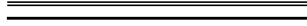


**The Bill Blackwood  
Law Enforcement Management Institute of Texas**



**Hybrid and Electric Vehicles in Law Enforcement**



**A Leadership White Paper  
Submitted in Partial Fulfillment  
Required for Graduation from the  
Leadership Command College**



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## **ABSTRACT**

Law enforcement agencies across the country are continually faced with rising fuel costs, budget constraints, and environmental concerns. Confronted with these issues, agencies are tasked with providing effective and efficient services to the communities they serve and protect. Law enforcement agencies rely on mobile response. Officers depend on some type of motor vehicle to respond to calls for service in the vast majority of cases. Law enforcement agencies can deliver timely service to their communities and still work within budget constraints, conserve fuel, and set a positive environmental example to the public by incorporating hybrid and electric vehicles into their fleets.

Hybrid and electric vehicle consume less fuel and get better gas mileage, which means less gasoline purchased. The amount of fuel consumption also means they operate in an environmentally friendly mode. Law enforcement agencies that utilize these vehicles will also demonstrate to the public they serve their willingness to be proactive when confronting environmental and economic issues.

Despite valid concerns such as initial purchase costs, maintenance issues, performance issues, and officer and equipment compatibility, law enforcement agencies can incorporate hybrid and electric vehicles within part, if not all, of their law enforcement duties. Agencies will need to determine what type of vehicle will blend with various divisions or units within the agency to allow hybrid and electric vehicles to fulfill specific mission objectives and make these vehicles a win- win situation for agencies, governing entities, and the public.

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## INTRODUCTION

Environmental concerns over the emission of fossil fuels and budget constraints relating to high gasoline prices has created valid concerns for law enforcement agencies across the country. Hybrid electric vehicles and electric vehicles are the answer, and law enforcement agencies should introduce these vehicles into their fleets. Hybrid electric vehicles have several benefits that make them ideal vehicles for law enforcement for part, if not all, of police duty. Before the benefits of hybrid electric vehicles are discussed, the definition of a hybrid electric vehicle as well as a brief history of hybrid vehicles would be beneficial.

According to Plug-in Electric vehicle handbook (2012) "hybrid electric vehicles combine an ICE or other propulsion source with batteries, regenerative braking, and an electric motor to provide high fuel economy" (p. 3). The ICE (Internal combustion Engine) uses traditional or alternate fuels to power the vehicle and does not require an electric plug in source ("Plug-In Electric," 2012, p. 3).

The first hybrid car was built in 1899, by German engineer Ferdinand Porsche. A gasoline engine was used to power an electric motor that propelled the front wheels. Called the Mixte, over 300 were built and were quite popular. When gasoline powered cars started to be mass produced in 1904, the demand for hybrids slowed. Basically, gasoline powered cars were less expensive to make and had more power. Hybrids were an afterthought until the 1960s. Renewed interest in hybrids gathered momentum with the Arab oil embargo in 1973. The oil crisis sent gasoline prices up while supply decreased. Even with these concerns, it was not until the late 90's, when Toyota introduced the Prius, that major public attention was finally sparked. Hybrid vehicles are

now very popular with the public and law enforcement is no exception ("A Brief History," 2013).

Because they use traditional fuels, hybrid electric vehicles do not require recharge from an electrical source. They generate their own electricity internally through the braking system. According to Whitehead (2006), "The hybrid will run off the electric motor when running at slower speeds or in stop and go traffic; at faster speeds the engine takes over and powers the car. While sitting at a stoplight, the hybrid shuts off altogether" (p. 5). With forward movement through acceleration, the engine takes over for the electric motor. If the vehicle needs more power to compensate for air conditioning or the internal battery requires recharging, then the engine will restart. A monitor on the dashboard lets the driver know which power source is engaged at all times, the internal combustion engine or the electric motor. Hybrid electric cars are classified as traditional motor vehicles. Under normal use, the internal batteries should not need replacing and should last as long as the vehicle (Whitehead, 2006).

