Vermont Agency of Transportation

Sec. 15. 2016 Plug-In Hybrid and Electric Vehicle Registration Fees

Legislative Report December 2016

Acknowledgements

This report was prepared by VTrans in consultation with the Agency of Natural Resources and the Departments of Public Service and Motor Vehicles and with technical support from the Vermont Energy Investment Corp (VEIC).

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The Legislative Mandate:

Sec. 15. 2016 Plug-In Hybrid and Electric Vehicle Registration Fees Legislative Report; on or before January 1, 2017, the Secretary of Transportation shall submit a report to the House Committee on Ways and Means, the Senate Committee on Finance, and the House and Senate Committees on Transportation recommending fees for the registration of plug-in hybrid and electric vehicles.

Executive Summary:

This is the third legislative study to consider registration fees for electric vehicles (EVs) which include plug-in hybrid (PHEV) and battery electric vehicles (BEV). Earlier studies include: Act 153: Section 39 Report: *Alternative Fuel Vehicle User Fee Options*, VT Agency of Transportation,11/5/2012, and 12: Section 28 Report: *A Study on Replacing Motor Fuel Tax Revenues Not Collected from Plug-In Electric Vehicles*, VT Department of Public Service, 12/15/2013.

The report fulfills the legislative mandate by providing EV background information and making specific recommendations as requested regarding instituting special registration fees for EVs. It begins by describing the history of state legislative discussions on this topic, and providing a summary of the state policy context including:

- Declining transportation revenues in Vermont due to increased fuel efficiency among all vehicles and a flattening of Vehicle Miles Traveled (VMT), and the overall need to stabilize transportation revenues.
- The goals and strategies in the Vermont Comprehensive Energy Plan and the state's commitments in statute to reduce greenhouse gas (GHG) emissions, all of which rely on vehicles in Vermont shifting from fossils fuels to renewably powered electricity. Transportation in Vermont today is almost wholly dependent on fossil fuels, is the largest source of air pollutants in Vermont, including air toxics, ozone precursors, carbon monoxide and contributes 46% of the state's GHG emissions.
- The State's adoption of the California vehicle emissions standards, and implementation of the Vermont Low Emission Vehicle Program (LEV), which includes requirements that a portion of vehicles sold in Vermont meet zero emission vehicle standards (ZEV). These may include BEVs, PHEVs, fuel cell electric vehicles (FCEV), or other combinations.

The report also briefly explains how EV technology works, the purchase price and lease rates of various models, information on the demographics of EV ownership, various sales forecasts and other ways EV contribute to transportation revenues. As of October 2016 there were 1,395 registered EV passenger cars or 0.3% of the roughly 450,000 passenger vehicles registered in the state. Lamoille County has the highest per capita rate of EV ownership.

Quarterly registrations of EVs in Vermont rise and fall to some extent, but since 2009 the average has been about 1.2% of all new registrations for passenger vehicles. This indicates that the EV market in Vermont, and in fact in all other states as well, is in a very early phase.

In a recent VTrans public opinion survey[1] of Vermonters, price was the biggest perceived barrier to purchasing EVs. The most popular EV model in Vermont, with 25% of the total EV registrations, is the Ford CMax Energi (PHEV). It a $31,000 car, the price of which is reduced to $26,913 after a federal tax credit and is typically leased at $129 with a $3,375 down payment. The Toyota Prius plug-in, another mid-range car, is second most popular with 277 registered. There are 249 registered Chevy Volt (PHEV) at 249. Sixty-four of the 1,395 are Teslas which currently range in price between $74,500 and $98,800. There are just over a dozen other luxury priced models. See page 14 for more details on additional models registration numbers.

Projecting the number of EVs that will be purchased in Vermont in the future is challenging. There are numerous variables that affect sales, including availability of models suitable for Vermonters, pricing, charging stations at workplaces and public locations, and consumer awareness, to name a few. This report presents three potential EV growth scenarios with EVs predicted to reach 10% - 28% of the new light duty vehicle market by 2025. The medium forecast scenario of 15.1% of sales in 2025 is in synch with expected LEV program requirements.

The report's final recommendations concur with the two previous legislative reports. EV registration fees should not be increased in the immediate future and not until the market for EVs moves beyond an "early adopter" phase. To increase the fees now is at cross purposes with the state's efforts to incentivize EV purchase and use, and increase the number of EVs on Vermont's roadways. Transitioning from conventional gasoline-powered to electric vehicles is essential for meeting the state's short and long term climate and energy goals, and will also reduce the public health problems caused by air pollution, keep many more dollars in the Vermont economy, and reduce the costs of transportation for businesses and households

[1] Research Systems Group for the Vermont Agency of Transportation. 2016. *Long Range Transportation Plan Public Opinion Survey Final Report.* vtrans.vermont.gov/sites/aot/files/planning/documents/planning/VTrans%20LRTP%20Survey%20Report%20Final%202016.pdf

Recommended policy considerations include:

1. A first priority of putting a comprehensive transportation revenue solution in place as vehicle efficiency increases and people drive less due to economic pressures and opportunities, desired lifestyles, healthier transportation options, and environmental concerns. A stable revenue source that grows with the economy is needed.
2. Second, if a comprehensive transportation revenue solution is not in place that addresses losses from overall increased vehicle efficiency, a fee should go into effect when the number of registered EVs represent 15% of auto sales or approximately 18,835 new registered passenger vehicles. This is estimated to be by 2025.

   If this second option is pursued, then:

   a. The Commissioner of the DEC will report to the Commissioner of DMV when new EV registrations are 15% of annual passenger vehicle registrations. The fee will then be put in place in the beginning of the following state fiscal year.

   b. The fee amounts should be reasonable and reflect factors such as estimated lost gas tax revenues due to factors such as battery technology and estimated average vehicle use at the time the fee is put in place.

Historical Context:

This report was requested by the legislature in part because the state Transportation Fund revenues, critical for road and bridge upkeep, are in decline due to a decrease in the consumption of gasoline caused by an increase in vehicle efficiency and an overall flattening of Vehicle Miles Traveled (VMT)[2].

The Section 10 Legislative Report[3] completed last year by VTrans reports that:

> Gasoline consumption in Vermont has declined consistently since State Fiscal Year (SFY) 2005. A general reduction in vehicle miles traveled (VMT), state investments in smart growth programs, transit, rail, park-and-rides, and carshare programs, the growth of hybrid and electric vehicles, and federal fuel economy standards have all contributed to reducing gasoline consumption. (p. 1-2)

Electric drive vehicles (EVs) are powered either entirely or partially by electricity. 'All electric' vehicles are also called battery electric vehicles or BEVs and partial electric vehicles – which run on both electricity and gasoline - are called plug-in hybrid electric vehicles or PHEVs. PHEV owners pay some gas taxes depending on how many miles they drive on gasoline, while BEV owners don't pay any. Both are thus exempt, either fully or partially, from an important Vermont road 'user fee'. All EV owners pay the vehicle purchase and use tax and inspection and registration fees associated with vehicle ownership.

