incentives are available for projects, infrastructure, or the purchase of non-consumer grade EVs:

- The Motor Vehicle Registration Fee Program requires that proceeds be spent on projects that reduce pollution; this includes the purchase of AFVs and alternative fuel infrastructure (*57*).
- The California Energy Commission's Clean Transportation Program provides up to $100 million annually in funding for EV charging infrastructure, hydrogen fueling infrastructure, and other clean energy projects (*58*). The program will be available until January 1, 2024 (*59*).
- CARB operates the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project that provides vouchers to reduce the cost of qualified electric, hybrid, and natural gas trucks or buses for fleets (*60*). The program has provided 2,501 vouchers for zero-emission vehicles amounting to $243,327,552. The program began in 2009 (*61*).

- The California Electric Vehicle Infrastructure Project (CALeVIP), which is funded by the California Energy Commission, works with local partners to expand access to EVSE through charger incentive projects. CALeVIP has $39 million in funding currently with a potential for up to $200 million through the Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program (*62*).
- AFV Parking Incentive Program requires that the California Department of General Services and the California Department of Transportation develop an AFV parking incentive program. This program must include preferential spaces, reduced fees, and fueling infrastructure for AFV drivers (*63*).
- The Electric Program Investment Charge supports the development of new clean energy technologies, such as EVSE. The program is funded through a charge to utility customers and then 80 percent of the funds are administered by the CEC and the rest by three utility companies in the state (*64*).
- The California Pollution Control Financing Authority operates the California Capital Access Program Electric Vehicle Charging Station Financing Program. The program provides $2 million in incentives for small business owners and landlords to install EV charging stations (*65*).

Colorado

Charge Ahead Colorado

The Regional Air Quality Council (RAQC) and the Colorado Energy Office (CEO) have partnered to provide financial support for EVs and EV charging stations through the Charge Ahead Colorado program. Table 48 details eligibility requirements for the different funding.

Table 48. Charge Ahead Program Requirements

	RAQC	**CEO**
Funding	EV and Charging Stations – Level 2 and Level 3	Charging Stations – Level 2 and level 3
Area of Operations	Fleets and entities located in the seven county Denver Metro Area (Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson Counties).	Entities located in Colorado outside of the seven-county Denver Metro Area.
EV Funding Available	RAQC will fund 80% of the incremental cost differential between an EV and the comparable gasoline vehicle up to $8,260. This funding is only available for leased vehicles.	CEO is not funding EVs.
Charging Station Funding Available	RAQC and CEO will fund 80% of the cost of a charging station up to the following set maximums: • Level 2, Dual Port Station: $9,000. • Level 3, Multiple Connection Standard Station: $30,000.	
Funding Priority	Priority is directed to those organizations that are excluded from existing state tax credits and incentives. For both charging stations and EV funding, eligible applications include local governments, school districts, state agencies, and non-profit agencies. Apartment/condominium complexes and businesses that own multivehicle parking facilities for fleet, public, or guest/visitor are also eligible for charging station funding.	Funding is directed to private non-profit or for-profit corporations, state agencies, federal agencies, public universities, and public transit agencies, in addition to local governments, landlords of multifamily apartment buildings and homeowner associations (as defined more specifically in C.R.S. Article 33.3 of title 38).

Table adapted from Clean Air Fleets (66).

The RAQC funding is specifically designated for the Denver Regional Council of Governments planning area and is provided through federal funding from the Congestion Mitigation/Air Quality (CMAQ) program. The CEO funding was approved by the state legislature in 2009 and funds local governments, state agencies, public universities, public transit agencies, private non-profit or for-profit corporations, landlords of multifamily apartment buildings, and homeowner associations to install EV charging stations (*66*).

AFV and EV Tax Credit

Colorado residents are eligible for up to a $5,000 tax credit for purchase, lease and conversion of light, medium, and heavy duty alternative fueled vehicles, such as EV, PHEV, compressed natural gas, liquefied natural gas, or hydrogen vehicles. In 2017, the program stopped providing credits for used vehicles (*29*). The program is currently phasing out, but there is no definitive end date set as of June 2019. Table 49 details the phase out process for PHEVs and EVs (*3*).

Table 49. Plug-In Electric Vehicle Tax Credit Amounts (3)

Category	2017–2019	2020	2021
Light-duty EV or PHEV	$5,000 for purchase or conversion; $2,500 for lease	$4,000 for purchase or conversion; $2,000 for lease	$2,500 for purchase or conversion; $1,500 for lease
Light-duty electric truck	$7,000 for purchase or conversion; $3,500 for lease	$5,500 for purchase or conversion; $2,750 for lease	$3,500 for purchase or conversion; $1,750 for lease
Medium-duty electric truck	$10,000 for purchase or conversion; $5,000 for lease	$8,000 for purchase or conversion; $4,000 for lease	$5,000 for purchase or conversion; $2,500 for lease
Heavy-duty electric truck	$20,000 for purchase or conversion; $10,000 for lease	$16,000 for purchase or conversion; $8,000 for lease	$10,000 for purchase or conversion; $5,000 for lease

Low Emission Vehicle Sales Tax Exemption

The sales and use tax exemptions applies to vehicles, vehicle power sources, or parts used for converting a vehicle power source to reduce emissions. Vehicles included in the exemption must comply for the federal low emission vehicle (LEV) standard and have a GVWR of over 26,000 lb (*67*). The exemption also applies if the GVWR is over 10,000 lb and the vehicle, power source, or parts used for converting the power source meets the following definitions:

- Original equipment manufacturer electric truck and plug-in hybrid electric truck.
- Conversion of a truck to an electric truck or a plug-in hybrid electric truck (*8*).

HOV Lane Exemption

The Colorado Department of Transportation (CDOT) allows qualified LEVs and hybrid electric vehicles to travel in HOV and HOT lanes while not meeting the occupancy requirements. The program is limited to 2000 permits due to federal law that requires speed not be degraded by allowing single occupancy vehicles into HOV and HOT lanes. CDOT reached the quota for permits and all new applicants are placed on a wait list (as of August 2019) (*68*).

EV Emissions Inspection Exemption

EVs are exempt from the statewide emissions inspection requirement; however, vehicles that are less than 7 years old are also exempt from these inspections (*69*).

Registration Fee Increase

Colorado assesses a $50 fee annually on vehicles classified as a plug-in electric motor vehicle; this includes both BEVs and PHEVs (*30*).

Other Incentives

The following incentives are available for projects, infrastructure, or the purchase of non-consumer grade EVs:

- ALT Fuels Colorado is a program by RAQC to incentivize the replacement and scrappage of pre-2009 fleet vehicles with fully electric or renewable natural gas (RNG) alternatives. The incentive is available to public, private, and non-profit fleets within the state. The program began in 2014

using CMAQ funding, which is no longer available (*70*). In 2018, additional funding was allocated from the VW settlement; there is a total of $21.5 million available for the program, through the settlement allocation, and $5 million has been expended as of July 2019 (*70*).