Electric vehicles (EV) and plug-in electric vehicles (PEVs), on the other hand, get their power from an external power source or from internal batteries that require charging from external sources. Robert Davidson built the first known electric car in 1837. The popularity of electric cars increased until the mass introduction of gasoline powered vehicles, which allowed for longer range with powerful engines. The interest in electric vehicles remained dormant until the global economic recession in the late 2000's created a renewed interest in electric vehicles. In 2010, the Nissan Leaf became the first all-electric, zero tailpipe emission vehicle to be mass produced (Paukert, 2009).

Since hybrid electric vehicles (HEVs) revolve around an ICE, mileage and fuel consumption are computed in miles per gallon (mpg) whereas EVs use miles per gallon equivalent (mpge). Miles per gallon equivalent is the federal government's way of comparing gasoline and other alternative fuels with electricity which powers EVs. Basically the mpge rating is how far an EV can travel on the amount of energy equal to a gallon of gasoline (Seredynski, 2010).

## **POSITION**

Law enforcement agencies would benefit from purchasing hybrids due to federal regulations that protect the environment. The Environmental Protection Agency (EPA) has set standards that require government agencies in larger metropolitan areas to introduce these hybrid vehicles. Government agencies that comply with these standards are awarded Program Compliance Credits (PCC's) that may be utilized at a later date, traded, or sold to another entity in the same compliance area.

Although these standards exempt emergency vehicles, it only makes sense for law enforcement administrators to consider the use of hybrid vehicles to assist city governments in attaining or exceed required PCC's. Hybrid electric vehicles reduce emissions released into the ozone. According to Hybrid cars.com, "a gallon of gasoline weighs just over 6 pounds. When burned, the carbon in it combines with oxygen from the air to produce about 19 pounds of carbon dioxide" (Whitehead, 2006, p. 2).

The Terrell Hills Police Department has a fleet of five marked units which recorded approximately 83,800 miles in 2013. Using a conservative figure of 15 miles per gallon, the city police vehicles discharged 106,146 pounds of carbon dioxide into the environment ("City of Terrell Hills," 2013). In contrast, the City of Washington, DC

had 716 marked units and recorded 7,112,310 miles driven from July 2011 to July 2012. Their carbon footprint was a staggering 9,008,926 pounds (Schaenman & Horvath, 2003). A hybrid vehicle that gets 30 mpg would cut the carbon footprint in half. Whitehead (2006) states, "the 2003 Civic Hybrid reduces both hydrocarbon and nitrogen oxide emissions by as much as 82%. The 2001-2003 Prius reduces hydrocarbon and nitrous oxide emissions by 97%, carbon monoxide emissions by 76%, and particulate emissions by 90%" (p. 3).

Several police departments have already added hybrids to their fleet. The Yuma, Arizona Police Department added two Ford Escape Hybrid patrol vehicles to its fleet. The Escapes will serve as fully marked patrol vehicles. "It puts us out there on the cutting edge," Fleet Manager for the City of Yuma Charlie Caudill said (Gilbert, 2009, p. 1). He went on to say that "We want to be good stewards of the environment, so what we are doing as a city is looking at what we can do to minimize our impact on the environment" (Gilbert, 2009, p.1).

In Schenectady, NY, hybrids would cost the city twice as much as regular cars. Some council members, however, think the added expense is worth helping the environment. They are trying to reduce the city governments "carbon footprint" by 1% to 2% each year, in hopes of eliminating enough pollution to stop the city's share of global warming (Moore, 2007).

Law enforcement agencies also need to consider fuel expenditures. Because law enforcement agencies spend a large amount of money on purchasing fuel for patrol vehicles and these vehicles are driven almost constantly, the result is a substantial gasoline bill. For example, fuel expenditures in the Washington, DC metropolitan police

department reached \$3.7 million dollars in 2011. This amount included marked and unmarked patrol vehicles (Schaenman & Horvath, 2003).

Hybrids typically use one-third the fuel of conventional vehicles. This reason alone would quickly pay for the higher initial cost of purchasing hybrid vehicles.

