

Electric Vehicle for Police Operations Proof of Concept (Tesla 2015 Model S Pilot Project)

The purpose of this report is to assess the performance of the City of Brookhaven's fleet in the context of transitioning to a 100% electric / hybrid fleet as part of the Sustainable Brookhaven policy. Specifically, this assessment compared traditional gasoline-powered vehicles to an electric vehicle for strategic fleet investment recommendations. Areas of focus include performance, operating and maintenance costs, and environmental impact.

EXECUTIVE SUMMARY

The City currently expends approximately \$228,000 per year on fuel (gasoline), and approximately \$50,000 in oil changes and minor maintenance for vehicles across all departments. Approximately 98% of fuel is purchased by the Police Department. Using conservative estimation, the fuel and maintenance costs could be reduced by roughly \$200,000 annually if the entire fleet transitioned to electric vehicles. Over the course of a six-year lifespan of an all-electric vehicle fleet, cost savings would be approximately \$1.2 million. If the City were to transition all 112 vehicles to all-electric models, the reduction of carbon emissions would be between five million and seventeen million pounds over six years. This equates to planting between 40,000 and 123,000 trees in an urban environment and letting them grow for ten years.¹

In 2019, the City of Brookhaven developed a strategic framework for sustainability known as Sustainable Brookhaven. It is a way of governing and managing that seeks to avoid and prevent the depletion or permanent damage of Brookhaven's resources. The framework consists of five elements that provide guidance so that the City may act consistently and assist with resource allocation decisions. The five sustainability elements include natural environment, built environment, financial, organizational, and civic governance.

Given the increasing viability of electric vehicles as a fleet platform, Brookhaven is considering options to move toward a more efficient fleet by adoption of electric vehicles (EV) and / or hybrid vehicles. In the interest of reducing expenditures on vehicle fleet fuel and maintenance, and in alignment with the Sustainable Brookhaven framework, the City of Brookhaven purchased a 2015 Tesla Model S to test the suitability of an electric vehicle for police operations. Note: The selection of the pre-owned Tesla Model S was not from a perspective that the City is seeking to transition

¹ Carbon emissions are based on estimations for two sample vehicles measured by Georgia Power. Number of trees is calculated based on EPA metrics, assuming one tree can offset ~0.06 metric tons of carbon. See **Appendix Exhibit H** for breakdown.

to Tesla specifically, but the pre-owned Tesla Model S was the most operationally-compatible model for police patrol operations at the time of this pilot study.

The City of Brookhaven has 112 fleet vehicles, the vast majority of which (roughly two-thirds) are utilized for police patrol purposes. Police officers have individually assigned vehicles and are allowed to take their vehicles home. Patrol officers spend a large portion of their shifts working in their vehicles. As Brookhaven looks to future fleet investments, it has measured data on gasoline-powered sedans and SUVs to compare with the all-electric Tesla Model S.

The City has a relationship with Georgia Power based on the mutual interest of optimizing natural resources. When Brookhaven began considering EV options, Georgia Power assisted in data collection and analysis by providing three telemetry devices to collect detailed usage data. Beginning in March 2019, the City began a detailed review of fleet usage and comparison of different vehicle types.

After monitoring and analyzing the usage and performance of various vehicle types, it is apparent that an operational cost savings of 70% or more could be achieved through the usage of electric vehicles rather than traditional gasoline-powered vehicles.

While the operating savings are significant, the EV market does not have an all-electric platform presently suitable for police patrol operations. A Tesla Model S is not designed to be a fleet vehicle or utility vehicle, and presents some difficulties as such. Its unique aerodynamic design made mounting lights and other police auxiliary equipment a challenge, and the low seat and roof line would make it impractical for a driver of large stature. Though the car is spacious enough for equipment, having a front and back trunk, the backseat is not suitable for transporting prisoners. Due to proprietary issues and the newness of this vehicle as a fleet option, outfitting the car took longer than expected. The delay between delivery to readiness for service was approximately five months. Despite these issues, the Tesla performs as a superior vehicle in speed and maneuvering, and has not demonstrated a lack of battery life for a full 12-hour patrol shift.

The Tesla Model S is a good option for some police purposes, though not an ideal choice for patrol operations, which is a bulk of the City fleet. Given the current market options available, all-electric vehicles should be considered for administrative purposes in the near term to achieve fuel savings and a reduction of the City's carbon footprint. Considerations for all-electric or hybrid patrol vehicles should be revisited regularly as the EV market evolves to offer mission-specific models.

INTRODUCTION: BROOKHAVEN'S VEHICLE FLEET

Currently, the Brookhaven fleet consists of 112 vehicles, with 101 in the Police Department. About 80% of the Police Department vehicles are Ford Taurus or Ford Explorer models (**Exhibit A**).

The City uses Fleetio and Networkfleet fleet management software. Within these systems, vehicles are categorized as listed below. Some vehicles are unassigned and used as spares when other fleet vehicles require repairs or maintenance, or as shared pool vehicles, as in the case at City Hall.

Group	Number of Vehicles
Patrol	63
Investigations	14
Police (Administrative)	14
Support Services	7
K-9 Patrol	2
Citizen Patrol	1
Parks & Recreation	3
City Hall (Community Development)	5
City Hall (Administrative)	3
TOTAL	112

City vehicle replacement policy recommends police patrol vehicles are replaced after 100,000 miles or five years in service. When these vehicles are removed from patrol service, they can be repurposed and utilized by other City departments. Brookhaven has used Ford vehicles out of convenience, affordability, and suitability.² Additionally, the City purchases all its vehicles via a competitively bid state contract. Outfitting a police patrol vehicle costs approximately \$12,000 including installation of decals, window tint, lights, sirens, radios, computer, prisoner transport screens, etc.

