City of Fremont Police Department

Electric Patrol Vehicle Pilot Program

Outcome Report

March 2019 – March 2020

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Contents

PILOT PROGRAM TIMELINE

- 2015 – Developed pilot program idea in support of the City's policy to identify and implement clean energy technology
- 2016 – Detailed discussions with City Manager, City Attorney, and Chief of Police
- 2017 – City leadership approved the Pilot Program
    - Various City departments formed a planning committee, including: City Manager's Office, City Attorney's Office, Finance, Public Works (Fleet and Building Maintenance), Community Development (Sustainability), and IT Services
    - Extensive research on various vehicle options (Tesla Model S 85 selected)
        - Visit with Los Angeles Police Department / Los Angeles Sheriff's Department who were initiating a similar pilot program
- Late 2017/Early 2018 – Fremont Police Department (FPD) purchases and accepts delivery of a used Tesla Model S 85
    - 12-month customized build/equipment installation
- 2019 – Vehicle build completed
    - Vehicle tested at Alameda County Emergency Vehicle Operations (EVOC) track
        - Exceeded expectations and performance objectives
    - Deployment date set for March 25, 2019
        - Pilot Program initiated
    - Media and law enforcement interest nationally and internationally
        - Multiple media & community presentation requests

PILOT PROGRAM OVERVIEW

- Program assessed the following:
  - Does the technology meet police application?
  - Is the electric vehicle durable enough for police usage?
  - Is the electric vehicle cost effective?
- Modifications to the Tesla Model S 85 included:
  - Overhead light-bar
  - Rear flashers
  - Wheel well lights
  - Headlight flashers
  - WatchGuard vehicle camera
  - Trunk lighting
  - Panasonic Mobile Digital Computer
  - Push-bumper
  - Prisoner partition
  - Prisoner seat
  - Center equipment console
  - Armor door panels for the driver and front passenger door
- Estimated $30,000 in fuel consumed during the life span of conventional police vehicles. As a result, the project was projected to have cost savings or be cost neutral (based on purchase price of test vehicle and anticipated lifespan)
- On-campus Tesla charging station installed
  - Tesla charging station supplemented by existing on-campus electric vehicle charging stations
- Data gathered daily for six to 12 months, including:
  - Electric vehicle's average range during an 11-hour patrol shift
  - Vehicle's performance during emergency response, safety, and comfort
  - Police Officer comments and input from City's department stakeholders were also collected as an added layer of evaluation
- Ongoing media and community interest

- Government agencies throughout the nation contacted City officials for information regarding the Electric Patrol Vehicle Pilot Program
- Vehicle requested for numerous community events, parades, and presentations

OUTCOMES

Methodology

The Electric Patrol Vehicle Pilot Program ran from March 25, 2019 to March 25, 2020. To calculate the annual cost comparisons between the Tesla Model S 85 and the Ford Utility police pursuit vehicle (PPV), various reports were generated to collect data for each vehicle's actual or average annual cost of maintenance, repair, fuel, energy, and downtime for comparison purposes. What follows is a description of the reports and how the data was collected and presented.

The Tesla Model S 85 actual annual energy cost was derived from Geotab's "Advanced Fuel & EV Energy Report," spanning the pilot program period. To calculate energy consumption and miles driven for the Tesla, City of Fremont Fleet Services used Geotab's fleet management software and a GPS vehicle tracking device. The kilowatt-hour (kWh) energy used for miles driven was converted into kWh per mile. Then, that total was multiplied by the Pacific Gas and Electric (PGE) kWh rate of $0.15 to get the energy cost per mile.

The Tesla Model S 85 average annual maintenance and repair costs were derived from 16 months of data and then converted to an average annual cost from the Faster 4150 Report, "Equip History: Cost and Quantity Detail Report." The yearly average maintenance and repair costs for the Tesla were calculated using data from the 16 months the vehicle has been patrolling, including the pilot program period.

The Ford Utility PPV maintenance, repair, and fuel costs were derived from 58 months of data from 10 2015 Ford Utility PPV vehicles and then converted to an average annual cost for comparison purposes.[1] This data was sourced from the Faster 4150 Report, "Equip History: Cost and Quantity Detail Report." The average annual fuel costs for the conventional Ford Utility PPV was determined from the

[1] The 10 2015 Ford Utility PPV vehicles were selected because they were in service the longest, came very close to the five-year life cycle of the Ford Patrols, and would give a closer true cost of maintenance/repair and fuel.

total gallons consumed and multiplied by a three-year average fuel cost of $3.00/gallon.

The Tesla Model S 85 actual downtime, presented in both annual percentage and days, was derived from one year of data spanning March 2019 to March 2020 from the Faster 4309 report, “Downtime-Detail Report.”

