

IS TEXAS READY FOR THE LIGHTNING F-150?

Executive Summary

The effect that carbon emissions from the tailpipe of our vehicles is a divisive topic in today's world, but are electric cars ready to take the role of our primary vehicles? In Texas, that question must be taken a step further with the love for larger vehicles. By examining two versions of the Ford F-150, one gas-powered and one electric, this report examines the question from the viewpoint of the Texas truck. The findings illustrate the strengths and weaknesses of each engine and detail the challenges that Texas itself presents to the electric vehicle. In the end, the report finds that some challenges were just too big for the Ford F-150 Lightning all-electric pickup truck to overcome.

Introduction and Technical Background

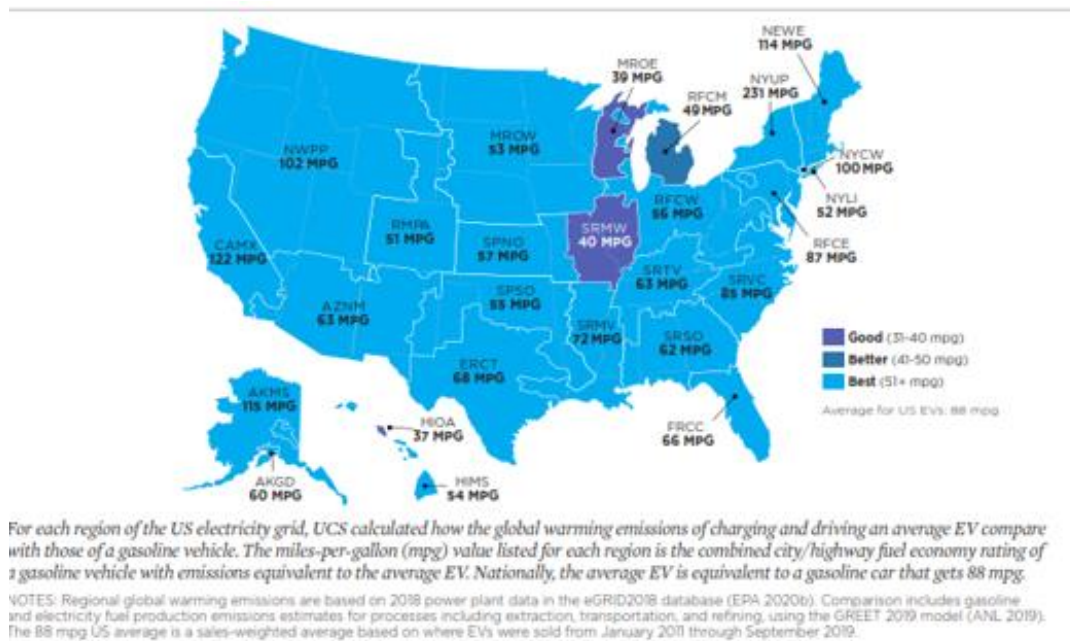
Texans love their cars and trucks, and they have no problem driving them everywhere. Some people would consider that a problem as the debate over global warming seems to rise to a new crescendo every year. When it comes to our transportation, two big changes could help the environment: using more public transportation and buying electric vehicles. According to statistics, Texas ranks 26th in the nation in public transportation usage. Even in our biggest cities, Dallas, and Houston, only four percent of the population uses public transportation. Only eight Texas cities even have public transportation usage above one percent. The problem is exacerbated by the lack of accessible public transportation in the vast rural areas of Texas. Electric vehicles are a more realistic option, but only if they meet the needs of the Texas driver.

When deciding what will meet the needs of the Texas driver, if widespread acceptance is going to happen, larger vehicles, such as SUVs and pickups, must be part of the discussion. Texas has a large population of ranchers and farmers, as well as many citizens who just want to drive big. Almost 60 percent of Texans drive an SUV or pickup truck. Comparing electric passenger cars cannot consider the role of these bigger vehicles. The Ford F-150 is the second highest-selling vehicle in Texas behind the Toyota Camry. Not only does a Camry not meet our large model, but there is not a fully electric version of the Camry. Therefore, the vehicle of choice for this paper will be the Ford F-150. By selecting this vehicle, we can consider the role of the pickup truck in Texas and conduct an apples-to-apples comparison by comparing the F-150 XL model to the F-150 Lightning Pro model, an all-electric version. The purpose of this report is to examine the differences between the gas-powered Ford F-150 and its all-electric counterpart and give a final recommendation to the Texas driver regarding which one will best suit their needs.

Requirements

This report will set aside the question of environment, as multiple scientific studies have proven that electric-powered cars are better for the environment. Even when pollution from coal and natural gas power plants is factored in, electric cars still come out ahead. Figure 1 below illustrates this fact by comparing driving an electric vehicle to the miles per gallon equivalent of a gas-powered vehicle.