Fuel Costs and Vehicle Usage

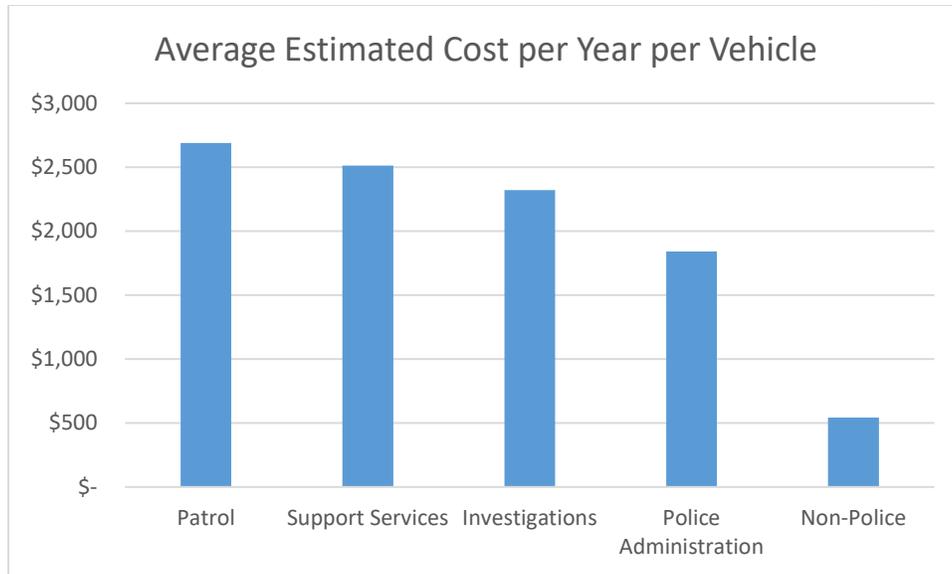
Brookhaven police officers in the Patrol Division drive between 35 and 100 miles each 12-hour shift (includes commuting mileage). On average, the gasoline-powered police vehicles get 15 miles per gallon (mpg) and SUVs get 12 MPG.³ In 2018 and 2019, the annual fuel cost across all departments was approximately \$228,000.⁴

Based on 2019 gasoline expenditures of \$227,787, the average per vehicle gasoline cost was \$2,034. This number encompasses spare vehicles as well as pool administrative vehicles, which are used infrequently or for very short trips, and does not accurately reflect average fuel cost per vehicle group; therefore, it is important to recognize that police patrol vehicles are responsible for the higher fuel costs to the City.

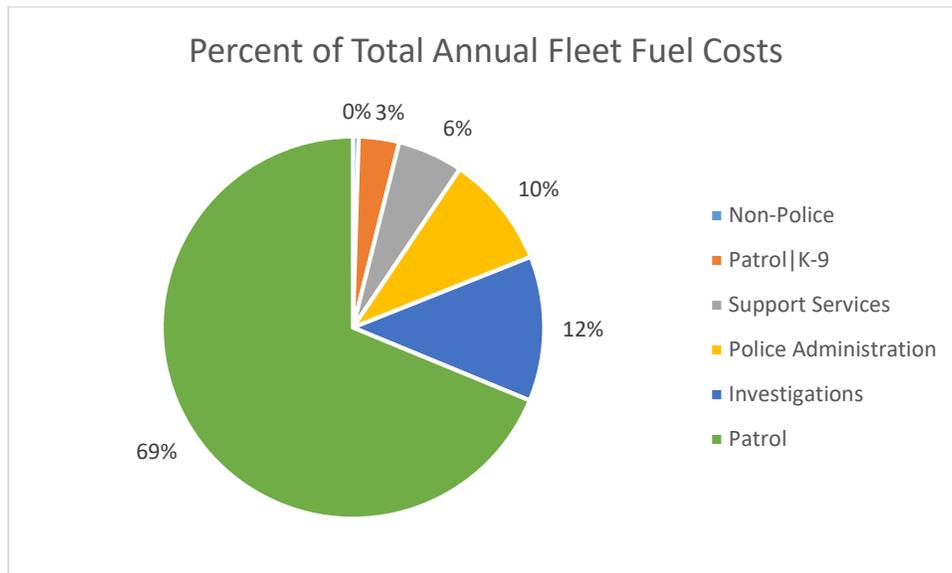
² There are a limited number of widely accepted police patrol vehicle platforms. Since the City’s inception the Police Department has utilized the following models as the primary patrol operations vehicle: Chevrolet Impala, Ford Taurus; Ford Explorer.

³ Networkfleet data over the past year

⁴ Paid to WEX Bank for fuel card purchases per Tyler (financial management system): 2018: \$227,739, 2019: \$227,787 with non-Police Department gasoline fuel purchases representing about 2% of the total



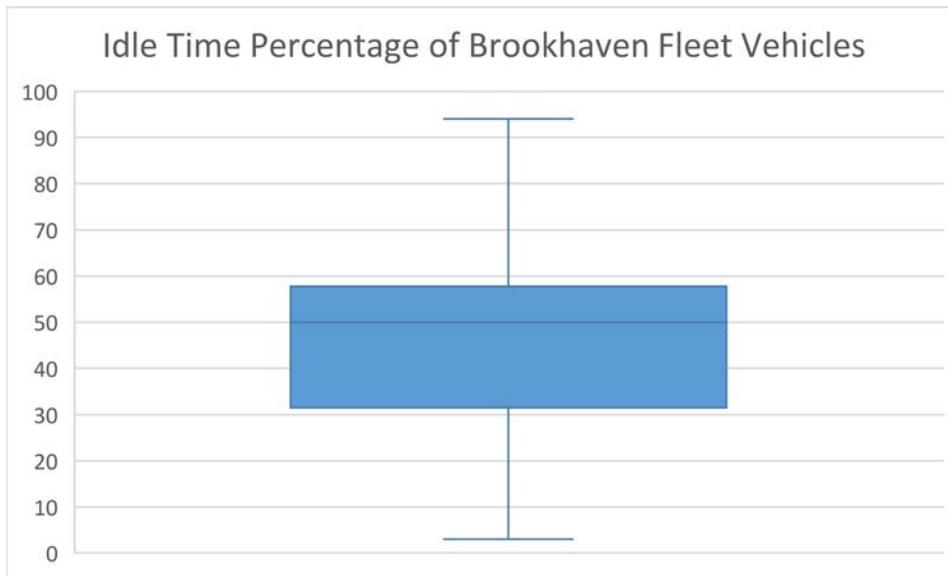
Data provided from vehicles tracked over a 12-month period indicates that Brookhaven police vehicles have an average fuel cost of \$2,598 per year, and of the fifty-eight (58) patrol vehicles within that sample, the average is \$2,688 per year. See **Appendix** for a note on fuel cost calculation methodology.



As depicted in the two preceding graphs, patrol vehicles have the highest annual fuel cost by usage and represent the largest portion of overall fuel expenditures.