The Ford Utility PPV average downtime was derived from the same downtime report spanning three years of data from July 2017 to July 2020. This data was then converted to average annual downtime percentage and days. The downtime data was collected from all PPVs existing at this time, with vehicle models including Chevrolet Tahoe, Chevrolet Caprice, and Ford F150.

The actual and average annual maintenance, repair, energy, fuel, and downtime data for the Tesla Model S 85 and Ford Utility PPV are shown side-by-side for comparison purposes in the chart on page 8.

Outcome Summary

The Pilot Program clearly established that an electric patrol vehicle is a feasible option for our City's police department. The Pilot Program affirmed the following information:

1. Does the technology meet police application?
    - Results: The Tesla Model S 85 exceeded performance and operational objectives.
2. Is the electric vehicle durable enough for police usage?
    - Results: The Tesla Model S 85 withstood the rigors of police use requiring minimal maintenance.
3. Is the electric vehicle cost effective?
    - Results: Although build cost for the Tesla Model S 85 was slightly higher than conventional police vehicles, maintenance/repair and fuel savings appears to balance or slightly reduce the overall operating cost as projected and compared to the lifespan of a police vehicle.

The chart below lists data derived from the pilot program and beyond as compared to calculated annual averages for a standard gas Ford police pursuit vehicle (PPV):

Factors	2014 Tesla Model S 85	Gas Ford PPV
Vehicle Cost	$61,478.50[2]	$40,500
Standard Equipment Build Cost	$35,000*	$35,000
Modifications Above/Beyond Standard Equipment Build Cost	$6,774.48*	$0
OEM Range	265 miles (85kWh battery)	344 miles (18.6 tank cap)

[2] Tesla and City of Fremont Motor Vehicle Purchase Agreement on December 13, 2017

Actual Annual Energy/Avg. Annual Fuel Cost	$1,036 *Cost of energy consumed while charging*	$5,133 *Calculated assuming $3.00 per gallon*
Avg. Annual Repair/Maintenance Cost	$4,865	$2,915
Actual Annual Costs of Energy/ Avg. Fuel and Maintenance/Repair Costs	**$5,901**	**$8,048**
Avg. Annual Maintenance Downtime	39.125 Days (10.72%)	66 days (17.98%)
Avg. Annual Operational CO2 Emissions	0 lbs.	42,198 lbs.

**Some costs were donated as part of the Pilot Program.*

After careful review, the Pilot Program was determined to be a success. The police patrol electric vehicle met the needs of police services.

Deployment Benefits

- Performance
    - The Tesla Model S 85 met or exceeded expectations often demonstrating superior performance when compared to gas-powered police vehicles.
    - Due to the vehicle's performance, Police Officers reported an enhanced feeling of safety and control when responding to emergency calls for service.
    - Police Officers reported a reduction in anxiety and stress when responding to emergency calls for service due to fewer engine noises.
    - Police Officers reported improved radio communication due to the lack of background engine noise.
- Range and Charging
    - The Tesla Model S 85 averaged **50% power usage** during a typical patrol shift (11 hours).
    - The 265-mile range of the Tesla Model S 85 easily accommodated the 40-70-mile range that patrol vehicles drove on average per day.
    - These results provided confidence in the ability to deploy an electric vehicle (with similar range) for a standard 11-hour patrol shift.
    - Electric vehicle technology was reasonably managed utilizing available on-campus charging stations.
    - FPD currently has charging infrastructure in place to support additional electric police vehicles. Capacity, however, will be limited until expansion of charging stations is achieved.
- Durability
    - The vehicle withstood the rigorous operational demands associated with policing a mid-sized municipality.
    - City's Fleet Maintenance staff reported significant reduction in repairs, maintenance, and downtime over the course of one year when compared to current police vehicles. Due to this reduction, the Tesla Model S 85 was able to remain in service more consistently (**27 more days** than a conventional PPV).

- It is expected that the Tesla's average annual maintenance and repair costs will decrease over time as more data is available and the sample period is extended, with a roughly 50% reduction (approximately $2,910).