The legislature mandated two previous studies that considered the revenue losses from EVs and recommended different solutions. See Act 153: Section 39 Report: *Alternative Fuel Vehicle User Fee Options*[4], VT Agency of Transportation,11/5/2012, and whether or not "pay at the plug" was feasible (Act 12: Section 28 Report: *A Study on Replacing Motor Fuel Tax Revenues Not Collected from Plug-In Electric Vehicles*[5], VT Department of Public Service, 12/15/2013).

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[2] VMT is an annual cumulative tally of

[3] Vermont Transportation Funding Options Section 10 (a) Act 40 (2015) http://legislature.vermont.gov/assets/Legislative-Reports/Sec-10-Funding-Study-Report-final.pdf

[4] Act 153: Section 39 Report (2012). *Alternative Fuel Vehicle User Fee Options*. http://legislature.vermont.gov/assets/Documents/Reports/292517.PDF

[5] Act 12: Section 28 Report (2013). *A Study on Replacing Motor Fuel Tax Revenues Not Collected from Plug-In Electric Vehicles*. http://legislature.vermont.gov/assets/Documents/Reports/295260.PDF

The 2013 report calculated fees of $120/year for BEVs and $71/year for PHEVs based on average vehicle efficiency technology available in 2013 and typical household mileage. It also found, that since most EV charging goes on at home, it would be a burden on the utilities and residential customers to require separate utility meters to serve EVs.

Both reports recognized, while the increase of EVs means loss of some gas tax revenues, there are other state policies and programs that strongly support their growth in numbers. Replacing fossil fuel dependent vehicles with those powered by renewably powered electricity is critical to the state achieving its renewable energy and greenhouse gas and other emissions goals described further in this report. Both reports recommend that any increase in EV registration fees be paired with an EV purchase incentive.

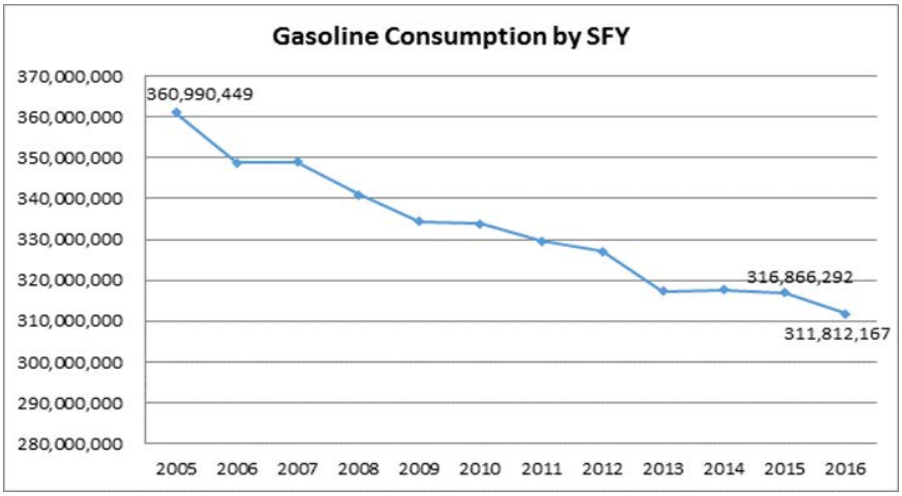
Policy Context:

Transportation Funding Challenges

The legislature has grappled with the overall transportation funding challenge and recognizes that the gas tax is not a sustainable funding mechanism. In addition to the 2015 study noted above that looked at non-fossil fuel based revenue options, a study in 2013, the Section 40 Study[6], estimated the gap between revenue sources and the cost to maintain, operate, and build the state's transportation system; and evaluated potential new state revenue sources, and how existing state revenue sources could be optimally modified to address the five-year and longer term transportation funding gaps. It too identified overall vehicle efficiency as a major driver in gas tax revenue declines.

The following chart shows that the SFY' 16 gasoline consumption continues to decrease. This is despite a decrease in gasoline prices and an increase in VMT in calendar year 2015 (from 7,035.1M to 7,310.9M VMT)[7]. The logical conclusion - drivers are buying less, not because of the cost of gasoline or because they are driving less. Consumption is down because of vehicle efficiency.

Figure 1. Gasoline Consumption in Vermont (in gallons), SFY 2005-2016



[6] Vermont Transportation Funding Options Section 40 Act 153 (2012). http://legislature.vermont.gov/assets/Documents/Reports/292520.PDF

[7] Vermont Agency of Transportation. Highway Research Data. *2015 Vehicle Miles Traveled.* http://vtrans.vermont.gov/docs/highway-research

As of October 2016, EVs constituted a very small portion of the total number of passenger vehicles on Vermont roadways – only 1,396 of the over 450,000 registered passenger vehicles. EVs account for a tiny percentage of the overall decline in gasoline consumption. Passenger, as well as all other vehicle types, across the entire state fleet are becoming more efficient due to federal vehicle efficiency requirements imposed on vehicle manufacturers.

Vermont policies that support a transition away from fossil fuels by increasing the number of EVs include:

- *The Vermont Comprehensive Energy Plan and Greenhouse Gas Emissions Goals*

> Achieving significant reductions of GHG emissions and fossil fuel consumption in Vermont's transportation sector will require a large-scale transformation to alternatively fueled vehicles that reduce petroleum usage and related emissions with advanced technologies and fuels (such as plug-in hybrid electric vehicles, all-electric vehicles, and fuel-cell electric vehicles.
>
> Vermont Comprehensive Energy Plan – 2016, p.158

The 2016 State of Vermont Comprehensive Energy Plan[8] (CEP) establishes the expansion of electric vehicle numbers as a critical strategy in Vermont for meeting the plan's near and long term energy conservation and renewable energy goals, and for reducing greenhouse gas emissions, improving air quality and saving consumers money. The CEP is developed by the Department of Public Service with substantial input from all state agencies.

The CEP's primary recommendations are to reduce energy use by one third by 2050, and also meet 90% of the remaining energy need with energy from renewable sources by that time. Within these goals, the CEP calls for 10% of Vermont's transportation energy being renewable by 2025, including making 10% of the registered cars in Vermont EVs by then and at least 80% of transportation fuels renewable by 2050. Since Vermont's electricity supply is increasingly generated from renewable sources, electric vehicles are an obvious way to reach the CEP goals.

According to the CEP, as of 2016, only 6% of Vermont's transportation energy is renewable. This is primarily in the form of corn-based ethanol.

[8] Department of Public Service. 2016. *Comprehensive Energy Plan*. http://publicservice.vermont.gov/publications-resources/publications/energy_plan/2015_plan

Greenhouse gas emissions (GHG) reductions are mandated in statute. Sec. 1. 10 V.S.A. § 578 states that it's the goal of the state to reduce emissions of greenhouse gases from a 1990 baseline by:

- 25 percent by January 1, 2012;
- 50 percent by January 1, 2028; and if practicable using reasonable efforts,
- 75 percent by January 1, 2050.