Figure 1: Electric Vehicle Environmental Impact by Region (Reichmuth)



For example, driving an electric vehicle in Texas is the equivalent to driving a gas-powered vehicle that gets 68 miles to the gallon. This is lower than the national average of 88 miles per gallon due to the higher number of coal and natural gas power plants in the Texas electrical grid, but it still illustrates that driving an electric vehicle will put less carbon pollution in the atmosphere than driving a gas-powered vehicle. So, setting environmental issues aside, this report will instead focus on requirements that are derived from the major issues people consider when buying a new vehicle, with equal consideration to concerns about buying an electric vehicle. These requirements are:

- Must serve as a primary vehicle.
- Must be convenient to fuel.
- Must be affordable to drive on a per-mile basis.
- Must be mechanically reliable.
- Must meet the towing and hauling needs.
- Must cost under \$50,000.

Only vehicle. The chosen vehicle must be capable of serving as the primary means of transportation for the purchaser. This means it must be able to travel distances driven daily.

Convenient to fuel. For this report, we are using the term “fuel” to denote filling the vehicle with the means of power, whether gasoline or electricity. Fueling the vehicle, with consideration of time and location of fueling stations, cannot be a serious impediment to usage.

Cost to drive per mile. The vehicle should not only be convenient to fuel, but it must be affordable.

Mechanically reliable. Consumers expect quality when shopping for vehicles. High instances of mechanical failure not only means that the car will be unavailable while being repaired, but it is also expensive for the owner.

Towing and hauling. Whether it is work or pleasure, pickup trucks are often purchased with utility in mind, and the vehicle purchased must serve that function if it is to be relevant.

Cost. The vehicle must be available to the average Texan. Kelly Blue Book data put the average price of a full-size truck in January of 2022 at just over \$59,000. This report is not comparing luxury and therefore will aim at a lower-than-average price point.

Options and Points of Comparison

To compare the two options, the Ford F-150 XL model and F-150 Lightning Pro model, the Ford webpage was used to construct two conceptual vehicles that are as identical as possible. To accomplish this, it was necessary to add options to the F-150 XL gasoline powered vehicle as the Lightning model has a more extensive range of items in its standard package. The specific changes will be discussed under the cost comparison, but with additions to the XL model, we can make a relevant comparison using the following points:

- Reliability as an only vehicle
- Fueling convenience
- Cost per mile
- Mechanical reliability
- Towing and Hauling
- Cost

Comparison of the Reliability as an Only Vehicle

If a vehicle is going to serve as the only vehicle for any Texan, there are several factors that a buyer will consider. However, this report only considers the most significant points, and if we are going to consider this as the only vehicle owned, the top consideration must be the ability of the F-150 models to get their owner to the intended destination. The XL model, with its internal combustion engine, is a known quantity with millions driving in the State of Texas every

day. The Lightning model claims a driving range of 230 miles with the standard battery pack, so if the owner remains within the typical daily Texas commute of just under 46 miles, there is no problem, but Texas is a big state with wide open spaces. The average American commute is 41 miles per day, about five miles less than the Texas commute. In addition, primary vehicle means out-of-town usage must be considered. An example of a typical out-of-town Texas drive, Google Maps puts Austin to Dallas at 195.3 miles. At first glance, the 230-mile range seems to leave room for comfort, but there is more to power consumption that must be considered. According to a Car and Driver report, a Tesla Model 3 was tested on a level track to determine the impact of air conditioning on the driving range. Setting the interior to a comfortable temperature resulted in the range of the electric vehicle being cut from 234 miles to 200 miles. When you also consider that the Austin to Dallas trip begins in the middle of the Texas Hill Country serious doubt must be cast on making the trip on one charge. To expand on this, a trip from Houston to Dallas is 239 miles, and Midland to Dallas is just over 330 miles. Charging issues will be covered below to explain why this can be a significant issue that gives the XL model an advantage in this category.

Comparison of the fueling convenience

Fueling the internal combustion engine of the XL model means stopping at a gas station and pumping gasoline into the tank of the vehicle. Every driver in Texas has done this, or at least watched a friend or family member do it for them. It is expected that waiting in line will sometimes be an issue and taking extra time to find the best price can be a consideration, especially in times of volatile oil prices. Filling your car's gas tank is not convenient, but a hassle that drivers have grown to accept. Fueling an electric car can be extremely convenient if you are staying within a typical city commute discussed above. At this range, the electric vehicle owner would pull into their home driveway, plug into their home charger, and go into their house to enjoy their evening. When they come out to go to work in the morning, their car will be fully fueled. As discussed, these longer drives can be a problem. Even when you consider that the Lightning accepts fast charging from public stations, Ford admits that it will still take about 35 to 40 minutes to charge your battery from a 15 percent charge to 80 percent. Reconsider the trips discussed above and it becomes obvious that this could become a hassle. A Lightning owner will have to plan for additional time on the road while fueling for a trip. A significant note to add is that there are no fast-charging stations in many reasonably sized cities in the state. Killeen, Abilene, and San Angelo are just three cities of note where your public charging is going to be measured in hours rather than minutes. It must also be stated that charging stations are extremely rare in rural Texas.