- Fuel Costs and Sustainability
    - Over the course of the one-year Pilot Program, the Tesla Model S 85 reduced the cost of fuel that would have been required for a traditional gas-powered police vehicle by **$4,097**.
    - Although only one vehicle out of a fleet of over 60 vehicles, the Tesla Model S 85 reduced greenhouse emissions produced annually by FPD.
    - The program demonstrated the effectiveness of electric vehicles in helping the City of Fremont meet its goals to reduce 2005 levels of GHG emissions by 55% by 2030 and achieve long-term carbon neutrality by 2045.
- Re-sale Value of the Model S
    - The total cost of ownership (TCO) over a five-year period was calculated for the Tesla Model S 85 at $132,758 and the Ford Utility Interceptor at $115,740 factoring in upfront costs such as purchase price and modification, miles driven, fuel/energy costs, and maintenance costs. However, the TCO for the Tesla Model S 85 will likely decrease over time as more data is collected and the sample period is extended. Additionally, the TCO will decrease if the vehicle exceeds 5 years of service as is projected.
    - The Tesla Model S 85 appears to **hold its value twice as well** as the average internal combustion engine (ICE) vehicle[3].
    - One study calculated the average five-year depreciation of Tesla Model S 85 to be 61.7%.[4] Taking the depreciation to be 80% after seven years, to account for the additional age and hard driving in a police application, would decrease the TCO by about $12,000-$13,000.

[3] City of Fremont Municipal Fleet Electrification Study May 2020

[4] https://www.iseecars.com/cars-for-sale#section=studies&study=cars-that-hold-their-value&v=2019

    - As the City continues to electrify its fleet, particularly if purchasing Tesla models or other long-range EVs for the Police Department, the potential higher resale value may reduce the TCO compared to ICE vehicles.

- Expected Lifespan
    - Initial data has indicated that the reduced maintenance needs of the Tesla Model S 85 will likely result in an expected lifespan of longer than five years. However, this assumption is still being proven through real-world application.

Deployment Challenges

- The Tesla Model S 85 has low ground clearance which reduces its ability to traverse certain types of terrain.
- Taller drivers of 6' or above reported the position of the Tesla Model S 85's "B pillar" made it more difficult to enter/exit the vehicle when compared to traditional Ford SUV police vehicles.
- The on-campus charging stations required two to four hours of charging to reach a full charge when battery power was at 50% or less. This created a challenge to redeploy the vehicle rapidly between consecutive patrol shifts.
    - While the on-campus Tesla charging stations were adequate for the Pilot Program, a Supercharger would be preferable to reduce the amount of time needed to redeploy the vehicle after the conclusion of a patrol shift.
- Police equipment storage was adequate in the Tesla Model S 85; however, a larger rear space would be preferred to allow for "trunk organizers" to be placed in a single location. The Tesla Model S 85 utilized the front and rear areas to accomplish storage needs which was not an ideal configuration.
- The rear seat (prisoner barrier) in the Tesla Model S 85 posed a challenge for larger prisoners due to the limited space.

RECOMMENDATIONS AND FUTURE PLANS

Though data garnered from the Electric Patrol Vehicle Pilot Program, the Fremont Police Department has concluded that it was a success and provided significant evidence that expansion of electric patrol vehicles is a feasible option.

Further, TCO calculations that were derived from the 388 City vehicles studied[5] indicated that EV replacement results in $3,156,000 of savings to the City over the next 20 years, with $2,457,000 of these savings directly related to Police vehicle replacement. Additionally, data from the City's current inventory of non-electric vehicles' greenhouse gas (GHG) emissions demonstrated that electrifying the fleet could reduce its GHG impact by 53% by 2030.

In determining the next EV to purchase, the FPD analyzed both the benefits and challenges that have been experienced with the Tesla Model S 85. Though the Tesla Model S 85 is cost-effective, energy-efficient, and a superior patrol vehicle when compared to gas vehicles, it lacks space for larger drivers and passengers, as well as sufficient rear storage for police gear.

Recently, various other car manufacturers have made significant progress in EV technology. For example, in 2021, Ford will be producing a vehicle with similar performance and specifications as the Tesla Model S 85. However, as it stands, Tesla currently remains the leading manufacturer that meets the needs of Fremont's policing environment.

To date, the FPD has already acquired two out of the three additional electric/hybrid patrol vehicles it has budgeted for the last two fiscal years: the 2020 Tesla Model Y (purchased for $57,126.83[6]) and the 2021 Ford Utility Hybrid PPV (purchased for $48,223). The third vehicle has not been purchased yet, as the City is considering a variety of car manufacturers and vehicle options prior to moving forward with this investment.

[5] City of Fremont Municipal Fleet Electrification Study May 2020

[6] Tesla and City of Fremont Motor Vehicle Purchase Agreement on July 20, 2020

The Tesla Model Y was identified as a vehicle that most closely satisfied its deployment needs and addressed many of the challenges noted in the assessment of the Tesla Model S 85 vehicle tested in the Pilot Program.