It is important to note that employees using vehicles for specific job-related purposes often lead to idle times much higher than those of personal-use vehicles. This is because they may go from site to site and do paperwork and make calls before and after getting out of their vehicles. Police vehicles need to be pursuit-ready and therefore are not turned off every time an officer exits the

vehicle. Idling consumes approximately one-fifth a gallon of gasoline fuel per hour. Switching to hybrid or all-electric vehicles would reduce or eliminate emissions created when idling.



This box-and-whisker plot divides the numbers into quartiles: the top and bottom lines show the full range of the data points, including the maximum and minimum outliers. The blue box shows half of Brookhaven fleet vehicles are idle between 31% and 58% of the time, with one quarter of vehicles idling between 58% and 94% of the time.

Concerning vehicle maintenance costs, in 2018 and 2019 the City expended approximately \$50,000 for oil changes and maintenance on brakes, tires, etc.⁵ (**Exhibit B**). When vehicles are undergoing regular service and maintenance, officers must use spare vehicles. This can interrupt their normal operations and require transferring equipment. If the maintenance is quick (i.e., an oil change) there is still an estimated downtime that interrupts an officer’s time on patrol duty.

⁵ This number represents costs for maintenance only, not collision repair.

TEST PERIOD RESULTS: TESLA



The Tesla began patrol operational service in August of 2019. Note: The vehicle was assessed by the driving instructors at the Georgia Public Safety Training Center on a closed-course track prior to placing in patrol service to ensure the vehicle could be safely driven in emergency operations mode.

Patrol officers work a 12-hour shift, 15 days a month depending on the calendar month and in-service training and court time. The driver assigned the Tesla Model S for the EV pilot study, Officer John Clifford, has logged ninety-four (94) days of data as of March 10, 2020.

Given the starting mileage of 23,864 and the March 10, 2020 mileage of 33,399, and taking into consideration variation in monthly or weekly usage, it is estimated that the Tesla would be used roughly 16,000 to 17,500 miles per year (**Exhibit C**). It should

be noted that due to the inability to install an after-market protection shield / cage in the Tesla, Officer Clifford does not do prisoner transports to the DeKalb County jail. With additional miles associated with prisoner transports, the Tesla would have comparable annual mileage to other Brookhaven patrol vehicles.

Using data from a telemetry device supplied by Georgia Power from August through the end of 2019, reports identified that the Tesla is idle 43% of the time.⁶ The Networkfleet data Brookhaven uses to monitor vehicle usage indicates other police vehicles average an idle rate of fifty percent (50%) of the time (**Exhibit D**). When in idle mode, the all-electric Tesla is not releasing carbon emissions like a gasoline-powered vehicle.

The speed and usage were also measured, revealing hard braking⁷ and hard acceleration about 25% of the time. The Tesla, like other EVs, has a regenerative braking system which is an energy recovery mechanism that converts its kinetic energy into a form that can be stored. The vehicle tested well in terms of performance, and its low center of gravity allows for quick and safe movement. The increased maneuvering executed by a police officer compared to that of an average driver, and the additional weight of equipment and energy required to run lights and sirens and other police ancillary equipment take a higher toll on the battery, reducing the range from that advertised by Tesla (208-270 miles). A sample study run by Georgia Power in October

⁶ The term “idle” for gasoline-powered cars indicates a vehicle is running but not being driven. Teslas, however, automatically stop using energy when they are not being driven and therefore the term “idle” is used here to measure comparable stop times.

⁷ Tesla Model S brake pads are estimated to last 200,000 miles.

revealed that the Brookhaven Police Tesla realized 1.75 miles per kWh, much less than the industry standard of 3.48. Despite this, the battery range has not proven to be an issue during a 12-hour patrol shift.

Using the telemetry device, the City monitored energy consumption and concluded the Tesla uses an average of 413 Wh/mi. At a rate of \$0.07 per kWh, given the number of annual miles assumed for the Tesla, the cost to provide electricity to the vehicle would be less than \$700 annually (**Exhibit E**), or about one-third the cost of fuel to power an average fleet vehicle.

With patrol vehicles using an average of \$2,688 in fuel each year, EV fuel savings would approximate \$2,000 annually per vehicle. Using electricity rather than gasoline to power its patrol fleet, City could reduce its fuel costs by 75%, more than \$10,000 in the five-year life of a gas-powered fleet vehicle. Georgia Power data suggests fuel savings of 77-80% is achievable.

Although it takes longer to charge a vehicle's battery than it does to fill a gasoline tank, a driver is not required to be present while charging as one is to pump gas. An electric vehicle can be left overnight, and chargers can be shared to service multiple vehicles around the clock.

One concern that was considered when purchasing an EV was that of range anxiety, or fear of the battery running out. This has not proven to be a problem with the Brookhaven Tesla, which has been driven an average of 92 miles daily, with a highest daily total of 166 miles. During the test period, without any change in the daily patrol routine, the lowest remaining battery capacity experienced was 29%. Average starting battery life after charging was 85% and average ending (when the driver begins to charge) is 49%. Note: Charging to over 90% of capacity is not recommended to preserve battery life.

Officer Clifford typically charges overnight at home, and usually leaves for work with an 87-90% charge. By the time the officer arrives at the police station in Brookhaven, the battery life is typically 72-75%. Once at the station, Officer Clifford charges the battery during roll call and pre-shift activities. Additionally, during the shift, Officer Clifford has the opportunity to use one of the 13 charging ports that the City has installed for public use around Brookhaven. While boosting the battery, the officer can complete reports, make phone calls, and perform other administrative duties.⁸ When using one of these charging stations, or those made by Tesla, the officer can simply plug in without additional equipment. When using a fast charger that is not made by Tesla, an adapter is needed. Officer Clifford stated that due to the availability of charging stations at his home and around the City, he rarely feels the need to use a fast charger.

⁸ Charging literally tethers the officer to a particular location. Officers with gas-powered vehicles typically write reports, return calls, etc. in highly visible areas, increasing the sense of police presence.