The Salt Lake Police Department added five Toyota Camry four door sedan hybrids to its fleet. Salt Lake Police Chief Chris Burbank said his department spends \$1.5 million a year to keep the fleet running. He hopes to reduce that number by as much as \$4000 per vehicle per year, by adding the hybrid cars. Burbank called the addition of the hybrid vehicles "necessary". "Anywhere I can save fuel costs is a saving on personnel cost," he said (Reavy, 2008, p. 1). Burbank drives one of the new Camry hybrids and his new car gets 25 miles per gallon compared to his old cruiser that got just over 10 miles per gallon (Reavy, 2008). The Yuma, Arizona the police department utilizes Ford Escape hybrids for patrol duty, and they expect to get about 21 to 23 miles a gallon, while the Crown Victoria Police Interceptor, which is still part of their fleet, averages only nine to eleven miles per gallon (Gilbert, 2009).

Several hybrid and standard police vehicles were compared relating to mile per gallon (mpg). The Toyota Prius Hybrid was compared to three standard police vehicles currently in use, the Ford Police Interceptor, Chevrolet Impala, and the Dodge Charger. The EPA combined miles per gallon showed the Ford Police Interceptor got 18 miles per gallon, the Chevrolet Impala got 23 miles per gallon, the Dodge Charger got 24 miles per gallon and the Toyota Prius got 55 miles per gallon. Electric vehicles and PEVs do not require traditional fuel so miles per gallon does not factor in (Arlt, n.d.).



Law enforcement agencies are under constant scrutiny from city government, civic organizations, and the community. By utilizing hybrid vehicles, a police department would take a pro-active approach in fuel emissions and fuel consumption. A police department could set the example and gain public support, showing the community that they are concerned about the impact their carbon footprint has on the environment.

Law enforcement agencies are having a positive response from citizens regarding use of hybrid vehicles. Some agencies have citizens engaging officers on the mechanics and questions about hybrids. In Westwood, N.J., residents came up to police officers and told them that they were supportive and delighted to know that the department adopted hybrids. These types of vehicles are encouraging open communication with citizens and creating positive relations between the community and law enforcement (Hoffmann, 2008).

When idling at red lights or when stopped and the engine shuts down, Marion County officers are approached by citizens who comment to the officer that their car is not running. This occurs because the electric motor is virtually noiseless. According to Whitehead (2006), Wyatt Earp, director of fleet management for Marion County Florida, stated "that he has even been approached by a national television news show about the department's Priuses" (p. 2). Earp has been interviewed in newspaper articles and maintains that in order to help with environmental concerns law enforcement agencies should consider doing their part (Whitehead, 2006).

## COUNTER POSITION

Although hybrid and electric vehicles are environmentally friendly and fuel efficient, there are several concerns that an agency will need to address prior to purchase. One of the concerns is the initial purchase cost of hybrid vehicles for police use. Generally, HEVs and EVs cost more than conventional vehicles. Electric vehicles and PHEV's, like the Chevy Volt, can run as much as \$39,900. Ford's EV, the Focus starts at \$39,995 (Healey, 2013). A 2014 Nissan Leaf retails for just under \$30,000 and a 2014 Toyota Prius plug-in hybrid retails for \$30,800 (Ingram, 2014).

Another concern revolves around the charging of PHEVs and EVs. Charging will require plugging into electric vehicle supply equipment (EVSE) or an external power station. This could be problematic for large agencies that have to make significant vehicle purchases or smaller agencies with small budgets. EVSE is the equipment used to deliver electrical energy to the vehicle from a department's electrical outlets. The three most common types of EVSE for recharging batteries are Level 1, Level 2 and DC fast charging. Level 1 and Level 2 recharging utilizes alternating-current (AC) electricity. This procedure incorporates the equipment within the vehicle to convert the alternating current to direct current. This, in turn, charges the internal batteries. A DC fast charging system, on the other hand, sends the current directly to the vehicle's battery. Charging times may vary from half an hour to more than 20 hours. Factors that determine the length of charging include battery type, the EVSE itself, the charge condition of the battery and the energy capacity of the battery. Since EV's rely solely on internal batteries to power the vehicle, charging a depleted EV battery will require more charging time than a PHEVs battery ("Plug-In Electric," 2012).

Agencies will also need to consider whether the existing facility is satisfactory enough to perform the charging or if it might be necessary to construct a location to install EVSE. The initial cost for EVSE in Houston, Texas varied from \$860 to \$7,400 per unit. Agencies will need to consider the cost of initial setup. Fast charging EVSE units can run anywhere from \$20,000 to \$50,000, as in the Washington D.C. area. Clearly, agencies will need to perform a cost analysis prior to procuring these types of stations. Initial costs can be offset through federal, state, municipal or utility incentives ("Plug-In Electric," 2012).