An analysis by the Agency of Natural Resources[9] shows that transportation is the largest GHG emissions sector and is responsible for 46% of the state's total emissions.

- *The Zero Emissions Vehicles (ZEV) Program:*

Most of the northeastern states - Vermont, Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, and Rhode Island, along with Oregon, have also adopted California's Low Emission Vehicle standards, as part of northeast and west coast efforts to reduce air pollution and help mitigate climate change. The ZEV requirements, which are part of the LEV program, apply to new vehicles sold in Vermont and the other ZEV states noted above. They have also helped spur technological developments, that have resulted in plug-in hybrid electric, all-electric, and hydrogen fuel-cell vehicles, as well as continuing advancements in significantly cleaner internal combustion engines.

In October 2013 the ZEV states signed a MOU to ensure successful expansion of state ZEV programs, with the goal of 3.3 million ZEVs on the roads in these states by 2025. In response the states collectively and individually prepared ZEV action plans. Vermont's, the Vermont ZEV Action Plan[10], outlines specific steps and strategies in support of the proliferation of ZEVs in the state.

Vermont and rest of the ZEV states also signed the International ZEV Alliance agreement at the 2015 Paris climate conference to push for 100% ZEV sales "as fast as possible, and no later than 2050" to help avoid the worst impacts of climate change.

[9] Agency of Natural Resources. *Climate Change in Vermont: Emissions and Goals.* http://climatechange.vermont.gov/climate-pollution-goals

[10] ZEV Program Implementation Task Force. 2014. *Multi-State ZEV Action Plan.* http://anr.vermont.gov/sites/anr/files/specialtopics/climate/documents/ZEV/MultiStateZEVActionPlan.pdf

- *EV Co-benefits:*

  Converting to an electric vehicle can have significant economic and environmental benefits besides reductions of GHG emissions, including:

  - Improved public health – Electric vehicles have reduced or no emissions compared to traditional vehicles powered by combustion engines. Reducing emissions help mitigate the most damaging health impacts from a long list of harmful pollutants emitted from tailpipes, including carbon dioxide, carbon monoxide, nitric oxide, nitrogen dioxide, sulfur oxides, metallic compounds and other toxics. A recent American Lung Association report[11] estimates Vermont had $347 million in health and climate costs associated with vehicle emissions in 2015.
  - Insulation from fluctuating gas prices - In Vermont, electric prices have been stable for nearly 20 years and even at current low prices for gasoline there are still significant savings when driving on electricity.
  - Supporting Vermont's economy - Most of the cost of charging electric vehicles stays within New England. Savings on gasoline can be spent on other household needs rather than sending energy dollars out of the region. EVs support Vermont's energy independence and the local economy.

[11] American Lung Association. 2016. *Clean Air Future Health and Climate Benefits of Zero Emission Vehicles.* http://www.lung.org/local-content/california/documents/2016zeroemissions.pdf

State of Vermont's Programs to Support EVs

The State of Vermont is actively supporting several programs linked to expanding the number of EVs per the policy direction described above.

- The state of Vermont, through the Agencies of Natural Resources and Transportation and the Department of Public Service, is a Drive Electric Vermont[12] (DEV) stakeholder. DEV is a public-private coalition working to increase the use of electric transportation in Vermont. The state provides grant support to the Vermont Energy Investment Corp (VEIC) to coordinate a diverse group of DEV stakeholders, undertake research, and engage in EV promotion and educational activities which are described on the DEV website. There is currently a VEIC administered vehicle purchase incentive program funded with nonprofit funds to support about 200 EV sales in partnership with local auto dealers. This program is expected to wind down by January 2017 as funding is depleted.
- The state has supported an EV charging programs for designated downtown areas. Just under $200,000 dollars have been available through the Agency of Commerce and Community Affairs and has resulted in 14 communities installing EV charging in downtown or village areas around the state.
- In 2012 the Governor and Premier of Quebec announced the Quebec/VT "Green Highway". The state and province have worked since then to locate public EV charging every 30 miles from Montreal to Burlington and on to the New Hampshire border.
- The Green Highway efforts helped support the October 2016 FHWA designation of a northeast EV Fuel Corridor[13] including I89 and 91 in VT. VTrans submitted the nomination on behalf of the 11 northeast states with the goal of connecting northeast urban areas with public charging infrastructure.
- The state of Vermont is a party to the VW settlement. EV charging and consumer education is an area that can be supported with the funds. More information about amount of money that will be available, the process for disbursement and the types of activities allowed under the agreement will become available in the year ahead.

[12] Drive Electric Vermont. http://www.driveelectricvt.com/

[13] Federal Highway Administration. 2016. http://www.fhwa.dot.gov/environment/alternative_fuel_corridors/

Incentives and other Complementary Policies to Grow the EV Market

The table below, completed in September of 2016 by NESCAUM (Northeast States for Coordinated Air Use Management), summarizes the policies in the ZEV states that complement ZEV manufacturer mandates.

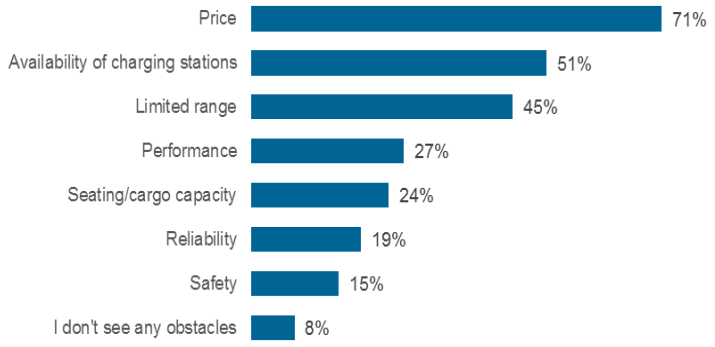
Table 1. Summary of Policies in ZEV States That Complement ZEV Manufacturer Mandates

Initiative	CA	CT	MD	MA	NY	OR	RI	VT
Consumer Vehicle Incentive	✓	✓	✓	✓	**		✓	✓
Charging Station Incentive	✓	✓	✓	✓	✓	✓	✓	✓
Fleet Incentives	✓	✓		✓	✓	✓	✓	
Dealership Outreach	✓	✓	✓	✓	✓		**	✓
Dealer Incentives		✓						✓
State ZEV Commission	✓		✓	✓			✓	✓
PUC EVSE Exemption	✓	✓	✓	✓	✓	✓		
Time of Use Rates (Including Pilots)	✓	✓	✓	✓	✓	✓		✓
Workplace Charging Grants		✓		✓	**			
Building Codes	✓			**				✓
HOV Lane Access	✓	NA	✓	**	✓		NA	NA
Toll Waivers	✓	NA			✓			NA

It should be noted that the Vermont consumer vehicle incentive noted in the table above is a program that began in 2015. Drive Electric Vermont administers this relatively small program that first provided rebates of up to $500 to Vermonters who purchased an EV, and incentive payments of $200 to dealerships that sold them. It was funded by the Vermont Low Income Trust for Electricity (VLITE). The program was extended for another year in 2016 with consumer incentives of $750 and $1,000 (depending on battery capacity) and $200 dealer incentives. The incentive program will run until funding is depleted, likely to end in January 2017.