TEST PERIOD RESULTS: OTHER VEHICLE MODELS

To compare the all-electric Tesla to current fleet vehicles, the City monitored three other vehicle models throughout 2019. Within the sample were a sedan used for police patrol, a sedan used by an inspector in the Community Development Department, and a police SUV. A summary comparison follows.⁹

Patrol Vehicle #108, 2014 Ford Taurus (March 19, 2019 – July 31, 2019)

Miles logged: 6,528
Days in service: 134
Total fuel consumption: 536 gallons
Idle time percentage: 66%
Idle fuel consumption: 159 gallons
Average MPG: 12
Estimated annual fuel cost to the City: \$3,256

Community Development Administrative Vehicle, 2013 Chevrolet Impala (March 15, 2019 – July 31, 2019)

Miles logged: 2,123
Days in service: 138
Total fuel consumption: 176 gallons
Idle time percentage: 60%
Idle fuel consumption: 64 gallons
Average MPG: 12
Estimated annual fuel cost to the City: \$1,038

Police SUV, 2019 Ford Explorer (September 1, 2019 – December 22, 2019)

Miles logged: 4,246
Days in service: 112
Total fuel consumption: 385 gallons
Idle time percentage: 79%
Idle fuel consumption: 142 gallons
Average MPG: 11
Estimated annual fuel cost to the City: \$2,798

⁹ Estimated annual fuel costs are calculated with an assumed cost of \$2.23 per gallon, which was the average price of gasoline fuel in Georgia over the past year.

2015 TESLA MODEL S IMPACT AND SUITABILITY

The Tesla is superb in speed and handling, is one of the quietest vehicles on the market, is a zero-emission producing vehicle, and due to its design can have maintenance issues resolved quickly through software adjustments. A regenerative braking system allows for less wear on the brakes and therefore less need for replacements. It has a fraction of the internal parts compared to a conventional combustion engine, resulting in less need for repair and therefore lower expected maintenance costs. The elimination of required oil changes, brake checks, etc. also results in less vehicle downtime and increased officer productivity.

The cost of the pre-owned Tesla was \$45,000, purchased with confiscated asset funds (i.e., not local tax revenues). Other EVs have similar benefits and are available at a lower cost. Several police officers and City Hall inspectors have expressed a preference for sports utility vehicles to meet the needs of their jobs in terms of size, power, and space. Currently, all-electric SUV options that would meet the needs of Brookhaven employees are not available at a price point that is practical for purchasing at scale. Hybrids are an option, and new electric and hybrid models are being developed at an increasing rate. The 2020 Police Department budget for vehicle replacements calls for 15 Ford Explorer hybrids. Ford is expected to have an all-electric SUV out by the end of 2020, and the anticipated price point may be within financial consideration.

The upfront acquisition cost of a new vehicle should not be the determining factor when deciding on fleet vehicles. Durability, suitability, reliability, and operating / maintenance costs should be factored into the financial sustainability of the investment. For example, a vehicle purchased at \$40,000 would be worth \$8,000 at the end of Year 4¹⁰, which may be less than or close to the cost of required maintenance and / or repairs. Prior to 2019, the City had not tracked data on maintenance and repair costs of various vehicles by make, use, and number of years in service. Anecdotal evidence confirms that it would be cost effective to replace some vehicles rather than invest in repairs.

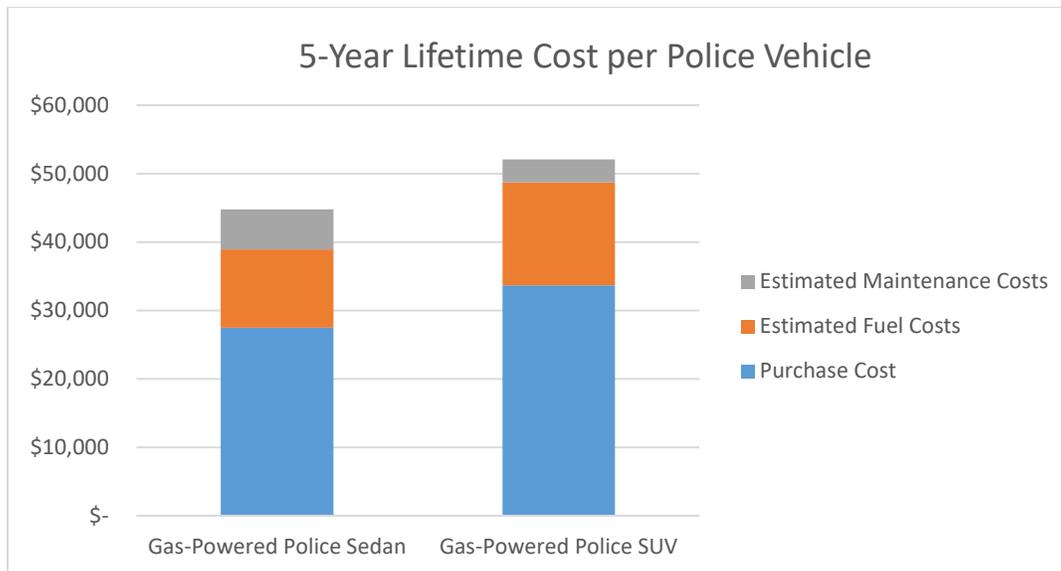
Given that the two police vehicles in the control test surpassed the fleet average in annual fuel expense, the cost savings estimated are conservative figures. Using the conservative maintenance cost estimate referenced in **Exhibit B**, fuel and maintenance can cost more than \$13,000 per vehicle over the span of five years. The City has already installed 13 EV charging ports across the City for community use, thus there is no upfront charger infrastructure cost for City fleet conversion to EVs.

In addition to significant fuel and maintenance expenditure savings, there is a significant reduction in the City's carbon footprint associated with fleet operations. Georgia Power estimated the CO₂ emissions over five years of the Brookhaven Impala and Taurus models would be 42,908 pounds and 131,963 pounds, respectively. Using these estimates, were Brookhaven to transition to an entirely all-electric fleet, a reduction of between five million and seventeen million pounds of carbon from the atmosphere over a six-year period could be achieved.

¹⁰ The City of Brookhaven accounts for straight-line depreciation over five years.

LIFETIME COSTS

Considering purchase price, and estimated fuel and maintenance costs, the estimated five-year lifetime cost of a typical patrol vehicle is depicted in the following chart. (Costs for vehicle outfitting are not included in the comparison as the amount is the same for each model.)