Maintenance and repair issues will need to be addressed. Technicians will require special training in handling and working around ultra-high voltage batteries and cables. According to Totten (2004), "The voltage is anywhere from 42 to 500 volts on these systems and the lethal threshold is 60 volts, although it is possible to get killed with less voltage than that" (p. 2). Technicians must ensure that the ignition is in the "off" position or the 12v auxiliary battery has been disconnected, both of which disables the high voltage system (Engebretson, 2004). Since EVs run exclusively on electricity, the battery is around \$3,000. While battery packs should last the life of the vehicle, with the number of miles that police departments accumulate, batteries may need replacing. Other electric parts on EVs would have to be purchased and kept at repair facilities. Fleet managers will need to keep this in mind concerning their budget (Garrett, 2009). Because HEVs use internal combustion engines, maintaining the vehicle would, for the most part, be just like traditional vehicles. The electrical system of the EV, on the other hand, could require a slightly different maintenance schedule. In general, EV's require

less maintenance because there are fewer fluids to change and far fewer moving parts ("Plug-In Electric," 2012).

Performance should be considered when deciding the feasibility of purchasing hybrids. Hybrid vehicles will not reach the speeds of standard vehicles. In a comparison done between the Ford Police Interceptor, Chevrolet Impala, Dodge Charger and Toyota Prius Hybrid, the Ford Interceptor attained a top speed of 120 mph. The Chevy Impala reached 142mph. The Dodge Charger topped out at 135mph. and the Toyota Prius attained 106 mph (Arlt, n.d.).

High top speeds, however, are not the critical issue due to the fact that many law enforcement agencies have a very restrictive or non-pursuit policy in place. In addition, many metropolitan areas are becoming increasingly crowded. With lower speed limits, traffic signals, signs, and numerous bicycle friendly lanes, high speeds are not practical or safe.

Another concern would be the safety of first responders when dealing with HEVs and EVs that are involved in an accident. First responders would have to be aware of high voltage cables and batteries that could cause explosion and electrocution hazards. According to *USAToday*, first responders would have to take the time to avoid potential dangers while assisting accident victims. This extra time could have an effect on the "golden hour," the 60 minutes that can decide life and death (Knaub, 2012).

Another factor that agencies need to consider in purchasing hybrid and electric vehicles is officer and equipment compatibility. Some hybrids may not be suitable for patrol duty due to their internal space. Easton police found the hybrid too small to transport prisoners and carry all the equipment police officers use on the job. Easton

Police Chief John Solomon stated "I could see right away that they were too small and cramped by our standards" (Spinelli, 2007, p. 7). Officers in New York City, for example, found the front seat of the Nissan Altima a tight fit (Hauser, 2009, p. A22). Conversely, officers in Westwood, N.J. say that their Ford Escape is very comfortable to operate and maneuverability and turning radius is a pleasant surprise (Hoffmann, 2008).

Officers of the Northern Illinois University Department of Public Safety report that the compact nature of their Prius hybrid allows them to get into areas where a full size police cruiser cannot fit. The cars maneuverability is also on par with the Crown Victoria, which was demonstrated during driver training at their regional law enforcement academy. Officer Alan Smith stated, "For departments like ours, we don't need the power as much as we need the maneuverability" (King, 2006, p. 9). Smith goes on to state, "We can get wherever we want just as fast with the Prius as with the Crown Vic." (King, 2006, p. 9). In addition, the officers found that the interior of their Prius is roomy, and they have no problem getting in or out of the vehicle even wearing body armor and duty belts. Also, all of the police package equipment installed in the Prius, such as lights, siren, prisoner cage, radios, video camera, etc, is the same as that installed in their Crown Vic's (King, 2006).

There are several different types of EV and PHEV on the market, and police agencies should consider the type of duty that would be most beneficial for each vehicle. This could also offset the financial burden. For example, it would be wise for police agencies to maintain some traditional police vehicles for highway duty or in the case of vehicle pursuits. However, the majority of police related duties could be handled

by hybrid and electric vehicles, especially in large metropolitan areas where congestion renders fast speeds impractical.

