Study on Imposing Fees on Alternatively Fueled Vehicles

December 1, 2020

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Table of Contents

Table of Figures, Charts or Tables

Executive Summary

Senate Bill 604, enacted during regular session of the 86th Texas Legislature, required the Texas Department of Motor Vehicles, in coordination with other specified state agencies, to organize a study on imposing fees on alternatively fueled vehicles (AFVs). The Public Utility Commission of Texas, the Texas Department of Transportation, the Texas Department of Public Safety, and the Texas Commission on Environmental Quality participated in the study and contributed to this report. The study examined the impact of the AFVs industry on the state, the options available to the state for collecting fees from owners of AFVs to replace the loss of revenue from motor fuel taxes, and the feasibility and desirability of establishing a fee for AFVs. The analysis included impacts on the state highway system, vehicle emissions and direct environmental benefits, the state's power grids and electricity markets, and state revenue related to vehicle use. The study examined potential fees on AFVs, including options related to electricity usage, vehicle registrations, and vehicle sales.

An alternatively fueled vehicle is a vehicle capable of using a fuel other than gasoline or diesel fuel. Those other fuel types include vehicles powered by electric and plug-in hybrid electric drives, compressed natural gas drives, and liquefied natural gas drives. The study focused heavily on electric vehicles due to the overall number of electric and hybrid vehicles and the growth in the numbers of such vehicles, especially electric ones. The large majority (almost 80%) of motor vehicles, including AFVs, registered in Texas are passenger vehicles and light trucks with less than 10,000 pounds gross weight. Medium-weight and heavy-weight vehicles are just becoming available as electric-type AFVs. Therefore, the data used in this analysis consists of AFVs in the lowest weight categories.

The Texas Department of Transportation examined the potential impacts of AFVs on the state highway system in terms of funding and road quality. The analysis estimates that for every conventional vehicle a consumer replaces with a hybrid-approximately $80 per year less in state gasoline taxes will be collected. This is about an 80% decline per year per vehicle. That number increases to a 100% decline if the consumer replaces the conventional vehicle with a fully electric one which would represent approximately a $100 reduction in state gasoline tax collections per year per vehicle, and similarly a $95 reduction in federal gasoline tax collections per year per vehicle. However, until the AFV market matures further, it is difficult to reasonably project the impact to state highway funding. The physical impact of AFVs on the state highway system is expected to be proportional, as AFVs weigh roughly the same as other vehicles in their classes.

The Texas Commission on Environmental Quality assessed the projected direct environmental benefit of AFVs on vehicle emissions in the state. The assessment found minimal direct environmental benefits from projected sales of AFVs because federal regulations apply the same emissions and fuel economy standards to all fuel types. Because federal regulations require vehicle manufacturers to meet tailpipe emissions and fuel economy standards based on their fleet averages and not on individual vehicle sales, manufacturers have the option of producing electric vehicles to offset the sales of higher-emitting gasoline and diesel vehicles so that overall fleet average requirements are achieved. However, since emissions and fuel economy standards are very stringent for newer model years, it is expected that overall electric vehicle sales will allow manufacturers to achieve but not exceed their fleet average requirements. Also, manufacturers whose fleet averages exceed federal requirements in certain model years can sell "credits" to manufacturers whose averages do not meet federal requirements. Since manufacturers have a financial incentive to sell credits, it is not expected that sales from electric-only vehicle manufacturers will result in additional emissions reductions overall. Based on certain assumptions, if none of the electric vehicles operating in the state are needed to meet the fleet average requirements, emissions could be reduced by 0.8% for nitrogen oxides and volatile organic compounds, 1.1% for carbon monoxide, 1.3% for particulate matter, and 2.2% for carbon dioxide, sulfur dioxide, and ammonia. In addition, since fuel consumption and tailpipe carbon dioxide emissions are directly correlated, the gallons of fuel consumed could also be reduced by 2.2% under this scenario.

The Public Utility Commission of Texas examined the potential impact of AFVs on the state's electric grids and markets. The analysis considered the market adoption of electric vehicles and the continued development of new charging technologies and their potential impact on the myriad electric utilities in Texas. While demand for electric vehicles has risen considerably and more types of electric vehicles are expected to be viable in coming years, most electric utilities do not anticipate difficulty managing the electricity demand from charging electric vehicles. However, the adoption of certain charging technologies may require utility system upgrades in localized areas.

As part of evaluating alternatives for levying fees on AFVs, the approaches used in other states were examined. As of early 2020, 29 states levy a registration fee specific to AFVs. Almost all levy a flat fee due at the time of vehicle registration. The average amount levied was approximately $120 a year.

The examination also consisted of current motor fuel taxes, vehicle registration and inspection fees, and electricity-related revenues collected in Texas. As mentioned above, the average amount of motor fuel tax collected from a hybrid vehicle is significantly less than the average amount collected for a conventional vehicle while the amount collected for an electric vehicle is zero. Vehicles registered in the state pay registration fees without regard to fuel type (except for large, diesel fueled vehicles which pay more but are less than 5% of vehicles registered). Therefore, there is no real difference in vehicle registration-related revenue if an AFV is registered versus a conventional vehicle. Gasoline and hybrid vehicles pay slightly more in inspection fees but only in non-attainment counties, while diesel and electric vehicles pay the same inspection fees. It is not possible to distinguish the amount AFVs currently pay in taxes, fees, and surcharges levied on the sale of electricity from the overall amounts collected.

The examined alternatives for levying a fee in Texas on AFVs included ones based on electricity usage, vehicle registration, and vehicle sales. The sales-based alternatives require larger assessments due to less frequent collection and may be a less consistent revenue source. The electricity usage alternatives have implementation issues but are similar to the motor fuel tax in being able to collect revenue from vehicles traveling through but not registered or based in the state. The registration-based alternatives would be a consistent source of revenue and align closely with existing collection methods.

The most straightforward alternative would be an increased vehicle registration fee. This is a similar approach used by almost every other state that has AFV fees and closely aligns with the current approach to vehicle registration in Texas. If the objective is to replace the average amount of state motor fuel tax that an equivalent conventional vehicle pays, the amount is estimated to be about $100 a year for an electric vehicle and a somewhat lower amount for a hybrid. The Texas Department of Transportation notes that the increased vehicle registration fee, as is done in some states, can be indexed to the cost of inflation, and that would help keep pace with the rising cost of building and maintaining the state's transportation infrastructure.

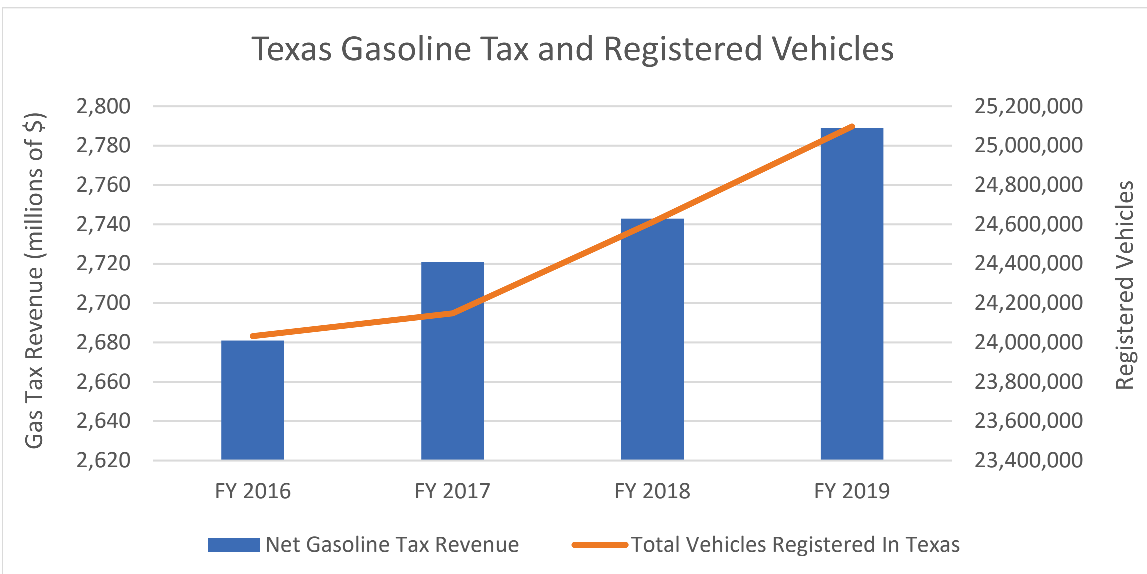
Section 1: Impact of Alternatively Fueled Vehicles on the State Highway System

Note: This section was prepared by the Texas Department of Transportation (TxDOT).

As the availability of more models of AFVs from automobile manufacturers continues to increase, so does the number of AFVs on Texas highways. The potential impact of this increase on the state highway system can be found largely in two critical areas: 1) the fiscal impact to the State Highway Fund, and 2) the impacts these vehicles have on the lasting durability and quality of the physical infrastructure of the state highway system. This section of the report will dive into each topic and explore how it affects Texas.

Fiscal Impact to the State Highway Fund

The Texas Comptroller of Public Accounts reports that in FY 2019, the net revenue for gasoline tax collections was just over \$2.789 billion.[1] This number has continued to increase annually, as have the number of registered vehicles on Texas' roadways.[2]



Sources: Texas Comptroller of Public Accounts and Texas Department of Motor Vehicles

Chart 1-1: Texas Gasoline Tax and Registered Vehicles

This growth also applies to AFVs. The two main AFVs are hybrids (including plug-in versions) and electric vehicles. Hybrid vehicles use both electricity and gasoline to propel their vehicles. These vehicles contribute to gasoline tax collections at a much lower rate per vehicle due to the increased miles traveled per gallon of gasoline. For example, a leading hybrid has a combined fuel economy of 133 miles per gallon.[3] In FY 2019, there were 225,212 hybrid vehicles registered in Texas, or 0.90% of the total registered vehicles.[3]

According to market projections, both the number of AFV brands and models available for consumer purchase will significantly increase in the coming years. From 2018 to 2023, the number of car brands offering at least one electric vehicle option is forecasted to increase from 14 to 43.[4] The number of different models offering electric propulsion

[1] Texas Comptroller of Public Accounts, FY 2019 Gasoline Tax https://fmcpa.cpa.state.tx.us/cashdrill/servlet/CDTable12Trend?det=0&yearMonth=2019-8&key=16
[2] Texas Department of Motor Vehicles FY01-18 Present Vehicles Registered by Registration Class
[3] Fuel Economy.gov 2020 Toyota Prius Prime https://www.fueleconomy.gov/feg/Find.do?action=sbs&id=41489
[4] "IHS Markit forecasts EV sales to reach US market share of 7.6% in 2026" https://ihsmarkit.com/research-analysis/--ihs-markit-forecasts-ev-sales-us.html

systems is projected to increase from 18 in 2018, to 38 by the end of 2020. By incorporating plug-in hybrids to the electric vehicle models, that number jumps to over 90 different models by 2022.[5] Consumers will have the ability to purchase a wide variety of vehicles ranging from sedans to sport utility vehicles and pickups.

Plug-in hybrid vehicles provide increased miles per gallon of fuel, or the complete removal of the need for fuel at all. This scenario creates the potential for a decrease in revenue collected by the state's motor fuel tax. The amount of decrease will be directly related to the actual number of AFVs on the roadway and the amount of replacement of conventional vehicles.

According to data collected by the Texas Department of Motor Vehicles in its FY 2019 Alternatively Fueled Vehicle Report,[6] the total number of AFVs registered in Texas at the end of FY 2019 was 259,800, which makes up 1.04% of the total number of vehicles registered in Texas. The number of AFVs on Texas' roads has increased every year since FY 2016, when the total number of AFVs registered in Texas was 212,420. The majority of these vehicles are hybrids, which have risen from 199,096 to 225,212 between FY 2016 and 2019, with a high of 233,645 in FY 2018.

In terms of percentage growth, according to the same report, the largest single category of AFVs to increase is electric vehicles. Those numbers have risen from 8,397 in FY 2016 to 29,540 in FY 2019[3]. The next closest category is natural gas vehicles, which have seen a fluctuation in the numbers of vehicles registered in Texas in the same timeframe from 3,889 in FY 2016 to 3,284 in FY 2019[3]. Due to their much higher numbers, this discussion will focus on electric vehicles and hybrids.

When considering the actual impact electric vehicles and hybrids have on the State Highway Fund, it is important to consider the average miles per gallon of these vehicles versus that of standard combustion engines. The top ten most fuel-efficient models of 2019 hybrid vehicles on the U.S. market averaged 108.1 miles per gallon of fuel.[7] If we apply the same criteria to the top ten most fuel-efficient electric vehicles on the U.S. market in 2019, that number increases to 124.3 miles per gallon of equivalent.[8]

The miles per gallon for conventional vehicles is substantially less for the same year of vehicle models. The top ten most fuel-efficient conventional vehicles - (gasoline, diesel and flex-fuel) on the U.S. market averaged 36.3 miles per gallon of fuel.[9] This reduction creates a disparity of 88 and 71.8 miles per gallon of fuel respectively between the models of electric and hybrid vehicles and those with combustion engines. However, electric vehicles require

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[5] "Nearly 100 electrified models slated to arrive through 2022" https://www.autonews.com/article/20181001/OEM04/181009990/nearly-100-electrified-models-slated-to-arrive-through-2022

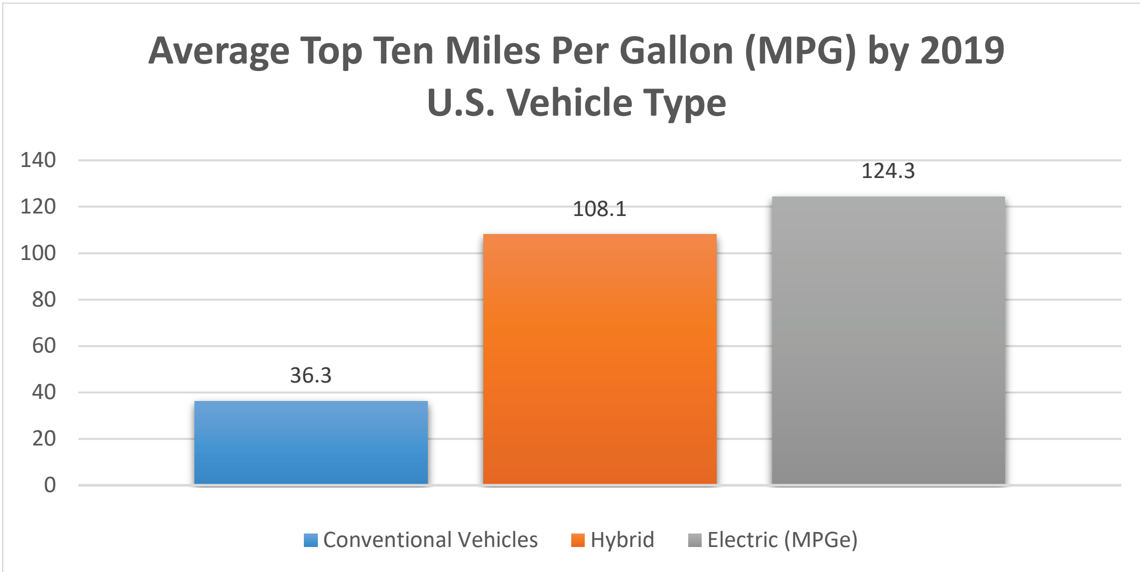
[6] Texas Department of Motor Vehicles Annual Reports https://www.txdmv.gov/node/3703

[7] Fuel Economy.gov vehicle search https://www.fueleconomy.gov/feg/PowerSearch.do?action=noform&year1=2019&year2=2019&minmsrpsel=0&maxmsrpsel=0&city=0&hwy=0&comb=0&cbvthybrid=Hybrid&cbvtplugin=Plug-in+Hybrid&YearSel=2019&make=&mclass=&vfuel=&vtype=Hybrid%2C+Plug-in+Hybrid&trany=&drive=&cyl=&MpgSel=000&sortBy=Comb&Units=&url=SearchServlet&opt=new&minmsrp=0&maxmsrp=0&minmpg=&maxmpg=&rowLimit=25&pageno=1&tabView=0

[8] Fuel Economy.gov vehicle search https://www.fueleconomy.gov/feg/PowerSearch.do?action=noform&year1=2019&year2=2019&minmsrpsel=0&maxmsrpsel=0&city=0&hwy=0&comb=0&cbvtelectric=Electric&YearSel=2019&make=&mclass=&vfuel=&vtype=Electric&trany=&drive=&cyl=&MpgSel=000&sortBy=Comb&Units=&url=SearchServlet&opt=new&minmsrp=0&maxmsrp=0&minmpg=&maxmpg=&rowLimit=25&pageno=1&tabView=0

[9] Fuel Economy.gov vehicle search https://www.fueleconomy.gov/feg/PowerSearch.do?action=noform&year1=2019&year2=2019&minmsrpsel=0&maxmsrpsel=0&city=0&hwy=0&comb=0&cbvtgasoline=Gasoline&cbvtdiesel=Diesel&cbvte85=E85&YearSel=2019&make=&mclass=&vfuel=&vtype=Gasoline%2C+Diesel%2C+E85&trany=&drive=&cyl=&MpgSel=000&sortBy=Comb&Units=&url=SearchServlet&opt=new&minmsrp=0&maxmsrp=0&minmpg=&maxmpg=&rowLimit=25&pageno=1&tabView=0

zero liquid fuel. This means that the difference in liquid fuel between an electric vehicle and a combustion engine when applied to revenue generated by the state motor fuels tax is 124.3 miles per gallon.



Source: Fuel Economy.gov

Chart 1-2: Average Top Ten Miles Per Gallon

This disparity is especially pronounced by performing a similar analysis as was completed previously (and maintaining all the same assumptions) and these miles per gallon numbers are applied to the average number of miles driven in the United States. In 2018, the average miles traveled per vehicle for all light duty vehicles in the United States was 11,484 miles.[10] If that number is divided by the top ten most fuel-efficient models of 2019 hybrid vehicles' average of 108.1 miles per gallon of fuel, it can be determined that these hybrids would need a total of 106.23 gallons of gasoline a year. If that number is multiplied by the state gasoline tax rate in Texas of $0.20 a gallon, it can be determined that these hybrids potentially generate $21.25 annually. The same equation applied to the top ten most fuel-efficient conventional vehicles available in the United States average of 36.3 miles per gallon generates $63.27 annually. This creates a state gasoline tax difference of $42.02 between the top ten most fuel-efficient hybrid and top ten most fuel-efficient conventional vehicle classification averages.[11]

From a federal gasoline tax perspective, the hybrid vehicles' average need of 106.23 gallons of gasoline a year multiplied by the federal gasoline tax rate of $0.184 would generate $19.55 annually. Additionally, the federal gasoline tax rate of $0.184 multiplied by the top ten most fuel efficient conventional vehicles average of 36.3 miles per gallon generates $58.21 annually. This creates a federal gasoline tax difference of $38.66 between the two top ten most fuel-efficient hybrid and top ten most fuel-efficient conventional vehicle classification averages.

These differences increase even more if we apply the same equations to the national light duty vehicle fleet average miles per gallon, rather than the average miles per gallon of the top ten most fuel-efficient conventional vehicles. According to the U.S. Department of Transportation's Bureau of Transportation Statistics, their most recent data states that the 2017 average fuel efficiency for a light duty vehicle in the United States was 22.3 miles per gallon.[12]

[10] U.S. DOT Bureau of Transportation Statistics https://www.fhwa.dot.gov/policyinformation/statistics/2018/pdf/vm1.pdf

[11] It should be noted that in the equation the average of the top ten vehicles on the market was used and not the top ten vehicles in Texas. This is largely responsible for the difference in annual motor fuel tax generation numbers in the different parts of the report.

[12] U.S. DOT Bureau of Transportation Statistics https://www.bts.gov/content/average-fuel-efficiency-us-light-duty-vehicles

If we divide the average miles traveled of 11,484 by 22.3 miles per gallon of fuel it can be determined that the average conventional fueled vehicle needs a total of 514.98 gallons of fuel. This would generate $103 in state taxes and $94.76 in federal taxes annually, increasing the differences from state and federal taxes collected from the average of the top ten most fuel-efficient hybrids. As it relates to the top ten most fuel-efficient electric vehicles, regardless whether they are compared to the top ten most fuel-efficient conventional vehicles, or the average conventional vehicle, the difference in revenue collected is the full amount of the state and federal taxes received from the conventional vehicles.

As the number of electric and plug-in hybrid models available to consumers continues to grow, there will potentially be a growing negative impact to the State Highway Fund. Simply put, using the same top ten comparison from this discussion, for every leading fuel-efficient conventional vehicle that a consumer replaces with a hybrid, the State Highway Fund will lose $42.02, or 66 percent of the revenue a conventional vehicle would generate in state gasoline taxes, and $38.66, or 66 percent of the revenue a conventional vehicle would generate in federal gasoline taxes. That number increases to a 100 percent decline if the consumer replaces their conventional vehicle with a fully electric automobile. Until the market matures further with more AFVs available, and their rate of adoption better understood, it is difficult to reasonably project the impact to the State Highway Fund, and to Federal Transportation Funds.

Impact on the Quality of the State Highway System

As the number of AFVs grow in Texas, their impact on the overall infrastructure quality of the state highway system should be reviewed. The best method to determine this impact is by analyzing the weight of these vehicles compared to those with combustion engines as the weight of vehicles is generally recognized as a critical factor in determining wear and tear on a roadway.[13] For this discussion the weight of AFVs will be compared to different models of conventional vehicles.

The number one selling plug-in electric vehicle in the United States for 2019 was the Tesla Model 3[14]. According to the report, this solely electric vehicle sold 154,840 vehicles of a total 326,644 plug-ins purchased nationwide. Additionally, the report notes the second most popular was the plug-in hybrid Toyota Prius at 23,630 vehicles sold, followed by the electric Tesla Model X at 19,425 vehicles.

The weights for these vehicles differ between models. Their 2020 model curb weights are as follows (in pounds):

2020 Tesla Model 3: 3,554-4,036[15]
2020 Toyota Prius: 3,010-3,075[16]
2020 Tesla Model X: 5,421-5,531[17]

According to Edmunds.com, the top selling conventional new vehicles in Texas in 2019 were the Ford F-Series, Dodge Ram 1500/2500/3500, Chevrolet Silverado, Toyota RAV4, and GMC Sierra.[18] Nationwide, their top 10 list also included the Honda CR-V, Chevrolet Equinox, Toyota Tacoma, Honda Civic, Toyota Corolla, and Nissan Rogue. (The GMC Sierra is not included in the listed top 10 selling vehicles.)