Table 50. Colorado Vehicle Electrification Program Costs (70)

Program	Total Amount Expended	Amount Expended on BEVs	FY2018 Amount Expended (BEVs)
ALT Fuels Colorado	$4,910,468	$418,000	$418,000

Connecticut

CHEAPR

The CHEAPR programs offers rebates up to $5,000 for the purchase of an EV, FCEV, or PHEV. Rebates are offered based on battery range.

Table 51. Incentive Structure (31)

Incentive Amount	EPA Rated Electric Range
$5,000	Any fuel cell EV
$2,000	BEV: 200 Miles or Greater
$1,500	BEV: 120–199 Miles
$1,000	PHEV: 45 Miles or Greater
$500	BEV: Less 120 Miles PHEV: Less than 45 Miles

Rebates are offered on a first come, first served basis until the funding has been depleted. The remaining available funds, as of August 2019, are $267,500; funds considered issued and reserved total $10,028,500. Fifty-eight percent of issued funding went to PHEVs with the remaining 42 percent issued to BEV owners (*31*).

Registration Fee Reduction

EVs pay a reduced vehicle registration fee of $38, as opposed to $80 for an ICE vehicle.

EV Emissions Inspection Exemption

EVs are exempt from the emissions inspection requirement (*71*).

Florida

HOV Lane Exemption

Florida allows qualified Inherently Low Emission Vehicles and hybrid electric vehicles to travel in HOV and HOT lanes, at any time, while not meeting the occupancy requirements. Vehicles must display certification of their status in accordance with federal regulations. The Florida Division of Motor Vehicles supplies decals, which can be renewed annually. A separate decal is required for the HOT lanes, which is provided by the South Florida Commuter Services for use on the I-95 Miami Express lanes (*72*).

EV Supply Equipment Financing

Florida law allows local governments to provide funding for property owners within their jurisdiction to finance EVSE installation on their property (*73*).

Illinois

Registration Fee Reduction

EVs pay a $35 registration fee every two years, as opposed to the $101 yearly charge for ICE passenger vehicles (*32*). State statute prohibits the fee from exceeding $18 per year (*33*).

> Definition (625 ILCS 5/12-805): "The owner of a motor vehicle of the first division or a motor vehicle of the second division weighing 8,000 pounds or less propelled by an electric engine and not utilizing motor fuel, may register such vehicle for a fee not to exceed $35 for a 2-year registration period. The Secretary may, in his discretion, prescribe that electric vehicle registration plates be issued for an indefinite term, such term to correspond to the term of registration plates issued generally, as provided in Section 3-414.1 (625 ILCS 5/3-414.1). In no event may the registration fee for electric vehicles exceed $18 per registration year. Electric vehicle license plates are prorated and have a registration period that begins January 1st of even-numbered years and ends December 31st of odd-numbered years."

EV Emissions Inspection Exemption

Vehicles powered by electricity are exempt from emissions inspection testing (*74*).

Other Incentives

The following incentives are available for projects, infrastructure, or the purchase of non-consumer grade EVs:

- Fleet User Fee Exemption – Fleet owners in certain areas of the state are required to pay a $20 per vehicle fee; EVs are exempt from this fee (*75*).
- Illinois law set up a trust, the Illinois Science and Energy Innovation Trust that will provide financial and technical support to public and private entities for technologies and methods that improve and modernize the state's electric grid. This includes PEVs and devices that can improve energy storage or contribute to peak-shaving technologies (*76*).
- The Driving a Cleaner Illinois program provides funding for the replacement of existing government-owned diesel public transit buses with new diesel, alternative fuel, and all-electric transit buses. Funding can also be used for all-electric school bus pilot projects. The program was established by the Illinois Environmental Protection Agency using funds from the Volkswagen Environmental Mitigation Trust (*77*).

Maryland

EVSE Rebate Program

Rebates available for individuals, businesses, or state or local government entity to go toward the cost of acquiring and installing qualified EVSE. The program is authorized from July 1, 2017, to June 30, 2020, and can cover up to 40 percent of the costs, up the maximum amounts shown in Table 52.

Table 52. Maximum Rebate Amounts (78)

Qualified Entity	Amount
Individual	$700
Business or State or Local Government	$4,000
Retail Service Station Dealer	$5,000

Funding for each fiscal year is limited to $1,200,000; applications have already exceeded program funding for fiscal year 2019 (as of February 2019). Additional applications will be placed on a waitlist. The waitlisted applications will be processed when new funding becomes available in the fiscal year 2020, starting 7/1/2019 (*78*).

Alternative Fuel Infrastructure Grants

Alternative fuel infrastructure grants are provided by the Maryland Energy Administration and referred to as the Maryland Alternative Fuel Infrastructure Program. The program provides grants to plan, install, and operate public access alternative fueling and charging infrastructure. Certain private access entities can also receive grant funding (natural gas and propone fueling stations). Grants are capped at 50 percent of project costs; applicant cost share must be 50 percent.

Table 53. Maryland Alternative Fuel Grant Award Amounts (79)

Station Type	Maximum Grant Award per Station
DC Fast Charger	$55,000
Ethanol	$35,000
Hydrogen	$300,000
Natural Gas	$500,000
Propane	$100,000

Applications are accepted from July 1 through December 31 each year (*79*).

EV Tax Credit

Maryland offers an EV tax credit of up to $3,000 tax on the purchase of a new EV, which does not exceed $60,000; this is applied to the excise tax on the vehicle. Additional criteria include:

- Be propelled to a significant extent by an electric motor that draws electricity from a battery with a capacity of at least 5 kWh.
- Have not been modified from original manufacturer specifications.
- Be purchased on or after July 1, 2017.

The credit is calculated based on $100 per kWh of battery capacity. Vehicles with over 30 kWh of battery capacity will only qualify for the maximum $3,000 credit. Vehicles must be new and being titled for the first time; vehicles purchased between July 1, 2017, and July 1, 2020, are eligible. There is $3,000,000 allocated for each fiscal year, and the funding has been depleted, as of June 2019, for the current fiscal year. Additional funding becomes available on July 1, 2019, as the state enters fiscal year 2020 (*4*). The allocation was increased to $6,000,000 for the fiscal year starting on July 1, 2019 (*34*).

Plug-in Electric Vehicle HOV Lane Exemption

Maryland offers an exemption from the HOV lane occupancy requirements with the use of a permit; the state does not currently charge for the permit, and the authorizing legislation limits the amount the Motor Vehicle Administration is allowed to charge to $20. Certain requirements apply:

- Vehicles must be able to reach a speed of 65 mph.
- Is rated at not more than 8,500 lb unloaded gross vehicle weight.
- Is propelled to a significant extent by an electric motor that draws electricity from a battery that has a capacity of not less than 4 kWh for 4-wheeled vehicles and not less than 2.5 kWh for 2 or 3-wheeled motor vehicles.
- The vehicle is capable of being recharged from an external source of electricity.
- Hybrid electric vehicles can use the HOV lane on the portion of Route 50 ONLY.