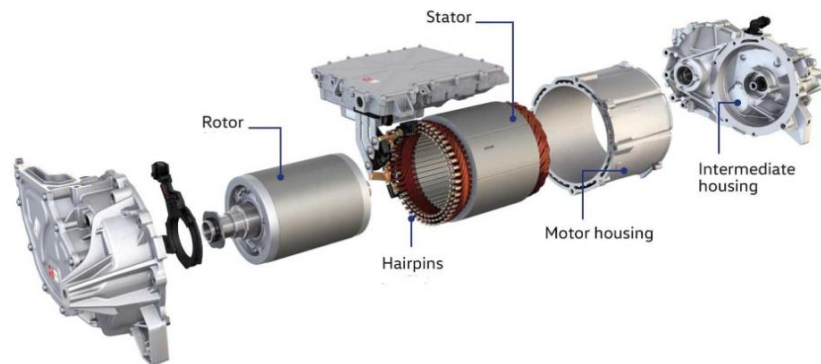
Comparison of Cost to Drive Per Mile

If two gas-powered vehicles were being compared, the term to use here would be gas mileage, but in consideration for the Lightning, cost per mile will be used. The Ford F-150 XL model with a 3.3L V6 engine and all-wheel drive is estimated by the EPA to get a combined 20 mpg. Using this official estimate, we can figure that the average Texas commute of 46 miles per day would only take 2.3 gallons per day. Using a conservative pricing of \$2.99 per gallon of gasoline would mean that the XL model would cost \$6.88 per day to drive. For the Lightning, we must look at kilowatt hours used per mile. The Lightning gets just over 2 miles per kWh. Keeping it simple and using a flat 2 miles and using the average cost per kilowatt hour in Texas for July 2022, which was 13.53 cents for residential customers, would put the cost of the same 46-mile commute at about \$3.11 per day if the Lightning owner is only charging at home. As with our other situations, this changes if you are on a road trip. Public charging stations can cost upward of \$30 for a single charge.

Comparison of Mechanical Reliability

At first glance, the mechanical reliability reports would appear to be bad for the gas-powered XL model, as Consumer Reports gives it a 2 of 5 reliability rating. Some digging into the reports reveals that this is a misleading rating, especially for the purposes of this report. We are comparing the mechanical reliability of the model, or the ability of the vehicle to operate when moving from point A to point B on a daily basis. The major issues in this report regard paint, trim, and body issues that do not affect its ability to function as a transportation vehicle. There are also concerns with the in-car electronic peripherals that will not affect driving. Ratings for the systems that directly affect the vehicle's ability to transport were almost all given excellent 5 out of 5 ratings. Only the power equipment received a rating of 4, which includes the body control module as well as functions of all interior and exterior lights and warning signals as well as the wiper functions and other systems that are not critical, but necessary to drive on Texas roads legally. In comparison, Figure 2 shows a typical electric engine and its working parts. Only the rotor has moving pieces. This means an electric car does not need oil changes, filters, spark plugs, or most of the fluids involved in an internal combustion engine. Just the fact that the engine has fewer moving parts means less area for something to go wrong. Consumer Reports lists the Lightning as "in test" and has not rated it at the time this report was written, but initial test drives report very positive expectations. Another Ford all-electric option is the Mustang Mach-E which has been tested. Consumer Reports has given the Mach-E a total rating of 82 out of 84 and a reliability rating of 4 out of 5 with major problems being in-car electric peripherals and the climate system.

Figure 2: Electric Engine (Source: insideevs.com)



Comparison of Towing and Hauling

It is not hard to research the towing and hauling capabilities of the gas-powered F-150. Just a cursory internet search yields multiple rankings that place the truck at the top of their rankings for towing and hauling capabilities. Ford itself boasts of “first in class towing and hauling” and this claim cannot be refuted. The capabilities of the Lightning are more complicated. Actual towing test results show that the driving range was cut to less than a third of the expected range. That means the estimated 230-mile range is suddenly less than 75 miles when towing maximum capacity weight. Reports also admit that lighter weights and better aerodynamics can improve this drastic cut, but not significantly. There is also a cut in high-end power while towing. Reports state that if you need to pass while towing, it should be done with planning and patience, as any sudden burst speed is gone from the Lightning with a load behind it.