Their 2020 model curb weights are as follows (in pounds):

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[13] State Smart Transportation Initiative https://ssti.us/wp/wp-content/uploads/2011/11/Trucks%20and%20Infrastructure%20Maintenance%20Costs.pdf
[14] U.S. Department of Energy Alternative Fuels Data Center https://afdc.energy.gov/data/10567
[15] Tesla Model 3 Website https://www.tesla.com/model3
[16] Toyota Prius Website https://www.toyota.com/prius/features/exterior/1221/1223/1225
[17] Tesla Model X Website https://www.tesla.com/modelX
[18] Edumnds.com https://www.edmunds.com/most-popular-cars/

2020 Ford F150 XL: 4,415-5,320[19]
2020 Dodge Ram 1500 Tradesman: 4,798[20]
2020 Chevrolet Silverado LT Train Boss: 4,815[21]
2020 Toyota RAV4: 3,370-3,710[22]
2020 GMC Sierra SLE: 4,622[23]
2020 Honda CR-V: 3,337-3,455[24]
2020 Chevrolet Equinox LT: 3,325[25]
2020 Toyota Tacoma: 4,445-4,505[26]
2020 Honda Civic: 2,771-2,963[27]
2021 Toyota Corolla: 2,850-3,150[28]
2020 Nissan Rogue: 3,464-3,551[29]

A comparison of vehicle weights demonstrates that in Texas the weights between the top five conventional vehicles averages at 4,528.5 pounds. To maintain consistency with earlier calculations in this report, this number does not take into consideration the larger versions of the Ford and Dodge trucks. By incorporating the rest of the national top 10, and excluding the GMC Sierra, the average is 3,859.1 pounds.

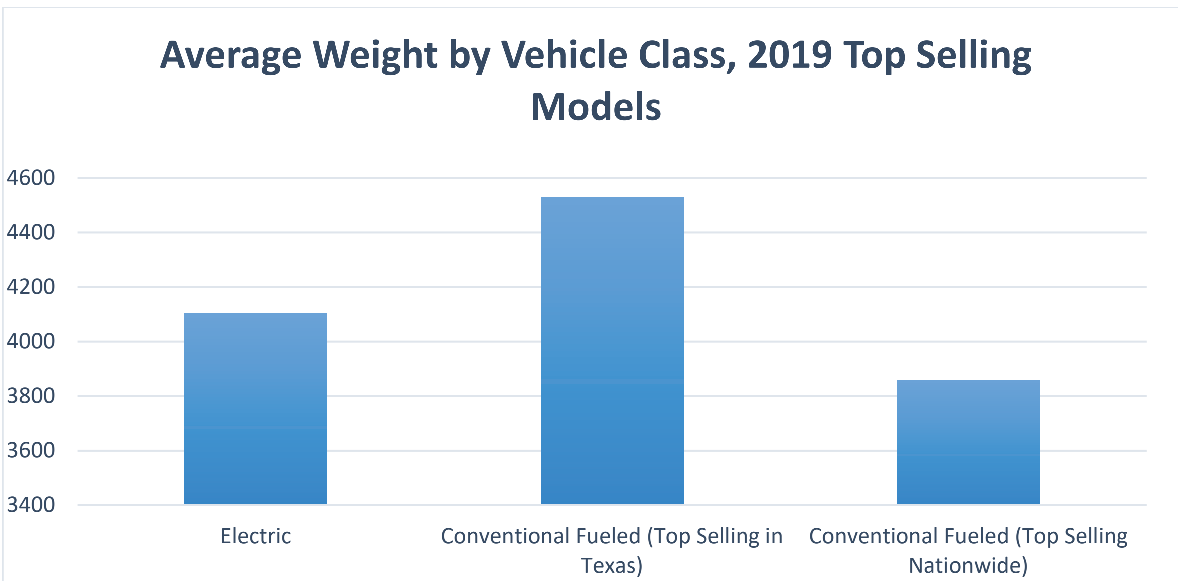

Chart 1-3: Average Weight by Vehicle Class

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[19] Ford.com https://www.ford.com/trucks/f150/models/f150-xl/
[20] Dodge Ram https://www.ramtrucks.com/ram-1500/specs.html
[21] Chevrolet Silverado https://www.chevrolet.com/trucks/silverado/1500/build-and-price/features/trims/table?section=Mechanical&section=Dimensions&styleOne=406485
[22] Toyota RAV4 https://www.toyota.com/rav4/features/exterior/4430/4435/4440
[23] GMC Sierra https://www.gmc.com/trucks/sierra/1500/sle-elevation-slt/build-and-price/features/trims/table?section=Highlights&section=Exterior&section=Dimensions&styleOne=406625
[24] Honda CR-V https://automobiles.honda.com/cr-v/specs-features-trim-comparison
[25] Chevrolet Equinox https://www.chevrolet.com/suvs/equinox/build-and-price/trim/compare/trims/table?section=Highlights&section=Dimensions&styleOne=406418
[26] Toyota Tacoma https://www.toyota.com/tacoma/features/mpg/7594/7544/7582
[27] Honda Civic https://automobiles.honda.com/civic-sedan/specs-features-trim-comparison
[28] Toyota Corolla https://www.toyota.com/corolla/features/mileage_estimates/1882/1856/1866
[29] Nissan Rogue https://www.nissanusa.com/vehicles/crossovers-suvs/rogue/specs/compare-specs.html#modelName=S|FWD,SL|FWD,SV|FWD

Comparing the weights of the electric and hybrid vehicles, there is very little difference between vehicle classifications. This leads to the conclusion that there will be minimal decrease to the quality of the state highway system by any physical characteristic of AFVs. As the hybrid and electric vehicle market continues to mature further with an expanding rate of adoption and usage of the transportation system, their lower rate of fuel tax contribution will have more negative impacts to the State Highway Fund. This impact will be compounded with growing fuel efficiency of conventional vehicles.

It should be noted that in addition to the wear and tear on the state highway system, AFVs, as do all vehicles, contribute to the operational needs of the state highway system, such as the maintenance of signs, signals and markings, along with congestion levels that are experienced in many parts of the state. It is difficult to specifically quantify a per vehicle cost associated with these activities, but these costs comprise a major portion of the expenditures from the State Highway Fund and federal transportation funds. Additionally, it should be recognized that the costs required to address vehicle impacts on our transportation systems increase over time due to inflation. Revenue collections to account for these costs in the State Highway Fund and federal transportation funds should consider including provisions that allow for them to increase at a proportional rate.

Section 2: Direct Environmental Benefit of Alternatively Fueled Vehicles

Note: This section was prepared by the Texas Commission on Environmental Quality (TCEQ).

Article 6, Study on Imposing Fees on AFVs, Senate Bill 604 (SB 604) from the 86th Legislative Session (2019) requires the TCEQ to assess "the projected direct environmental benefit of AFVs on vehicle emissions in this state." The Texas Transportation Code defines an AFV as one that is "capable of using a fuel other than gasoline or diesel fuel." For the purposes of this analysis, TCEQ defined direct environmental impacts as emissions occurring from vehicles during operation and refueling. This analysis found minimal direct environmental benefits from projected sales of alternatively fueled light-duty vehicles because federal regulations apply the same emissions and fuel economy standards to all fuel types.

Federal regulations require vehicle manufacturers to meet tailpipe emissions and fuel economy standards based on their fleet averages and not on individual vehicle sales. These requirements are referred to as "fleet average requirements" (see *Vehicle Emissions Under Federal Regulations* below for more details). Manufacturers have the option of producing electric vehicles[30] to offset the sales of higher-emitting gasoline and diesel vehicles so that overall fleet average requirements are achieved. Since the tailpipe emissions and fuel economy standards are very stringent for newer model years, it is expected that overall electric vehicle sales will allow manufacturers to achieve but not exceed their fleet average requirements.

Under credit averaging, banking, and trading (ABT) programs, manufacturers whose fleet averages exceed federal requirements in certain model years have the option of obtaining credits for the difference between their fleet average and the required fleet average. These manufacturers can then sell their credits to other manufacturers whose fleet averages do not meet federal requirements and need additional credits for compliance purposes. Since manufacturers have a financial incentive to sell ABT credits, it is not expected that sales from electric-only vehicle manufacturers will result in additional emissions reductions from the overall fleet.

Using the most recent federal regulations for tailpipe emissions[31] and fuel economy[32], the TCEQ quantified the maximum possible reductions in emissions if all light-duty electric vehicles operating on Texas roads in 2028 are not needed by manufacturers to meet fleet average requirements. These maximum possible reductions for the 2028 light-duty fleet were calculated by taking the difference between two scenarios: one where all electric vehicles are needed to meet fleet average requirements, and one where no electric vehicles are needed to meet fleet average requirements. While these scenarios are based on the regulatory standards, the calculations used are based on in-use emissions rates, which typically differ from the fleet average requirements.

In 2028, 486,811 light-duty electric vehicles are projected to be operating throughout Texas. If none of these vehicles are needed to meet fleet average requirements, light-duty emissions would be reduced by 0.8% for nitrogen oxides (NOX) and volatile organic compounds (VOC), 1.1% for carbon monoxide (CO), 1.3% for particulate matter (PM), and 2.2% for carbon dioxide (CO2), sulfur dioxide (SO2), and ammonia (NH3). In addition, since fuel consumption and tailpipe CO2 emissions are directly correlated, the gallons of fuel consumed would also be reduced by 2.2% under this scenario.

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[30] For the purposes of this analysis, electric vehicles include battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) that can be powered exclusively by electricity. Hybrid electric vehicles (HEVs) that can only be powered by gasoline are not included per the definition in the Texas Transportation Code.

[31] *Final Rule for Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards*, U.S. Environmental Protection Agency, https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-air-pollution-motor-vehicles-tier-3.

[32] *The Safer Affordable Fuel-Efficient 'SAFE' Vehicles Rule*, U.S. National Highway Transportation Safety Administration, https://www.nhtsa.gov/corporate-average-fuel-economy/safe.

Electric options are starting to become available for medium-duty and heavy-duty vehicles. Since future electric vehicle sales projections for these categories are not yet available, this analysis focused on impacts to the light-duty portion of the fleet.

Scope of Analysis

Article 6.02(c)(8) of Senate Bill 604 (SB 604) from the 86th Texas Legislature (2019) requires the TCEQ to examine "the projected direct environmental benefit of AFVs on vehicle emissions in this state." Section 502.004 of the Texas Transportation Code defines an alternatively fueled vehicle as one that "is capable of using a fuel other than gasoline or diesel fuel." Although multiple types of vehicles exist on roadways, this report focuses on light-duty cars and trucks, which account for the majority of on-road vehicles and over 98% of current alternatively fueled vehicle registrations in the state (Texas Department of Motor Vehicles [TxDMV], 2019).

The TCEQ compared the emissions of conventional vehicles versus AFVs in the context of the regulatory environment that influences overall vehicle emissions. The U.S. Environmental Protection Agency (EPA)'s fleet average requirements are fuel neutral, which means the emissions limits contained in these requirements "are applicable regardless of the type of fuel that the vehicle is designed to use" and "vehicles certified to operate on any fuel (e.g., gasoline, diesel fuel, E85, compressed natural gas, liquefied natural gas, hydrogen, and methanol) are all subject to the same standards" (EPA, 2014).

The TCEQ assessed the impacts of AFVs on tailpipe and refueling emissions in 2028. The TCEQ did not focus on impacts upstream of the primary energy source (e.g., gas station pump or electric charging station) as any upstream impacts are not direct environmental benefits. For gasoline and diesel fuel, the upstream impacts include extraction of crude oil, refining, and transport by pipeline and/or truck. For generating electricity, the upstream impacts include power plant operation along with the extraction and transport of natural gas and coal. Fully accounting for the upstream impacts would significantly change the methods employed in this analysis and could alter the results. In addition, air quality benefits from pollutant reductions (e.g., reductions in ozone or haze) are also not included in this analysis because such benefits are not a direct benefit on vehicle emissions.

In agreement with the partner agencies, the TCEQ chose 2028 as the future year for analysis. The TCEQ chose to limit the future year to within 10 years due to the inherent uncertainty associated with all future year analyses. The 2028 future year coincides with a vehicle emissions study recently developed for TCEQ air quality modeling applications (Texas A&M Transportation Institute [TTI], 2019). Additionally, all current federal vehicle emissions standards will be phased in by 2026, and therefore a 2028 projection year allows full implementation of these standards to be included.

TCEQ's analysis focuses on electric vehicles since all other vehicles that use a hydrocarbon fuel have tailpipe emissions that must be controlled by some type of exhaust after-treatment. In contrast, electric vehicles do not have tailpipe emissions and are therefore the primary alternatively fueled category that has the potential for achieving emissions reductions from the light-duty fleet beyond what would occur due to fleet average requirements. In this analysis, electric vehicles encompass both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) that can be powered by either gasoline or electricity, as PHEVs also have zero emissions when powered exclusively by electricity. For the purposes of this analysis, hybrid electric vehicles (HEVs) powered exclusively by gasoline were not defined as alternatively fueled because the statutory definition referenced above requires "a fuel other than gasoline or diesel."

This analysis quantifies the maximum possible emissions reductions that could be achieved if all the light-duty electric vehicles projected to be operating in 2028 were not needed by manufacturers to meet current federal fleet average requirements. The relevant federal regulations are further explained below in *Vehicle Emissions Under Federal Regulations*, and the logic behind the assessment of maximum possible emissions reductions is detailed below in *Framework for Projected Environmental Benefits Analysis*.

Vehicle Emissions Under Federal Regulations

The National Emissions Standards Act of 1965 established the first set of vehicle emissions requirements starting with the 1968 model year. These standards have been periodically tightened, with the most recent Tier 3 emissions standards phasing in from the 2017 through 2025 model years (EPA, 2014) for the pollutants of nitrogen oxides (NO_X), non-methane organic gases (NMOG)[33], carbon monoxide (CO), and particulate matter (PM). When the Tier 3 emissions standards are fully implemented, the light-duty fleet average requirement will be 30 milligrams per mile of NO_X and NMOG combined. More information on Tier 3 emissions standards is provided in Appendix B: *Detailed Discussion of Direct Environmental Benefit*.

The Energy Policy and Conservation Act of 1975 established the first set of Corporate Average Fuel Economy (CAFE) standards starting with the 1978 model year. These standards have been periodically revised, with the most recent changes applying to the 2021 through 2026 model years (EPA/National Highway Traffic Safety Administration [NHTSA], 2020). Tailpipe emissions of carbon dioxide (CO_2) are directly correlated with fuel consumption because the amount of CO_2 emitted per gallon of gasoline and diesel fuel is constant. Tailpipe emissions of sulfur dioxide (SO_2) and evaporative emissions of volatile organic compounds (VOC) from refueling also directly correlate with fuel consumption, as SO_2 is released as a byproduct of the sulfur content in gasoline, and VOC refueling emissions correspond to the gallons of gasoline pumped.

For 2026-and-later model years, the most recent CAFE standards specify an average fuel economy for the light-duty fleet of 40.4 miles per gallon (mpg) and 199 grams per mile of CO_2. The CAFE rules note that in-use fuel economy is typically 20% lower and in-use CO_2 emissions are typically 25% higher than these compliance standards. This results in actual light-duty fleet averages closer to 32 mpg and 249 grams per mile of CO_2.

As shown in Figure 2-1: *NO_x, VOC, and CO_2 Emission Rates in 2028 by Model Year for Passenger Cars*, the Tier 3 emissions standards that phase in from 2017 through 2025 are more stringent than the Tier 2 emissions standards from 2004 through 2016, which in turn are more stringent than earlier standards. Fuel economy rates were relatively constant through the 2011 model year and then started to steadily increase based on rules for the 2012 through 2016 model years (EPA/NHTSA, 2010), the 2017 through 2020 model years (EPA/NHTSA, 2012), and the 2021 through 2026 model years (EPA/NHTSA, 2020). As fuel economy increases, CO_2 emissions decrease, leveling off for passenger cars around 212 grams per mile for 2026-and-later model years. Emission rates in 2028 by model year for CO, PM, SO_2, and ammonia (NH_3) are provided in Appendix B.

[33] NMOG is equivalent to volatile organic compounds (VOC) plus ethane.

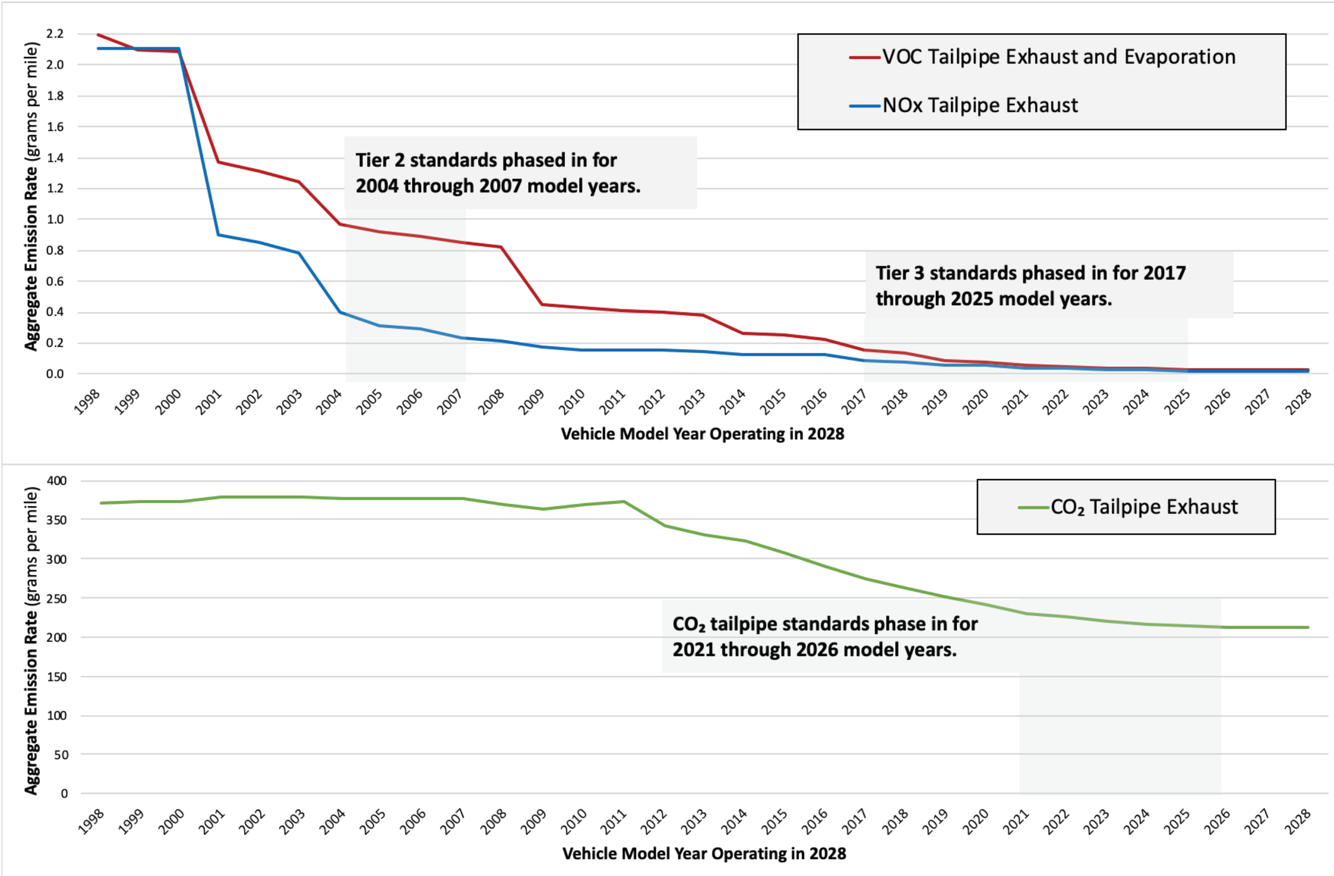


Figure 2-1: NOX, VOC, and CO2 Emission Rates by Model Year for Passenger Cars

Maximum Environmental Benefit Analysis

Framework for Projected Environmental Benefits Analysis

In its most recent rulemaking related to tailpipe emissions standards (EPA, 2014), the EPA acknowledged that manufacturers will likely produce a significant number of zero-emitting electric vehicles to comply with the very stringent fleet average requirements. The current light-duty fleet is comprised of vehicles that, taken as a whole by model year, meet but do not exceed the federal fleet average requirements. Therefore, it is likely that most manufacturers will use electric vehicles to offset their production of higher-emitting vehicles. However, if manufacturers meet their fleet average requirements without using any electric vehicle sales, then electric vehicles could potentially supply emission reduction benefits beyond those currently needed for fleet average requirements.

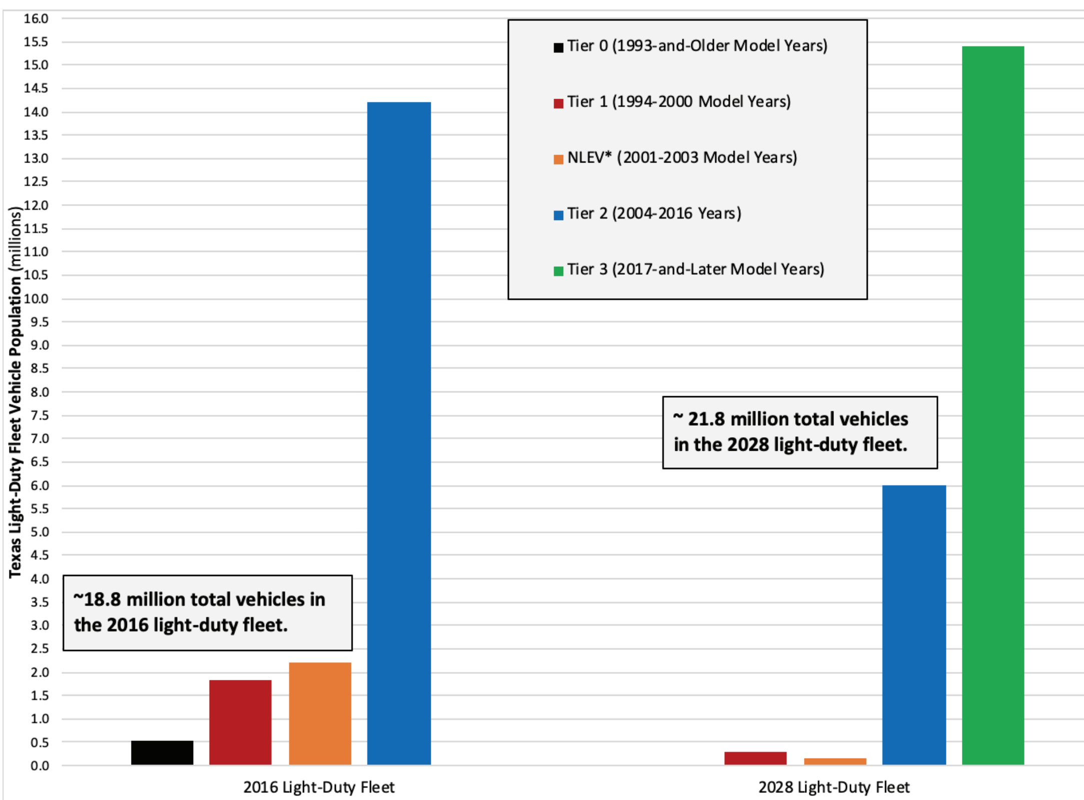
The TCEQ conducted an analysis to determine what the maximum possible emissions reductions would be if none of the electric vehicles projected to be operating in 2028 were needed to meet fleet average requirements. These maximum possible emissions reductions were calculated by taking the difference between two scenarios for the 2028 light-duty fleet: one where all electric vehicles are needed to meet fleet average requirements, and one where no electric vehicles are needed to meet fleet average requirements. TCEQ staff estimated the total emissions per day of each pollutant for both scenarios using projections of the Texas vehicle fleet composition in 2028 (including the projected number of electric vehicles), vehicle emissions rates, and the vehicle miles traveled (VMT). These elements are discussed in more detail below in *Vehicle Fleet Composition, Emissions Rates, and VMT Estimations*.