Research has shown that purchase incentives support an increase in EV ownership. The 2016 VTrans Statewide Transportation Survey of Vermonters[14] indicates cost considerations as a barrier to wider interest in owning EVs. Below are the totals when survey respondents were asked what the barriers are to purchasing an EV.

Figure 2. VTrans 2016 Statewide Transportation Survey - Barriers to Purchasing an Electric Vehicle



Developing financial and non-financial incentives is a top recommendation of the Vermont ZEV Action Plan. Many European countries offer incentives — and in California, where over 100,000 EVs are registered and where market share for EVs has reached higher levels compared to other states, the Clean Vehicle Rebate Project has been effectively promoting the use and production of EVs since 2008.

Many of the states that have rebate programs have opted for those that are paid out immediately after the purchase of the vehicle. Others include point-of-sale tax breaks or income tax credits. The programs support the early phases of market transformation by reducing up-front costs and encouraging early adopters to purchase or lease their first EV. Some of the states with the largest electric vehicle incentives. California, Hawaii, Oregon, and Washington — have sales shares that are approximately two to four times the national average.

[14] Research Systems Group for the Vermont Agency of Transportation. 2016. *Long Range Transportation Plan Public Opinion Survey Final Report.* vtrans.vermont.gov/sites/aot/files/planning/documents/planning/VTrans%20LRTP%20Survey%20Report%20Final%202016.pdf

According to the 2016 CEP - financial incentives in the form of tax breaks or rebates, or other kinds of incentives such as preferential parking, help catalyze market demand among potential early adopters and help the Vermont EV market move into a phase of sustainable growth. The incentives also increase interest among manufacturers and in-state auto dealerships in selling and actively marketing a diversity of models within the state.

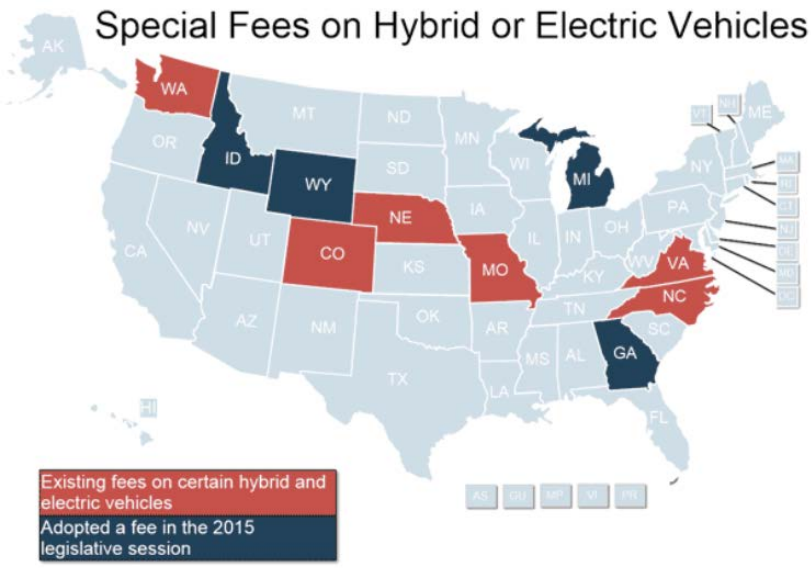
Creating a new point-of-sale financial incentive at the state level — such as elimination of the purchase-and-use tax for EV transactions, or rebates — could generate considerably more interest, especially if applied to both new and used models, and targets those who can benefit the most, and for whom cost is a real barrier.

Coordinating the timing for offering incentives, as well as instituting registration or other user fees, with the stage of development in the EV market is an important consideration for policy makers. Incentives that require public resources should only be used in the early stages of market development. Innovation diffusion theory suggests that once new technologies are sought by 15% of the potential users or consumers, markets can grow on their own.

EV User Fees and Other States

The National Conference of State Legislatures (NCSL) has information on its website[15] both summarizing other states' incentives programs and efforts by states to implement EV user fees. Georgia, Idaho, Michigan and Wyoming enacted legislation in 2015 requiring new fees on certain hybrid and electric vehicles. Colorado, Nebraska, North Carolina, Virginia and Washington adopted fees for electric vehicles during previous legislative sessions. See the map below from the NCSL website. None of the ZEV states (Vermont, Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, and Rhode Island, Oregon and California), who are actively promoting EVs, have put user fees in place.

Figure 3. Map of State Fees on Hybrid and Electric Vehicles



[15] National Conference of State Legislatures. http://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx

What is an EV?

Plug-in electric vehicles (EVs) receive energy from the electric grid to recharge a battery used to power a motor. There are two types of EVs:

1. All Electric Vehicles (AEVs, also referred to as Battery Electric Vehicles) are powered solely by energy stored in a battery; and
2. Plug-in Hybrid (PHEV) vehicles can be powered by battery for a distance, but also have a gasoline or diesel engine for extended range operation.

EVs are distinct from traditional hybrid vehicles, such as the Toyota Prius, which do not charge batteries from the electric grid. EVs can plug into standard 120V outlets to gain about 5 miles of range per hour for Level 1 charging. Level 2 charging requires 240V power (similar to an electric clothes dryer) and provides 10-20+ miles of range per hour of charging depending on the vehicle and equipment used. DC Fast Charging is available for many all electric models which provides 75+ miles in about 30 minutes. Most charging occurs at home during the overnight hours when demand on the grid is low, but there are over 140 locations with public charging in Vermont, over 20 of which have DC Fast Charging available. Many employers have also installed workplace charging for commuter and visitor use. The DEV website[16] has general information on EVs, a public charging map and additional resources.

Modern EVs have been available for sale at auto dealers in Vermont since late 2011, starting with the Chevrolet Volt PHEV. As of October 2016 there were 20 different models of EVs registered across 75% of Vermont communities. Tables 1 and 2 below include details on the various EV models now at dealers, including range and pricing information. AEVs range from 62 to 315 miles of range, while PHEVs travel 11 to 97 miles on the battery before switching to gasoline operation. PHEVs comprise 78% of Vermont registered EVs.

Typical lease prices are included in the tables. Approximately 75% of EVs registered in Vermont are leased. The federal tax credit benefit is usually included in the lease resulting in much more affordable monthly payments for many vehicles – under $200/month in many cases. Leasing also protects EV owners from depreciation as the technology continues to improve at a rapid pace.