This chart uses averages for the twenty-six (26) Ford Taurus and Chevy Impala patrol vehicles listed in Fleetio for “Gas-Powered Police Sedan” calculations. All models were 2014 or 2015, and the average manufacturer’s suggested retail price (MSRP) is \$27,472. Data for “Gas-Powered Police SUV” uses the thirty-two (32) Ford Explorers in Fleetio. All models were 2019 or 2020, and the average MSRP was \$33,655. Maintenance costs for the gasoline-powered vehicles are strictly estimates based on historical data reported by drivers and manually uploaded over the past twelve months and likely are an under-representation of actual maintenance costs.¹¹

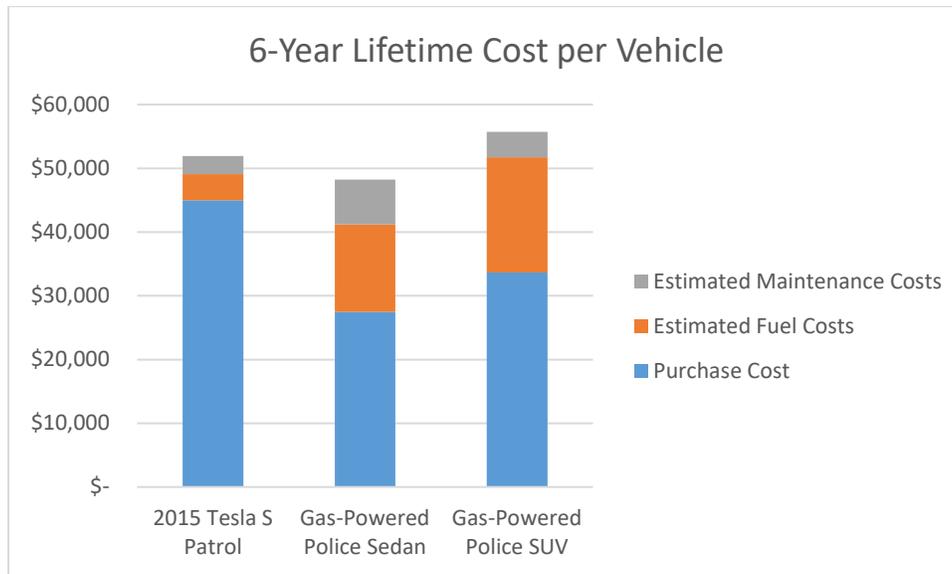
Based on reliability and reduced maintenance of an electric vehicle, serious consideration should be given to extend the anticipated service life of a fleet vehicle to six years and 120,000 miles.

A key reason EVs can be seen as a less popular investment is the cost of replacing the battery; however, battery replacement during the fleet vehicle lifespan should not be necessary. The Tesla Model S battery has an expected longevity of 300,000-500,000 miles, with 90% battery energy capacity after 160,000 miles. This exceeds the 100,000-mile lifespan Brookhaven has for its fleet vehicles, so not only should battery replacement not be necessary, but the capacity of the Tesla to perform could extend its lifespan in the fleet.

Given that a Tesla Model S has a guaranteed battery life of eight (8) years or 125,000 miles, and the expected annual mileage on the Brookhaven Tesla is roughly 17,000 miles, it can be argued

¹¹ Data provided by Georgia Power comparing maintenance costs of a standard gas-powered vehicle and a 2018 Nissan Leaf over a seven year lifecycle show a total maintenance cost savings of 84%, with only \$500 in expected maintenance for the Leaf. See **Exhibit J** for detail.

that the Tesla could remain in the fleet longer than the stated five years. Total lifetime costs for a Tesla to remain in the fleet for six years are less than total lifetime costs for a gas-powered SUV that remains in the fleet for only five years, at \$51,928 and \$52,064 respectively.



Data used for calculating Tesla costs include: purchase cost of \$45,000, electricity fuel costs (calculated in **Exhibit E**), and estimated maintenance costs that were averaged using a variety of sources. See **Appendix** and **Exhibit G** for cost calculation and source information.

EXAMPLES ELSEWHERE

Other cities around the country have started experimenting with EVs, though prior to Brookhaven’s Tesla purchase, many jurisdictions were purchasing Nissan Leafs and Chevy Bolts for administrative purposes. The City of Fremont, California began patrol service with a 2014 Tesla Model S in March 2019. Despite having a Tesla manufacturing plant within the city, the delay between the date of purchase to full operation was significant (more than one year). This indicates that modifying a Tesla for police use presents challenges that can be experienced.

The City of Westport, Connecticut recently purchased a 2020 Tesla Model 3 for \$52,590, primarily for performance, its five-star crash ratings, and collision avoidance technology.

Several other cities, including Atlanta, are committed to converting to lower or no emissions from their fleets to contribute to their goals of 100% clean energy for municipal operations, in alignment with the United Nations 17 Sustainable Development Goals.

CONCLUSIONS

EVs are cost effective and able to meet police applications, though other EV models that will emerge in the near future that would be more suitable for police patrol purposes than the Tesla Model S.

Officer Clifford finds the Tesla to be a superb police vehicle, and would prefer to continue using it to other vehicles. That being said, the Tesla does not meet some of the basic operational police needs. The biggest issues impeding the Tesla Model S from being a standard fleet police vehicle are the inability to transport passengers in the backseat, the discomfort of the driver's seat for a larger officer wearing full police gear, and the difficulty and time required to outfit or perform maintenance on the vehicle, compared to the ease of using the same vendors who are accustomed to quickly outfit and maintain or repair the models Brookhaven has predominantly used.

Some of the aforementioned deficiencies of the Tesla Model S were known going into the pilot study, but the study was mostly about fuel efficiency and performance. Using EVs can significantly reduce or eliminate carbon emissions, especially for police patrol vehicles with high idle times.

The transition to an all-electric fleet is certainly applicable to the natural environment and financial elements of the Sustainable Brookhaven strategy, but there needs to be careful attention given to the selection of the EV platform for police patrol vehicles from a perspective of operational need (i.e., transporting inmates and comfort) and true fleet availability at scale (i.e., prep time for service readiness and repair times).

APPENDIX

Exhibit A: Police Fleet Vehicles, March 2020

Model	Count
Explorer	43
Taurus	37
Impala Limited	5
Impala	4
F-150	3
Express Cargo	2
Fusion	2
Caprice	1
Escape	1
Model S	1
Transit Passenger	1
UD2000	1
TOTAL	101

Exhibit B: Vehicle Maintenance Costs

Vendor	2018	2019
Hi-Speed Car Wash*	\$12,723	\$3,408
Hi Speed Oil Change	\$0	\$6,922
Hennessy Ford	\$38,030	\$40,774
TOTAL MAINTENANCE	\$50,753	\$51,104

Maintenance costs do not factor in productivity losses due to vehicle downtime.

*The vendor Hi-Speed Car Wash was divided in the payment system as two separate business entities in 2019. Data here includes only two vendors as they are easily identified for maintenance costs; however, additional charges with any other vendors are unaccounted for in this report.