The estimated maximum possible emissions reductions from electric vehicles calculated for this study could not be used to take additional emissions credit in the Texas State Implementation Plan (SIP) required under the 1990 Federal Clean Air Act (FCAA) Amendments because the TCEQ SIP air quality modeling follows the EPA assumption that all AFVs will be used to meet federal fleet average requirements. The EPA noted in its rulemaking for the Tier 3 emissions standards that manufacturers have “a very limited ability to offset sales of vehicles certified above the 30 milligrams per mile fleet average emission standard” since the fleet average limit is so stringent (EPA, 2014).

Vehicle Fleet Composition, Emissions Rates, and VMT Estimations

The TCEQ used emissions estimates by TTI that included vehicle population, emission rates, and VMT for Texas for both a 2016 historical year and a 2028 future year (TTI, 2019). At any given time, the light-duty vehicle fleet is made up of a mix of vehicles of different ages with different emission rates due to changing fleet average requirements and vehicle deterioration over time. Older model year vehicles may have a higher emission rate than they would have had the year the car was manufactured due to vehicle deterioration over time.

Over time, consumers replace older vehicles with newer vehicles, continuously phasing out older vehicle models from the light-duty vehicle fleet; this is called fleet turnover. As shown in Figure 2-2: *Composition of Texas Light-Duty Fleets in 2016 and 2028*, roughly 75% of the light-duty vehicles that operated in 2016 were manufactured after 2004, meaning they met Tier 2 emissions standards. By 2028, roughly 71% of the fleet is expected to be comprised of very low-emitting vehicles that meet Tier 3 emissions standards (2017-and-later model years).



** NLEV refers to the National Low Emissions Vehicle program.*

Figure 2-2: Composition of Texas Light-Duty Fleets in 2016 and 2028

Electric Vehicle Population Projections

Manufacturers are not required by any state or federal regulation to produce a minimum number or percentage of electric vehicles in any given model year. As a result, this analysis relies on predictions of the number of electric vehicles that will be operating in Texas during any particular future year.

Since 2016, TxDMV has annually reported the number of AFVs registered in the state. As of September 2019, 29,540 BEV registrations were reported (TxDMV, 2019). The hybrid registrations reported combine the HEV and PHEV categories, so only the BEV registrations were used in this analysis. The 2020 Annual Energy Outlook (AEO) from the U.S. Energy Information Administration (EIA) provides light-duty electric vehicle sales projections by model year for multiple areas of the U.S., and separate estimates for BEV and PHEV sales are included. At this time, medium-duty and heavy-duty electric vehicle sales projections are not available from the EIA.

Figure 2-3: *Texas Electric Vehicle Population Projections by Model Year* presents TxDMV electric vehicle registrations and the Texas portion of the AEO projections for the 2020 through 2028 model years. Combining the historical TxDMV registrations with the AEO projections results in a predicted 2028 electric vehicle population of 486,811 for Texas. More details about how the specific values by model year were derived are provided in Appendix B.

The sharp increase between TxDMV registrations in 2019 and the AEO projections for the 2020 model year indicates that the EIA methodologies may overestimate the future electric vehicle population. Excluding PHEVs from the 2019 TxDMV registrations may also contribute to this sharp increase from 2019 to 2020. Despite these discrepancies, the TCEQ determined that combining the TxDMV data with the AEO projections provided the best available projection of the 2028 electric vehicle population at the time this analysis was performed.

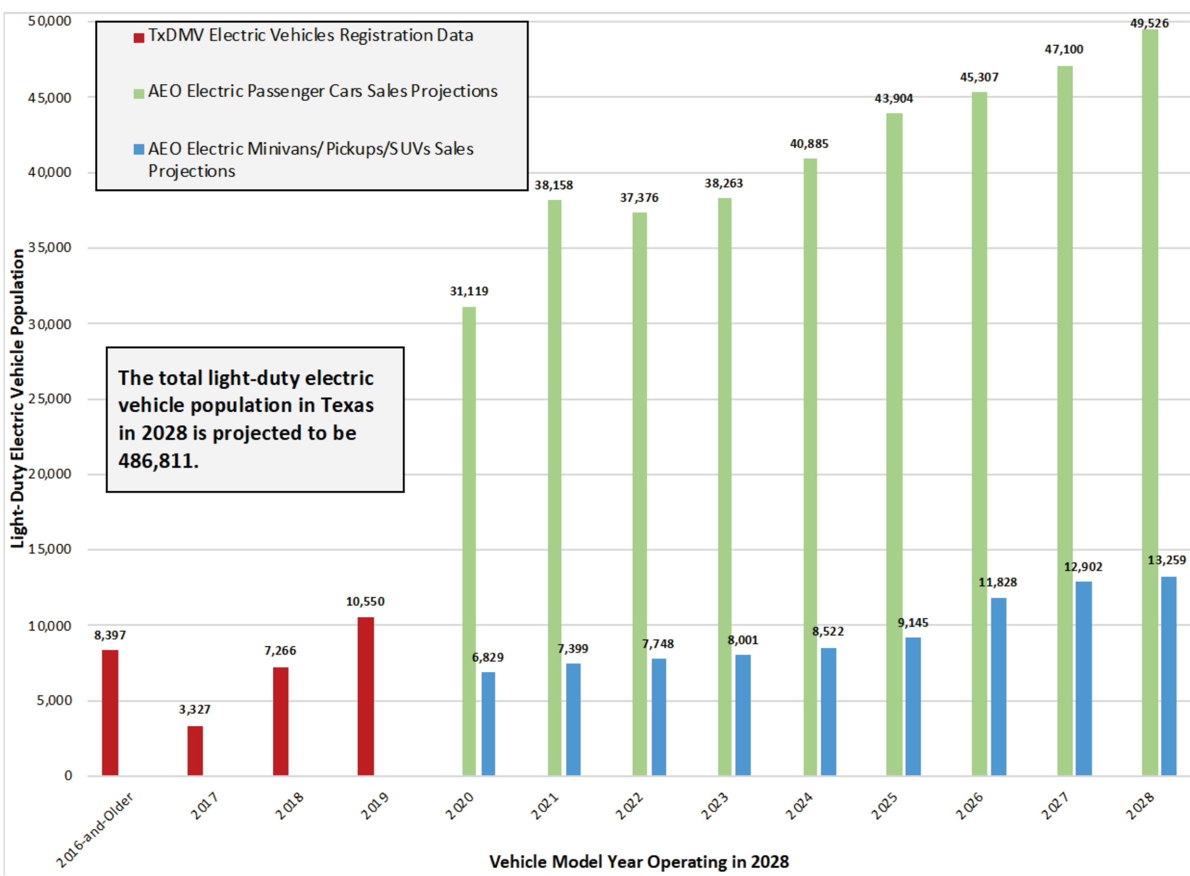


Figure 2-13: Texas Electric Vehicle Population Projections by Model Year Operating in 2028

Maximum Potential Emissions Reductions in 2028

The maximum possible emissions reductions that could be achieved if all the predicted 486,811 light-duty electric vehicles in 2028 are not needed by manufacturers to meet fleet average requirements are presented in Table 2-1: *2028 Maximum Annual Emissions Benefits from Light-Duty Electric Vehicles*. Results are provided for NO_X, VOC, CO, CO_2, SO_2, NH_3, and PM at thresholds of both 2.5 microns ($PM_{2.5}$) and 10 microns (PM_{10}), reported in tons per year. This approach is based on the assumption that each electric vehicle replaced a gasoline or diesel vehicle of the same type that met the fleet average requirements per model year.

Pollutant or Vehicle Data	2028 Light-Duty Fleet Totals	2028 Maximum Electric Vehicle Impacts	2028 Maximum Electric Vehicle Impact Portion
Vehicle Population	21,844,307	486,811	2.2%
Annual Vehicle Miles Traveled	266,935,091,907	6,859,346,184	2.6%
NO_X (tons per year)	29,354.43	238.11	0.8%
VOC from Vehicles (tons per year)	41,671.52	324.65	0.8%
CO (tons per year)	566,668.22	6,175.61	1.1%
CO_2 (tons per year)	76,572,720.80	1,713,238.74	2.2%
SO_2 (tons per year)	507.83	11.36	2.2%
NH_3 (tons per year)	5,692.66	125.73	2.2%
$PM_{2.5}$ (tons per year)	1,004.20	12.78	1.3%
PM_{10} (tons per year)	1,134.20	14.44	1.3%
VOC from Refueling (tons per year)	2,796.75	52.79	1.9%
Fuel Consumption (gallons per year)	8,128,923,443	181,899,225	2.2%

Table 2-1: 2028 Maximum Annual Emissions Benefits from Light-Duty Electric Vehicles

To provide context for these results, the second column contains the light-duty fleet emissions and fuel consumption totals from the TTI analysis for 21.8 million light-duty vehicles projected to be traveling approximately 267 billion miles in 2028. The third column summarizes the possible emissions and fuel consumption reductions from 486,811 of these 21.8 million vehicles being operated by electricity instead of gasoline or diesel fuel. The fourth column provides the relative reductions that could be achieved from the 2028 light-duty fleet totals.

To obtain these results, the electric vehicle population projections from Figure 2-3 were multiplied by fleet average emissions rates per model year from the 2014a version of the Motor Vehicle Emissions Simulator (MOVES2014a) model (EPA, 2018) that was used in the TTI analysis. Maximum daily emissions benefits and an example calculation are available in Appendix B. These daily emissions benefits were converted to the annual totals presented in Table 2-1.

The emissions reductions achieved in the maximum environmental benefits scenario may be lower than expected in comparison to the environmental impacts reported in media and other scientific analyses. Studies that report larger reductions in emissions due to electric vehicles often include indirect sources of emissions, upstream from tailpipe emissions, which are outside the scope of the present study (Nichols, Kockelman, and Reiter, 2015; Nopmongcol et. al, 2017). These upstream emissions sources are also frequently the focus of news and media articles on electric vehicle benefits (Harvey, 2020; Scott, 2020; Union of Concerned Scientists, 2020). Another prominent narrative in the media presents electric vehicles as replacing emissions from conventional vehicles, an argument which does not acknowledge the incorporation of electric vehicles in meeting fleet average tailpipe emissions standards (Pabst, 2019; Stevens, 2019; Leinert, White, and Klayman, 2020).

Moreover, other studies investigating future vehicle emissions assume greater electric vehicle market penetration (17% to 70% of fleet population, depending on the timeframe for the projections[34]) than the AEO projections used in the present study (2.2% of vehicle population by 2028). The TCEQ believes that the 2028 electric vehicle population projection presented here represents a best-case scenario, as it assumes that no electric vehicles bought between 2016 and 2028 leave the vehicle fleet. Furthermore, as discussed above in *Electric Vehicle Population Projections*, the discrepancy between registered electric vehicles and projected sales in Texas shown in Figure 2-3 indicates a possible over-prediction in the 2028 electric vehicle population.

Data Source Updates

Appendix B contains further explanation of the relevant federal regulations and detailed emissions calculation tables. The electronic files used in the analysis are available for interested readers at ftp://amdaftp.tceq.texas.gov/EI/onroad/sb604/ (TCEQ, 2020). This analysis incorporated updated fuel economy and CO2 regulations for the 2021 through 2026 model years (EPA/NHTSA, 2020). Should there be changes to electric vehicle sales projections and/or relevant federal rules, this analysis could be updated to account for those situations.

[34] 20% by 2018, Thompson et al., 2011; 17% by 2030, Nopmongcol et. al, 2017; 35% - 70% by 2040, Public Citizen/University of Houston, 2018

Section 3: Impact of Alternatively Fueled Vehicles on the State Power Grid and Markets

Note: This section was prepared by the Public Utility Commission of Texas (PUCT).

This section of the report addresses the projected impact of AFVs to the state's power grids and electricity markets. As electric vehicles will have the greatest impact to these, this section of the report analyzes electric vehicles specifically. The PUCT posed questions to its stakeholder community about this topic. Municipally owned utilities, electric cooperatives, transmission and distribution utilities, investor-owned vertically integrated utilities, and retail electric providers submitted comments. Interest groups such as charging station companies, advanced technology groups, and electric vehicle manufacturers also participated.

Market Adoption of Electric Vehicles

Electric vehicles come in three vehicle classes: light-duty, medium-duty, and heavy-duty. The market for light-duty personal electric vehicles has grown in recent years, with sales in Texas increasing 117% from 2017 to 2018.[35] Medium-duty vehicles include buses, package delivery fleets, and refuse trucks. Growth in this category has been encouraged by corporate sustainability goals, decreasing battery costs, and efforts to meet local emissions reduction goals. Heavy-duty vehicles for long-haul trucking are not yet on the market, but are expected to be commercially available within the next three to five years.[36]

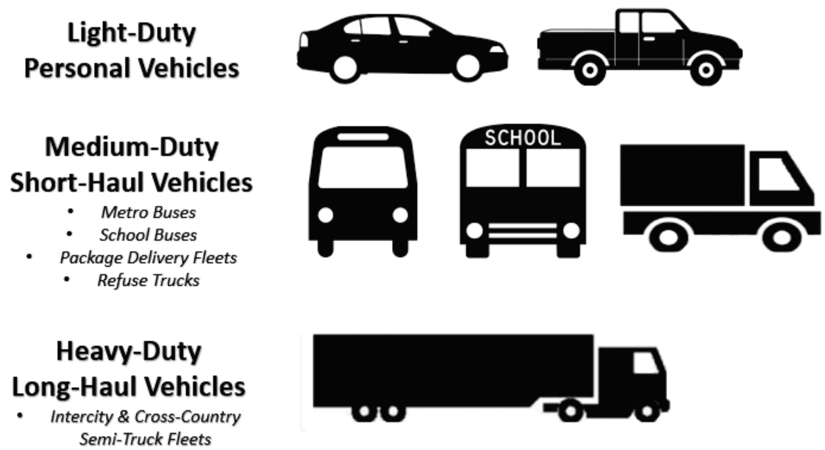


Figure 3-1: Classes of Electric Vehicles

Electric Vehicle Charging Technologies

There are three electric vehicle charging categories: Level 1, Level 2, and Direct Current Fast Charging ("DC Fast," sometimes called Level 3). Each technology has different impacts on a utility's distribution system. The power draw and energy usage are different for each technology. The types of charging stations installed and the charging patterns for different types of electric vehicles will have varied effects on Texas's electric grid.

Level 1 charging equipment uses a 120 Volt wall outlet common in homes. The power requirements of Level 1 chargers are similar to common household appliances.[37] Depending on the battery, Level 1 charging typically takes between eight and 12 hours to charge when fully depleted. Small amounts of power are used over a longer time period. Level 1 charging is not expected to have significant impacts on the utility's distribution system.

Level 2 charging requires 240 Volt electric service. At a home, this might be a power outlet like that used by an electric clothes dryer. Depending on the electric vehicle's battery range, Level 2 charging typically takes between

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[35] "EV Market Share by State," EVAdoption.com. Available at: https://evadoption.com/ev-market-share/ev-market-share-state/.

[36] PUCT Project No. 49125, *Review of Issues Relating to Electric Vehicles,* Comments of TechNet at 2 (Feb. 3, 2020).

[37] PUCT Project No. 49125, Comments of ChargePoint, Inc. at 6 (Feb 3. 2020).

four and six hours to fully charge.[38] Residential customers will do most Level 2 charging at night but may "top off" their battery while parked at a commercial site or workplace during the day. Commercial customers are still in the early stages of electrifying their fleets. However, most Level 2 charging is expected to occur at night for commercial vehicles.[39]

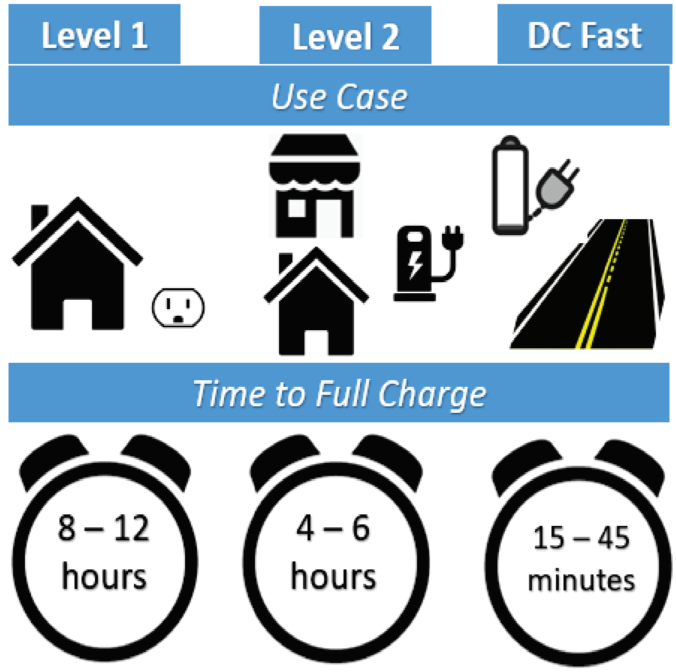

Figure 3-2: Charging Technologies for Electric Vehicles

DC Fast charging equipment uses a 480 Volt direct current ("DC") plug enabling a vehicle to charge its battery to 80% of capacity within 30 minutes.[40] To charge a battery this quickly, a DC Fast charger requires a large power draw (electric demand, or kilowatts) and a high rate of charge (electric energy, or kilowatt-hours). This means that DC Fast chargers have the greatest potential impact on the local electric system. Typically, multiple DC Fast chargers, each with a high demand, are installed together at one site.[41] Because DC Fast charging is expected to be used for long-haul freight trucks and long-distance personal travel, most DC Fast chargers will likely be placed along highways that connect major cities. DC Fast charging is expected to occur primarily during the day and be a small portion of overall charging needs.

Projected Impact on the State's Power Grids: Utility Distribution Systems

Generally, a utility's system is designed to accommodate an expected "peak" demand. This is the time that the simultaneous use of the electric system by customers is highest, such as when air conditioning load comes on during a hot summer afternoon. If charging station load increases beyond what the utility's systems were originally designed to support, reliability problems could result. Utilities have well-established processes for accommodating new electric load like charging stations. Therefore, most utilities do not anticipate difficulty managing the load from charging for electric vehicles on their distribution system. However, high DC Fast charging penetration and significant on-peak daytime charging could affect specific areas and require the utility to upgrade parts of its distribution system.

Investor-Owned Transmission and Distribution Utilities

Investor-owned transmission and distribution utilities are responsible for evaluating the growth of electric demand in their service territories and managing the reliability of their distribution system. An investor-owned transmission and distribution utility delivers electric power to the end-use customer but does not have a retail electric provider relationship with that customer. This means an investor-owned transmission and distribution utility may not have specific insight into whether a residential or commercial customer is using their electric service to charge an electric vehicle. For this reason, the utility may need to make more assumptions about electric vehicle adoption in its service area and the effect that adoption may have on its systems.

[38] PUCT Project No. 49125, Comments of Texas Advanced Energy Business Alliance at 6 (Feb 3. 2020).
[39] PUCT Project No. 49125, Comments of Austin Energy at 2 (Feb. 3, 2020).
[40] *Id.* at 3.
[41] *Id.*

The Dallas-Fort Worth area, the fourth largest metroplex in the United States with a population of over 7.5 million, is a potential hub for electric vehicle adoption. Oncor Electric Delivery Company (Oncor), the local transmission and distribution utility, expects most growth to occur in clusters, led by electric short-haul fleets. Oncor pointed to a data source that identifies more than 20,000 fleets in its service territory. Together, growth in clustered areas, extensive fleet electrification, and a resulting increase in DC Fast charging are expected to lead to an increase in overall electric load on its system.

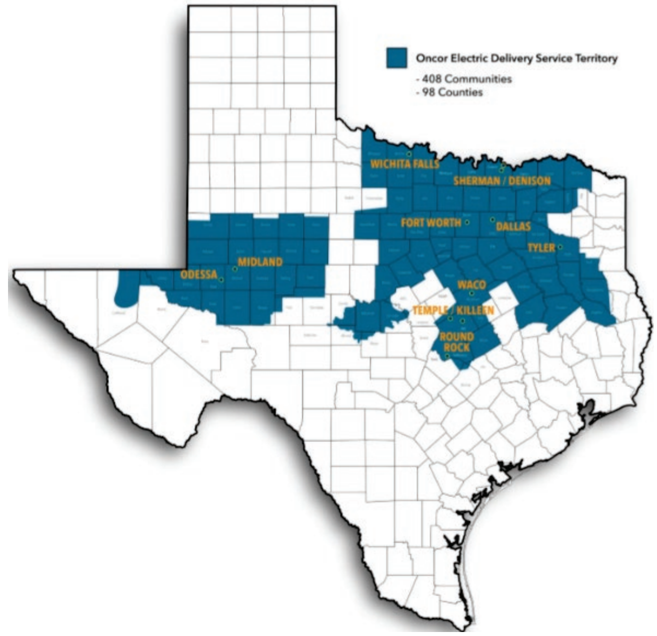

Figure 3-3: Oncor Electric Delivery Company Service Territory

Oncor expects most electric vehicle adoption to occur over the next five to 10 years, which will give the utility time to plan for needed changes. Oncor commissioned a study that forecasted an increase from 224 to 2,193 DC Fast charging stations in its service territory by the year 2030. The amount of load that will trigger a need for system upgrades will vary based on how close the load is to critical distribution infrastructure and how much capacity is being used by other customers.[42]

The Houston metroplex is another area that may see rapid electric vehicle adoption for both commercial and personal use. CenterPoint Energy Houston Electric, LLC (CenterPoint) is the transmission and distribution utility serving most of the Houston area.

CenterPoint anticipates residential charging impacts to be manageable unless the electric vehicle adoption rate increases significantly. If commercial charging consistently overlaps with the peak demand, modifications to the distribution system would be required. CenterPoint expects more than 163,000 light-duty vehicles in its service territory by 2030 given a likely scenario for adoption.[43]

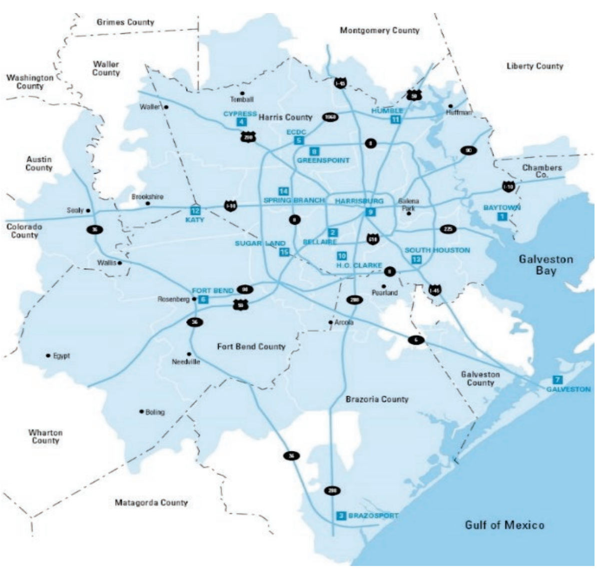

Figure 3-4: CenterPoint Energy Houston Electric Service Territory

The state's two other investor-owned transmission and distribution utilities, AEP Texas and Texas-New Mexico Power, also anticipate being able to absorb electric vehicle growth into the distribution system within their current planning processes.

[42] PUCT Project No. 49125, Comments of Oncor Electric Delivery Company (Feb. 3, 2020).

[43] PUCT Project No. 49125, Comments of CenterPoint Energy Houston Electric, LLC (Feb. 3, 2020).