[16] Drive Electric Vermont. http://www.driveelectricvt.com/

Table 2. Plug-in Hybrid Vehicles Available in Vermont

Make/Model	Electric Range† (miles)	Total Range (miles)	Base MSRP	Federal Tax Credit	Lease Monthly Payment	Lease Down Payment
Audi A3 e-tron	16	380	$38,900	$4,168	$456	$3,890
BMW i3 REX	97	180	$47,450	$7,500	$319	$3,000
BMW X5 xDrive40e	14	540	$66,495	$4,668	$639	$4,000
Chevrolet Volt	53	420	$33,220	$7,500	$262	$500
Ford C-MAX Energi	19	550	$31,770	$4,007	$129	$3,373
Ford Fusion Energi	19	550	$33,120	$4,007	$149	$3,243
Hyundai Sonata PHEV	27	600	$34,600	$4,919	$289	$1,699
Mercedes S550e	12	450	$95,650	$4,043	$899	$6,693
Toyota Prius Prime	22	640	$27,100	$4,500	TBD	TBD
Volvo XC90 T8 PHEV	14	350	$68,100	$4,585	$815	$4,915

†Electric range is from official manufacturer ratings. Range is often 20-50% less in cold winter conditions.

Table 3. All Electric Vehicles Available in Vermont

Make/Model	Electric Range† (miles)	Base MSRP	Federal Tax Credit	Lease Monthly Payment	Lease Down Payment
BMW i3 BEV	114	$43,600	$7,500	$279	$3,000
Ford Focus Electric	76	$29,120	$7,500	$149	$2,943
Mercedes-Benz Electric Drive	104	$41,450	$7,500	$329	$4,123
Mitsubishi iMiEV	62	$22,995	$7,500	$189	$3,388
Nissan LEAF	107	$30,680	$7,500	$279	$2,520
Smart Electric Drive††	68	$25,000	$7,500	$139	$1,433
Tesla Model S†††	249	$74,500	$7,500	$914	$6,609
Tesla Model X†††	257	$98,800	$7,500	$1,264	$6,959
Volkswagen e-Golf	83	$28,995	$7,500	$179	$2,349

†Electric range is from official manufacturer ratings. Range is often 20-50% less in cold winter conditions.
††No Vermont Smart dealerships, but vehicles are available to Vermonters in nearby states.
†††No Vermont Tesla dealerships, but vehicles are available for online purchase. Specifications are for mid-range vehicles. Varying battery sizes offer lesser or greater range potential, up to 315 miles for the Model S.

EV Owner Demographics and Sales History

Detailed demographics of current Vermont EV owners are not readily available, but national data suggests the market is still in the early stages of transformation, with many buyers falling into the "early adopter" category preceding mass market sales. These early adopters tend to be more affluent, with median incomes 50-80% higher than typical internal combustion engine vehicle buyers according to a 2014 survey of new vehicle purchasers[17].

Figure 4 below shows California data on EV owner household income over time and appears to show a moderate trend toward lower household income brackets as more affordable EV options were available in the marketplace and the overall EV market expanded.

Figure 4. California EV Buyer Household Income, 2012-201518

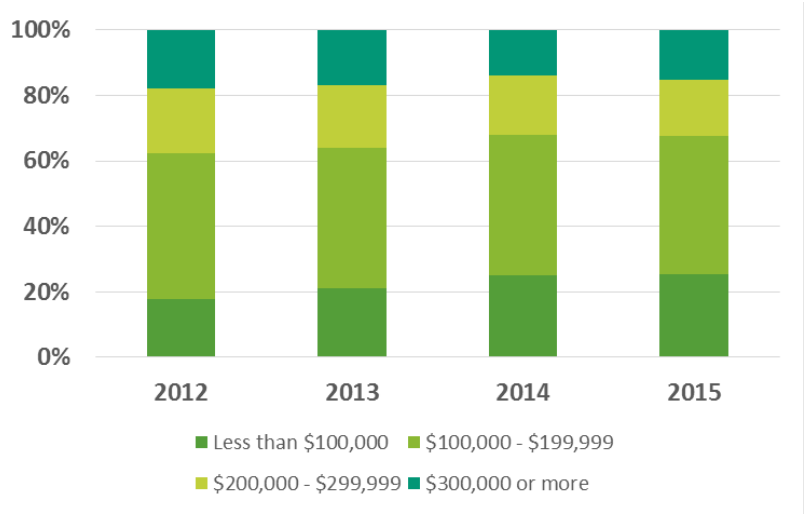


Table 4 and Figure 5 below provide additional details on models and geographic distribution of vehicles currently registered in Vermont. The Ford CMax Energi PHEV is the most popular EV and is one of the more affordable options with lease pricing under $200/month for many Vermonters. In terms of affordability, 90% of the EVs registered in Vermont have starting MSRPs below the national average selling price of a new vehicle ($33,419 in 2015[19]) before the federal tax credit is applied. In addition, used

[17] Transportation Research Board and National Research Council. 2015. *Overcoming Barriers to Deployment of Plug-in Electric Vehicles.* https://www.nap.edu/catalog/21725/overcoming-barriers-to-deployment-of-plug-in-electric-vehicles

[18] Center for Sustainable Energy. 2016. California Air Resources Board Clean Vehicle Rebate Project, EV Consumer Survey Dashboard. Retrieved 11/15/2016 from https://cleanvehiclerebate.org/survey-dashboard/ev

[19] NADA. 2016. *NADA Data 2015*. https://www.nada.org/nadadata/

EV sales represent greater opportunities for low cost purchases and currently represent 15% of the total EV market, with growth anticipated as more supply flows into the secondary market.

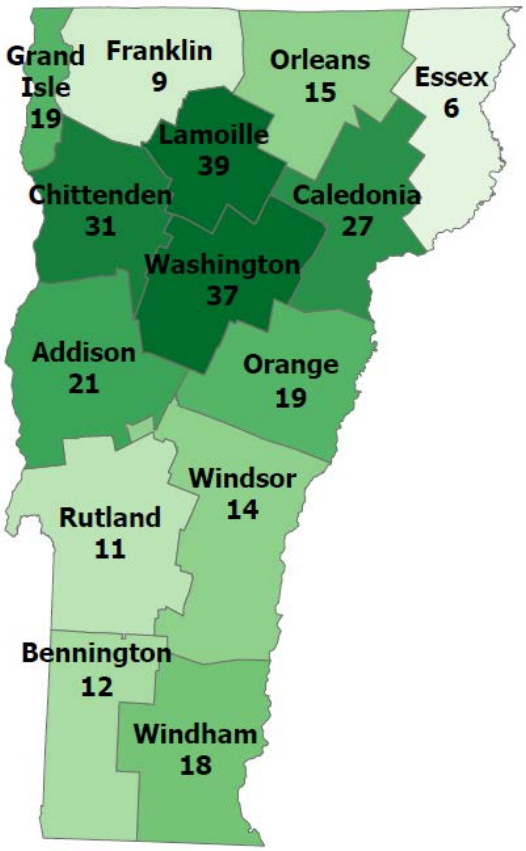
Lamoille County has the highest per capita rate of ownership in the state, primarily due to the efforts of Ford and Chevrolet dealers in the region and their ability to offer affordable EVs for their customers.