The permits are provided by the Maryland DOT's Motor Vehicle Administration; the permit for hybrid electric vehicles expired on September 30, 2019, and only 2000 such permits will be issued. The permits for EVs will expire on September 30, 2022 (*80*).

Other Incentives

The following incentives are available for projects, infrastructure, or the purchase of non-consumer grade EVs:

- The Maryland Freedom Fleet Voucher Program provides voucher for the purchase of new AFV fleets or the conversion of current fleets to alternative fuels. The vouchers are available for commercial, non-profit, and public entities. The program ended on June 1, 2019, with a fixed budget of $1,500,000 (*81*).
- House Bill 1255 passed in 2019 requiring the Maryland Department of the Environment to administer a Zero Emission School Bus Transition Grant Program. The program will provide grants for zero emission school buses and charging infrastructure. As of May 2019, the program has not been funded (*82*).

Massachusetts

MOR-EV Program

MOR-EV is run by the Massachusetts Department of Energy Resources and offers rebates of up to $2,500 for customers purchasing or leasing a PEV or zero emission motorcycle through the end of 2018. Starting January 1, 2019, the maximum rebate drops to $1,500 toward the purchase or lease of eligible BEVs and FCEVs and to $450 for zero emission motorcycles. Applications must be submitted within three months of the purchase or lease date. In addition, applicants are required to retain ownership of the vehicle for at least 36 months. The program ended September 30, 2019; applications for vehicles purchased before that date will be accepted until December 31, 2019 (*35*).

Massachusetts Electric Vehicle Incentive Program

MassEVIP provides grants for up to 80 percent of the cost of Level 2 EVSE acquisition and installation (for a maximum possible grant of $50,000) for eligible non-residential entities. The application period has ended for the Public Access Charging grants (*83*). Funding is also available for multi-unit residential dwellings, and the program will provide grants for up to 60 percent of the cost of level 1 or level 2 EVSE (maximum possible grant of $50,000). Non-residential entity recipients must make their chargers available to the public 12 hours per day (*84*). MassEVIP also provides the same level of funding for workplace EVSE for public, private, and non-profit entities that have 15 or more employees on site (*85*).

In addition to the EVSE grants, grants are available for public fleets, which cover up to $7,500 of the cost of purchase of a BEV and up to $5,000 for the lease of a BEV (*86*). These incentives are available to local governments, public universities and colleges, and state agencies. The program is partially funded by Volkswagen Environmental Mitigation Fund (*83*).

EV Emissions Inspection Exemption

Vehicles powered exclusively by electricity are exempt from the emissions testing requirement (*87*).

Other Incentives

The following incentives are available for projects, infrastructure, or the purchase of non-consumer grade EVs:

- The Massachusetts Department of Environmental Protection administers the Volkswagen Open Solicitation Grant Program, which provides incentives to eligible entities for new diesel or alternative fuel replacement vehicles. The program is funded through the Volkswagen Environmental Mitigation Trust. Applications are no longer being accepted at this time (*88*).
- The Department of Energy Resources administers the Clean Vehicle Project that aims to replace more than 200 public and private vehicles powered by gasoline and diesel with an AFV. The project will also provide funding for EVSE and natural gas infrastructure. Funding will cover the differential cost for the various clean fuels and will use CMAQ funds (*89*).

New Jersey

EVSE Grants

The New Jersey Department of Environmental Protection (NJDEP) provides grants for the purchase of EVSE and to support EV adoption though the It Pay$ to Plug In: New Jersey's Electric Vehicle Workplace Charging Grant Program (*90*). The grants are offered as reimbursements on a first come, first served basis for the cost and installation of eligible EVSE at the following locations:

- Workplaces.
- Government and educational facilities.
- Non-profits.
- Parking facilities.
- Multi-unit dwellings.

NJDEP will reimburse the applicant for a percentage of the eligible costs up to the following amounts:

- Up to $750 for Level 1 EVSE.
- Up to $5,000 for single-port Level 2 EVSE.
- Up to $6,000 for dual port Level 2 EVSE.

Table 54 details the percentage of costs that will be covered:

Table 54. Percentage of EVSE Costs to be Covered by NJDEP (90)

Location	Charging Station on Government-Owned Property	Charging Station on Non-Government-Owned Property
Public place	100% up to maximum	80% up to maximum
Workplace	60% up to maximum	60% up to maximum
Multi-unit dwelling	60% up to maximum	60% up to maximum

ZEV Tax Exemption

New and used ZEVs are exempt from sales and use tax at the time of sale. The exemption applies to ZEVs sold, rented, or leased in the state of New Jersey. The exemption does not apply to partial ZEVs, such as hybrids (*9*).

HOV Lane Exemption

The New Jersey Turnpike Authority allows qualified vehicles, both hybrid electric and plug-in electric, to travel in the HOV lanes between Interchange 11 and Interchange 14 on the New Jersey Turnpike (*91*).

Plug-in Electric Vehicle Toll Discount Program

The New Jersey Turnpike Authority operates a Green Pass Discount Plan that provides a 10 percent discount on off-peak New Jersey Turnpike and Garden State Parkway toll rates for drivers of vehicles that have a fuel economy of 45 MPG or higher or that meet the California Super Ultra Low Emission Vehicle standard. Vehicles must register with EZ-Pass to gain the discount (*92*).

New York

Plug-In Electric Vehicle Rebate Program

NYSERDA provides rebates of up to $2,000 for the purchase or lease of an eligible EV. The vehicle must comply with the following requirements:

- Be a four-wheeled motor vehicle manufactured for use on public streets, roads, and highways.
- Have a gross vehicle weight rating of not more than 8,500 lb.
- Have a maximum speed of at least 55 mph.
- Be propelled at least in part by an electric motor and associated power electronics that draws electricity from a hydrogen fuel cell or from a battery that has a battery capacity of at least 4 kWh, and is capable of being charged from an external source of electricity (*36*).

Vehicles with a MSRP of over $60,000 are eligible for a $500 rebate only (*37*).

EVSE Rebate Program

NYSERDA provides rebates for public and private entities to lower the cost of purchase and installation of Level 2 EVSE at public parking facilities, workplaces, and multi-unit dwellings through their Charge Ready NY Program. The maximum rebate is $4,000 per port, which can equate to a 30 to 80 percent saving depending on station and installation costs (*93*).

Alternative Fueling Infrastructure Tax Credit

The alternative fueling infrastructure tax credit is available to individuals or businesses who have made investments in alternative fuel infrastructure, such as EV infrastructure, on or after the 2013 tax year. The credit is available for each installation of property and is the lesser of $5,000 or 50 percent of the

cost of the property after any cost that is covered by other grants or funding. The property must be placed in New York State, be used 50 percent or more during the tax year for a trade or business carried out in the state, or constitute alternative fueling property, which has not been paid for through a grant proceed from before January 1. 2015. The credit will expire on December 31, 2022 (*5*).