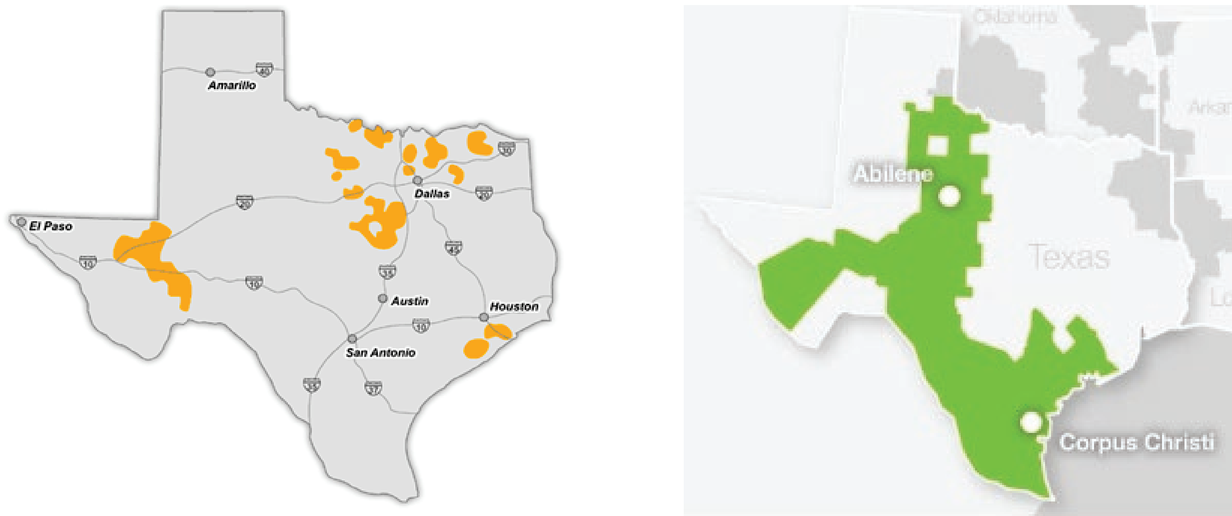

Figure 3-5: AEP Texas Service Territory (Left) and Texas-New Mexico Power Service Territory (Right)

Municipally Owned Utilities

A municipally owned utility provides transmission or distribution service and makes retail sales to the end-use customer. Many also own power plants. Municipally owned utilities are primarily governed by the city council of the municipality or its designated independent board, with the PUCT having limited regulatory authority. The municipally owned utilities CPS Energy in San Antonio and Austin Energy respectively serve the third and fourth largest metropolitan statistical areas in Texas and provide power to over 1.3 million customers. The San Antonio and Austin areas may also see growth in vehicle electrification for the same reasons seen in Dallas-Ft. Worth and Houston.

CPS Energy has not experienced any issues to date in integrating electric vehicles into its system. CPS Energy is piloting a program to incentivize a shift in DC Fast charging from peak to off-peak periods and will also launch additional product offerings for customers with electric vehicles. System upgrades will likely be required in certain areas. However, the lead time should be sufficient to factor growth projections into system planning. For medium- and heavy-duty vehicles, these loads are expected to charge in clusters that could necessitate transformer upgrades or even an entirely new substation. Current projections for light-duty electric vehicle adoption in CPS Energy's service territory are not expected to have a significant impact on distribution system infrastructure and tailored product offerings to customers will help manage any impacts.[44]

Austin Energy anticipates a need to expand its distribution system in areas of higher electric vehicle penetration in both commercial and residential areas. Like CenterPoint, Austin Energy expects electric vehicle charging in commercial areas at peak demand. However, this impact should be manageable when considered in the planning of new commercial developments. Austin Energy also anticipates its distribution system will be impacted by charging stations along major transit corridors during peak times.[45]

Electric Cooperatives

Much like a municipally owned utility, an electric cooperative owns wires and poles and makes retail sales of electricity to the end-use customer. Some cooperatives also own power plants. Electric cooperatives are member-owned. A board of directors provides policy direction for the electric cooperative, including infrastructure build-out. Electric cooperative service areas are typically rural and have not seen a significant adoption of electric vehicles.

[44] PUCT Project No. 49125, Comments of CPS Energy (Feb. 3, 2020).
[45] PUCT Project No. 49125, Comments of Austin Energy (Feb. 3, 2020).

In higher density areas, certain cooperatives have deployed charging stations and work with commercial developers to ensure visibility into planned charging stations. Current practices to manage new load additions are expected to be adequate to incorporate electric vehicle charging stations.[46]

Investor-Owned Vertically Integrated Utilities

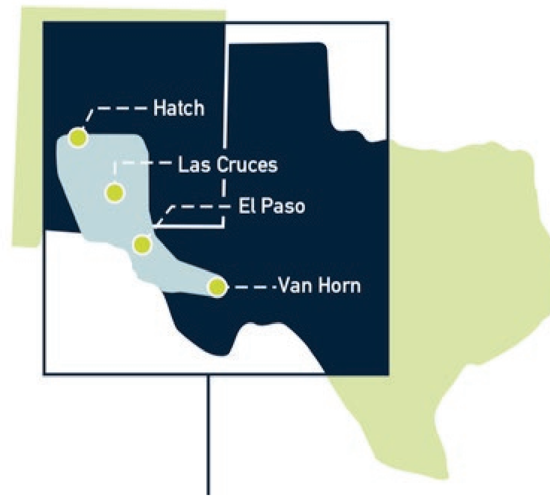

Figure 3-6: El Paso Electric Company Service Territory

Over 1.2 million customers receive their electricity from one of the four vertically integrated investor-owned utilities in Texas. These utilities generate electric power, provide transmission and distribution service, and make retail sales to the end-use customer. The four investor-owned vertically integrated utilities in Texas generally expect to manage the impact of electric vehicle charging on their distribution system through incentivizing customers to charge at off-peak times. Shifting use of the system to off-peak times will improve overall utilization of the distribution system and reduce the need for the utility to build additional infrastructure. Existing processes should be sufficient to incorporate charging stations into these distribution systems and identify any needed upgrades.

Of these four investor-owned vertically integrated utilities, El Paso Electric (EPE) serves the most densely populated area, with 332,000 customers in Texas. EPE expects that public electric vehicle charging stations will have a higher on-peak charging pattern during the day compared to commercial fleet charging stations. While some distribution upgrades may be required, these improvements are not currently anticipated to be problematic. However, with the advent of long-haul trucking, EPE may be uniquely positioned for DC Fast charging because El Paso is a transportation and warehousing hub.[47]

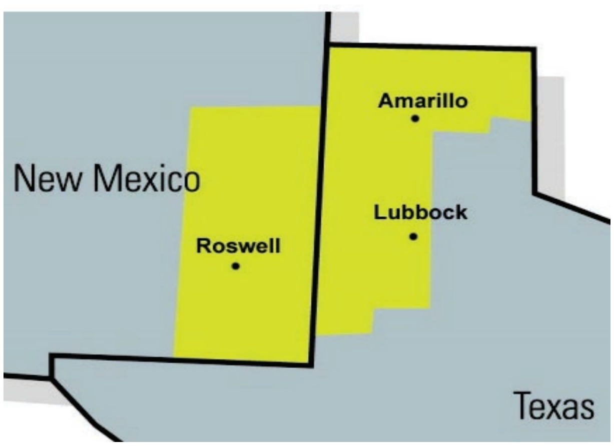

Figure 3-7: Southwestern Public Service Company Service Territory

The state's other vertically integrated utilities serve less densely populated areas. These utilities generally expect to accommodate electric vehicle adoption in their service areas without substantial impacts to their system with existing processes.

Southwestern Public Service Company (SPS[48]), which serves the Texas Panhandle, does not forecast significant electric vehicle load growth in its service territory. SPS expects any impacts to be clustered and anticipates that some older facilities on its distribution system will need to be replaced.

The southeast Texas area is served by Entergy Texas, Inc., and northeast Texas along with a small portion of the Panhandle is served by Southwestern Electric Power Company (SWEPCO). Neither Entergy Texas nor SWEPCO anticipate any unmanageable distribution grid impacts and will account for increased electric vehicle adoption into its planning.[49]

[46] PUCT Project No. 49125, Comments of Texas Electric Cooperatives (Feb. 3, 2020).
[47] PUCT Project No. 49125, Comments of El Paso Electric Company (Feb. 3, 2020).
[48] PUCT Project No. 49125, Comments of Southwestern Public Service Company (Feb. 3, 2020).
[49] PUCT Project No. 49125, Comments of Entergy Texas, Inc. (Feb. 3, 2020).

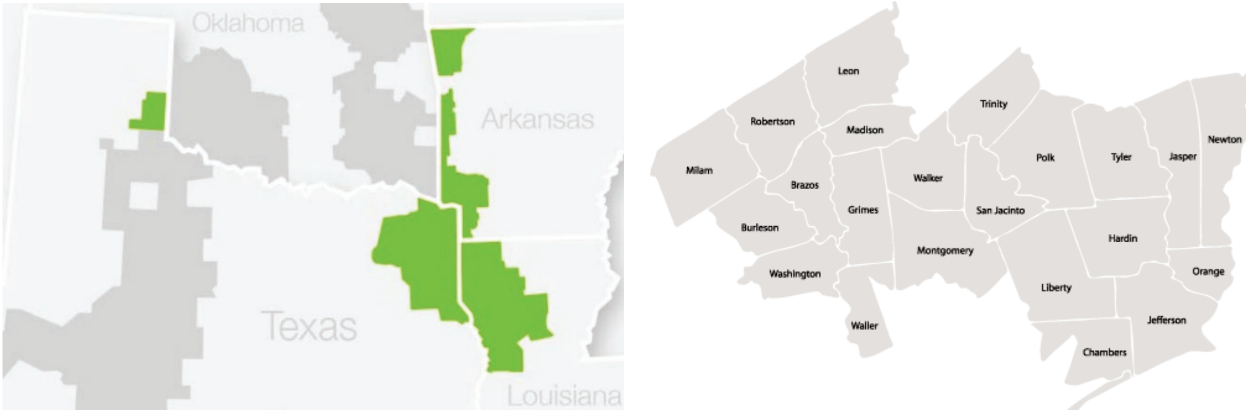

Figure 3-8: Service Territory of Entergy Texas, Inc. (L) and Southwestern Electric Power Company (R)

Projected Impact on the State's Power Grids: Utility Transmission Systems

Power plants are in geographic locations that allow ready access to a fuel source but may be some distance from the population centers. A utility must build and maintain a transmission system that can deliver these large power flows from power plant to end-use customer. These transmission systems are interconnected and share responsibility to manage the demand for electric power across a state or region. Transmission systems are generally built to accommodate the peak demand for electricity.

Three separate grid operators serve Texas: the Electric Reliability Council of Texas (ERCOT), the Southwest Power Pool (SPP), and the Midcontinent Independent System Operator (MISO). Each of these grid operators helps manage the transmission system. When there is growth in demand for electricity, especially near the peak demand for electricity, changes to the transmission system may be needed. These changes require careful coordination among utilities, the grid operators, and regulators.

ERCOT

ERCOT is the grid operator responsible for ensuring reliable electric power for approximately 85% of the land area in Texas and serves approximately 90% of the state's electricity demand. The ERCOT grid is fully contained within the state and therefore is under the oversight of the PUCT.

All utilities in ERCOT, including transmission and distribution utilities, municipally owned utilities, and electric cooperatives, collaborate with ERCOT on transmission planning. Transmission build-out in ERCOT is generally evaluated through the stakeholder process at ERCOT. ERCOT staff works with each transmission utility to better understand load forecasts and evaluates the need for the additional infrastructure. The PUCT approves the utilities' request for transmission infrastructure through Certificate of Convenience and Necessity (CCN) proceedings when a new CCN is needed by the utility.

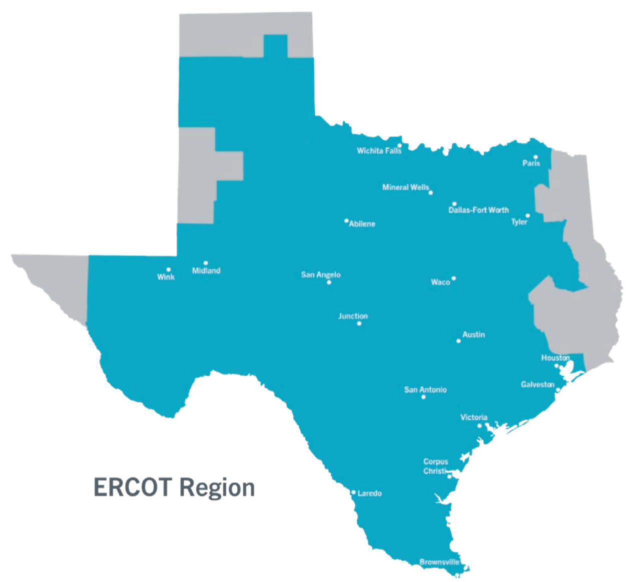

Figure 3-9: Map of the ERCOT Grid

ERCOT develops a Long-Term System Assessment (LTSA) every two years. To help develop this study, ERCOT engages with its stakeholders to determine what scenarios may change the need for future transmission build-out. ERCOT incorporated a widespread electric vehicle adoption scenario in its 2018 LTSA and created a load forecast that included an assumed accelerated electric vehicle adoption rate.[50] ERCOT's 2018 LTSA found that increased adoption of electric vehicles could result in a significant shift in electric use patterns, while increasing demand on the system.[51] ERCOT's 2020 LTSA will be published in December 2020, with a widespread electric vehicle adoption scenario.

SPP

Figure 3-10: Map of SPP

SPS and SWEPCO and three electric cooperatives in Texas are part of SPP. SPP oversees the bulk electric grid and wholesale power market over fourteen states. SPP coordinates transmission build-out in its footprint.

In January 2020, SPP released its 2021 Integrated Transmission Plan. For the first time, this annual analysis includes a scenario for widespread electric vehicle adoption.[52] The scenario reflects electric vehicles primarily charging off-peak in the evening and overnight. Therefore, SPP expects few long-term transmission issues from electric vehicle adoption.

MISO

MISO is the regional transmission operator for 15 states in the United States and the Canadian province of Manitoba. In Texas, MISO is the regional transmission operator for the vertically integrated investor-owned utility Entergy Texas, in southeast Texas.

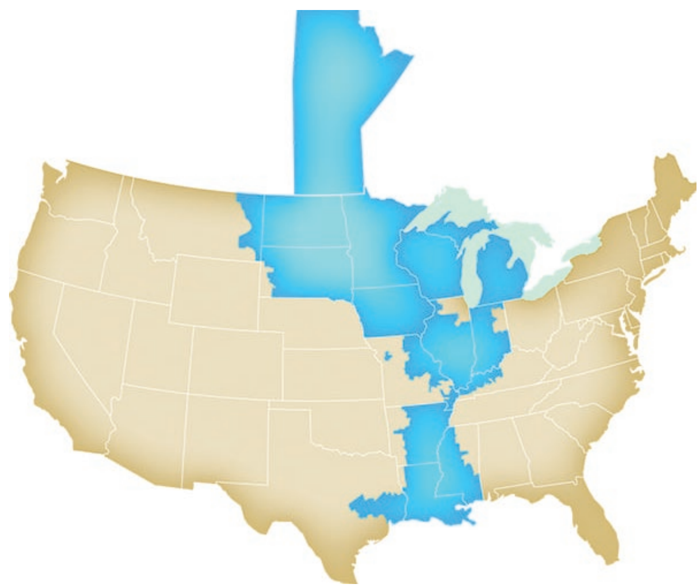

Figure 3-11: Map of MISO

In 2019, MISO commissioned a report to quantify the potential of electric vehicles to provide grid benefits to MISO.[53] This report noted that the MISO region can expect significant electric vehicle penetration reaching over a million vehicles by 2039. However, significant adoption is not expected in the Entergy Texas service territory at this time.

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[50] PUCT Project No. 49125, Comments of the Electric Reliability Council of Texas, Inc. at 2 (Feb. 3, 2020).
[51] "2018 Long-term System Assessment for the ERCOT Region: December 2018" at 11. Available at: http://www.ercot.com/content/wcm/lists/144927/2018_LTSA_Report.pdf.
[52] "2021 ITP Future Drivers: Electric Vehicles (EV)," Jason Speer and Jake Pannell, Southwest Power Pool (Jan. 8, 2020).
[53] "Quantifying the Potential of Electric Vehicles to Provide Electric Grid Benefits in the MISO Area: Final Report to the Midcontinent Independent System Operator, Inc.," Jeffrey Greenblatt, Cong Zhang, and Samveg Saxena. MISO. Available at: https://cdn.misoenergy.org/Quantifying%20the%20Potential%20of%20Electric%20Vehicles%20to%20Provide%20Electric%20Grid%20Benefits%20in%20the%20MISO%20Area354192.pdf.

El Paso Electric (EPE)

EPE is a member of the Western Electric Coordinating Council (WECC). WECC is responsible for ensuring compliance monitoring for reliability standards but does not manage an electricity market or coordinate transmission systems operation, investment, or build-out. EPE is solely responsible for its transmission planning, subject to the oversight of the PUCT and the Federal Energy Regulatory Commission (FERC). EPE does not expect electric vehicle charging to have a significant impact on its transmission system planning.

Projected Impact on the State's Electricity Markets

Retail Market

The service areas of investor-owned transmission and distribution utilities are open to competition. Texans in these areas choose electricity products from a variety of retail electric providers. The retail electric provider buys power at wholesale and handles the retail relationship with the customer, including billing and service. These retail electric providers are incentivized to optimize customer experience by providing services and pricing packages that meet customer expectations. Retail electric providers are already offering programs tailored to electric vehicle owners and pairing these programs with other incentives to encourage customers to charge during off-peak hours. Outside the competitive market, municipally owned utilities and electric cooperatives, such as Austin Energy, CPS Energy, and Pedernales Electric Cooperative are also engaging customers in this way in response to customer interest.

Customer engagement will continue as electric vehicle adoption grows and the surrounding industries gain more experience with the effect of electric vehicles on the grid. Incentivizing off-peak charging is a priority for these retail electric providers and municipally owned utilities, and businesses and customers will become more sophisticated as the market evolves. Smart charging technologies include hardware and software that enable customers to respond to both time-varying rates and participate in load management programs that utilities may offer. These smart charging technologies may become increasingly commercially available.

Wholesale Markets

Most stakeholders agree that available electric vehicle technology does not have meaningful impacts on the wholesale power markets in Texas. There is potential for electric vehicles to sell electricity back into the grid, for example, but deployment of this technology is not imminent. If technologies develop to couple energy storage with electric vehicle charging stations, charging stations could theoretically provide benefits by returning electricity to the grid when it is most needed. As electrification of commercial fleets, mass transit buses, school buses, and long-haul interstate trucking becomes more widespread, new opportunities and challenges could arise for integration into a wholesale marketplace.

Managing the Impact of Electric Vehicle Adoption

Load "Hot Spots"

Many stakeholders noted the likelihood that electric vehicle adoption and associated charging may occur in clustered areas or load "hot spots." A utility must identify potential hot spots so that demand in these clusters can be carefully managed to avoid adversely impacting reliability.

Hot spots are often a result of commercial fleets that are already located near each other. As these companies electrify their fleets, the utility may expect a significant increase in demand on its distribution systems in the hot spot. Hot spots can also develop in densely populated urban and suburban centers. Hot spots for commercial electric vehicle deployment include distribution centers, airports, rail yards, ports, bus hubs, truck stops, highway rest areas, commercial centers such as big box stores, large grocery stores, and super centers. Hot spots for personal electric vehicles could arise in four types of locations: parking garages, large multifamily residential developments, commercial centers drawing large numbers of customers, and large highway fueling stations.

Time of Use

A utility builds its transmission and distribution infrastructure to accommodate times of peak demand. In Texas, peak demand tends to occur in the summer afternoons, as air-conditioning load comes on from the hours of 4 p.m. to 7 p.m. More demand for electricity at the same time as the utility's peak will typically require more infrastructure to be built. A utility can reduce this need for additional infrastructure build-out by encouraging electric vehicle customers to charge at a different time rather than at peak. Rate designs that align with utility cost causation incent charging behaviors that optimize the use of the grid and ensure that customers can manage their energy usage and energy costs. These incentives will influence customer charging pattern behavior.

Emerging Technology

Electric vehicle charging technologies continue to evolve, with changing impacts on the distribution system. Some anticipated changes include increased charging speed and voltage, wireless charging, storage use for ultra-high-speed charging, or inductive charging. All these changes will have an impact on the distribution grid.

Section 4: Current Texas Fees & Taxes on Vehicle Usage

This section examines the current motor fuel taxes, electricity-related fees and taxes, and vehicle registration and inspection fees levied in the state. The levies (except for the electricity-related ones) are examined on a per vehicle basis.

Motor Fuel Taxes

Note: This subsection was prepared by TxDOT.

The State of Texas is responsible for the collection of a tax on fuels. In Texas, motor fuel taxes are paid and collected at the point of sale at the bulk transfer/terminal distribution terminals. It is then remitted to the state by the gasoline suppliers. However, state law requires the amount of tax paid by a supplier to be added to the selling price so that the tax is ultimately paid by the person using or consuming the gasoline. Motorists pay this when they refuel at a pump.[54]

This collection applies to vehicles that use gasoline, diesel, and/or liquefied and compressed natural gas. According to the *Texas Department of Motor Vehicles Fiscal Year (FY) 2019 Alternatively Fueled Vehicle Report*, most vehicles registered in Texas are either gasoline or flexible fuel operated. Flexible fueled vehicles are designed to run on either gasoline or gasoline-ethanol blends of up to 85% ethanol.[55] In FY 2019, gasoline and flexible fuel-run vehicles accounted for 19,013,716 vehicles or approximately 76% of all registered vehicles in the state.[56] Further, this number may even be under-reported, when considering that according to the Texas Department of Motor Vehicles, the fuel type of over 18% of registered vehicles are undisclosed or unknown, and could be a vehicle that is not-self-propelled, such as a trailer.

To determine the amount that these gasoline and flexible fuel-run vehicles pay in fuel taxes for each mile driven, the following assumptions are made to determine the estimated calculation. First, the U.S. Department of Transportation's Bureau of Transportation Statistics estimates that in 2018, the average miles traveled per vehicle for all light duty vehicles in the United States was 11,484 miles.[57] Additionally, the most recent data available by the same federal agency states that in 2017, the average fuel efficiency for a light duty vehicle in the United States was 22.3 miles per gallon.[58]

If the 11,484 average miles traveled per vehicle for all light duty vehicles in the United States is divided by 22.3 miles per gallon of gasoline, it can be determined that the average light duty vehicle needs a total of 514.98 gallons of gasoline a year. To determine what that means in gasoline tax revenue, 514.98 gallons of gasoline need to be multiplied by the Texas state gasoline tax rate of $0.20 a gallon. This calculation determines that the average light duty vehicle pays an average of nearly $103 in state gasoline tax revenue per vehicle.[59] If 514.98 gallons of gasoline is multiplied by the federal tax rate of $0.184, the average light duty vehicle pays an average of $94.76 in federal gasoline tax revenue per vehicle.[60] It is worth noting, that Texas does not receive an equal return in gasoline taxes submitted to the federal government, but for purposes of analysis, we will assume a 100% return on federal gasoline taxes to the state.

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[54] In Texas, gasoline and diesel fuel are subject to a 20-cent tax per gallon. In addition, the federal government imposes taxes of 18.4 cents per gallon on gasoline and 24.4 cents per gallon on diesel fuel.