New statewide EV registrations, with October 2016 numbers included, comprise approximately 2.5% of new passenger vehicle registrations. This number is 1.5% of new registrations over the last two years. Total EV registrations are less than 0.3% of total passenger vehicles registered in Vermont, but significant growth is underway as shown in Figure 5 below.

Table 4. Vermont EV Registrations by Model, Oct 2016[20]

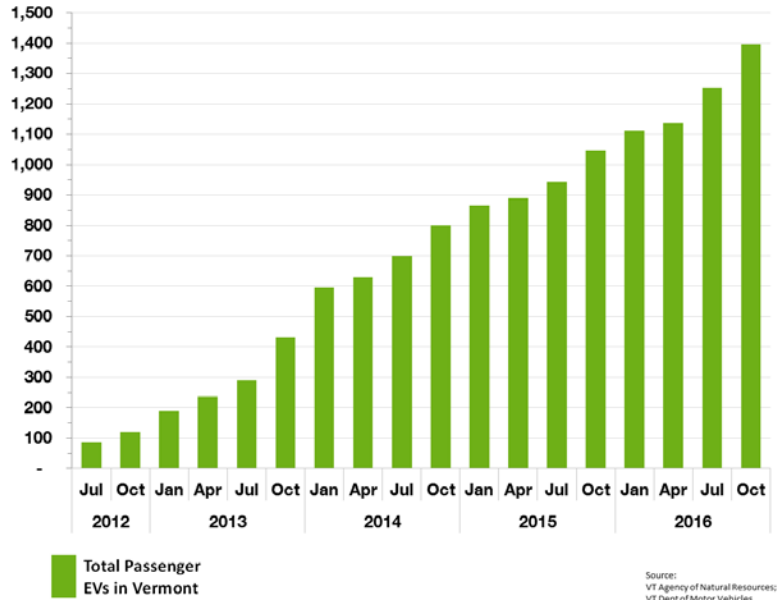
Plug-in Hybrids (1,088)	
Ford CMax Energi	335
Toyota Prius Plug-in	277
Chevrolet Volt	249
Ford Fusion Energi	185
BMW i3 REX	19
BMW X5 XDrive40e	7
Audi A3 e-Tron	6
BMW i8	3
Volvo XC90 T8	4
Cadillac ELR	1
Honda Accord PHEV	1
Porsche Cayenne SE Hybrid	1
All Electric Vehicles (308)	
Nissan Leaf	145
Tesla Model S	62
Mitsubishi i-MiEV	25
Volkswagen e-Golf	24
Ford Focus Electric	17
Smart Electric Drive	12
Tesla Model X	10
Tesla Roadster	5
BMW i3 BEV	4
Kia Soul EV	1
Other (e.g. after market conversions)	3
TOTAL PASSENGER CARS	**1,396**

Figure 5. Vermont EVs per 10,000 people by County, Oct 2016[21]



[20] VT ANR / VT DMV data on EV registrations as of 9/24/2016
[21] *ibid*

Figure 6. Vermont Plug-in Electric Vehicle Registrations



EV Sales Forecast

> Many factors shape the number, type, and relative efficiency of the vehicles registered in Vermont: federal and state vehicle efficiency standards, the development and sale of new technologies (such as batteries that can increase EV range), the diversity and quantity of vehicles available in new and used markets, the price of gasoline or other fossil fuels, consumer preferences, and evolving consumer knowledge about vehicle technologies. While the pace of the transformation of vehicle markets is a complex process driven by many factors, the market for electric vehicles is still very new, and state government and partner organizations can play a critical role in spurring its growth by developing supportive policies and programs that both increase consumer awareness and demand and ensure adequate supply of new technologies and models in the Vermont vehicle marketplace.
>
> Vermont Comprehensive Energy Plan – 2016, p.156

Vermont has approximately 450,000 registered passenger vehicles with annual sales of approximately 30,000 vehicles across all types of vehicles. SUVs and light trucks are the most popular options in new vehicle sales, comprising 70% of market, with smaller passenger cars picking up the remaining 30%.

Long term growth of the EV market in Vermont will depend on several related factors, including vehicle availability of models from auto makers suitable for Vermonters, pricing, EV charging infrastructure availability, consumer awareness, macroeconomic conditions, government regulations, adoption of disruptive technology (e.g. autonomous vehicles), and any incentive programs offered by government or other entities.

The difficulty of forecasting the shifting influences of the above factors over time suggests the use of scenarios as a way of considering how EV adoption might proceed in Vermont over the next 30 years based on existing regulations and statewide goals for renewable energy use. Three scenarios are detailed below as follows:

- Low scenario – EVs reach 40% of the light duty fleet, or about 180,000 by 2050.
- Medium scenario – EVs reach 60% of the light duty fleet, or 270,000 vehicles by 2050.
- High scenario – EVs reach 90% of the fleet, or 405,000 vehicles by 2050.

Table 5 below shows total EV registrations based on these three scenarios. Table 6 expresses the % of total EVs in relation to the 450,000 total passenger vehicles. Table 7 is the annual increase in EVs registered associated with each scenario and Table 8 expresses the EV growth in relation to the estimate 30,000 annual sales of new light duty vehicles. Figure 7 shows the total EV forecast in Table 5 graphically.

Under these scenarios EVs are predicted to reach 10% of the new light duty vehicle market between 2022 and 2025. The scenarios reflect continued growth in sales through 2035 before beginning to taper.

Vermont EV Market Forecast Scenarios

Table 5. Total EVs Registered by Forecast Scenario

Year	Low	Medium	High
2015	1,113	1,113	1,113
2020	4,080	4,655	5,935
2025	14,457	18,873	30,506
2030	45,731	67,835	131,420
2035	107,012	170,371	318,979
2040	158,676	247,399	395,489
2045	175,852	266,687	404,233
2050	179,283	269,559	404,940

Table 6. EV Forecast as a % of Total Passenger Vehicles

Year	Low	Medium	High
2015	0.2%	0.2%	0.2%
2020	0.9%	1.0%	1.3%
2025	3.2%	4.2%	6.8%
2030	10.2%	15.1%	29.2%
2035	23.8%	37.9%	70.9%
2040	35.3%	55.0%	87.9%
2045	39.1%	59.3%	89.8%
2050	39.8%	59.9%	90.0%