HOV Lane Exemption

The Clean Pass Program allows eligible plug-in electric and hybrid electric vehicles to use the Long Island Expressway HOV lanes, regardless of the number of occupants in the vehicle. A sticker must be displayed and is provided by the New York State Department of Motor Vehicles (*94*).

Plug-in Electric Vehicle Toll Discount Program

The New York Thruway Authority operates the Green Pass Discount Plan (in addition to and in coordination with New Jersey and the Port Authority of New York and New Jersey). The plan provides a 10 percent discount to qualifying vehicles that register through their E-Z Pass account (*95*).

EV Emissions Inspection Exemption

Vehicles powered exclusively by electricity are exempt from the emissions inspection test (*96*).

Other Incentives

The following incentives are available for projects, infrastructure, or the purchase of non-consumer grade EVs:

- NYSERDA provides incentives for the purchase of alternative fuel trucks, buses, and diesel emission controls. Vouchers are available in the statewide nonattainment or maintenance area for public, private, and non-profit fleets for the purchase of electric trucks or buses. Private and non-profit fleets operating in New York City can apply for vouchers for other AFVs. The program had allocated all its funding in June 2018 after providing almost $16 million through the voucher program (*97*).
- The Port Authority of New York and New Jersey operates a Clean Truck Replacement Program that provides funding for the replacement of older port drayage trucks. The replacement trucks are required to be cleaner but not necessarily electric (*98*).
- The Public Transit Technology and Innovation Program provides funding for the development and demonstration of technologies and strategies to reduce greenhouse gas emissions (*99*).
- The NY State Department of Environmental Conservation has several grant funding opportunities for municipalities in terms of electric vehicles. The Climate Smart Communities Grant Program began in 2016 and offers 50/50 matching grants to cities, towns, villages, and counties in the state as well as boroughs of New York City for climate adaptation and mitigation projects. This can include transportation related projects. In addition, the Municipal ZEV Clean Vehicle Rebate Program offers rebates for the purchase or lease of new clean vehicles for fleet use. Rebates of $5,000 are available for vehicles with an electric range of 50 miles or greater. Round three of the Clean Vehicle Rebate program is now closed, which had a total of $300,000 available. Round three of the Infrastructure Rebate Program will open in the future (*100*). There was $300,000 available for clean vehicles and $2,000,000 will be available for EV infrastructure in the future for a total of $2,300,000 (*101*).
- The Charge to Work NY programs offers funding for businesses in the metropolitan area to incentivize their workers to replace gasoline vehicles with EVs and provide charging equipment for their employees. Rebates of $8000 per EV workplace charging station and $500 per EV

purchase or lease are available (*102*). The program will provide 66 rebates for charging stations and 450 for EV purchase or lease.

North Carolina

HOV Lane Exemption

Qualified EVs and FCEVs are allowed to use the North Carolina HOV Lanes regardless of the number of occupants in the vehicle. The exemption expires September 30, 2025 (*103*).

EV Emissions Inspection Exemption

Qualified vehicles are exempt from state emissions inspections. The following requirements apply:

- Is made by a manufacturer primarily for use on public streets, roads, and highways and meets National Highway Traffic Safety Administration standards included in 49 C.F.R. § 571.
- Has not been modified from original manufacturer specifications with regard to power train or any manner of powering the vehicle.
- Is rated at not more than 8,500 lb unloaded gross vehicle weight.
- Has a maximum speed capability of at least 65 mph.
- Draws electricity from a battery that has all the following characteristics:
    - A capacity of not less than four kWh.
    - Capable of being recharged from an external source of electricity.

The vehicle must also have four wheels (*104*).

Registration Fee Increase

North Carolina first instituted an increased registration fee for EVs in 2013; it was set at $100 annually due at the time of registration or renewal (*38*). In 2015, the fee was increased to $130 (*39*).

Other Incentives

The following incentives are available for projects, infrastructure, or the purchase of non-consumer grade EVs:

- The North Carolina Department of Environmental Quality (DEQ) administers a program using their Volkswagen settlement funds. $3.45 million is available in Phase 1 for DC Fast Charge infrastructure. Priority is given to certain corridors in the state. Nonprofits, public agencies and school districts, planning organizations, air quality and transportation organizations, and businesses are eligible. Applications closed for Phase 1 on September 30, 2019 (*105*).
- DEQ is administering a Diesel Bus and Vehicle program using the Volkswagen settlement funds to reduce diesel emissions. $24.5 million of a total $30.7 million is available in Phase 1 for bus and heavy-duty vehicle replacements (*106*).
- The Clean Fuel Advanced Technology Project provides funding for projects that aim to reduce transportation-related emissions in 24 eligible North Carolina counties. The program uses CMAQ funding. Available funds total $2,350,000 with a maximum project award of $400,000. The program will run from June 14, 2019–January 30, 2022 (*107*).
- North Carolina law exempts the retail sale, use, storage, and consumption of alternative fuels from the state retail sales and use tax (*108*).

Ohio

Alternative Fueling Infrastructure Incentive

The Ohio Development Services Agency offers financial assistance to businesses, non-profits, school districts, and local governments to purchase and install alternative fueling, blending, and distribution facilities or terminals. Loan amounts range from $250,000 to $750,000 and cannot exceed 75 percent of the project costs. As of November 2018, the program is not accepting new applications (*109*).

AFV Emissions Inspection Exemption

Vehicles powered exclusively by electricity are exempt for emissions inspection testing after receiving a one-time verification inspection (*110*).

Other Incentives

The following incentives are available for projects, infrastructure, or the purchase of non-consumer grade EVs:

- The Ohio Environmental Protection Agency (EPA) operates several transportation related grant programs; one of these programs offer incentives related to electrification. The Diesel Emissions Reduction Grant provides funding for diesel emission reduction through CMAQ funds (*111*).
    - In 2018, the Ohio EPA awarded $8,077,742 to replace 26 diesel transit buses. Nine of those 26 were electric buses for a total EV investment of $2,215,120 in 2018 (*112*).
- The Ohio EPA provides funds through their portion of the VW settlement for medium and heavy diesel fleets in 26 Ohio priority counties to replace diesel vehicles with cleaner alternatives including all-electric vehicles and equipment. All projects require a minimum match of 25 percent with larger matches required for certain projects. The program operates in yearly cycles with the next round opening on June 1, 2020.
    - There is a total of $15 million available for grant awards between $50,000 and $2 million (*113*).