Exhibit C: Estimated Annual Mileage for Tesla, Calculated Two Ways

Starting mileage August 9, 2019:	23,864
Ending mileage March 10, 2020:	33,399
Estimated annual mileage	16,263

Or

Miles driven in 143-day period (August 1 – December 22, 2020):	6,873
Adjusted for 365-day period:	17,543

Exhibit D: Networkfleet Idle Time Analysis, March 2019 – March 2020

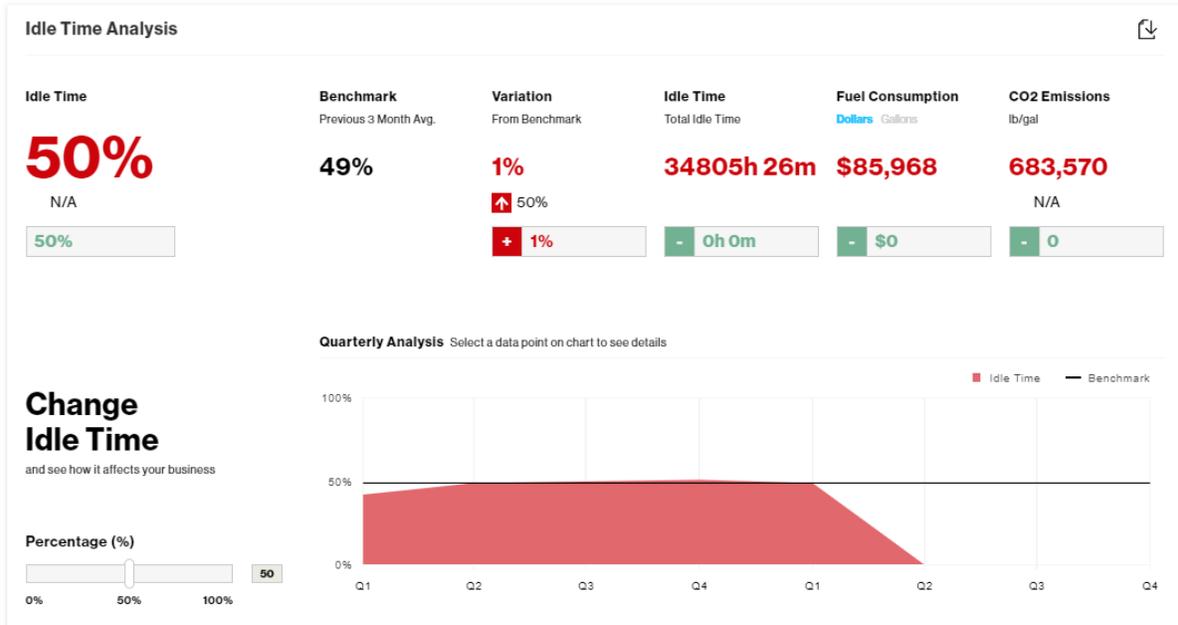




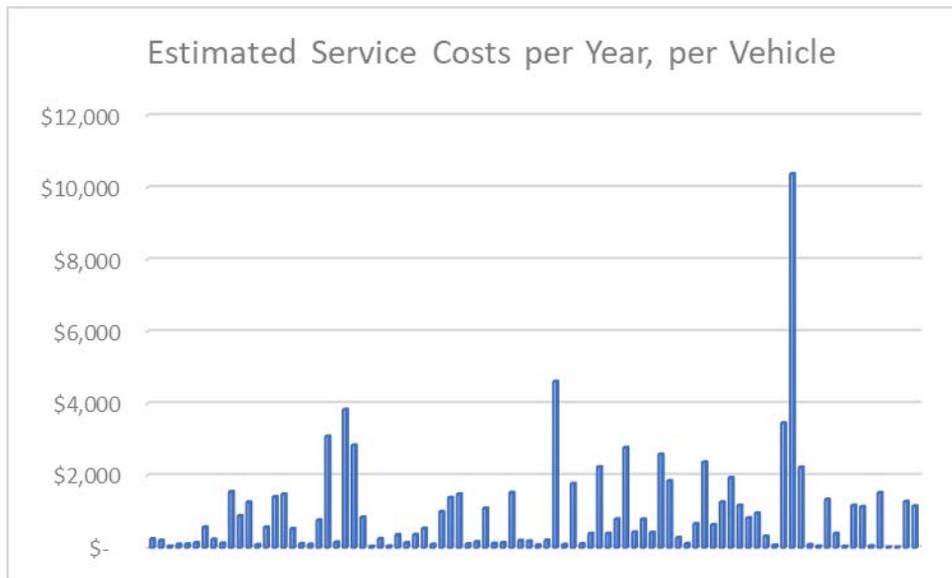
Exhibit E: Estimated Annual Electric Costs for Tesla

Data is extrapolated from a 143-day sample of Georgia Power telemetry report of the Brookhaven Tesla's electricity utilization.

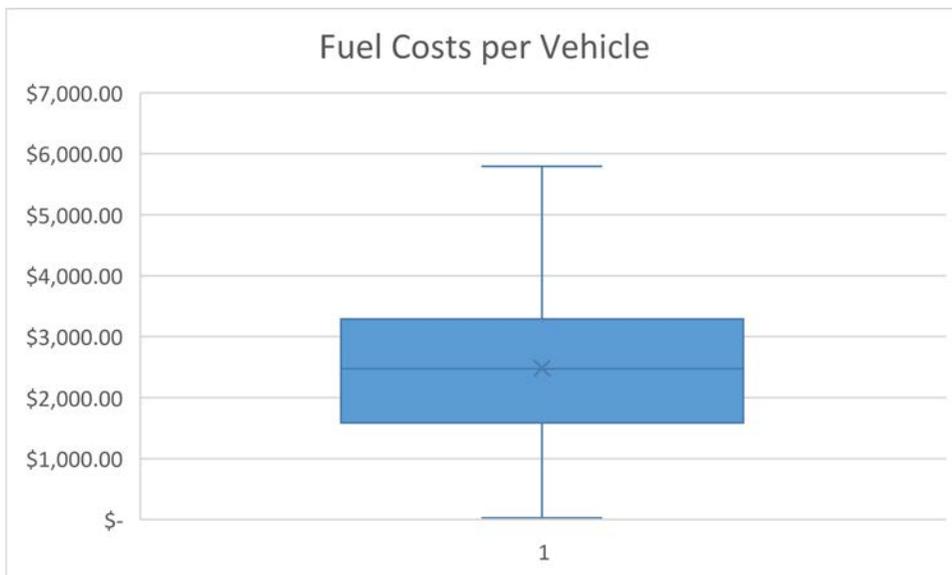
Total kWh used charging per Georgia Power	3,804
Average electricity used per day (kWh)	27
Average electricity used per year (kWh)	9,710
Average electricity cost per year at \$0.07 per kWh	\$ 679.67

Exhibit F: Numbers Pulled from Fleetio

The following data was pulled from Fleetio. The City of Brookhaven began using this fleet management system in March of 2019 to track maintenance, fuel usage, costs, and other vehicle data points. Due to a lag in onboarding fleet vehicles into the system, and manual inputs of maintenance costs, this data does not fully reflect all vehicle costs the City has incurred over the last twelve months.