[55] Fuel Economy.gov https://www.fueleconomy.gov/feg/flextech.shtml

[56] Texas Department of Motor Vehicles Annual Reports, https://www.txdmv.gov/node/3703

[57] U.S. DOT Bureau of Transportation Statistics https://www.fhwa.dot.gov/policyinformation/statistics/2018/pdf/vm1.pdf

[58] U.S. DOT Bureau of Transportation Statistics https://www.bts.gov/content/average-fuel-efficiency-us-light-duty-vehicles

[59] 514.98 gallons multiplied by $0.20 equals $102.996.

[60] 514.98 gallons multiplied by $0.184 equals $94.75632.

To narrow that number down to a per-mile basis, when the estimated annual state gas tax collected amount of $103 is divided by the average annual miles driven per light duty vehicle of 11,484, it is estimated that the average gasoline-powered vehicle pays slightly less than $0.01 per mile driven in state gasoline tax, and similarly less than $0.01 per mile driven in federal gasoline tax.[61]

The average fuel consumption of the top ten most fuel-efficient models of 2019 hybrid vehicles on the U.S. market is 108.1 miles per gallon of fuel.[62] Using the same 11,484 average miles for all light duty vehicles as the previous section, it is estimated that the 2019 top ten most fuel-efficient models of hybrid-vehicles pay an average of just under $0.002 per mile driven in state gasoline tax, and similarly less than $0.002 per mile driven in federal gasoline tax.[63] (This is explained in more detail in *Section 1*. It should be noted that 2019 hybrid models were used as that is more current data and is consistent with data points used later in this report.)

Fully electric vehicles in Texas do not contribute to the gasoline tax as they do not require the use of gasoline to operate.

	Light Duty Vehicles		
	Conventional Gas[1]	Hybrid[2]	Electric[2]
Estimated Average Annual Mileage	11,484	11,484	11,484
Average MPG	22.3	108.1	0
Gallons of gas per year	515	106	0
State Fuel Tax/Gallon[3]	$0.20	$0.20	$0.20
Federal Fuel Tax/Gallon	$0.184	$0.184	$0.184
State Fuel Taxes/Year	$103	$21	$0
Federal Fuel Taxes/Year	$95	$20	$0
Total Fuel Taxes/Year	$198	$41	$0

Table 4-1: Fuel Taxes by Vehicle Fuel Type

Note: Data represents current estimates based on 2017-2019 national rates for mileage, fuel efficiency and vehicle mixes.
1. Numbers provided for conventional gas vehicles are based on the 2017 national average for all light duty vehicles.
2. Numbers provided for hybrid and electric vehicles are based on the 2019 average of the top ten most fuel-efficient vehicles for each class.
3. Of the State Motor Fuel Tax, 15 cents per gallon goes to the Highway Trust Fund and 5 cents per gallon goes to education in Texas.

[61] $103 divided by 11,484 miles equals $0.008969; $94.76 divided by 11,484 miles equals $0.00825148.

[62] Fuel Economy.gov vehicle search https://www.fueleconomy.gov/feg/PowerSearch.do?action=noform&year1=2019&year2=2019&minmsrpsel=0&maxmsrpsel=0&city=0&hwy=0&comb=0&cbvthybrid=Hybrid&cbvtplugin=Plug-in+Hybrid&YearSel=2019&make=&mclass=&vfuel=&vtype=Hybrid%2C+Plug-in+Hybrid&trany=&drive=&cyl=&MpgSel=000&sortBy=Comb&Units=&url=SearchServlet&opt=new&minmsrp=0&maxmsrp=0&minmpg=&maxmpg=&rowLimit=25&pageno=1&tabView=0

[63] $21.25 annual state taxes divided by 11,484 miles equals $0.00185; $19.55 annual federal taxes divided by 11,484 miles equals $0.00170.

Electricity Taxes & Fees from Alternatively Fueled Vehicles

Note: This subsection was prepared by the PUCT.

It is not currently possible to distinguish the amount AFVs currently pay in taxes, fees, and surcharges levied on the sale of electricity from the overall amounts collected. However, the below table summarizes the current sources of state revenue from the sale of electricity.

Assessment	Party Responsible	Rate	Exemptions
Miscellaneous Gross Receipts Tax	Each company in Texas that sells electricity within an incorporated city or town with a population greater than 1,000	Varies from 0.581% to 1.997% of gross receipts by population of the city	• Some electricity surcharges, such as nuclear decommissioning fees and transition charges
Public Utility Gross Receipts Assessment	On each electric utility, retail electric provider, and cooperative that serves the end-use customer in Texas.	.001667% of the gross receipts from rates charged to the ultimate customer in the state	• Some electricity surcharges, such as nuclear decommissioning fees and transition charges
Sales Tax (State Portion)	On each electric utility, retail electric provider, and cooperative that serves the end-use customer in Texas.	6.25% of the sales price of electricity	• Some electricity surcharges, such as nuclear decommissioning fees and transition charges • Residential electric customers are generally exempt from the state portion of the sales tax • Non-residential customers (such as a small business or electric vehicle charging station) must submit a tax exemption certificate to their retailer to be exempt

Table 4-2: Current Texas Electric-related Taxes, Fees, & Surcharges

Vehicle Registration Fees

Note: This subsection was prepared by TxDMV.

In general, motor vehicles operated on Texas public roads must pay annual registration fees. With very few exceptions, motor vehicle registration transactions are performed by local county tax assessor-collectors. The county tax assessor-collectors remit the registration fees to the state. The registration fee due varies by gross vehicle weight and certain vehicle characteristics. Some vehicle types and uses do not require registration (see Appendix C).

Motor vehicles with a gross weight of 6,000 lbs. or less have an annual registration fee of $50.75. This weight category includes nearly all passenger vehicles and light trucks and accounts for more than 75% of registered vehicles. The registration fee for motor vehicles classified as motorcycles and mopeds is $30.00.

Motor vehicles with gross weights of more than 6,000 lbs. pay higher fees according to the following schedule:

Vehicle Gross Weight	Fee
6,001 to 10,000 lbs.	$54.00
10,001 to 18,000 lbs.	$110.00
18,001 to 25,999 lbs.	$205.00
26,000 to 40,000 lbs.	$340.00
40,001 to 54,999 lbs.	$535.00
55,000 to 70,000 lbs.	$740.00
70,001 to 80,000 lbs.	$840.00

Table 4-3: Vehicle Registration Fees by Gross Weight

Except passenger cars, trucks with gross weights of 18,000 lbs. or less, and vehicles with combination registration, motor vehicles with diesel motors pay an 11% surcharge on the above registration fee. Vehicles with combination registration pay a 10% surcharge for deposit to the Texas Emissions Reduction Plan (TERP).

Customers pay a $4.75 processing and handling fee along with the registration fee to cover the cost associated with processing the transaction by the counties and the Texas Department of Motor Vehicles, except that the fee is only $3.75 for online registration renewals. Additionally, most motor vehicle registrations also pay a $1.00 fee to cover the costs of the state's electronic liability insurance verification program.

A county may assess on vehicles registered in it the following fees to be collected at the time of registration. Revenue from these fees is retained by the assessing county.

Fee Type	Amount Allowed
Road & Bridge	$0 to $10.00
Child Safety	$0 to $1.50
Regional Mobility[64]	$0 to $10.00

Table 4-4: Local Option Vehicle Registration Fees

Current law does not charge registration fees based on the fuel type of the vehicle. Therefore, owners of alternatively fueled and conventional vehicles pay the same amount. The exceptions to this are the 10% and 11% registration fee surcharges paid for vehicles with diesel motors. This extra fee applies to less than 4% of all registered vehicles and does not apply to any light duty vehicles including passenger vehicles and light trucks as noted above.

Vehicle Inspection Fees

Note: This subsection was prepared by TxDMV.

Motor vehicles must pass an annual vehicle safety inspection to be registered. Certain vehicles registered in selected counties must also pass a vehicle air emissions inspection. Before the registration-based enforcement system for

[64] Only allowed in Bexar, Cameron, El Paso, Hidalgo, and Webb counties. Cameron and Webb counties may levy up to $20.

the inspection program, customers paid a fee to the inspection station for the inspection. The station kept a portion of the fee as compensation for performing the inspection and then remitted the other portion of the fee to the state. Now the customer still pays the station's portion of the fee at the time of inspection but pays the state's portion of the fee at the time of registration. Depending on the type of inspection, the state's portion of the inspection fee ranges from $2.75 to $24.75 and is divided among the Texas Mobility Fund, Clean Air Fund, TERP, and the Texas Online program.

Type of Inspection	Applicable Counties	State Fee	Fee Distribution
Safety only	Statewide	$7.50	Texas Online $2.00 Mobility Fund $3.50 Clear Air Fund $2.00
2-year Safety only (new vehicles)	Statewide	$16.75	Texas Online $2.00 Mobility Fund $10.75 Clear Air Fund $4.00
Commercial Safety only	Statewide	$22.00	Texas Online $2.00 Mobility Fund $10.00 TERP $10.00
Emissions only	Brazoria, El Paso, Fort Bend, Galveston, Harris, Montgomery, Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, Travis, Williamson	$2.75	Texas Online $0.25 Mobility Fund $2.00 Clear Air Fund $0.50
Safety & Emissions (TSI & OBD, all model years)	Brazoria, El Paso, Fort Bend, Galveston, Harris, Montgomery, Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, Travis, Williamson	$8.25	Texas Online $0.25 Mobility Fund $5.50 Clear Air Fund $2.50
Commercial Safety & Emissions	Brazoria, El Paso, Fort Bend, Galveston, Harris, Montgomery, Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, Travis, Williamson	$24.75	Texas Online $2.25 Mobility Fund $12.00 Clear Air Fund $0.50 TERP $10.00

Table 4-5: Vehicle Inspection Fees

Generally, motor vehicles, regardless of fuel type, pay a safety-type inspection fee. Almost all gasoline-fueled vehicles registered in selected counties also pay an emissions-type inspection fee. This means in those counties, for conventional vehicles, those using gasoline pay an emissions fee while those using diesel do not. For AFVs, hybrids pay an emissions fee in selected counties, but all others do not.

Section 5: Vehicle Fees in Other States

Note: This section was prepared by TxDMV.

This section examines the type and amount of fees by which other states generate revenue from AFVs and conventional vehicles. The focus is on those states that levy a specific fee on AFVs.

In this section, AFVs are the following:

- **Electric** - vehicles powered by an electric motor which uses energy stored in a battery and must be plugged into an electric power source to charge. Electric vehicles do not rely on internal combustion or conventional fuels.
- **Plug-In Hybrid Electric** - vehicles powered by an internal combustion engine and an electric motor that uses energy stored in a battery but can also be plugged in to an electric power source to charge the battery. Plug-in hybrid electric vehicles can operate using only electric power, only internal combustion or through a combination of the two and can rely on conventional fuels.
- **Hybrid Electric** - vehicles powered by an internal combustion engine and an electric motor that uses energy stored in a battery. The battery is charged by the internal combustion engine as well as through regenerative braking. Hybrid electric vehicles do not plug in to charge and must use conventional fuels.
- **Natural or Petroleum Gases** - vehicles specifically designed or converted to use some form of either gaseous or liquid hydrocarbons to drive internal combustion engines. The hydrocarbons can be categorized as: liquefied petroleum gas (LPG) which liquifies when compressed for storage in pressurized tanks, compressed natural gas (CNG) consisting primarily of methane which is compressed for storage in pressurized tanks, and liquefied natural gas (LNG) consisting primarily of methane but, rather than being compressed, is cooled to temperatures below negative 250 degrees Fahrenheit turning the gas into a liquid for storage.

Conventional Vehicle Registration Fees

Every state requires motor vehicle owners to pay some form of vehicle use fee, and the fees differ significantly by jurisdiction. Approaches range from charging flat fees per vehicle to fees determined by a vehicle's Manufacturer's Suggested Retail Price or MSRP, purchase price, current value, gross weight, carrying capacity, model year, age, horsepower, fuel type, fuel efficiency rating, the number of years the vehicle has been previously registered and/or whether the vehicle is used for commercial purposes; even the number of vehicles registered to a single owner can affect fees assessed.

Because this report focuses on AFVs, details on registration fees other states levy on conventional vehicles is not discussed. However, information on these fees can be found at the website for the National Conference of State Legislatures.[65]

Alternatively Fueled Vehicle Registration Fees

As of early 2020, 29 states levy a registration fee specific to electric-type vehicles. Nine states levy a fee on electric vehicles but not hybrid or plug-in hybrid electric vehicles: California, Georgia, Illinois, Minnesota, North Carolina, Oregon, Tennessee, Virginia and Wyoming. Thirteen states levy a fee on electric and plug-in hybrid electric vehicles but not hybrid electric vehicles: Alabama, Arkansas, Colorado, Hawaii, Idaho, Iowa, Michigan, Missouri, Nebraska,

[65] https://www.ncsl.org/research/transportation/registration-and-title-fees-by-state.aspx

North Dakota, Oklahoma, West Virginia and Wisconsin. Seven states levy a fee on electric, plug-in hybrid, and hybrid electric vehicles: Indiana, Kansas, Mississippi, Ohio, South Carolina, Utah and Washington. Ten states levy some type of fee specific to vehicles powered by LPG, CNG and/or LNG: Alabama, Arkansas, California, Hawaii, Indiana, Mississippi, Missouri, Oklahoma, Oregon and Washington.

Twenty-one states do not levy a fee specific to AFVs: Alaska, Arizona, Connecticut, Delaware, Florida, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, Pennsylvania, Rhode Island, South Dakota, Texas and Vermont.

Alabama

In addition to other registration fees, electric vehicles pay an annual fee of $200 and plug-in hybrid electric vehicles pay an annual fee of $100. Beginning July 1, 2023, these fees increase by $3 every four years. Vehicles fueled by LPG, CNG or LNG pay annual fees between $80 and $180 based on gross weight. Vehicles registered out-of-state refueling with LPG, CNG or LNG in Alabama may purchase the annual fee decal or must pay state motor fuel taxes.

Arkansas

In addition to other registration fees, electric vehicles pay an annual fee of $200 and plug-in hybrid electric vehicles pay an annual fee of $100. LPG and LNG used as motor fuel must purchase on a per vehicle basis an annual special fuel user's permit. The permit costs between $130 and $609 based on vehicle gross weight.

California

In addition to other registration fees, zero-emission vehicles pay an annual road improvement fee of $100 at the time of registration for model years 2020 and later. This fee increases annually as determined by the California Consumer Price Index. State excise taxes on LPG, CNG and LNG may be paid on a gallon equivalency basis or with the purchase of an annual sticker tax that costs between $36 and $168 based on vehicle gross weight.

Colorado

In addition to other registration fees, plug-in electric and plug-in hybrid electric vehicles pay an annual fee of $50.

Georgia

In addition to other registration fees, plug-in electric vehicles used for non-commercial purposes pay an annual fee of $213.69 and if used for commercial purposes pay $320.54. These fees adjust annually and do not apply to plug-in hybrid electric vehicles.

Hawaii

In addition to other registration fees, plug-in electric vehicles or AFVs pay an annual fee of $50.

Idaho

In addition to other registration fees, electric vehicles pay an annual fee of $140 and plug-in hybrid electric vehicles pay an annual fee of $75.

Illinois

In addition to other registration fees, electric vehicles pay an annual fee of $100.

Indiana

In addition to other registration fees, battery electric vehicles pay an annual fee of $150 and hybrid and plug-in hybrid electric vehicles pay an annual fee of $50. The Indiana Bureau of Motor Vehicles determines new fee amounts every five years. Vehicles fueled by LPG must purchase an alternative fuel decal that costs between $150 and $750 based on vehicle type and gross weight. Vehicles fueled by LPG that are registered out-of-state must purchase a temporary trip permit.

Iowa

In addition to other registration fees, electric vehicles pay an annual fee of $65 and plug-in hybrid electric vehicles pay an annual fee of $32.50. These fees increase to $97.50 and $48.75 in 2021 and to $130 and $65 in 2022 respectively.

Kansas

The annual registration fee for electric passenger vehicles is $100 and $50 for hybrid and plug-in hybrid electric vehicles, respectively. The standard registration fee for other vehicles weighing 4,500 lbs. or less is $30 and $40 for vehicles weighing 4,501 lbs. or more. This results in electrics paying either $60 or $70 more than equivalent weight conventional vehicles and hybrids paying either $10 or $20 more. Vehicles fueled by LPG, CNG or LNG may pay fuel taxes on a gallon equivalency basis or per an estimate of the number of gallons used on Kansas highways as determined by vehicle gross weight.

Michigan

In addition to other registration fees, vehicles with a minimum battery capacity of four kilowatt-hours pay a gross weight based annual fee of $100 or $200 for electric vehicles and $30 or $100 for hybrid and plug-in hybrid electric vehicles. The electric vehicle fees increase by $5 and the plug-in hybrid electric vehicle fees increase by $2.50 per $0.01 that the state motor fuel tax exceeds $0.19 per gallon.

Minnesota

In addition to other registration fees, electric vehicles pay an annual fee of $75.

Mississippi

In addition to other registration fees, electric vehicles pay an annual fee of $150 and hybrid and plug-in hybrid electric vehicles pay an annual fee of $75. Beginning July 1, 2021, these fees will increase annually based on the Consumer Price Index for urban consumers for the prior year. Vehicles fueled by natural gas with a gross weight of 10,000 lbs. or less pay an annual flat rate privilege tax of $165. Vehicles fueled by natural gas with a gross weight greater than 10,000 lbs. pay privilege taxes on a gallon equivalency basis.

Missouri

State motor fuel taxes do not apply to alternatively fueled passenger vehicles and certain buses or commercial vehicles if an alternative fuel vehicle decal is purchased. The decal cost is between $37.50 and $1,000 based on vehicle type and gross weight.

Nebraska

In addition to other registration fees, vehicles powered by any energy source not taxed as a motor fuel pay an annual alternative fuel fee of $75. This fee applies to plug-in and plug-in hybrid electric vehicles.

North Carolina

In addition to other registration fees, plug-in electric vehicles weighing 8,500 lbs. or less with a maximum speed of at least 65 miles per hour and at least a four kilowatt-house battery capacity pay an annual fee of $130.

North Dakota

In addition to other registration fees, electric vehicles, plug-in hybrid electric vehicles and plug-in electric motorcycles pay annual fees of $120, $50 and $20 respectively.

Ohio

In addition to other registration fees, electric and plug-in hybrid electric vehicles pay an annual fee of $200 and hybrid electric vehicles pay an annual fee of $100.

Oklahoma

In 2017, Oklahoma enacted a $100 fee on electric vehicles and a $30 fee on plug-in hybrid electric vehicles, both in addition to other registration fees. However, the Oklahoma Supreme Court ruled those fees to be unconstitutional. In lieu of state motor fuel taxes, vehicles fueled by LPG or natural gas pay an annual fee of $50 and vehicles fueled by methanol or blends of 85% methanol and 15% gasoline pay an annual fee of $100 when the vehicle's carrying capacity does not exceed 2,000 lbs. Vehicles fueled by LPG, methanol, or blends of 85% methanol and 15% gasoline with a carrying capacity greater than 2,000 lbs. pay an annual fee of $150.

Oregon

Electric vehicles pay an annual fee of $110 while registration fees for conventional vehicles range from $18 to $33 as determined by the vehicle's average miles per gallon. Beginning January 1, 2022, the electric fee increases to $115. In lieu of state fuel taxes, vehicles fueled by natural gas or LPG pay an annual special use fuel license fee between $170 and $1,333 based on vehicle gross weight.

South Carolina

In addition to other registration fees, fuel cell and plug-in electric vehicles pay a biennial fee of $120 and hybrid and plug-in hybrid electric vehicles pay a biennial fee of $60.

Tennessee

In addition to other registration fees, plug-in electric vehicles pay an annual fee of $100 unless it is a low- or medium-speed vehicle. This fee does not apply to plug-in hybrid electric vehicles.

Utah

In addition to other registration fees, battery electric, plug-in hybrid electric, and hybrid electric vehicles pay annual fees of $90, $39 and $15 respectively. These increase to $120, $52 and $20 in 2021. The vehicle may instead be enrolled in a mileage-based fee program in lieu of paying the annual fee.

Virginia

In addition to other registration fees, electric vehicles pay an annual license tax of $64.

Washington

In addition to other registration fees, plug-in electric vehicles pay an annual fee of $150 and plug-in hybrid vehicles with an electric range of at least 30 miles and hybrid electric vehicles pay an annual fee of $75. In lieu of state motor fuel taxes, vehicles fueled by natural gas or LPG pay an annual license fee between $185.25 and $1,029.17 based on vehicle gross weight.

West Virginia

In addition to other registration fees, vehicles fueled by electricity, natural gas or hydrogen pay an annual fee of $200, and plug-in hybrid electric vehicles pay an annual fee of $100.

Wisconsin

In addition to other registration fees, electric vehicles pay an annual fee of $100, and plug-in hybrid electric vehicles pay an annual fee of $75.

Wyoming

In addition to other registration fees, plug-in electric vehicles pay an annual decal fee of $200.

Annual Fees Specific to Alternatively Fueled Vehicles and Alternative Fuels

	Hybrid Electric	Plug-in Hybrid	Electric	LPG - CNG - LNG
Alabama		$100	$200	$80 - $180
Arkansas		$100	$200	$130 - $609
California			$100[66]	$36 - $168
Colorado		$50	$50	
Georgia			$213.69 or $320.54	
Hawaii		$50	$50	$50
Idaho		$75	$140	
Illinois			$100	
Indiana	$50	$50	$150	$150 - $750
Iowa		$32.50	$65	
Kansas*	$10 or $20	$10 or $20	$60 or $70	
Michigan**		$30 or $100	$100 or $200	
Minnesota			$75	
Mississippi	$75	$75	$150	$165
Missouri		$37.50 - $500	$75 - $1000	$75 - $1000
Nebraska		$75	$75	
North Carolina**			$130	
North Dakota		$50	$120	
Ohio	$100	$200	$200	
Oklahoma		$30[65]	$100[67]	$50 - $150
Oregon*			$77 - $92	$170 - $1,333
South Carolina[68]	$30	$30	$60	
Tennessee			$100	
Utah	$15	$39	$90	
Virginia			$64	
Washington	$75	$75	$150	$185.25 - $1,029.17
West Virginia		$100	$200	
Wisconsin		$75	$100	
Wyoming			$200	
AVERAGE[69]	**$59**	**$70.97**	**$119.54**	

Table 5-1: Annual AFV Fees in Other States

[66] Fee applicable only to vehicle model years 2020 and later.
* Adjusted to indicate amount of fee more than equivalent conventional vehicle fees.
** Fee applicable only to vehicles with a minimum battery capacity of 4 kilowatt-hours or more.
[67] Fee enacted by Oklahoma State Legislature but struck down by Supreme Court of Oklahoma.
[68] Fee assessed biennially; amount adjusted to show an annual average.
[69] Does not include Georgia, Kansas, Michigan, Missouri or Oregon as their assessments are not directly comparable with the other listed states.