Oregon

Plug-In Electric Vehicle Rebate Program

The rebate program is open to individuals, businesses, government agencies, and non-profits. The Oregon Clean Vehicle Rebate Program offers a cash rebate for purchases or leases of eligible EVs, including PHEVs and BEVs, through two programs; the standard rebate based on battery capacity and the Charge Ahead rebate based on income level (*40*). New PHEVs and BEVs with a battery capacity less than 10 kWh are eligible for a rebate of $1,500 and those with a battery capacity greater than 10 kWh are eligible for a rebate of $2,500 (*41*). Oregon residents that meet the low-income threshold are eligible for the Charge Ahead program that offers rebates of $2,500, which can be used toward the purchase of a new or used BEV only. The vehicle must be registered and remain with the individual for at least 24 months for both programs (*42*). Some applicants may be eligible for both programs (*41*). As of 2019, this program is authorized to distribute $10.8 million per year in rebates (*43*). The program is currently set to end in 2023 (*44*).

Registration Fee Increase

Beginning on January 1, 2020, Oregon will assess an additional fee on EVs at the time of registration or renewal. This fee is set at $110 per vehicle for 2020–2021 (*45*). However, EV owners can opt into OReGO,[61] the road usage charge system, and waive the increased registration fee (*46*).

Other Incentives

The following incentives are available for projects, infrastructure, or the purchase of non-consumer grade EVs:

- Oregon law exempts original equipment manufacturer natural gas vehicle and all-electric vehicles from installing a certified pollution control system (*114*).
- Oregon law is requiring the Oregon Department of Environmental Quality to use funds from the Volkswagen Environmental Mitigation Trust to provide funding for Clean School Bus Grants. The grants are intended to reduce diesel emissions (*115*).
- The Oregon Department of Energy offers loans through the State Energy Loan Program (SELP) for qualified projects, such as fuel production facilities, dedicated feedstock production, fueling infrastructure, and fleet vehicles. There is a loan application fee, and SELP is not currently accepting new applications as of April 2018. They have provided more than $600 million in funding through the program (*116*).

Pennsylvania

Alternative Fuel Vehicle Rebate

The Pennsylvania Department of Environmental Protection (DEP) administers the rebate program for AFVs. Current program requirements and guidelines are valid until December 31, 2019, and then the program will be reassessed. The rebate is available for the purchase or lease of a new AFV or the purchase of a leased AFV. New AFVs must have a final purchase price of less than $50,000 to qualify; hydrogen or fuel cell vehicles must have a final purchase price of less than $75,000. Used AFVs must have less than 75,000 miles with a market value of less than $50,000 and only one previous owner to qualify; the purchase must be made at a registered dealer.

The rebate amount for BEVs is set at $1,500. Low income households, household federal taxable income of below 200 percent of the federal poverty level, are eligible for an additional $1,000 rebate (*48*).

EVSE and Hydrogen Fuel Cell Infrastructure Grants

The DEP provides grants for acquisition, installation, operation, and maintenance of EVSE and hydrogen fuel cell infrastructure. The EV Fast chargers must be installed in community charging hubs, transportation corridors, and destination locations. $10 million is being allocated over 5 years for this competitive grant program. The Volkswagen Mitigation Settlement is funding the program (*117*).

[61] OReGO is a road usage charge program where individuals pay 1.7 cents per mile in lieu of paying state gas taxes. Individuals receive a tax credit for money spent on state gas taxes.

Other Incentives

The following incentives are available for projects, infrastructure, or the purchase of non-consumer grade EVs:

- Heavy duty truck and transit bus grants are available for vehicles with model years between 1992–2009 to repower or replace with new diesel, electric, or alternative fuels. $16 million is being allocated to fund the five-year program; the state is using the VW Settlement to fund this initiative (*117*).
- The Alternative Fuels Incentive Grant Program administers several programs, including the FAST Act Corridor Infrastructure Grant program and the Alternative Fuels Incentive Grant. The Alternative Fuels Incentive Grant provides approximately $5 million per year in grants for school districts, municipal authorities, political subdivisions, nonprofit entities, corporation, and limited liability companies or partnerships to support the use of alternative fuels, AFVs, and alternative fuel infrastructure. The FAST Act Corridor Infrastructure Grant has approximately $1 million in grant funding for public-use electric, hydrogen, propane, and compressed natural gas refueling infrastructure along highway corridors in the state. Individual project awards are capped at $500,000 and up to 50 percent reimbursement is provided toward project costs (*118*).
- The DEP offers rebates for the acquisition, installation, operation, and maintenance of Level 2 EVSE. These rebates are available for public uses at both government and non-government owned property, and non-public uses at work places and multi-unit dwellings (*117*).

References

1. U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. 2019. Federal Tax Credits for All-Electric and Plug-In Hybrid Vehicles. https://www.fueleconomy.gov/feg/taxevb.shtml (Accessed on June 3, 2019).
2. Pepco. 2019. Nissan Leaf Rebate Flyer 2019. https://www.pepco.com/SmartEnergy/InnovationTechnology/Documents/FY19%20Q1%20LEAF%20Fleetail%20Pepco.pdf (Accessed on June 3, 2019).
3. U.S. Department of Energy, Energy Efficiency & Renewable Energy. 2019. Plug-In Electric Vehicle (PEV) Tax Credit. *Alternative Fuels Data Center.* https://afdc.energy.gov/laws/11702 (Accessed on June 4, 2019).
4. Maryland Department of Transportation, Motor Vehicle Administration. 2019. Titling – Excise Credit for Plug-In Electric Vehicles. http://www.mva.maryland.gov/about-mva/info/27300/27300-71T.htm (Accessed on June 4, 2019).
5. New York Department of Taxation and Finance. 2019. Alternative Fuels and Electric Vehicle Recharging Property Credit (For Tax Years Beginning on or After January 2013). https://www.tax.ny.gov/pit/credits/alt_fuels_elec_vehicles.htm (Accessed June 4, 2019).
6. Ariz. Rev. Stat. §42-5159 (2019).
7. California Alternative Energy and Advanced Transportation Financing Authority. 2019. Sales and Use Tax Exclusion (STE) Program. https://www.treasurer.ca.gov/caeatfa/ste/index.asp (Accessed on June 4, 2019).
8. Colorado Revised Statutes. 2018. §39-22-516.8.
9. New Jersey Department of the Treasury, Division of Taxation. 2017. Sales Tax Exemption – Zero Emission Vehicles (ZEV) (N.J.S.A. 54:32B-8.55). https://www.state.nj.us/treasury/taxation/zevnotice.shtml (Accessed on June 4, 2019).
10. California Bureau of Automotive Repair. 2019. Consumer Assistance Program – Vehicle Retirement. https://www.bar.ca.gov/Consumer/Consumer_Assistance_Program/CAP_Vehicle_Retirement_Program.html (Accessed on June 3, 2019).
11. California Air Resources Board. 2019. Enhanced Fleet Modernization Program. https://ww2.arb.ca.gov/our-work/programs/enhanced-fleet-modernization-program/about (Accessed on August 29, 2019).
12. Hartman, K. and K. Pula. 2019. New Fees on Hybrid and Electric Vehicles. *National Conference of State Legislatures.* http://www.ncsl.org/research/energy/new-fees-on-hybrid-and-electric-vehicles.aspx (Accessed on June 3, 2019).