Average estimated service costs: \$958, using data from 89 vehicles between March 2019 – March 2020. Data is self-reported by drivers and manually uploaded into Fleetio; therefore, this data is likely an underrepresentation of average maintenance costs.



This data reflects 87 vehicles and shows an average fuel cost of \$2,481.09 per vehicle. Of the 41 vehicles that were in the top two quartiles, the average annual fuel cost was \$3,476.95. For the purposes of this report, the average fuel cost of most relevance is that of the Patrol vehicle group, amounting to \$2,688.

Exhibit G: A Note on Cost Calculation Methodology

Not all fleet vehicles use fuel equally. If average gasoline fuel costs per vehicle were calculated by taking the total spent by the City of Brookhaven and divided by the total number of vehicles, the average would be \$2,034:

2019 total WEX fuel card purchases per Tyler: $\$227,787 / 112 \text{ vehicles} = \$2,034$

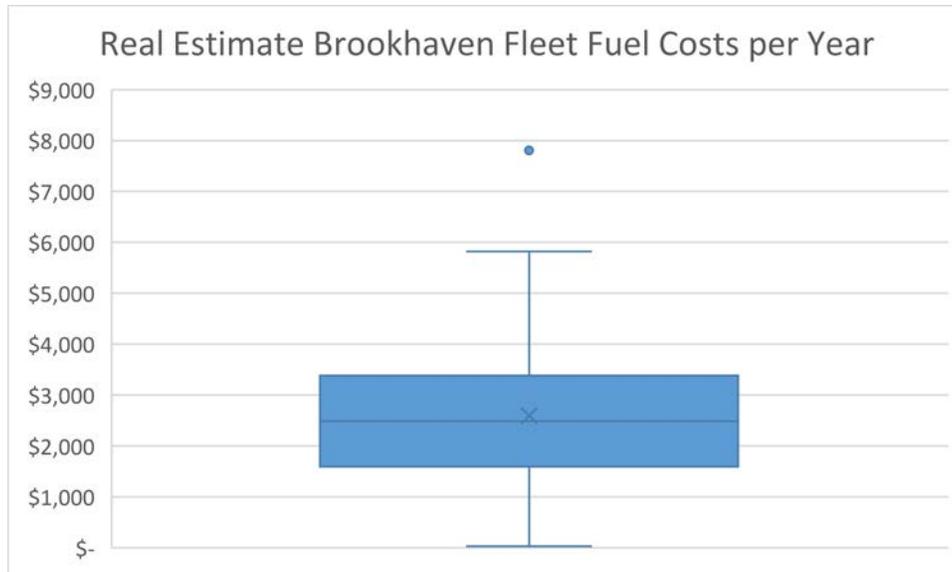
Consider that some vehicles are used for minimal administrative purposes, while others idle on work sites, and others engage in high-speed chases. It is necessary to look at average costs in different ways.

Fleetio fuel expense recorded for 87 vehicles from March 22, 2019 through March 27, 2020 for a total of 34,797 data point days. This data, while extremely helpful, does not create a complete representation of the entire fleet's usage over the course of a year. Estimations were extrapolated where possible, and other vehicles were removed from calculating estimations due to an insufficient number of data points.

Non-police vehicles, which tend to use less fuel, were among those not being logged throughout the year. Of the 112 vehicles registered in Fleetio, only 2 of the 87 which logged fuel costs were associated with City Hall. Those two, for the Fire Division, indicate an average of \$548.06 per annum fuel cost per vehicle.

Fleetio shows \$215,855 spent from March 2019-March 2020 for 87 vehicles. Not all vehicles were registered and updated for the full year, so a per diem average was calculated. (It indicated a total average expense of \$7.12 on fuel per car per day.) Using average per diem calculations to estimate a full year of expense per vehicle, those same 87 vehicles would cost \$226,015 per year (quite closely aligned with the actual expense of just over \$227,000 in both 2018 and 2019 years).

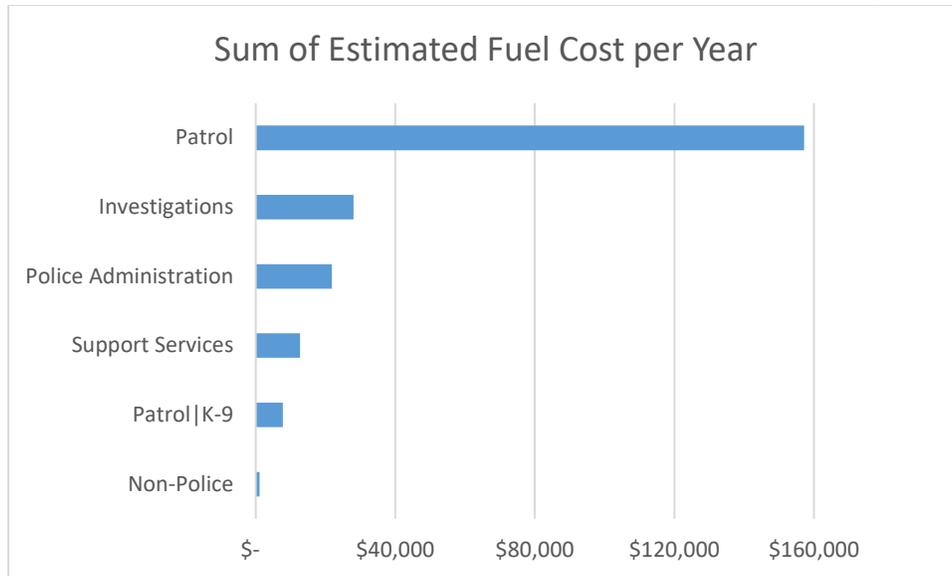
Using the recorded data from 87 vehicles and the per annum estimations, a more accurate representation of Brookhaven fleet fuel costs per year can be seen in the following chart:



The highest and lowest numbers are outliers and should be recognized as not accurate representations of Brookhaven fleet fuel usage.