Section 6: Alternative Methods for Collecting Fees from Alternatively Fueled Vehicles

Levying a fee on AFVs consists of determining the amount of the fee and the actual collection of the fee. While the fee amount can be determined in many ways, in Texas there are currently few feasible fee collection methods. Available collection methods include fee collection as part of the sale of a good or service, or direct fee collection from consumers. An example of the former is the state's current sales and excise tax system, and an example of the latter is the current vehicle registration program. Creating a new collection method can be an expensive proposition, especially when used a relatively small number of times. Therefore, the alternatives examined assume any fee will be collected using an existing collection method. To also avoid further implementation and administration costs, as well as limit demands placed on customers, it is also assumed that the frequency of collection of any fee remains the same. For example, vehicle registrations are currently due annually (except that a brand new vehicle may be initially registered for two years) so it is assumed that any fee using the vehicle registration process as its collection method will be due once a year at the time of registration. The same assumption is made for the frequency of any fee using a sales-based collection method.

An issue with imposing a fee on owners of AFVs will be determining when a vehicle is alternatively fueled. Currently the state does not track alternative fuel types as part of a vehicle's record. Because the state does track when a vehicle has a diesel motor, the framework for fuel types being part of a vehicle's record exists. For a vehicle entering state records for the first time (e.g. a new purchase or titling a vehicle from out of state in Texas), gathering the fuel type can be a part of issuing the vehicle a Texas title. This would allow assessment of a fee going forward since the alternative fuel type will become part of the vehicle's record.

For vehicles currently registered or titled in Texas, identifying the corresponding fuel type will be more difficult, which could create challenges when levying a fee. The Texas Department of Motor Vehicles produces an annual report on the number of registered AFVs in the state).[70] Software "decodes" the vehicle identification numbers of registered vehicles in TxDMV records to determine the number of vehicles by fuel type. However, the decoding process is imperfect and not all vehicles are easily identifiable through this process. Once the possible AFVs are identified and verified, the registration records of the vehicles can be updated to reflect any new fee. However, the current owners would need to be informed their vehicles will be assessed the new fee.

State motor fuel taxes are not collected in many instances. These instances include when a vehicle is used by the federal government, public school districts, commercial transportation companies or metropolitan rapid transit authorities transporting students under a contract with a public school district, volunteer fire departments or nonprofit entities whose sole purpose is providing emergency medical services. Diesel used by certain commercial motor vehicles transporting passengers is tax exempt, as are natural and petroleum gases used to power vehicles owned by nonprofit electrical or telephone co-ops, municipalities, counties or regional transportation or metropolitan rapid transit authorities when use for transportation services. Since a conventional vehicle does not pay motor fuel taxes if it qualifies for a motor fuel tax exemption, it would need to be decided if any AFV fee would be assessed on an AFV qualifying for the same exemption.

Electricity Usage Fee Alternatives

Note: This subsection was prepared by the PUCT.

This subsection evaluates options for levying fees on the electricity used to charge electric vehicles.

[70] Texas Department of Motor Vehicles Annual Reports https://www.txdmv.gov/node/3703

Taxing Electricity Used by Electric Vehicles

Like the current assessment levied on gasoline purchases, a tax could be levied on the vehicle's fuel: in this case, electricity. Assessing electricity fees at an easily identifiable point of sale, like public charging stations, would be relatively simple, like taxes charged at a gasoline pump. Electric vehicles that use these sites pay the assessment at the point of sale. This assessment would also be paid by vehicles traveling through the state but not registered or based in the state. This feature of the assessment would align with the way motor fuel taxes are also paid by such vehicles.

However, public charging stations do not account for electric vehicle charging behavior. Most personal use electric vehicle charging takes place at a residence. To successfully levy assessments on this electricity use, the in-home charging stations would need to be separately metered to account for the electricity used. Even when a charging outlet is separately metered, the assessment could be avoided by connecting the electric vehicle to an ordinary 120-Volt wall outlet. Given that a direct assessment on electricity to compensate for the loss of motor fuel tax could be up to 50% of the cost of the electricity, the customer may have an incentive to avoid the assessment.[71] Such customer behavior, if adopted on a widespread scale, could reduce the assessment paid to the state.

Directing Existing Electricity Assessments to Highway Funding

Another alternative would be to direct existing assessments on electricity usage to roadway funds. This would have the benefit of being easy to estimate and administratively simple to complete. Additionally, directing existing electricity assessments to roadway funds could not be evaded by changes in customer charging behavior like a direct assessment on electricity usage by electric vehicles.[72] However, this approach would result in all users of electricity paying a tax intended for electric vehicle use.

Vehicle Registration-based Alternatives

Note: This subsection was prepared by TxDMV.

The alternatives examined here all assume an AFV fee will be in addition to, not in lieu of, all registration-related fees currently in law. The alternatives also assume payment occurs once per year at the same time as regular registration. Setting up a system that allows multiple payments/transactions in a year will be much more difficult and costly to administer. Also, unless limited to online transactions only, multiple transactions will result in more foot-traffic at county tax assessor-collector offices. Multiple transactions, even online only, will also incur service charges for each transaction which will result in increased costs for customers. To do otherwise would require online registration transactions to either be exempt from Texas.gov or receive new treatment under that program. If multiple payments throughout the year occur, the current registration sticker could not serve as evidence of payment as it does today unless multiple stickers are created and affixed to the vehicle throughout the year. This would increase costs to the state and be an inconvenience to customers. Also, equity concerns can be raised about allowing a different payment approach to an additional fee on AFVs while not also allowing such an approach for the payment of regular registration fees for all customers.

There are more than a dozen exemptions to paying vehicle registration fees. Examples of such exemptions include: government-owned vehicles, certain agricultural uses, antique, specialty and service vehicles, and vehicles registered with certain specialty license plates, including many that are military-related. Many of these vehicles

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[71] "Funding Roadway Infrastructure in an Electrified World," Glitman, Karen, LeBel, Mark, and Lazar, Jim. Regulatory Assistance Project (Jul. 16, 2019). Available at: https://www.raponline.org/knowledge-center/funding-roadway-infrastructure-in-an-electrified-world/.

[72] *Id.*

would pay motor fuel taxes. Therefore, it would need to be decided whether a registration-based AFV fee would apply to an AFV that is exempt from current registration fees.

Registration-based fees tend to generate relatively stable revenue streams when compared to sales-based taxes and fees. However, the more expensive a registration-based fee becomes, the more likely compliance issues are to arise.

The numbers in Table 4-1 provide an estimate of possible fee amounts if the objective is to replace lost motor fuel tax revenue from the use of an AFV instead of a conventional one.

Flat Fee

Levying a flat fee in addition to current vehicle registration fees is the most common type of alternately fueled vehicle fee levied in other states. This approach is used by 24 of the 29 states with fees specific to AFVs. The fees for electric vehicles range from $50 to $200 and from $26 to $200 on plug-in hybrid electric vehicles. A rough average from other states is $70 for plug-in hybrids and $120 for electric vehicles.

Feasibility & Desirability

A flat fee is a straightforward, easy to administer and understandable approach to levying a fee on AFVs. There already are flat-fees assessed on most vehicles at the time of registration, such as the Financial Responsibility Verification Program fee (see *Transportation Code 502.357*) and local fees (see *Transportation Code 502 Subchapter H*).

A flat fee does not reflect the impact a vehicle has on the roads. With a flat fee, a vehicle that uses roads only rarely or only short distances still pays the same amount as a vehicle that uses roads more frequently or drives long distances. Similarly, a large heavy vehicle that puts more wear and tear on the roadway pays the same amount as a small light vehicle that has little to no impact on the roadway.

Weight-based Fee

A fee based on the weight of an AFV is the method used by three states. This approach to a fee is also how registration fees in Texas are currently assessed.

Feasibility & Desirability

A fee schedule based on vehicle weight could easily align with the weight categories used for vehicle registration fees currently. There currently are eight different weight categories with registration fees ranging from $50.75 for the most common category (up to 6,000 lbs.) to $840 for vehicles in the category of vehicles weighing more than 70,000 lbs. The weights are based on the gross weight of the vehicle which is the vehicle's empty weight plus its carrying capacity.

A weight-based fee could be a fixed amount for each weight category or a percentage of the current fee for each category. The state already uses the second method for certain vehicles with a diesel motor. Such an approach could be used for AFVs (see *Transportation Code Section 502.359*). However, to replace the estimated amount of a vehicle's motor fuel taxes, a percentage approach for the lower weight levels, which account for more than 80% of all registrations, could require a high percentage rate (more than 200%).

Because of the current AFV options available on the market, assessing a fee only on the less than 10,000 lbs. vehicle weight categories would likely cover almost all AFVs. However, as technology and the market changes, assessing a fee on heavier weight categories may need to be considered.

Miles-based Fee

A fee based on the miles traveled by a motor vehicle corresponds with the use of roadways. Unlike other fee alternatives, nothing like this fee exists in the state except for certain interstate motor carriers. Very few other states have a miles-based fee program but those that do focus on electric-type vehicles.

Feasibility & Desirability

A miles-based fee would closely align with a vehicle's actual usage of roads. However, the fee amount would not be known until the actual time of registration since the miles traveled in the prior year would not be known until the time of inspection or registration. This would result in customers not knowing exactly how much they owe until the time of registration. It also would result in inaccurate fee information on the registration renewal notices sent by the Texas Department of Motor Vehicles and make renewing registration by mail difficult. (Mail-in registrations represent less than 4% of registrations). To make estimating fees more feasible, the fee structure could be determined based on larger increments than per mile (i.e. per hundreds or thousands of miles driven).

Collecting the miles traveled from customers is the key element of a miles-based fee, and there are several options for doing so. Customers can self-report their miles at the time of registration. This option requires the customer to track and report this information and there is not currently a verification method for the information reported resulting in possible so avoidance of paying the full and accurate amount. Miles can be tracked electronically through the vehicle's onboard diagnostic systems which, once set up, would require little action on the part of the customer. This option may require additional equipment and software for the vehicle and for state systems and may raise privacy concerns with some customers. Lastly, miles traveled can be reported by an independent, third-party. For example, vehicle inspection stations currently record and report to the Texas Department of Public Safety odometer readings taken during inspections. This information could be used by Texas Department of Motor Vehicles systems to determine the miles traveled for levying a fee. However, the odometer reading would usually be captured after the registration renewal notice has been created. A miles-based fee calculated based upon mileage data captured by inspection stations would result in customers not knowing exactly how much they owe until the time of registration.

Several states are testing and implementing a miles-based fee system as an alternative or supplement to motor fuel taxes. The U.S. Department of Transportation's Surface Transportation System Funding Alternatives grant program has encouraged the development of such programs.

In Oregon, electric (and vehicles with a fuel rating of 40+ mpg) can enroll in the Oregon road usage charge program. The program allows the option of paying a fee of 1.8¢ per-mile driven in-state in lieu of paying increased registration fees. Instead, program participants pay an annual registration fee of $43 plus any per-mile charges. Participating vehicles electronically report mileage to the program's vendor who keeps the personal information of participants secure and private.

In January 2020, Utah began an optional miles-based fee program for certain AFVs. The program is in lieu of paying the additional AFV registration flat fee. A third-party vendor collects and reports miles driven using technology in the vehicle. Mileage fees are deducted periodically from a credit card on file or a pre-paid wallet with the vendor. Collection of the 1.5¢ per-mile fee stops when the total paid for the year equals the applicable additional registration flat fee.

Combination Fee

A fee based on some combination of the prior three alternatives could be implemented. This approach would have the advantages and disadvantages of each of the analyzed alternatives.

Feasibility & Desirability

This approach could allow policy makers to craft a fee that meets multiple objectives, but such a fee does not eliminate the disadvantages of any of the other fees; it would simply mitigate their impact. Regardless, there would be the same set-up and administrative costs associated with any combination of fees. Also, a combination fee could also prove more difficult for customers to understand.

Vehicle Sale-based Alternatives

Note: This subsection was prepared by TxDMV.

The alternatives examined here are based on a transaction of some sort occurring and would generally not be collected on the same fixed schedule as the registration-based alternatives.

Motor Vehicle Sales Tax

A sales tax is levied on motor vehicles purchased or brought into the state. The tax is 6.25% of the vehicle's value. There are some exemptions to the tax and some instances where the tax is not 6.25%. Though the tax is generally paid at the time a vehicle is titled, the program is administered by the Comptroller of Public Accounts rather than the Texas Department of Motor Vehicles. However, the systems used to collect the tax are the same ones used for vehicle titling and registration. A sales tax surcharge or a separate, higher sales tax could be charged to owners of AFVs.

Feasibility & Desirability

The state currently charges a motor vehicle sales tax surcharge of between 1% and 2.5% for certain heavy diesel motor vehicles (see *Tax Code Section 152.0215*) so the model of charging more sales tax based on vehicle fuel-type already exists.

Revenue from a sales tax will possibly be more volatile than other alternatives. Sales tax revenue will likely move in the same direction of the economy as people make vehicle purchase decisions in response to economic conditions.

To achieve similar overall revenues, a sales tax surcharge would need to collect more revenue at the time of collection than a fee that is collected on a regular schedule (such as a registration-based fee). The average age of a U.S. vehicle is approximately 12 years old. It is estimated that ownership will change an average of two times during that 12-year period, which would result in a motor vehicle sales tax-based surcharge/fee being collected only twice on a vehicle. This could result in the sales-tax based surcharge needing to be up to six times more than an annual registration-based fee would need to be to achieve the same overall impact to state revenue. While many customers might be able to finance this amount as part of the vehicle purchase, the surcharge amount could be a sizable expense.

There are several exemptions from the current motor vehicle sales tax. These largely relate to how the vehicle will be used and include use by a child care facility or religious organization and for driver training, fire/ambulance, or agriculture. Also, certain owners like government agencies do not pay motor vehicle sales taxes. Off-highway vehicles are not subject to the motor vehicle sales tax but are subject to the general sales and use tax. Interstate motor carriers are also exempt and any change to that could encourage such customers to purchase their vehicles in another state. New residents, gifted vehicles, and even trades pay a fixed sales tax amount. It would need to be decided how to treat such transactions if an AFV sales tax surcharge is adopted.

A sales tax surcharge, unless structured in a very different way than the current tax, would bear little relation to vehicle characteristics or use, such as weight or size or mileage, that affect roads.

Vehicle Title Fee

Motor vehicles are required to be titled whenever ownership of the vehicle changes. The current fee for a title is $28 (or $33 if titled in a county with an air quality non-attainment status). The title fee is currently a flat one and not based on vehicle type or characteristics. A higher title fee could be charged to owners of AFVs.

Feasibility & Desirability

A higher title fee for AFVs would function much the same as the motor vehicle sales tax alternative.

The revenue volatility will be similar to the motor vehicle sales tax alternative as people may be less likely to buy a car during a downturn in the economy and the need to set the title fee at a higher rate due to less frequent/fewer transactions may be necessary. The frequency with which a title fee-based alternative fee would be paid would most likely be the same as the motor vehicle sales tax-based alternative and therefore require a larger amount to be collected at the time the vehicle is titled versus annually at time of registration. Also, a higher title fee, unless structured in a very different way than the current fee, would bear little relation to vehicle characteristics or use, such as weight or size or mileage, that affect roads.

Some vehicles are exempt from title fees (see Appendix C). Many of these vehicles may pay motor fuel taxes. Therefore, it would need to be decided whether a title-based AFV fee would apply to an AFV that is exempt from current title fees. Also, a title-based fee could discourage owners from applying for title as part of a private sale or to remove a paid-off lien.

A higher title fee could encourage interstate motor carriers (e.g. commercial trucks) to not use Texas as their base jurisdiction when operating under the International Registration Plan (a vehicle registration reciprocity program that allows interstate carriers to pay registration fees based on their usage of each state's roads). This would not affect their actual usage or operations in Texas but would result in a county not receiving its local option fees and reduce the amount of business property subject to ad valorem taxation in the state.

Conclusion

The use of alternatively fueled vehicles continues to grow in Texas, the nation and throughout the world. Other states, countries and the vehicle industry continue to explore various possibilities to traditional vehicle fueling methods for many reasons, including mobility efficiency and environmental benefits. It is important to consider all opportunities to ensure funds are available to continue to build and maintain Texas' transportation network. This report provides a basis for which the Texas Legislature can continue to consider options for collecting road use fees from various sources to help keep pace with the rising cost of building and maintaining the state's transportation infrastructure.

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Appendices

Appendix A. Article 6, Senate Bill 604, 86th Regular Session

ARTICLE 6. STUDY ON IMPOSING FEES ON ALTERNATIVELY FUELED VEHICLES

SECTION 6.01. DEFINITIONS. In this article:

(1) "Alternatively fueled vehicle" has the meaning assigned by Section 502.004, Transportation Code.

(2) "Conventional vehicle" means a vehicle, as defined by Section 502.001, Transportation Code, that is exclusively powered by gasoline or diesel fuel.

(3) "Motor fuel taxes" means the motor fuel taxes imposed under Chapter 162, Tax Code.

SECTION 6.02. STUDY AND REPORT. (a) Using existing funds, the Texas Department of Motor Vehicles shall organize a study on:

(1) the impact of the alternatively fueled vehicles industry on the state;

(2) the options available to the state for collecting fees from owners of alternatively fueled vehicles to replace the loss of revenue from motor fuel taxes; and

(3) the feasibility and desirability of establishing a fee for alternatively fueled vehicles.

(b) The study organized under Subsection (a) of this section shall be conducted by:

(1) the Texas Department of Motor Vehicles;

(2) the Public Utility Commission of Texas;

(3) the Texas Department of Transportation;

(4) the Department of Public Safety of the State of Texas; and

(5) the Texas Commission on Environmental Quality.

(c) The study must examine:

(1) the current revenue generated from motor fuel taxes imposed on a conventional vehicle and each type of alternatively fueled vehicle for each mile the vehicle is operated;

(2) the net revenue generated by fees and taxes paid by owners of alternatively fueled vehicles and conventional vehicles for the use of the vehicle, including motor vehicle registration fees under Chapter 502, Transportation Code, motor fuel taxes, and taxes, fees, and surcharges on the retail sale of electricity consumed by alternatively fueled vehicles;

(3) the methods to determine the average number of miles traveled in this state by alternatively fueled vehicles and conventional vehicles each year;

(4) the type and amount of fees by which other states generate revenue from alternatively fueled vehicles and conventional vehicles;

(5) alternative methods for determining and collecting road use fees from owners of alternatively fueled vehicles, including methods that consider the weight of and the number of miles traveled by an alternatively fueled vehicle;

(6) the projected revenue to the state for each method examined under Subdivision (5) of this subsection;

(7) the projected impact of alternatively fueled vehicles on the state highway system, including the maintenance required because of the impact;

(8) the projected direct environmental benefit of alternatively fueled vehicles on vehicle emissions in this state; and

(9) the projected impact of alternatively fueled vehicles to the state's power grids and electricity markets.

(d) Not later than December 1, 2020, the Texas Department of Motor Vehicles shall prepare and submit to the governor, lieutenant governor, speaker of the house of representatives, and members of the legislature a written report that includes a summary of the results of the study conducted under this section and any legislative recommendations based on the study.

SECTION 6.03. EXPIRATION DATE. This article expires September 1, 2021.

Appendix B. Detailed Discussion of Direct Environmental Benefit

This appendix presents the data, procedures, and assumptions used in the analysis conducted as required by Senate Bill 604 (SB 604). It provides a detailed explanation of the components used to calculate the potential maximum direct emissions benefits of AFVs, including the federal fleet average requirements (emissions limits), electric vehicle population projections, and vehicle emissions estimates.

Overview of Tier 2 and Tier 3 Emissions Standards for the Light-Duty Fleet

Vehicle manufacturers are required to meet U.S. Environmental Protection Agency (EPA) fleet average requirements based on the mix of vehicles in their manufactured fleet per model year. Vehicles are classified in certification bins that correspond to emissions limits. These certification bins play a key role in this analysis.

Under the Tier 2 emissions standards that applied from the 2004 through 2016 model years, vehicles were certified to Bins 1 through 8 with Bin 5 representing the fleet average requirements of 0.07 grams per mile of nitrogen oxides (NO_X) and 0.09 grams per mile of non-methane organic gases (NMOG). The NO_X and NMOG grams per mile rates for the other Tier 2 bins are provided in Table B-1: *Summary of Tier 2 and Tier 3 Full Useful Life Emissions Standards*.

Tier 2 Certification Bin	NO_X (grams per mile)	NMOG (grams per mile)	NO_X + NMOG (milligrams per mile)	Tier 3 Certification Bin
Bin 1 (Electric Vehicles)	0.000	0.000	0	Bin 0 (Electric Vehicles)
			20	Bin 20
Bin 2	0.020	0.010	30	Bin 30 (Tier 3 Average)
			50	Bin 50
			70	Bin 70
Bin 3	0.030	0.055	85	
Bin 4	0.040	0.070	110	
			125	Bin 125
Bin 5 (Tier 2 Average)	0.070	0.090	160	Bin 160 (Tier 3 Maximum)
Bin 6	0.100	0.090	190	
Bin 7	0.150	0.090	240	
Bin 8 (Tier 2 Maximum)	0.200	0.125	325	

Table B-1: Summary of Tier 2 and Tier 3 Full Useful Life Emissions Standards

Under the Tier 3 emissions standards that phase in from the 2017 through 2025 model years, the NO_X and NMOG rates are converted from units of grams per mile to milligrams per mile and combined into a NO_X + NMOG total for certification purposes. Vehicles that would have been certified to Bins 6, 7, and 8 under Tier 2 emissions standards can no longer be manufactured under Tier 3 emissions standards.

For each model year, the EPA *Green Vehicle Guide* provides a comprehensive list of how various makes and models are certified. For the most recent 2020 model year (EPA/DOE, 2020), summaries of 1,200 makes and models are provided in Table B-2: *Distribution of 2020 Model Year Vehicles by Tier 3 Bin and Fuel Type*. Of the 1,200 various make and model combinations available in 2020, 3% are in Bin 0, 19% are in Bin 30, 6% are in Bin 160, and the remaining 72% are from Bins 20, 50, 70, and 125. The electricity category is for battery electric vehicles (BEVs), the combination fuel type of gasoline/electricity is for plug-in hybrid electric vehicles (PHEVs), and the remaining hybrid electric vehicles (HEVs) are included in the gasoline category.

Tier 3 Bin	Gasoline	Gasoline/ Electricity	Electricity	Diesel Fuel	Ethanol/ Gasoline	Hydrogen	Total	Distribution
Bin 0			33			4	37	3.1%
Bin 20		1					1	0.1%
Bin 30	207	20					227	18.9%
Bin 50	116	1					117	9.8%
Bin 70	383	3			6		392	32.7%
Bin 125	328	9		5	16		358	29.8%
Bin 160	51			15	2		68	5.7%
Total	1,085	34	33	20	24	4	1,200	100.0%

Table B-2: Distribution of 2020 Model Year Vehicles by Tier 3 Bin and Fuel Type

The federal rulemaking for Tier 3 emissions standards states that "compliance with the more stringent Tier 3 fleet average standards will require vehicle manufacturers to certify a significant amount of vehicles to bin standards that are below the Bin 30 fleet average standard to offset other vehicles that are certified to bin standards that remain somewhat above the Bin 30 fleet average even after significantly reducing their emissions. […] There is also very limited ability for vehicle manufacturers to certify vehicles below the stringent Tier 3 fleet average exhaust emissions standard since Bin 20 and Bin 30 standards for individual vehicle certification test groups are approaching the engineering limits of what can be achieved for vehicles using an internal combustion engine and Bin 0 can only be achieved by electric-only vehicle operation. The result is that there is a very limited ability to offset sales of vehicles certified above the 30 milligrams per mile fleet average emission standard." (EPA, 2014).