Comparison of Cost

The two models being compared are structurally the same vehicle, but major differences come concerning the engines in each one. A sincere effort was made to make the two models as close to each other as possible within the limits of what Ford offers. To begin, the Lightning comes standard with a SuperCrew cab, a 5 ½' rear box, 18-inch wheels, and all-wheel drive, all of which can have a direct impact on fuel efficiency. These options were configured to the XL model. In addition, the XL High option package added cruise control and a reverse sensory system that comes standard on the Lightning. This package was added for the purpose of price comparison. This comparison report used the base model engine for the XL, the 3.3L V6, and the only option in the Lightning, the Dual eMotor. Figure 3 gives the price of each model as configured on the Ford website. When you look at the figure, it appears that the Lightning does not meet our cost requirement, however, government rebates must be taken into

consideration. The federal government offers a \$7500 tax rebate on electric vehicle purchases and the Texas government offers a \$2500 tax rebate on approved electric vehicles, of which the Lightning is one. Taking these rebates into consideration, the Lightning falls well below our \$50,000 threshold and is slightly less expensive than the XL.

Figure 3: Model prices (source: Ford.com)

Ford F-150 XL		Ford F-150 Lightning Pro	
PRICING SUMMARY		PRICING SUMMARY	
BASE MSRP ^{S1}	\$43,450	BASE MSRP ^{S1}	\$51,974
OPTIONS ^{S4}	+ \$170	OPTIONS ^{S4}	+ \$500
ACCESSORIES ^{S8}	+ \$0	ACCESSORIES ^{S8}	+ \$0
DESTINATION CHARGES ^{S17}	+ \$1,795	DESTINATION CHARGES ^{S17}	+ \$1,795
TOTAL MSRP ^{S16}	= \$45,415	TOTAL MSRP ^{S16}	= \$54,269
ESTIMATED NET PRICE ^{S5}	= \$45,415	ESTIMATED NET PRICE ^{S5}	= \$54,269

Summary Table

The following table summarizes the evaluation of the Ford F-150 XL versus the Ford F-150 Lightning Pro. Each category is ranked on a scale of 1 to 4, with 1 being the worst and 4 being the best.

Table 1: Comparison of the F-150 XL and the F-150 Lightning Pro

Points of comparison	Ford F-150 XL	Ford F-150 Lightning Pro
Reliability as an only vehicle	4	2
Fueling convenience	3	3
Cost per mile	2	4
Mechanical reliability	4	4
Towing and hauling	4	2
Cost	4	4
Total	21	19

Conclusions

1. Texas' wide-open spaces hinder the ability of an all-electric vehicle to be the only vehicle owned.
2. If this report only considered in-town driving, the Lightning would have had significantly more advantages over the gas-powered XL, but the report considered average usage of vehicles in Texas, which often include longer commutes.

3. The electric vehicle cost to drive per mile is less than half the cost of vehicles with an internal combustion engine.
4. The Ford F-150 has an excellent reliability record and customer satisfaction record.
5. Based on the simpler design of an electric motor versus an internal combustion engine, and based on initial tests, the F-150 Lightning is fully expected to match the excellent ratings of the gasoline-powered designs.
6. While the F-150 gas-powered pickup trucks are leaders in towing and hauling capabilities, the Lightning exhibits serious deficiencies in range and power when towing at the top of its capacity.
7. The time it takes to recharge using a public charging station means electric vehicle owners will have to plan for more time in getting to out-of-town destinations.
8. Rural residents do not have the same public charging options that city residents do.
9. The Lightning Pro model comes with more luxury items in its standard package than the XL model, but, considering government tax rebates, the Lightning ultimately costs slightly less than the XL model.
10. The best option for Texans is the Ford F-150 XL, primarily due to its high reliability, and utility capabilities.

Final Recommendation

If the only consideration of this report were a work commute and in-town driving, it would be easy to recommend the F-150 Lightning Pro, but from the beginning, it was stated that the purpose was to compare both vehicles as a primary vehicle without considering the ownership of a second car. This means navigating a longer-than-average daily commute and the wide-open spaces of Texas. With this consideration, and the workload a pickup truck can expect in Texas, the advantage slides to the F-150 XL with an internal combustion engine. The F-150 XL is a known quality, while the Lightning is new to the market this year and still has many factors that can be questioned. As technology and infrastructure advances, the place for the electric truck might arrive in Texas but now is not the time. I recommend purchasing the known quality gasoline-powered Ford F-150 over its electric counterpart.

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