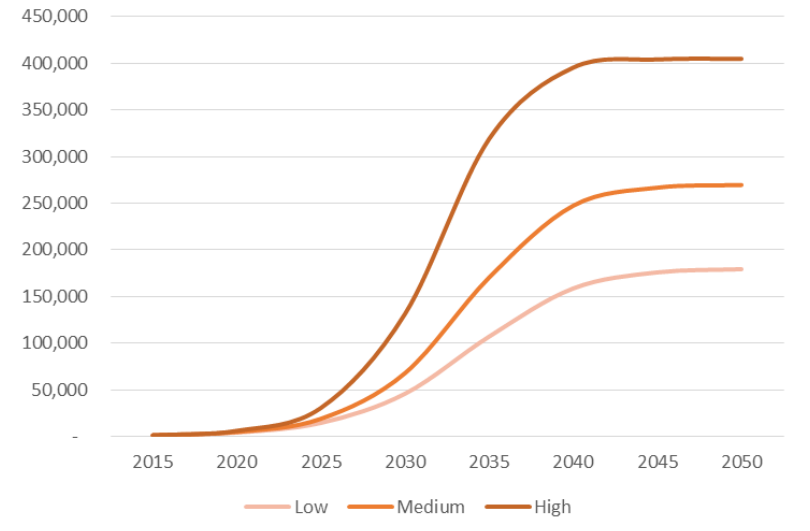
Table 7. Annual EV Growth

Year	Low	Medium	High
2015	330	370	445
2020	930	1,155	1,685
2025	3,175	4,535	8,370
2030	8,805	14,330	30,340
2035	13,480	22,335	33,740
2040	7,201	9,430	5,945
2045	1,696	1,615	510
2050	305	220	40

Table 8. EV Growth as a % of Total Passenger Vehicle Sales

Year	Low	Medium	High
2015	1.1%	1.2%	1.5%
2020	3.1%	3.9%	5.6%
2025	10.6%	15.1%	27.9%
2030	29.4%	47.8%	101.1%
2035	44.9%	74.5%	112.5%
2040	24.0%	31.4%	19.8%
2045	5.7%	5.4%	1.7%
2050	1.0%	0.7%	0.1%

Figure 7. Vermont Total EV Registration Forecasts



EV Contributions to Transportation Infrastructure Funding

State funding for transportation infrastructure maintenance and investments are provided by several different taxes and fees related to transportation system users. The primary taxes and fees include:

1. Fuel Taxes – Gasoline and diesel fuel is taxed on a combination of per gallon excise taxes and ad valorem fees based on a percentage of fuel prices, with floors and ceilings to maintain consistent levels of funding when prices fluctuate[22]. The current gasoline tax rate totals $0.2946/gallon comprised of $0.121/gallon tax, $0.0396/gallon motor fuel transportation infrastructure assessment, and a $0.134/gallon fuel tax assessment.
2. Vehicle Registration Fees – the Vermont Department of Motor Vehicles levies annual registration fees which go into the transportation fund.
3. Purchase and Use Taxes – The 6% state purchase and use tax is levied on vehicle purchases, with 4% of this going toward the transportation fund.

Figure 8 below provides the history of transportation revenues over the past 10 fiscal years. Gasoline and diesel taxes and fees represented 40% of the total, with the remaining 60% coming from other sources which EVs share in contributing to.

[22] Vermont Statutes Annotated. 23 V.S.A. § 3106. http://legislature.vermont.gov/statutes/section/23/028/03106

Figure 8. Vermont Transportation Fund Revenue by Source23

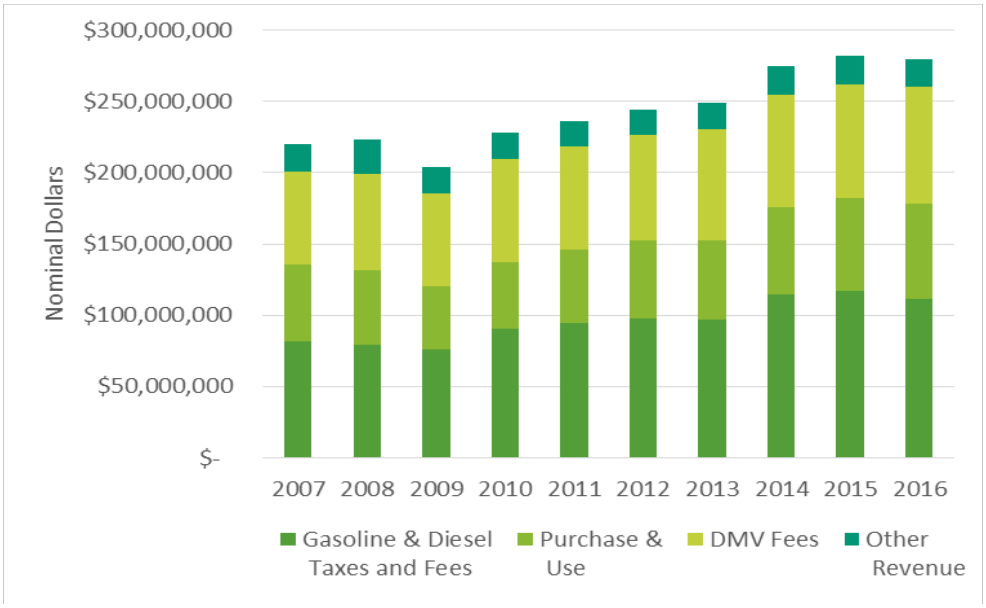


Table 9 below includes comparisons of different types of vehicles and their annual transportation funding contributions of gasoline taxes and registration fees. Adjustments are made to account for the reduced gasoline use of PHEVs which are estimated to travel 51% of their miles on gasoline based on data from US EPA and EVs registered in Vermont as of October 2016.

Table 9. Average Annual Contributions to State Transportation Funding by Vehicle Type

Type of Vehicle	Average Miles per Gallon	% Travel on Gasoline	Average Miles Traveled on Gasoline	Gasoline Consumption (gallons)	VT Gas Tax Contribution ($0.2946 / gallon)	Registration Fee	Total Annual Gas Tax and Registration Fees
Average Internal Combustion Engine	25	100%	12,000	480	$141	$76	**$217**
Hybrid Vehicle	50	100%	12,000	240	$71	$76	**$147**
Plug-in Hybrid Vehicle	42	51%	6,120	146	$43	$76	**$119**
All Electric Vehicle	n/a	0%	0	0	$0	$74	**$74**

[23] Vermont Joint Fiscal Office. 2016. *Transportation Fund Revenue*. http://www.leg.state.vt.us/jfo/transportation.aspx

The purchase and use tax contributions of different vehicles is highly variable. Table 10 below includes an estimate of the purchase price premium for PHEV and AEV vehicles based on manufacturer pricing for several different models available with standard internal combustion engines, hybrid drive, PHEV and AEV configurations. The purchase price premium is based on a weighted average of Ford Fusion, Ford CMax, Ford Focus, Nissan LEAF, BMW X5, VW Golf, Toyota Prius, Audi A3 eTron, and Volvo XC90 pricing. The additional purchase and use contribution is calculated as 6% of the premium, of which 2/3 flows into the state transportation fund. The $830 in purchase and use taxes paid over the life of an AEV represents over 5 years of the annual difference between AEV and standard vehicle gasoline tax revenue indicated in Table 9 above ($143/year).