Based on how the Tier 3 emissions standards are structured, a manufacturer will have the option of providing 100% of its 2025-and-later vehicles in Bin 30, or providing up to 81% of its vehicles in the Bin 0 category for electric vehicles while certifying the remaining 19% in the Bin 160 maximum category. These and other certification scenarios are summarized in Table B-3: *Compliance Options Under Tier 3 Emissions Standards for 2025-and-Later Model Years*.

Tier 3 Certification Bin	Gasoline Vehicle Sales	Bin 0 Electric Vehicle Sales	Gasoline and Electric Vehicle Sales	Total Emissions (milligrams per mile)	Fleet Average (milligrams per mile)	Gasoline Portion	Electric Portion
Bin 30	1	0	1	30	30	100%	0%
Bin 50	3	2	5	150	30	60%	40%
Bin 70	3	4	7	210	30	43%	57%
Bin 125	6	19	25	750	30	24%	76%
Bin 160	3	13	16	480	30	19%	81%

Table B-3: Compliance Options Under Tier 3 Emissions Standards for 2025-and-Later Model Years

On-Road Emissions Inventories for 2016 and 2028

Under a grant agreement with the Texas Commission on Environmental Quality (TCEQ), the Texas A&M Transportation Institute (TTI) developed on-road emissions inventories for all 254 Texas counties for both a 2016 historical year and a 2028 future year (TTI, 2019) using the 2014a version of the Motor Vehicle Emissions Simulator (MOVES2014a) model (EPA, 2018). For a given calendar year, the MOVES2014a model provides emissions rates for

31 model years in operation. For this TTI study, the vehicle miles traveled (VMT) projections were based on Highway Performance Monitoring System (HPMS) data from the Texas Department of Transportation (TxDOT), and the vehicle population projections were based on registration database queries from the Texas Department of Motor Vehicles (TxDMV).

Emissions and fuel consumption rates for the 1986 through 2016 model years are presented in Figure B-1: *Passenger Car NO_X, VOC, and Fuel Economy Rates by Model Year Operating in 2016*. As shown, the Tier 2 emissions standards that phased in from 2004 through 2007 have lower emissions for NO_X and volatile organic compounds (VOC) than the standards that applied for Tier 1 in the 1990s and for the National Low Emissions Vehicle (NLEV) program from 2001 through 2003. The Tier 2 and Tier 3 emissions standards specify NMOG, but VOC is provided here because it is more commonly used and reported for air quality modeling purposes. NMOG are total organic gases excluding methane, while VOC are total organic gases excluding methane and ethane. The 2011-and-older model year passenger cars operating in 2016 have roughly similar average fuel economy rates because the Corporate Average Fuel Economy (CAFE) standards affecting the 2012 through 2016 model years did not yet apply (EPA/NHTSA, 2010).

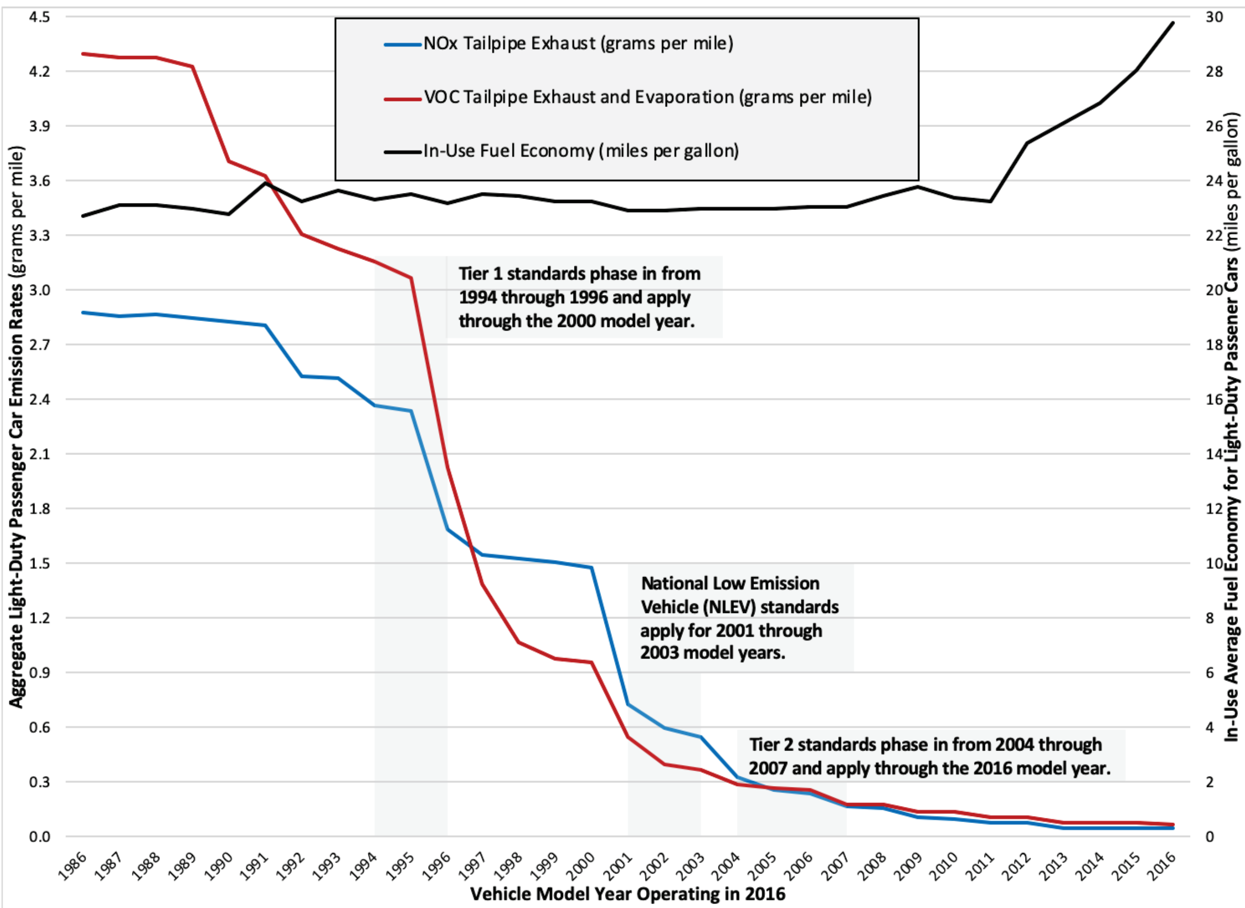

Figure B-1: Passenger Car NOX, VOC, and Fuel Economy Rates by Model Year Operating in 2016

Emissions and fuel consumption rates for the 1998 through 2028 model years are presented in Figure B-2: *Passenger Car NO_X, VOC, and Fuel Economy Rates by Model Year Operating in 2028*. Under the *2020 Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule*, fuel economy standards phase in from the 2021 through 2026 model years, resulting in an average in-use fuel consumption rate for passenger cars of roughly 40 miles per gallon (mpg) after 2026 (EPA/NHTSA, 2020). Emission rates in 2028 by model year for carbon monoxide (CO), particulate matter (PM), sulfur dioxide (SO_2), and ammonia (NH_3) are provided in Table B-8: *2028 Summer Weekday Activity and Emissions Rates by Model Year for Electric Passenger Car Analysis* and Table B-9: *2028 Summer Weekday Activity and Emissions Rates by Model Year for Electric Passenger Truck Analysis*.

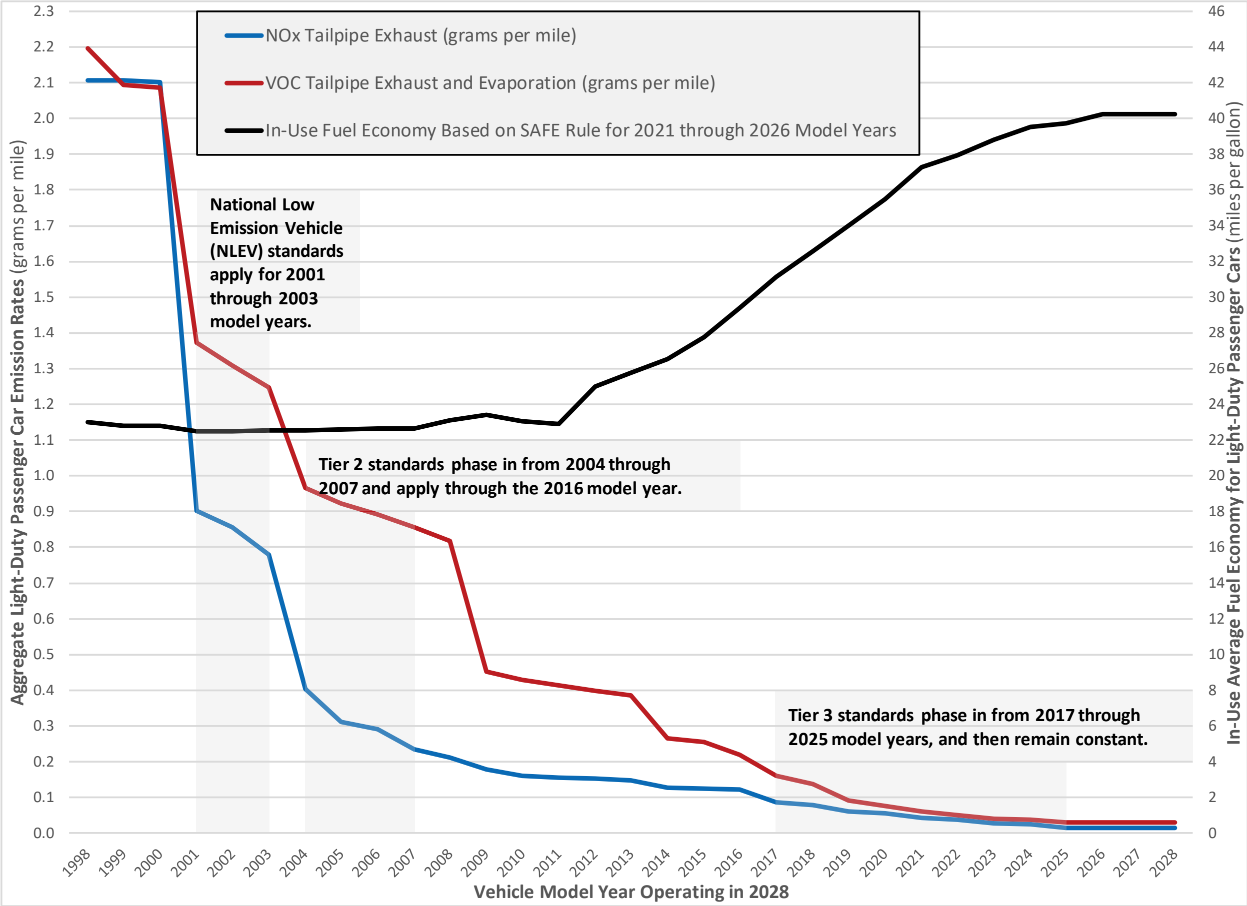

Figure B-2: Passenger Car NOX, VOC, and Fuel Economy Rates by Model Year Operating in 2028

In 2028, the majority of Tier 1, NLEV, and Tier 2 vehicles that operated in 2016 are expected to have left the fleet due to attrition, and roughly 71% of the fleet is expected to be comprised of very low-emitting vehicles that meet the Tier 3 emissions standards. The expected impact of this fleet turnover is presented in Figure B-3: *Texas Light-Duty Fleet NO_X and VOC in 2016 and 2028 by Emissions Standard*.

The 18.8 million light-duty vehicles operating in 2016 are estimated to have emitted 282 tons of NO_X per day, while the 21.8 million light-duty vehicles projected to be operating in 2028 are estimated to emit 78 tons of NO_X per day, which is a reduction of 72% even though the overall fleet is expected to grow by 16%. The VOC emissions from the light-duty fleet are expected to decline by roughly 50% during this period, from 247 tons per day in 2016 to 123 tons per day in 2028.

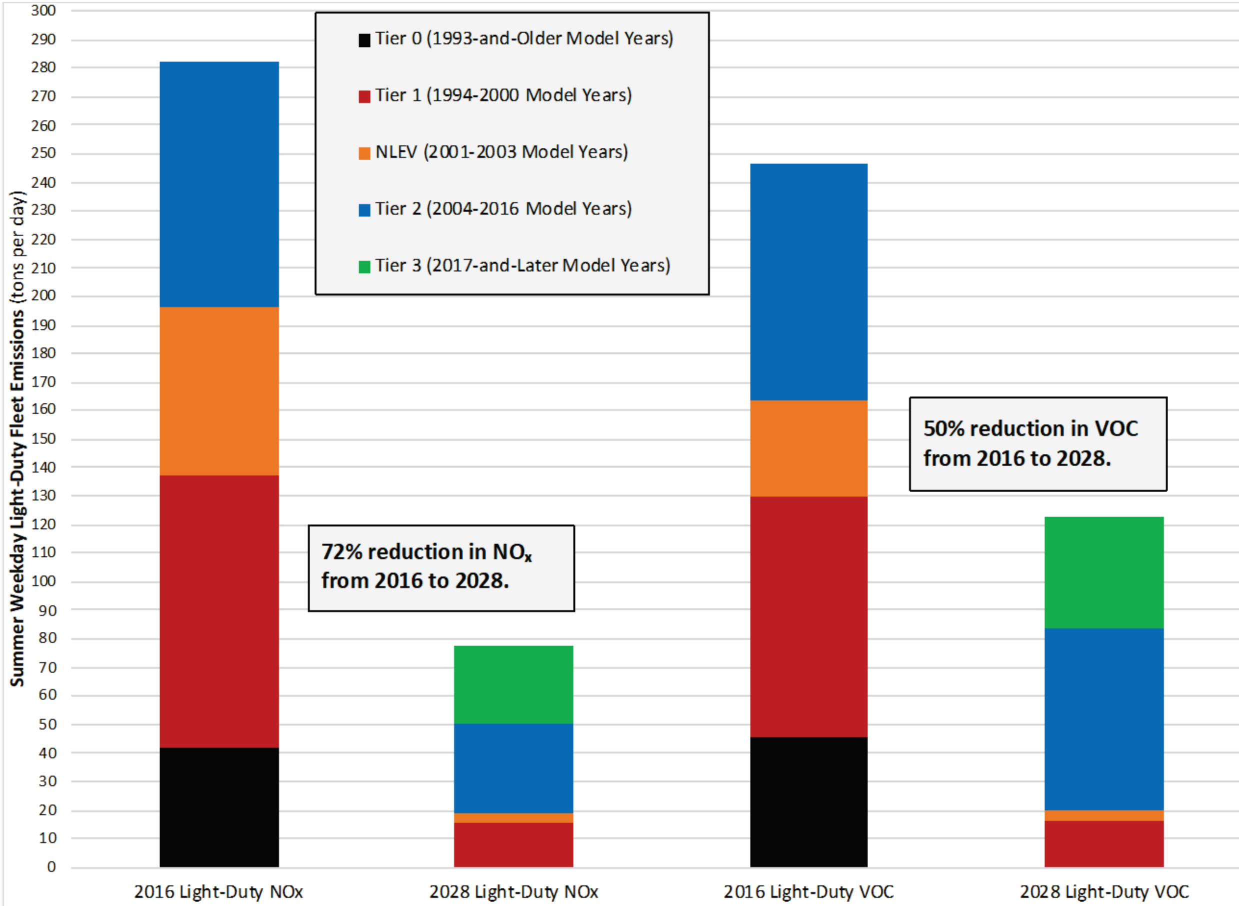

Figure B-3: Texas Light-Duty Fleet NO_X and VOC by Emissions Standard

Due to the increasing stringency of fuel economy standards that must be met after the 2016 model year, total carbon dioxide (CO_2) emissions from 2016 to 2028 are expected to decline by 16% even though the light-duty vehicle population is expected to increase by 16%. This is shown in Figure B-4: *Texas Light-Duty Fleet CO_2 Emissions in 2016 and 2028 by Model Year Groups*. The tailpipe emissions standards affecting pollutants such as NO_X and VOC have typically not phased in simultaneously with standards for fuel economy and CO_2. To be consistent with Figure B-3, the same model year groups are used in Figure B-4 to shows the fleet turnover effects for CO_2.

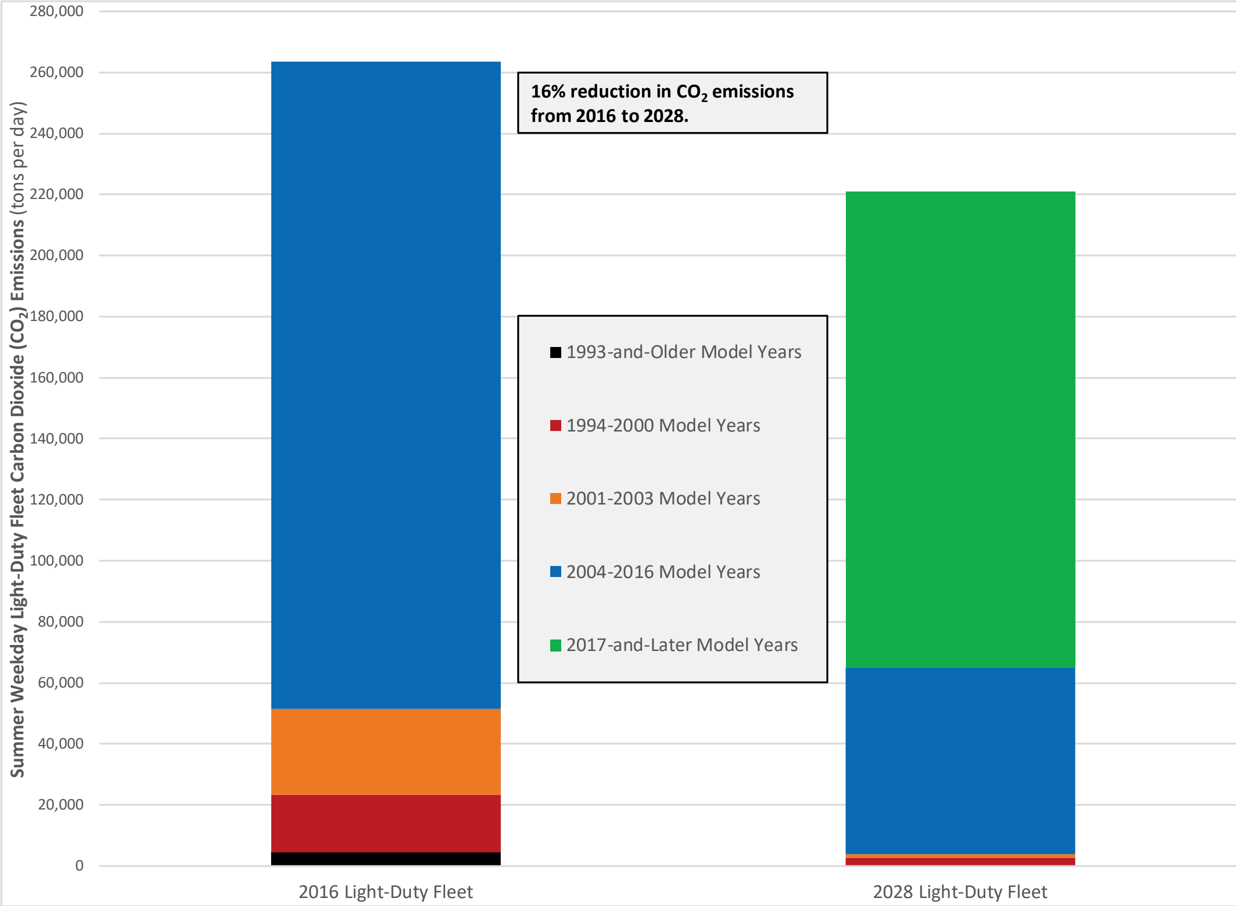

Figure B-4: Texas Light-Duty Fleet CO2 Emissions in 2016 and 2028 by Model Year Groups

Electric Vehicle Population Projections for 2028

The TxDMV is required to annually report the number of AFVs operating in the state. The number of electric vehicle registrations for the 2016 through 2019 fiscal years are available in Appendix E of the *2019 Alternatively Fueled Vehicle Report*. The differences between the fiscal year registrations were used to obtain incremental model year assignments for electric vehicles that were needed for this analysis. The results are presented in Table B-4: *Texas Statewide Electric Vehicle Registrations by Fiscal Year and Model Year*.

Texas Statewide Electric Vehicle Registrations	2016	2017	2018	2019
Texas Registrations by Fiscal Year	8,397	11,724	18,990	29,540
Percent Increase in Registrations		39.6%	62.0%	56.0%
Incremental Model Year Assignment	8,397	3,327	7,266	10,550

Table B-4: Texas Statewide Electric Vehicle Registrations by Fiscal Year and Model Year

The U.S. Energy Information Administration (EIA) typically updates its Annual Energy Outlook (AEO) in January of each year. The TCEQ obtained data from the 2020 AEO, Table 38.7, *Light Duty Vehicle Sales by Technology Type: West South Central Region* (EIA, 2020). This table contains vehicle sales projections from 2019 through 2050 for the region encompassing Arkansas, Louisiana, Oklahoma, and Texas.

The U.S. Department of Transportation (DOT) Federal Highway Administration (FHWA) annually publishes its Highway Statistics Series (FHWA, 2019). For the most recently available 2018 data set, Texas automobile registrations comprised 69.6% of the total from all four West South Central states. This percentage was applied to the BEV and PHEV projections from the 2020 AEO. Separate projections were provided by the 2020 AEO for passenger cars and light trucks, with the latter category covering most minivans, pickups, and sport utility vehicles (SUVs).

These general categories align with the passenger car and passenger truck source use types (SUTs) in the MOVES2014a model used for this analysis (EPA, 2018). Summaries of this work are presented in Table B-5: *Estimation of 2020-through-2028 Electric Passenger Car Sales for Texas* and Table B-6: *Estimation of 2020-through-2028 Electric Passenger Truck Sales for Texas*.

2020 AEO Passenger Car Projections	2020	2021	2022	2023	2024	2025	2026	2027	2028
BEVs	36,408	47,854	47,711	49,346	53,393	58,569	60,409	62,605	65,585
PHEVs	8,318	6,989	6,008	5,648	5,369	4,533	4,710	5,090	5,596
West South Central Total	44,726	54,843	53,719	54,994	58,762	63,102	65,118	67,695	71,181
Texas Portion (69.6%)	31,119	38,158	37,376	38,263	40,885	43,904	45,307	47,100	49,526

Table B-5: Estimation of 2020-through-2028 Electric Passenger Car Sales for Texas

2020 AEO Minivan/Pickup/SUV Projections	2020	2021	2022	2023	2024	2025	2026	2027	2028
BEVs	6,475	7,256	7,983	8,515	9,383	9,695	9,812	10,050	10,462
PHEVs	3,340	3,379	3,153	2,985	2,866	3,449	7,188	8,494	8,594
West South Central Total	9,815	10,635	11,136	11,500	12,249	13,144	17,001	18,544	19,056
Texas Portion (69.6%)	6,829	7,399	7,748	8,001	8,522	9,145	11,828	12,902	13,259

Table B-6: Estimation of 2020-through-2028 Electric Passenger Truck Sales for Texas

Estimation of Maximum Environmental Benefits in 2028

The TCEQ conducted an analysis to determine what the maximum possible additional direct emissions reductions would be if all the 486,811 light-duty electric vehicles projected to be operating in 2028 were not used to meet fleet average requirements. Under such a hypothetical scenario, all the gasoline and diesel vehicle sales from 2016 through 2028 would average out to the fleet average requirements, thus leaving electric vehicle sales to provide additional direct environmental benefits.