13. American Petroleum Institute. 2019. *State Motor Fuel Taxes*. https://www.api.org/oil-and-natural-gas/consumer-information/motor-fuel-taxes/gasoline-tax (Accessed on August 29, 2019).

14. Nicholas, M. A., Tal, G., and T. S. Turrentine. 2017. Institute of Transportation Studies. *Advanced Plug-in Electric Vehicle Travel and Charging Behavior Interim Report*. https://phev.ucdavis.edu/wp-content/uploads/2017/08/25.-Advanced-Plug-in-Electric-Vehicle-Travel-and-Charging-Behavior-Interim-Report-.pdf (Accessed on August 29, 2019).

15. United States Environmental Protection Agency. 2018. *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emission, and Technology since 1975.* https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100W3WO.pdf (Accessed on August 29, 2019).

16. Hyundai. 2018. Hyundai Ioniq. https://web.archive.org/web/20181109193751/https://www.hyundaiusa.com/ioniq-electric/index.aspx (Accessed on August 29, 2019).

17. Honda. 2019. Honda Clarity Electric. https://automobiles.honda.com/clarity-electric (Accessed on August 28, 2019).

18. Fiat. 2019. Fiat 500e https://www.fiatusa.com/500e.html (Accessed on August 28, 2019).

19. INSIDEEVs. 2019. Monthly Plug-In EV Sales Scorecard: Historical Charts. https://insideevs.com/news/344007/monthly-plug-in-ev-sales-scorecard-historical-charts/ (Accessed on August 29, 2019).

20. IHSMarkit. 2019. Average Age of Cars and Light Trucks in U.S. Rises Again in 2019 to 11.8 Years, IHS Markit Says. https://news.ihsmarkit.com/press-release/automotive/average-age-cars-and-light-trucks-us-rises-again-2019-118-years-ihs-markit- (Accessed on October 28, 2019).

21. Federal Highway Administration. 2019. Highway Statistics 2017. https://www.fhwa.dot.gov/policyinformation/statistics/2017/vm1.cfm (Accessed on August 29, 2019).

22. Arizona S.B. 1332 (2019).

23. Center for Sustainable Energy. 2019. California Clean Vehicle Rebate Project. https://cleanvehiclerebate.org/eng (Accessed on June 3, 2019).

24. Center for Sustainable Energy. 2019. California Clean Vehicle Rebate Project: CVRP Rebate Statistics. https://cleanvehiclerebate.org/eng/rebate-statistics (Accessed on June 3, 2019).

25. California Clean Vehicle Rebate Project. 2019. *How often do CVRP program requirements change?* https://cleanvehiclerebate.org/eng/faqs/how-often-do-cvrp-program-requirements-change-0 (Accessed on December 13, 2019).

26. Clean Vehicle Assistance Program. 2019. https://cleanvehiclegrants.org/ (Accessed on June 3, 2019).

27. California Air Resources Board. 2019. *EFMP Scrap and Replace and CC4A Summary Report*. https://ww2.arb.ca.gov/efmp-scrap-and-replace-and-cc4a-summary-report (Accessed on July 29, 2019)

28. Cal. Vehicle Code § 9250.6 (2019)

29. Colorado Energy Office. 2019. Alt Fuels Vehicles Tax Credits. https://www.colorado.gov/pacific/energyoffice/alt-fuel-vehicle-tax-credits. (Accessed on June 4, 2019).

30. Colo. Rev. Stat. §42-3-304(25)(a)

31. Connecticut Department of Energy & Environmental Protection. 2019. CHEAPR: Home. *EVConnecticut: The Path to a Clean Vehicle Future.* https://www.ct.gov/deep/cwp/view.asp?a=2684&q=561424&deepNav_GID=2183 (Accessed on August 6, 2019).

32. Office of the Illinois Secretary of State. 2019. Electric Vehicle: License Plates Guide. https://www.cyberdriveillinois.com/departments/vehicles/license_plate_guide/electric_vehicle.html (Accessed June 4, 2019).

33. Illinois Compiled Statutes. 625 5/12-805.

34. Maryland State Legislature. 2019. House Bill 1246. http://mgaleg.maryland.gov/webmga/frmMain.aspx?id=hb1246&stab=01&pid=billpage&tab=subject3&ys=2019RS (Accessed on September 11, 2019).

35. Massachusetts Offers Rebates for Electric Vehicles. 2019. https://mor-ev.org/ (Accessed on June 4, 2019).

36. New York State Energy Research and Development Authority. 2019. How the Drive Clean Rebate Works. https://www.nyserda.ny.gov/All-Programs/Programs/Drive-Clean-Rebate/How-it-Works (Accessed on June 4, 2019).

37. New York State Energy Research and Development Authority. 2019. Consumer FAQ. https://www.nyserda.ny.gov/All-Programs/Programs/Drive-Clean-Rebate/How-it-Works/Consumer-FAQ (Accessed on September 11, 2019).

38. N.C. Gen. Stat. §20-87(13)

39. North Carolina H.B. 97 (2015)

40. Oregon Department of Environmental Quality. 2019. How the EV Rebate Program works. https://www.oregon.gov/deq/aq/programs/Pages/Applying-for-EV-Rebate.aspx (Accessed on June 5, 2019).

41. Oregon Department of Environmental Quality. 2019. Comparing the Standard and Charge Ahead Rebates. https://www.oregon.gov/deq/aq/programs/Pages/EV-Rebates.aspx (Accessed on June 5, 2019).

42. Oregon Department of Environmental Quality. 2019. Requirements for Charge Ahead Applicants. https://www.oregon.gov/deq/aq/programs/Pages/Charge-Ahead-Rebate.aspx (Accessed June 5, 2019).

43. Oregon Department of Environmental Quality. 2019. About Electric Vehicle Rebate Program. https://www.oregon.gov/deq/aq/programs/Pages/About-EV-Rebate.aspx (Accessed July 30, 2019)

44. Oregon Department of Environmental Quality. 2019. Oregon Clean Vehicle Rebate Program: Frequently Asked Questions. https://www.oregon.gov/deq/FilterDocs/zev-faq.pdf (Accessed on July 31, 2019).

45. H.B. 17, 80th Oregon Legislative Assembly, 2019 Reg. Sess. (Ore. 2019)

46. H.B. 2881, 80th Oregon Legislative Assembly, 2019 Reg. Sess. (Ore. 2019).

47. Oregon Department of Environmental Quality. 2018. VW Environmental Mitigation Plan for the State of Oregon. https://www.oregon.gov/deq/FilterDocs/VWmitigplan.pdf (Accessed August 28, 2019).