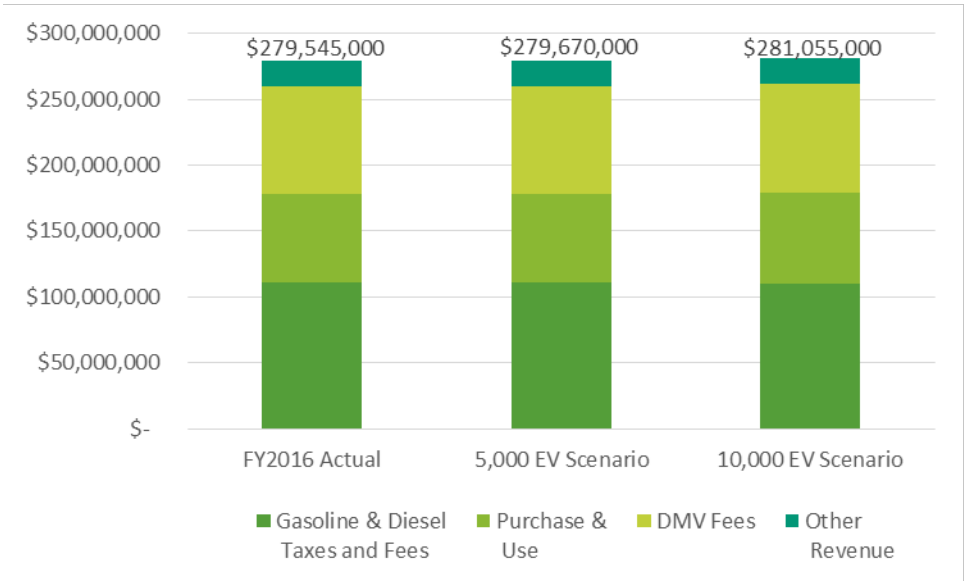
Table 10. EV Premiums and Additional Purchase & Use Tax Collected

Type of Vehicle	Average Purchase Premium[24]	Additional Purchase and Use Contribution
Hybrid Vehicle	$3,490	$210
Plug-in Hybrid Vehicle	$8,220	$490
All Electric Vehicle	$13,770	$830

Figure 9 below compares total transportation funding revenues for FY2016 with potential changes in total EVs and annual increases in EVs based on the medium EV growth forecast, the above reductions in motor fuel taxes and fees compared to an average vehicle, the increase in purchase and use taxes flowing to transportation (2/3 of the values in Table 10) and an assumed 60/40 split of PHEV / AEV options. While there are many uncertain influences which could shift this analysis, it appears growth in EV sales could actually have a beneficial effect on transportation funding. The scenario with 10,000 total EVs would require about 5,800 added vehicles in the year 2027. The added purchase and use tax from these vehicles more than makes up for lost fuel taxes, with total transportation funding estimated to increase by $1.5 million compared to the 2016 baseline.

[24] NADA. 2016. *NADA Guides MSRP Pricing*. http://www.nadaguides.com/Cars/Compare-Cars

Figure 9. Total Transportation Funding Scenarios



Report Recommendations

EV user fees should not be added in the immediate future. As articulated in the two previous studies, an EV fee is at cross purposes with the state's efforts to incentivize EV purchase and use, and thus get more electric vehicles on Vermont's roadways –an essential step in reducing the state's GHG emissions, and dependence on fossil fuels in the transportation sector and replacing fossil fuel use with renewably powered electricity. It sends the wrong message to Vermonters and partner states at a critical time when the states are expected to lead on addressing climate change. It would also make the state an outlier among the states that have adopted the CA ZEV program. Those states are wrestling with how to promote and incentivize sales, not asking that consumers pay more to own an EV.

Instead policies should be considered that include the following:

1. First is a Stable and Comprehensive Transportation Revenue Solution: A long term stable and comprehensive transportation revenue solution that grows with the economy is needed as overall vehicle efficiency increases and people drive less due to economic, desired lifestyle, health, and environmental reasons. EVs are an exceedingly small part of today's transportation revenue problem.

2. Second, *if a comprehensive transportation revenue solution is not in place that addresses losses from increased vehicle efficiency*, a fee should go into effect when the number of registered EVs represent 15% of auto sales. This is approximately 18,835 new registered passenger vehicles in a calendar year, and estimated to be by 2025. EVs would then be considered mainstreamed.

   If this second option is pursued, then the Commissioner of the DEC will report to the Commissioner of DMV when new EV registrations are 15% of annual passenger vehicle registrations. The fee will then be put in place in the beginning of the following state fiscal year.

   The fee amounts should be reasonable and reflect factors such as estimated lost gas tax revenues due to factors such as battery technology and estimated average vehicle use at the time the fee is put in place.

   The table below shows that 15.1% of sales could be achieved in 2025 under a "medium scenario". 18,873 EVs will be registered, representing 4.2% of the passenger vehicle fleet and with an annual growth rate of 4,535 vehicles.

Table 11. Total EVs Registered by Forecast Scenario

Year	Low	Medium	High
2015	1,113	1,113	1,113
2020	4,080	4,655	5,935
2025	14,457	18,873	30,506
2030	45,731	67,835	131,420
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2040	158,676	247,399	395,489
2045	175,852	266,687	404,233
2050	179,283	269,559	404,940

Table 12. EV Forecast as a % of Total Light Duty Vehicles

Year	Low	Medium	High
2015	0.2%	0.2%	0.2%
2020	0.9%	1.0%	1.3%
2025	3.2%	4.2%	6.8%
2030	10.2%	15.1%	29.2%
2035	23.8%	37.9%	70.9%
2040	35.3%	55.0%	87.9%
2045	39.1%	59.3%	89.8%
2050	39.8%	59.9%	90.0%

Table 13. Annual EV Growth

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2035	13,480	22,335	33,740
2040	7,201	9,430	5,945
2045	1,696	1,615	510
2050	305	220	40

Table 14. EV Growth as a % of Total Light Duty Sales

Year	Low	Medium	High
2015	1.1%	1.2%	1.5%
2020	3.1%	3.9%	5.6%
2025	10.6%	15.1%	27.9%
2030	29.4%	47.8%	101.1%
2035	44.9%	74.5%	112.5%
2040	24.0%	31.4%	19.8%
2045	5.7%	5.4%	1.7%
2050	1.0%	0.7%	0.1%

As noted previously, there are numerous factors in play in forecasting the growth in EVs including the number of vehicles available from the automakers that are suitable for Vermonters, pricing, EV charging infrastructure availability, consumer awareness, macroeconomic conditions, government regulations, adoption of disruptive technology (e.g. autonomous vehicles), and any incentive programs offered by government or other entities.

Fifteen percent of sales is generally consistent with the growth necessary for Vermont's contribution to the regional sales goal in the ZEV MOU. The ZEV Action Plan explains that new registrations of electric vehicles (plug-in hybrid and all-electric) will need to reach approximately 4,600 by 2025, about 15% of new passenger vehicle registrations in the state each year. This goal also aligns with the 2016 CEP's objective of making 10% of the state's fleet EVs by 2025.