The potential additional reductions that could be achieved daily if none of the 486,811 light-duty electric vehicles in 2028 are needed by manufacturers to meet fleet average requirements are presented in Table B-7: *2028 Maximum Daily Emissions Benefits from Light-Duty Electric Vehicles*. To obtain these results, the MOVES2014a model was run for a summer weekday scenario in 2028 for all 254 Texas counties to obtain fleet average emissions rates by model year.

Pollutant or Vehicle Data	2028 Light-Duty Fleet Totals	2028 Maximum Electric Vehicle Impacts	2028 Maximum Electric Vehicle Impact Portion
Vehicle Population	21,844,307	486,811	2.2%
Daily Vehicle Miles Traveled	737,198,139	18,945,921	2.6%
NO_X (tons per day)	77.65	0.63	0.8%

Pollutant or Vehicle Data	2028 Light-Duty Fleet Totals	2028 Maximum Electric Vehicle Impacts	2028 Maximum Electric Vehicle Impact Portion
VOC from Vehicles (tons per day)	122.67	0.95	0.8%
CO (tons per day)	1,811.19	19.70	1.1%
CO_2 (tons per day)	220,966.51	4,945.73	2.2%
SO_2 (tons per day)	1.47	0.03	2.2%
NH_3 (tons per day)	15.71	0.35	2.2%
$PM_{2.5}$ (tons per day)	2.72	0.03	1.3%
PM_{10} (tons per day)	3.07	0.04	1.3%
VOC from Refueling (tons per day)	8.14	0.15	1.9%
Fuel Consumption (gallons per day)	23,457,278	525,093	2.2%

Table B-7: 2028 Maximum Daily Emissions Benefits from Light-Duty Electric Vehicles

Light-duty passenger vehicles comprise the majority of the vehicles on roadways and are the focus of this analysis. The TCEQ separately analyzed gasoline passenger cars, diesel passenger cars, gasoline passenger trucks, and diesel passenger trucks, which are collectively considered the light-duty fleet. These results were aggregated to obtain fleet average emissions rates by model year for passenger cars and passenger trucks. Summaries are provided in Table B-8: *2028 Summer Weekday Activity and Emissions Rates by Model Year for Electric Passenger Car Analysis* and Table B-9: *2028 Summer Weekday and Emissions Rates by Model Year for Electric Passenger Truck Analysis*. To estimate the maximum possible benefits that could be obtained from electric vehicles, the fleet average emissions rates by model year for passenger cars and trucks were multiplied by the daily miles accrued from each electric vehicle.

This approach presumes that each electric vehicle would have been a gasoline or diesel vehicle from the same model year that meets the fleet average requirements. For example, Table B-8 shows that 49,526 electric passenger cars from the 2028 model year are projected to operate an average of 42.7 miles per day, which totals 2,114,760 miles. When multiplied by a fleet average emissions rate of 0.014 grams per mile of NO_X, a maximum possible benefit of 65 pounds is obtained. Similar calculations were done for different pollutants, model years, and vehicle types as presented in Table B-10: *2028 Summer Weekday Emissions and Fuel Consumption by Model Year for Electric Passenger Car Analysis* and Table B-11: *2028 Summer Weekday Emissions and Fuel Consumption by Model Year for Electric Passenger Truck Analysis*. All of the electronic files used in the analysis are available for download at ftp://amdaftp.tceq.texas.gov/EI/onroad/sb604/ (TCEQ, 2020).

Inventory Parameter	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total/ Average
Electric Vehicle Miles Traveled	254,209	104,711	237,255	356,935	1,087,383	1,377,945	1,391,800	1,464,688	1,610,083	1,775,132	1,875,066	1,988,781	2,115,847	15,639,834
Electric Vehicle Population	8,397	3,327	7,266	10,550	31,119	38,158	37,376	38,263	40,885	43,904	45,307	47,100	49,526	401,178
Daily Accumulation (miles per vehicle)	30.3	31.5	32.7	33.8	34.9	36.1	37.2	38.3	39.4	40.4	41.4	42.2	42.7	39.0
NO_X (grams per mile)	0.1228	0.0852	0.0783	0.0617	0.0560	0.0420	0.0378	0.0281	0.0252	0.0142	0.0140	0.0141	0.0140	0.0283
VOC from Vehicles (grams per mile)	0.2204	0.1597	0.1375	0.0911	0.0760	0.0613	0.0497	0.0406	0.0379	0.0300	0.0294	0.0304	0.0301	0.0465
CO (grams per mile)	4.3413	2.2765	2.1379	1.6225	1.5142	1.3670	1.2720	1.0348	0.9670	0.4958	0.4926	0.5049	0.5028	0.9382
CO_2 (grams per mile)	290.40	273.95	262.16	250.97	240.50	228.92	225.07	219.92	216.06	214.78	212.21	212.21	212.21	221.53
SO_2 (grams per mile)	0.0019	0.0018	0.0017	0.0017	0.0016	0.0015	0.0015	0.0015	0.0014	0.0014	0.0014	0.0014	0.0014	0.0015
NH_3 (grams per mile)	0.0228	0.0228	0.0228	0.0185	0.0185	0.0185	0.0185	0.0152	0.0152	0.0153	0.0152	0.0152	0.0152	0.0164
$PM_{2.5}$ (grams per mile)	0.0049	0.0040	0.0038	0.0027	0.0023	0.0017	0.0017	0.0015	0.0014	0.0012	0.0012	0.0012	0.0012	0.0016
PM_{10} (grams per mile)	0.0056	0.0045	0.0043	0.0031	0.0026	0.0019	0.0019	0.0016	0.0016	0.0013	0.0013	0.0013	0.0013	0.0018
VOC from Refueling (grams per gallon)	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.27	0.27	0.27	0.27	0.26	0.27
Total Energy Consumption (kilojoules per mile)	4,039	3,811	3,647	3,491	3,345	3,184	3,131	3,059	3,005	2,988	2,952	2,952	2,952	3,081
Fuel Economy (miles per gallon)	29.4	31.2	32.6	34.0	35.5	37.3	37.9	38.8	39.5	39.8	40.2	40.2	40.2	38.5
CO_2 (grams per gallon)	8,538	8,538	8,538	8,538	8,538	8,538	8,538	8,538	8,538	8,538	8,538	8,538	8,538	8,538
SO_2 (grams per gallon)	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567

Table B-8: 2028 Summer Weekday Activity and Emissions Rates by Model Year for Electric Passenger Car Analysis

Inventory Parameter	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total/ Average
Electric Vehicle Miles Traveled					227,108	254,975	277,200	295,474	325,054	359,924	478,435	531,256	556,663	3,306,087
Electric Vehicle Population					6,829	7,399	7,748	8,001	8,522	9,145	11,828	12,902	13,259	85,633
Daily Accumulation (miles per vehicle)					33.3	34.5	35.8	36.9	38.1	39.4	40.4	41.2	42.0	38.6
NO_X (grams per mile)					0.0970	0.0714	0.0615	0.0440	0.0376	0.0221	0.0219	0.0219	0.0218	0.0377
VOC from Vehicles (grams per mile)					0.0864	0.0686	0.0558	0.0441	0.0404	0.0307	0.0300	0.0306	0.0301	0.0415
CO (grams per mile)					1.9703	1.7459	1.5781	1.2623	1.1420	0.5799	0.5772	0.5888	0.5870	0.9675
CO_2 (grams per mile)					336.02	322.23	317.21	313.45	310.94	307.18	300.91	300.91	300.92	309.1243
SO_2 (grams per mile)					0.0022	0.0021	0.0021	0.0021	0.0021	0.0020	0.0020	0.0020	0.0020	0.0020
NH_3 (grams per mile)					0.0202	0.0202	0.0202	0.0169	0.0169	0.0169	0.0169	0.0169	0.0169	0.0176
$PM_{2.5}$ (grams per mile)					0.0037	0.0028	0.0028	0.0026	0.0025	0.0017	0.0017	0.0017	0.0017	0.0022
PM_{10} (grams per mile)					0.0041	0.0032	0.0031	0.0029	0.0029	0.0019	0.0019	0.0019	0.0019	0.0024
VOC from Refueling (grams per gallon)					0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Total Energy Consumption (kilojoules per mile)					4,671	4,479	4,410	4,357	4,323	4,270	4,183	4,183	4,183	4,297
Fuel Economy (miles per gallon)					25.5	26.6	27.0	27.3	27.6	27.9	28.5	28.5	28.5	27.7
CO_2 (grams per gallon)					8,568	8,568	8,568	8,568	8,568	8,568	8,568	8,568	8,568	8,568
SO_2 (grams per gallon)					0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567

Table B-9: 2028 Summer Weekday and Emissions Rates by Model Year for Electric Passenger Truck Analysis

Inventory Parameter	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total
NO_X (pounds per day)	69	20	41	49	134	128	116	91	90	55	58	62	65	977
VOC from Vehicles (pounds per day)	124	37	72	72	182	186	152	131	135	118	121	133	140	1,603
CO (pounds per day)	2,433	526	1,118	1,277	3,630	4,153	3,903	3,341	3,433	1,940	2,036	2,214	2,346	32,350
CO_2 (pounds per day)	162,752	63,241	137,126	197,490	576,545	695,442	690,596	710,150	766,949	840,536	877,222	930,422	989,868	7,638,338
SO_2 (pounds per day)	1	0	1	1	4	5	5	5	5	6	6	6	7	51
NH_3 (pounds per day)	13	5	12	15	44	56	57	49	54	60	63	67	71	565
$PM_{2.5}$ (pounds per day)	3	1	2	2	6	5	5	5	5	5	5	5	5	54
PM_{10} (pounds per day)	3	1	2	2	6	6	6	5	6	5	6	6	6	61
VOC from Refueling (pounds per day)	5	2	4	6	18	22	21	22	24	26	27	29	31	237
Fuel Consumption (gallons per day)	8,647	3,360	7,285	10,492	30,631	36,948	36,691	37,729	40,747	44,657	46,606	49,432	52,590	405,816

Table B-10: 2028 Summer Weekday Emissions and Fuel Consumption by Model Year for Electric Passenger Car Analysis

Inventory Parameter	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total
NO_X (pounds per day)					49	40	38	29	27	18	23	26	27	275
VOC from Vehicles (pounds per day)					43	39	34	29	29	24	32	36	37	302
CO (pounds per day)					987	981	964	822	818	460	609	690	720	7,052
CO_2 (pounds per day)					168,240	181,132	193,855	204,185	222,830	243,749	317,394	352,435	369,298	2,253,118
SO_2 (pounds per day)					1	1	1	1	1	2	2	2	2	15
NH_3 (pounds per day)					10	11	12	11	12	13	18	20	21	129
$PM_{2.5}$ (pounds per day)					2	2	2	2	2	1	2	2	2	16
PM_{10} (pounds per day)					2	2	2	2	2	2	2	2	2	18
VOC from Refueling (pounds per day)					5	6	6	6	7	8	10	11	11	70
Fuel Consumption (gallons per day)					8,906	9,589	10,262	10,809	11,796	12,904	16,802	18,657	19,550	119,276

Table B-11: 2028 Summer Weekday Emissions and Fuel Consumption by Model Year for Electric Passenger Truck Analysis

Appendix C. Texas Motor Vehicle Fee & Tax Exemptions

Registration Fee Exemptions

Vehicles registered with the following license plates are exempt from registration fees:

License Plate	License Plate Fee	Reference
Air Medal & Air Medal with Valor, first set	N/A	Sections 504.3015 & 504.315(a-1), Transportation Code
Airman's Medal, first set	N/A	Sections 504.3015 & 504.315(m), Transportation Code
Antique Auto, Bus, Motorcycle, or Truck (manufactured 1921 or later)	$10.00	Section 504.502, Transportation Code
Antique Auto, Bus, Motorcycle, or Truck (manufactured before 1921)	$8.00	Section 504.502, Transportation Code
Bronze Star Medal & Bronze Star Medal with Valor	N/A	Sections 504.3015 & 504.315(a), Transportation Code
Coast Guard Medal, first set	N/A	Sections 504.3015 & 504.315(l), Transportation Code
Congressional Medal of Honor, first set	N/A	Sections 504.3015 & 504.315(e), Transportation Code
Cotton Vehicle	N/A	Section 504.505, Transportation Code
Defense Meritorious Service Medal, first set	N/A	Sections 504.3015 & 504.315(j), Transportation Code
Defense Superior Service Medal, first set	N/A	Sections 504.3015 & 504.319, Transportation Code
Disabled Veteran, first set	$3.00	Section 504.202, Transportation Code
Disaster Relief	$5.00	Section 502.454, Transportation Code
Distinguished Flying Cross Medal & Distinguished Flying Cross Medal with Valor, first set	N/A	Sections 504.3015 & 504.308, Transportation Code
Distinguished Service Medal, first set	N/A	Sections 504.3015 & 504.315(b), Transportation Code
Foreign Organization License Plate	N/A	Section 504.4061, Transportation Code
Golf Cart License Plate	$10.00	Sections 551.402 & 504.002(b), Transportation Code
Legion of Merit, first set	N/A	Section 504.316, Transportation Code
Legion of Valor, first set	N/A	Sections 504.3015 & 504.315(f), Transportation Code
Log Loader License Plate	$62.50	Section 504.506, Transportation Code
Machinery License Plate	$5.00	Section 502.146, Transportation Code
Meritorious Service Medal, first set	N/A	Sections 504.3015 & 504.315(k), Transportation Code
Navy and Marine Corps Medal, first set	N/A	Sections 504.3015 & 504.315(o), Transportation Code
Off-Highway Vehicle License Plate	$10.00	Section 551A.052, Transportation Code
Package Delivery License Plate	$25.00	Section 551.452, Transportation Code
Peace Officer Purple Heart	$3.00	Section 504.5115, Transportation Code
Pearl Harbor Survivor, first set	$3.00	Sections 504.3015 & 504.315(d), Transportation Code
Prisoner of War, first set	N/A	Sections 504.3015 & 504.315(p), Transportation Code
Purple Heart, first set	N/A	Sections 504.3015 & 504.315(g), Transportation Code
Silver Star Medal, first set	N/A	Sections 504.3015 & 504.315(h), Transportation Code
Soldier's Medal, first set	N/A	Sections 504.3015 & 504.315(n), Transportation Code
Surviving Spouse of a Disabled Veteran, first set	$3.00	Section 504.317, Transportation Code

Table C-1: Texas License Plates with Non-standard Registration Fee.

Title Transfer Fee Exemptions

The following title transactions are exempt from the title application fee:

1. Title transfers for vehicles owned by state agencies, *Section 501.138, Transportation Code*
2. Title transfers for vehicles owned by political subdivisions of the state, *Section 501.138, Transportation Code*
3. Title corrections when a county tax office error is confirmed for original title transaction
4. Non-title transactions

Motor Vehicle Sales Tax Exemptions

The following are exempt from the motor vehicle sales tax:

1. Motor vehicles purchased, rented, or used by child care facilities, *Section 152.093, Tax Code*
2. Motor vehicles used for religious purposes, *Section 152.088, Tax Code*
3. Community Property/Divorce
4. Dealer Resale
5. Driver training motor vehicles, *Section 152.081, Tax Code*
6. Vehicles for farm or timber use, *Section 152.091, Tax Code*
7. Fire trucks and emergency medical services vehicles, *Section 152.087, Tax Code*
8. Heirship
9. Interstate motor vehicle (motor carrier), *Section 152.089, Tax Code*

10. Minor
11. Motor vehicles used by foreign consular officers, *34 Texas Administrative Code § 3.63*
12. Motor vehicles used by NATO personnel stationed in Texas, *34 Texas Administrative Code § 3.68*
13. Off-Highway
14. Motor vehicles driven by orthopedically handicapped persons, *Section 152.086, Tax Code*
15. Motor vehicles sold to or used by a public agency, *Section 152.082, Tax Code*
16. Hydrogen-powered vehicles that meet the Phase II standards established by the California Air Resources Board as of September 1, 2007, for an ultra low-emission vehicle II or stricter Phase II emission standards established by that board and is either hydrogen power capable and has a fuel economy rating of at least 45 miles per gallon or is fully hydrogen-powered.
17. Rental
18. Seller-Financed Sale

Motor Fuel Tax Exemptions

Gasoline Tax

Section 162.104, Tax Code, provides that the gasoline tax does not apply to gasoline:

1. Sold to the United States for its exclusive use, provided that the exemption does not apply with respect to fuel sold or delivered to a person operating under a contract with the United States
2. Sold to a public school district in this state for the district's exclusive use
3. Sold to a commercial transportation company or a metropolitan rapid transit authority that provides public school transportation services to a school and that uses the gasoline only to provide those services
4. Exported by either a licensed supplier or a licensed exporter from this state to any other state, provided that the bill of lading indicates the destination state and the supplier collects the destination state tax

   Note: Does not apply to gasoline that is transported and delivered outside this state in the motor fuel supply tank of a motor vehicle other than an interstate trucker

   Note: Applies only if the destination state recognizes, by agreement with this state or by statute or rule, a supplier in this state as a valid taxpayer for the motor fuel being exported to that state from this state

   Note: Does not apply to a sale by a distributor
5. Moved by truck or railcar between licensed suppliers or licensed permissive suppliers and in which the gasoline removed from the first terminal comes to rest in the second terminal, provided that the removal from the second terminal rack is subject to the gasoline tax
6. Delivered or sold into a storage facility of a licensed aviation fuel dealer from which gasoline will be delivered solely into the fuel supply tanks of aircraft or aircraft servicing equipment, or sold from one licensed aviation fuel dealer to another licensed aviation fuel dealer who will deliver the aviation fuel exclusively into the fuel supply tanks of aircraft or aircraft servicing equipment
7. Exported to a foreign country if the bill of lading or shipping documents indicate the foreign destination and the fuel is actually exported to the foreign country
8. Sold to a volunteer fire department in this state for the department's exclusive use
9. Sold to a nonprofit entity that is organized for the sole purpose of and engages exclusively in providing emergency medical services and that uses the gasoline exclusively to provide emergency medical services, including rescue and ambulance services

Diesel Fuel Tax

Section 162.204, Tax Code, provides that the diesel fuel tax does not apply to:

1. Diesel fuel sold to the United States for its exclusive use, provided that the exemption does not apply to diesel fuel sold or delivered to a person operating under a contract with the United States
2. Diesel fuel sold to a public school district in this state for the district's exclusive use
3. Diesel fuel sold to a commercial transportation company or a metropolitan rapid transit authority operating and that uses the diesel fuel only to provide those services
4. Diesel fuel exported by either a licensed supplier or a licensed exporter from this state to any other state, provided that the bill of lading indicates the destination state and the supplier collects the destination state tax

   Note: does not apply to diesel fuel that is transported and delivered outside this state in the motor fuel supply tank of a motor vehicle other than an interstate trucker

   Note: applies only if the destination state recognizes, by agreement with this state or by statute or rule, a supplier in this state as a valid taxpayer for the motor fuel being exported to that state from this state

   Note: does not apply to a sale by a distributor
5. Diesel fuel moved by truck or railcar between licensed suppliers or licensed permissive suppliers and in which the diesel fuel removed from the first terminal comes to rest in the second terminal, provided that the removal from the second terminal rack is subject to the diesel fuel tax
6. Diesel fuel delivered or sold into a storage facility of a licensed aviation fuel dealer from which the diesel fuel will be delivered solely into the fuel supply tanks of aircraft or aircraft servicing equipment, or sold from one licensed aviation fuel dealer to

another licensed aviation fuel dealer who will deliver the diesel fuel exclusively into the fuel supply tanks of aircraft or aircraft servicing equipment

7. Diesel fuel exported to a foreign country if the bill of lading or shipping documents indicate the foreign destination and the fuel is actually exported to the foreign country
8. Dyed diesel fuel sold or delivered by a supplier to another supplier and dyed diesel fuel sold or delivered by a supplier or distributor into the bulk storage facility of a dyed diesel fuel bonded user or to a purchaser who provides a signed statement as provided by Section 162.206
9. The volume of water, fuel ethanol, renewable diesel, biodiesel, or mixtures thereof that are blended together with taxable diesel fuel when the finished product sold or used is clearly identified on the retail pump, storage tank, and sales invoice as a combination of diesel fuel and water, fuel ethanol, renewable diesel, biodiesel, or mixtures thereof
10. Dyed diesel fuel sold by a supplier or permissive supplier to a distributor, or by a distributor to another distributor
11. Dyed diesel fuel delivered by a license holder into the fuel supply tanks of railway engines, motorboats, or refrigeration units or other stationary equipment powered by a separate motor from a separate fuel supply tank
12. Dyed kerosene when delivered by a supplier, distributor, or importer into a storage facility at a retail business from which all deliveries are exclusively for heating, cooking, lighting, or similar nonhighway use
13. Diesel fuel used by a person, other than a political subdivision, who owns, controls, operates, or manages a commercial motor vehicle if the fuel:
    a. is delivered exclusively into the fuel supply tank of the commercial motor vehicle and
    b. is used exclusively to transport passengers for compensation or hire between points in this state on a fixed route or schedule
14. Diesel fuel sold to a volunteer fire department in this state for the department's exclusive use
15. Diesel fuel sold to a nonprofit entity that is organized for the sole purpose of and engages exclusively in providing emergency medical services and that uses the diesel fuel exclusively to provide emergency medical services, including rescue and ambulance services

Compressed Natural Gas and Liquefied Natural Gas Tax

Section 162.356, Tax Code, provides that the compressed natural gas and liquefied natural gas tax does not apply to compressed natural gas or liquefied natural gas delivered into the fuel supply tank of:

1. A motor vehicle operated exclusively by the United States, provided that the exemption does not apply with respect to fuel delivered into the fuel supply tank of a motor vehicle of a person operating under a contract with the United States
2. A motor vehicle operated exclusively by a public school district in this state
3. A motor vehicle operated exclusively by a commercial transportation company or a metropolitan rapid transit authority that provides public school transportation services to a school district and that uses the fuel only to provide those services
4. A motor vehicle operated exclusively by a volunteer fire department in this state
5. A motor vehicle operated exclusively by a municipality or county in this state
6. A motor vehicle operated exclusively by a nonprofit electric cooperative corporation
7. A motor vehicle operated exclusively by a nonprofit telephone cooperative corporation
8. A motor vehicle that is not registered for use on the public highways of this state and that is used exclusively off-highway
9. A motor vehicle operated exclusively by a nonprofit entity that is organized for the sole purpose of and engages exclusively in providing emergency medical services and that uses the fuel exclusively to provide emergency medical services, including rescue and ambulance services
10. Off-highway equipment, a stationary engine, a motorboat, an aircraft, equipment used solely for servicing aircraft and used exclusively off-highway, a locomotive, or any device other than a motor vehicle operated or intended to be operated on the public highways
11. A motor vehicle used to provide the services of a transit company, including a metropolitan rapid transit authority or a regional transportation authority and operated by a person who on January 1, 2015, paid tax on compressed natural gas or liquefied natural gas as provided by Section 162.312, as that section existed on that date. *Note: Does not apply to compressed natural gas or liquefied natural gas delivered into the fuel supply tank of a motor vehicle from a refueling facility accessible to motor vehicles other than those described in the first sentence in this exemption*