48. Pennsylvania Department of Environmental Protection. 2019. *Alternative Fuel Vehicle Rebate Program Guidance.*http://www.depgreenport.state.pa.us/elibrary/GetDocument?docId=1459887&DocName=ALTERNATIVE%20FUEL%20VEHICLE%20REBATE%20PROGRAM%20GUIDANCE%202019.PDF%20%20%3Cspan%20style%3D%22color%3Agreen%3B%22%3E%3C%2Fspan%3E%20%3Cspan%20style%3D%22color%3Ablue%3B%22%3E%3C%2Fspan%3E (Accessed on October 9, 2019).

49. ADOT. 2019. Alternative Fuel Vehicle. https://azdot.gov/motor-vehicles/vehicle-services/vehicle-registration/alternative-fuel-vehicle (Accessed on October 9, 2019).

50. ADOT. 2019. Energy Efficient Plate Program. https://azdot.gov/motor-vehicles/vehicle-services/plates-and-placards/energy-efficient-plate-program (Accessed on October 9, 2019).

51. Ariz. Rev. Stat. §49-542 (2019)

52. Center for Sustainable Energy. 2019. *California Clean Vehicle Rebate Project: For Public Fleets.* https://cleanvehiclerebate.org/eng/fleet (Accessed on June 3,2019).

53. Community Housing Development Corporation. 2019. #DRIVING CLEAN https://drivingcleandotchdcnrdotcom.wordpress.com/ (Accessed on June 4, 2019).

54. PACENation. 2019. Active Pace Program: California. https://pacenation.us/pace-in-california/ (Accessed on June 4, 2019).

55. California Air Resources Board. 2019. Carpool Stickers: About. https://ww2.arb.ca.gov/index.php/our-work/programs/carpool-stickers/about (Accessed on June 4, 2019).

56. California Air Resources Board. 2019. Current Clean Air Vehicle Decal. https://ww2.arb.ca.gov/resources/fact-sheets/current-clean-air-vehicle-decal. (Accessed on June 4, 2019).

56. California Air Resources Board. 2017. Motor Vehicle Registration Fee Program – Criteria and Guidelines. https://ww3.arb.ca.gov/planning/tsaq/mvrfp/criteria/criteria.htm (Accessed on August 20, 2019).

57. California Energy Commission. 2019. Clean Transportation Funding Areas. https://ww2.energy.ca.gov/transportation/altfueltech/index.html (Accessed on August 20, 2019).

59. U.S. Department of Energy, Energy Efficiency & Renewable Energy. 2019. Alternative Fuel and Vehicle Incentives. *Alternative Fuels Data Center.* https://afdc.energy.gov/laws/6307 (Accessed on August 20, 2019).

60. California HVIP. 2019. Home. https://www.californiahvip.org/ (Accessed on August 20, 2019).

61. California HVIP. 2019. Results. https://www.californiahvip.org/tools-results/#program-numbers (Accessed on August 20, 2019).

62. CALeVIP. 2019. About CALeVIP. https://calevip.org/about-calevip (Accessed on August 20, 2019).

63. Cal. Pub. Res. Code §25722.9

64. California Public Utilities Commission. 2019. Energy Research, Development & Deployment. https://www.cpuc.ca.gov/energyrdd/ (Accessed on August 20, 2019).

65. State Treasurer's Office. 2019. California Pollution Control Financing Authority: Electric Vehicle Charging Station Financing Program. https://www.treasurer.ca.gov/cpcfa/calcap/evcs/index.asp (Accessed on August 20, 2019).

66. Clean Air Fleets. 2019. Charge Ahead Colorado. http://cleanairfleets.org/programs/charge-ahead-%20colorado (Accessed on June 4, 2019).

67. U.S. Department of Energy, Energy Efficiency & Renewable Energy. 2019. Low Emission Vehicle (LEV) Sales Tax Exemption. *Alternative Fuels Data Center.* https://afdc.energy.gov/laws/202 (Accessed on June 4, 2019).

68. Colorado Department of Transportation. 2019. Hybrid Vehicle Use in the HOT/HOV Lanes. https://www.codot.gov/programs/hybrids (Accessed on August 6, 2019).

69. Air Care Colorado. 2019. Need to Know. https://aircarecolorado.com/need-know (Accessed on June 4, 2019).

62. Clean Air Fleets. 2019. ALT Fuels Colorado. https://cleanairfleets.org/programs/alt-fuels-colorado (Accessed on August 19, 2019).

71. U.S. Department of Energy, Energy Efficiency & Renewable Energy. 2019. Electric Vehicle Emissions Inspection Exemption. *Alternative Fuels Data Center.* https://afdc.energy.gov/laws/11583 (Accessed June 4, 2019).

72. Florida Highway Safety and Motor Vehicles. 2019. High Occupancy Vehicle Decal. https://www.flhsmv.gov/motor-vehicles-tags-titles/high-occupancy-vehicle-decal/ (Accessed on June 6, 2019).

73. Fla. Stat. §163.08

74. Illinois Air Team. 2019. Your Resource for the Illinois Vehicle Emissions Testing Program: Does My Vehicle Need to be Tested? https://illinoisairteam.net/does-my-vehicle-need-to-be-tested/ (Accessed on June 4, 2019).

75. 415 Ill. Comp. Stat. §120/35

76. 220 Ill. Comp. Stat. §5/16-108.5 – 108.7

77. U.S. Department of Energy, Energy Efficiency & Renewable Energy. 2019. Heavy-Duty Transit Bus and School Bus Grants. *Alternative Fuels Data Center*. https://afdc.energy.gov/laws/12058 (Accessed on August 20, 2019).

78. Maryland Energy Administration. 2019. Electric Vehicle Supply Equipment (EVSE) Rebate Program 2.0. https://energy.maryland.gov/transportation/Pages/incentives_evserebate.aspx (Accessed on June 4, 2019).

79. Maryland Energy Administration. 2018. Alternative Fuel Infrastructure Program. https://energy.maryland.gov/transportation/Pages/afip.aspx (Accessed June 4, 2019).

80. Maryland Department of Transportation, Motor Vehicle Administration. 2019. High Occupancy Vehicle (HOV) Permit Issuance for Plug-in Electric Vehicles. http://www.mva.maryland.gov/About-MVA/INFO/27300/27300-54T.htm (Accessed June 4, 2019).

81. Maryland Energy Administration. 2017. Maryland Freedom Fleet Voucher Program. https://energy.maryland.gov/transportation/Pages/incentives_ffvp.aspx (Accessed on August 21, 2019).

82. U.S. Department of Energy, Energy Efficiency & Renewable Energy. 2019. Zero Emission School Bus Grant Program and Study. *Alternative Fuels Data Center*. https://afdc.energy.gov/laws/12219 (Accessed on August 20, 2019).

83. Mass.gov. 2019. Apply for MassEVIP Public Access Charging Incentives. https://www.mass.gov/how-to/apply-for-massevip-public-access-charging-incentives (Accessed on August 20, 2019).