Highest fuel spend	\$	7,806.94
Second highest fuel spend	\$	5,818.55
Average fuel spend	\$	2,597.88
Median fuel spend	\$	2,491.01
Second lowest fuel spend	\$	170.36
Lowest fuel spend	\$	31.20

Of the 87 vehicles with Fleetio fuel expense data, 58 were in the “Patrol” group. Of these, the average gasoline fuel use cost per day was \$7.36, yielding an estimated average of \$2,688.22 per year.



Since Teslas are newly designed vehicles, and the City of Brookhaven only has a few months of data-tracking for its proof of concept, maintenance costs are estimated based on analysis of outside information. The number used to determine maintenance costs per year is \$475, a price recognized for a full-service Tesla inspection. Typical maintenance costs identified in the research ranged from \$1,490 to \$2,800 over a five-year period.

Exhibit H: CO2 Emissions and Offset Calculations

	CO2 Emissions over 5 Years, Reported by Georgia Power (lbs)	CO2 Emissions for 112 Vehicles over 6 Years (lbs)	Number of Trees to Offset Emissions over 6 Years, per EPA Calculations
Low Range Estimation, made for 2014 Impala (Administrative)	42,908	5,766,835.20	43,253
High Range Estimation, made for 2014 Taurus (Patrol)	131,963	17,735,827.20	133,023

Exhibit J: (Provided by Georgia Power) EVs Can Reduce Vehicle Operating Costs by 80%-90%

Compare Maintenance & Repair Costs

7 Year lifecycle, Projected Maintenance & Repair

Standard Gas Powered Car									
Maintenance & Repair	Year 1 10k-15k	Year 2 20k-25k	Year 3 30k-35k	Year 4 40k-45k	Year 5 50k-55k	Year 6 60k-65k	Year 7 70k-75k	7 Year Lifecycle	Higher Mileage Additions
Oil Changes	\$ 160	\$ 160	\$ 160	\$ 160	\$ 160	\$ 160	\$ 160	\$ 1,200	\$ 80
Air Filter, Engine			\$ 35			\$ 35		\$ 70	\$ 35
Air Filter, Cabin			\$ 45			\$ 45		\$ 90	\$ -
Fuel Filter			\$ 40			\$ 40		\$ 80	\$ 40
Coolant Flush			\$ 79			\$ 79		\$ 158	\$ -
Tire Rotation	\$ 20	\$ 20	\$ 20	\$ 20	\$ 20	\$ 20	\$ 20	\$ 140	\$ 40
Brake Pads, Front			\$ 150			\$ 150		\$ 300	\$ 150
Brake Pads, Rear					\$ 150			\$ 150	
Serpentine Belt					\$ 125			\$ 125	
Thermostat					\$ 160			\$ 160	
Water Pump, Gasket							\$ 225	\$ 225	
Spark Plugs, Platinum							\$ 145	\$ 145	
Coil Pack						\$ 325		\$ 325	
Ignition Wires							\$ 135	\$ 135	
Starter, Engine								\$ -	\$ 365
Alternator, Engine								\$ -	\$ 485
12 Volt Battery					\$ 125			\$ 125	
Brake Fluid Flush			\$ 90				\$ 90	\$ 180	
Transmission Fluid Flush	\$ 129			\$ 129			\$ 129	\$ 387	
Oil Pan Gasket, Plug								\$ -	\$ 235
Manifold Gaskets								\$ -	\$ 325
Timing Belt or Chain							\$ 575	\$ 575	
ICE Cost per Year	\$ 309	\$ 180	\$ 619	\$ 309	\$ 740	\$ 854	\$ 1,479	\$ 5,965	\$ 1,755

2018 Nissan LEAF									
Tire Rotation	\$ 20	\$ 20	\$ 20	\$ 20	\$ 20	\$ 20	\$ 20	\$ 140	\$ 40
Annual Battery Check	Included	Included	\$ 29	\$ 29	\$ 29	\$ 29	\$ 29	\$ 145	\$ 29
Brake Pads, Front								\$ -	\$ 150
Brake Pads, Rear								\$ -	\$ 150
Air Filter, Cabin			\$ 45			\$ 45		\$ 90	\$ -
12 Volt Battery					\$ 125			\$ 125	\$ 40
EV Cost per Year	\$ 20	\$ 20	\$ 94	\$ 49	\$ 174	\$ 94	\$ 49	\$ 500	\$ 150
Projected Savings	\$289	\$160	\$525	\$260	\$566	\$760	\$1,430	\$ 5,180	\$ 1,605

Assumes maintenance and repair at intervals common within the automotive industry. Prices are averages, and may be higher or lower in certain regions. Skill and affiliation of the technician may also affect cost. Oil Changes calculated at 3 months or 5,000 miles, at \$40 each. May be significantly more if synthetic oil or special filters are required. Repairs, such as gasket replacement, timing chain, sparkplugs or thermostat, consider average useful life. Some manufacturers may require added maintenance not specified. For simplicity, items common to both ICEs and EVs were omitted from this calculation, like Tires, Wiper Blades and Shocks. This comparison looks at like-sized vehicles comparable to a Nissan LEAF. Larger vehicles, or those used under stress, like police pursuit, may incur higher repair and maintenance costs, as will much older units. This comparison also doesn't consider modern safety features, like Automatic Emergency Braking, which is standard equipment on LEAF, and likely would reduce collision repair costs. It also doesn't consider a zero emissions vehicle like LEAF, will reduce CO₂ output, compared to a ICE vehicle by 6-9 Tons annually.

Other Sources Referenced:

- Analysis tracked and provided by Georgia Power
- Daily log created and provided by Officer John Clifford (driver assigned to Tesla)
- Networkfleet analytics
- ChargePoint analytics
- <https://www.tesla.com/support/car-maintenance>
- <https://www.marketwatch.com/story/youll-save-money-on-gas-with-a-tesla-but-also-consider-these-unique-expenses-2017-07-06>
- <https://www.motor1.com/reviews/406938/tesla-maintenance-cost/>
- <https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>
- <https://www.arboday.org/trees/treefacts/>
- <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>
- https://afdc.energy.gov/vehicles/electric_emissions.html