Benefits of the Tesla Model Y include:

- Lower starting price
- Crossover SUV similar to current police vehicle SUV platforms
- More rear cargo and storage for police equipment
- Increased range of over 300 miles
- Overall performance similar to Tesla Model S 85
- Added front entry/exit space enhancing driver comfort
- Higher ground clearance allowing vehicle to traverse a wide variety to terrain

Additionally, seven 2020 Ford Utility Hybrid PPVs and seven more 2021 Ford Utility Hybrid PPVs are being added to the FPD fleet to replace existing patrol vehicles that are at the end of their lifespan, funded by the City's overall vehicle replacement budget.

The City is evaluating the feasibility of a larger scale replacement of fleet vehicles with EVs over the coming years via the Municipal Fleet Electrification study cited earlier this report[7]. This study, funded through a Bay Area Air Quality Management District Climate Protection grant, identifies upfront costs, long terms savings, GHG emissions reductions calculations, and EV charging infrastructure needs associated with an EV fleet and provides recommendations to the City on possible next steps. The project team has developed a website, https://evfleet.tools/, to share resources for other public agencies wishing to conduct a similar analysis.

Looking to the future, 23 dual port level 2 chargers and 1 direct current (DC) fast charger are projected to be needed at the Fremont Police Department complex to accommodate long-term fleet vehicle electrification into 2023 and beyond.

[7] City of Fremont Municipal Fleet Electrification Study May 2020

While the added cost of EV charging infrastructure was not included in the vehicle TCO, it will be considered as a separate infrastructure upgrade cost.

The study is now further evaluating options for EV charging infrastructure, including what costs would be for transitioning EV charging infrastructure to existing or new onsite solar photovoltaic systems and adding battery energy storage options. Funding for charging infrastructure is being evaluated as well, such as grants that would support its expansion within the FPD campus.

APPENDIX

The History of the Fremont Automobile Industry and the Fremont Police Department's Green Energy Initiative Timeline

- 1962 – The General Motors Fremont Assembly line is built.
- 1997 – The Fremont Police Department (FPD) begins to patrol using the Crown Victoria.
- 2009 – The FPD purchases two Ford Escape Hybrid vehicles and five 2009 Toyota Prius vehicles.
- 2010 –The GM Fremont Assembly line closes; Tesla Motors announces they had purchased part of the GM plant.
- 2011 – The FPD deploys nine Ford Escape Hybrids for CSO fleet; FPD discontinues use of the Crown Victoria.
- 2012 – The City of Fremont begins to implement the Climate Action Plan with the goal of reaching 25% greenhouse gas emission reductions from a 2005 baseline by the year 2020.
- 2016 –The FPD deploys five Ford Fusion Hybrids for command staff and admin Lieutenants.
- 2017 – The FPD purchases and deploys two additional Ford Fusion Hybrid Plug-Ins.
- 2018 – The FPD purchases and deploys one additional Ford Fusion Hybrid Plug-Ins for command staff; All Chief, Captains, and Administrative Lieutenants are driving hybrid vehicles; Tesla vehicle purchased.
- 2019 – The 2014 Tesla Model S 85 begins to patrol along with the 2019 Ford Fusion Police Responder PPV.
- 2020 – The Fremont Police Department shares findings from the nation's first Electric Patrol Vehicle Pilot Program.

The Fremont Police Department's Current Hybrid Fleet

- 9 Ford Escape Hybrids for Community Service Officers
- 9 Ford Fusion Hybrids for Admin Lieutenants
- 3 Ford Fusion Hybrid Plug-Ins for Chief and Captains
- 5 Toyota Prius Vehicles for Admin assignments
- 1 2019 Fusion Hybrid Responder PPV
- 1 Tesla Model S 85

- 1 Tesla Model Y
- 7 2020 Ford Utility Hybrid PPVs
- 8 2021 Ford Utility Hybrid PPVs

Additional Sustainability Facts from the Fremont Police Department

- The City's General Plan vision is for Fremont to serve as a national model of how an auto-oriented suburb can evolve into a sustainable, strategically urban, modern city.
- The City's Robert Wasserman Police Complex has 872 kW of solar carport structures installed onsite, providing clean and renewable electricity to the facility and to the electric vehicle as well as saving the City money on its electricity and vehicle operation bills.
- With all of Fremont's electricity supply coming from either onsite renewable solar power or 100% carbon-free, grid-based electricity through East Bay Community Energy (EBCE), each police vehicle that is replaced with an EV will completely zero out the greenhouse gas emissions associated with that vehicle's operation.

The Fremont Police Department Police Patrol Vehicle Image Gallery

A fleet of vintage Fremont police patrol vehicles sit outside the Fremont Police Station.

A Police Officer poses with a pedestrian while out on patrol.

A Police Officer smiles next to his police patrol vehicle.

The FPD's 1958 Chevy

The FPD's Tesla Model S 85, complete with modifications

The Tesla Model S 85 is tested ahead of its deployment in 2019.