For general patrol duties, agencies could use the hybrid Toyota Camry, Toyota Prius, Nissan Altima, Ford Fusion, Ford Escape, and Chevy Tahoe. Westward Industries GO-4EV is 100% electric and can be used for parking enforcement, light patrol duties, and campus patrol. The GO-4EV offers a range of 65 to 75 miles between charges. It charges in 5 to 6 hours on 240V and 10 to 12 hours on standard 120V. The speed is electronically governed at 40 or 45 mph ("Westward Industries," 2014).

The Zero DS electric motorcycle can be used for campus duty and traffic enforcement. The Zero DS is nearly silent and has an approximate range of 112 miles on a single charge and can reach speeds of 80 mph. The Zero DS costs about \$13,300 ("Calif. Campus Police Add Zero," 2013). The stand-up vehicle from T3 motion is perfect for heavy traffic areas, downtown, and campus patrol. It can be kept in service 24 hours a day using the vehicles' removable batteries. The vehicle operates on approximately ten cents per day of standard 120-volt electricity. The T3 also provides a more stable and balanced riding platform compared to the Segway. It has a range of 25 miles and a maximum speed of 20 mph ("Miami PD," 2013).

Administrative and investigations personnel can use any number of hybrid vehicles such as the Chevy Volt and Nissan Leaf. These vehicles, while not necessarily effective for general patrol could be beneficial for non-uniformed members. Citizens on patrol (COP), volunteers in policing (VIPs) and any number of civilian entities associated with police agencies that do not require marked units could also benefit from these vehicles.

Smaller police agencies should not let the substantial cost of electric plug-in stations discourage them from using EVs. To offset initial purchase costs for recharging stations, smaller municipalities could join together into a financial agreement where the cost would be distributed among the agencies. The agencies could then share the facilities. The Townships of Barnegat, Westwood, and Ocean along with Ocean County in the State of New Jersey would be prime examples of multiple agencies teaming up. Ocean County uses hybrid Ford Escapes as does Westwood but City Officials in Ocean Township are reluctant to switch to hybrids (Procida, 2008).

Grants are available for police agencies that want to switch to hybrid vehicles. The American Clean Energy and Security Act (ACES) has extensive provisions for electric cars. The bill also allows for the Department of Energy (DOE) to fund projects that support the development of EV and smart grid technology and infrastructure ("Discussion Draft of Waxman," 2009).

The Centralia Clean Fuels coalition, an organization that promotes the use of hybrid vehicles says that grants can offer up to 80% in funding to help agencies purchase hybrid and electric vehicles (Warmack, 2007). The federal government announced grants totaling 2.4 billion for EVs. United States based manufacturers could obtain 1.5 billion in grants to produce highly efficient batteries and their components. Other grants for \$500 million would be used to produce other components needed for EVs. Grants of \$400 million would be used to demonstrate and evaluate Plug-In Hybrids and other infrastructure concept including charging stations and training for technicians to build and repair EVs ("President Obama," 2009).

## RECOMMENDATION

The impact of hybrid electric vehicles and electric vehicles in the law enforcement community cannot be overstated. The police use of hybrid electric vehicles and electric vehicles can significantly reduce the carbon footprint of law enforcement agencies and allow municipalities to become more environmentally friendly. In addition, they can reduce fuel consumption and ease budget constraints. Hybrid electric vehicles and electric vehicles can have a positive impact within the community, showing the public that law enforcement can take a leading role in protecting the environment as well as protecting the community.

Although the initial purchase costs of hybrid police vehicles are more than standard police vehicles, law enforcement agencies have the ability to apply for grants to offset these costs. Since a significant reduction in fuel costs is a benefit of hybrid vehicles, the vehicles would pay for themselves in a short time. Repair and maintenance costs can also be reduced because HEVs rely on a dual power source, which distributes the wear and tear more evenly between the power sources. In the case of EVs. There are less moving parts and fewer fluids to change.

Agency administrators have a golden opportunity to use hybrid vehicles to their advantage by choosing from a wide variety of vehicles to fit specific agency roles. In a modern and complex society, the ability and opportunity for police administrators to think 'outside the box' can create a win-win situation for law enforcement, the communities they serve, and the environment. The "blue" needs to go "green".



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