84. Mass.gov. 2019. Apply for Multi-Unit Dwelling Charging Incentives. https://www.mass.gov/how-to/apply-for-massevip-multi-unit-dwelling-charging-incentives (Accessed on August 20, 2019).

85. Mass.gov. 2019. Apply for MassEVIP Workplace Charging Incentives. https://www.mass.gov/how-to/apply-for-massevip-workplace-charging-incentives (Accessed on August 20, 2019).

86. Mass.gov. 2019. Apply for MassEVIP Fleets Incentives. https://www.mass.gov/how-to/apply-for-massevip-fleets-incentives (Accessed on August 20, 2019).

87. Massachusetts Vehicle Check. 2019. Vehicles to be Tested. https://www.mavehiclecheck.com/motorists-vehicles#VehicleTypes (Accessed June 4, 2019).

88. Mass.gov. 2019. Apply for a VW Open Solicitation Grant. https://www.mass.gov/how-to/apply-for-a-vw-open-solicitation-grant (Accessed on August 20, 2019).

89. Mass.gov. 2019. State and Federal Electric Vehicle Funding Programs. https://www.mass.gov/service-details/state-and-federal-electric-vehicle-funding-programs (Accessed on August 20, 2019).

90. New Jersey Department of Environmental Protection, Bureau of Mobile Sources. 2019. It Pay$ to Plug In. https://www.drivegreen.nj.gov/plugin.html (Accessed June 4, 2019).

91. U.S. Department of Energy, Energy Efficiency & Renewable Energy. 2019. High Occupancy Vehicle (HOV) Lane Exemption. *Alternative Fuels Data Center.* https://afdc.energy.gov/laws/6145 (Accessed June 4, 2019).

92. U.S. Department of Energy, Energy Efficiency & Renewable Energy. 2019. Plug-In Electric Vehicle (PEV) Toll Discount Program. *Alternative Fuels Data Center.* https://afdc.energy.gov/laws/11621 (Accessed on June 4, 2019).

93. New York State Energy Research and Development Authority. 2019. Charge Ready NY. https://www.nyserda.ny.gov/All-Programs/Programs/ChargeNY/Charge-Electric/Charging-Station-Programs/Charge-Ready-NY (Accessed on June 4, 2019).

94. New York Department of Transportation. 2019. New York's Clean Pass Program. https://www.tax.ny.gov/pit/credits/alt_fuels_elec_vehicles.htm (Accessed on June 4, 2019).

95. New York Thruway Authority. 2019. Green Discount Plan. http://www.thruway.ny.gov/ezpass/greentag.html (Accessed on June 4, 2019).

96. New York Department of Motor Vehicles. 2019. New York Vehicle Inspection Program (NYVIP2). https://dmv.ny.gov/inspection/new-york-vehicle-inspection-program-nyvip. (Accessed on June 4, 2019).

97. New York State. 2019. Truck Voucher Incentive Program. https://truck-vip.ny.gov/index.php (Accessed on August 21, 2019).

98. Port Authority of NY & NJ. 2019. Truck Replacement Program. http://www.panynj.gov/truckers-resources/truck-replacement.html (Accessed on August 21, 2019).

99. New York State. 2019. Public Transit Technology and Innovation Program (3914). https://portal.nyserda.ny.gov/CORE_Solicitation_Detail_Page?SolicitationId=a0rt000000FoKymAAF (Accessed on August 21, 2019).

100. New York State. 2019. Department of Environmental Conservation: Grant Funding for Municipalities. http://www.dec.ny.gov/energy/109181.html (Accessed on August 21, 2019).

101. New York State. 2018. Department of Environmental Conservation: *Guidelines and Application Instructions.* http://www.dec.ny.gov/docs/administration_pdf/cleanvehiclerfa3.pdf (Accessed on August 21, 2019).

102. Charge To Work NY. 2019. Home. https://www.chargetoworkny.com/ (Accessed on August 21, 2019).

103. U.S. Department of Energy, Energy Efficiency & Renewable Energy. 2019. High Occupancy Vehicle (HOV) Lane Exemption. *Alternative Fuels Data Center.* https://afdc.energy.gov/laws/9353 (Accessed on June 6, 2019).

104. North Carolina Statutes §20-4.01.

105. NCDEQ. 2019. VW Settlement Phase 1-DC Fast Charge Program. https://deq.nc.gov/about/divisions/air-quality/motor-vehicles-and-air-quality/volkswagen-settlement/vw-settlement-0 (Accessed on August 21, 2019).

106. NCDEQ. 2019. VW Settlement Phase 1-Diesel Program. https://deq.nc.gov/node/87980 (Accessed on August 21, 2019).

107. NC Clean Energy Technology Center. 2019. Clean Fuel Advanced Technology (CFAT) Project. https://nccleantech.ncsu.edu/our-work/center-projects/cfat-project-request-for-proposals-information/ (Accessed on August 21, 2019).

108. N.C. Gen. Stat. §105-164.13

109. Ohio Development Services Agency. 2019. Alternative Fueling Stations. https://development.ohio.gov/bs/bs_altfueltrans.htm (Accessed June 5, 2019).

110. U.S. Department of Energy, Energy Efficiency & Renewable Energy. 2019. Alternative Fuel Vehicle (AFV) Emissions Inspection Exemption. *Alternative Fuels Data Center.* https://afdc.energy.gov/laws/11573 (Accessed on June 5, 2019).

111. Ohio Environmental Protection Agency. 2019. Office of Environmental Education: Diesel Emission Reduction Grants. https://www.epa.ohio.gov/oeef/#131364252-diesel-emission-reduction-grants (Accessed on August 21, 2019).

112. Ohio Environmental Protection Agency. 2018. *Ohio Diesel Emission Reduction Grant Program New Grant Awards Fall 2018.* https://www.epa.ohio.gov/Portals/42/documents/DERG/D19F%20Awarded%20summary.pdf (Accessed on August 21, 2019).

113. Ohio Environmental Protection Agency. 2019. Office of Environmental Education: VW Mitigation Grants. https://epa.ohio.gov/oee/#131365122-vw-mitigation-grants (Accessed on August 21, 2019).

114. Ore. Rev. Stat. §815.300

115. Ore. Rev. Stat. §468A.795-468A.803

116. Oregon Department of Energy. 2019. Energy Loan Program. https://www.oregon.gov/energy/Incentives/Pages/Energy-Loan-Program.aspx (Accessed June 5, 2019).

117. Pennsylvania Department of Environmental Protection. 2019. Driving PA Forward. http://www.depgis.state.pa.us/DrivingPAForward/ (Accessed on October 9, 2019).

118. Pennsylvania Department of Environmental Protection. 2019. Alternative Fuels Incentive Grant Program (AFIG). https://www.dep.pa.gov/Citizens/GrantsLoansRebates/Alternative-Fuels-Incentive-Grant/Pages/default.aspx#.Vl9OeHarSUk (Accessed on October 9, 2019).