TO GO OR NOT TO GO GREEN?

The Impact of Alternative Fuel Vehicles in the Law Enforcement Profession

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This Command College Independent Study Project is a FUTURES study of a particular emerging issue in law enforcement. Its purpose is NOT to predict the future, but rather to project a number of possible scenarios for strategic planning consideration.

Defining the future differs from analyzing the past because the future has not yet happened. In this project, useful alternatives have been formulated systematically so that the planner can respond to a range of possible future environments.

Managing the future means influencing the future--creating it, constraining it, adapting to it. A futures study points the way.

The views and conclusions expressed in the Command College project are those of the author and are not necessarily those of the Commission on Peace Officer Standards and Training (POST).

INTRODUCTION

So what is all the fuss about Alternative Fuel Vehicles (AFVs) anyway? Emissions? Improving the quality of life for our communities and employees? Reducing our dependence on foreign oil? Increased fuel costs? Hydrogen gas powered vehicles? Wasn't the Hindenberg hydrogen-filled when it went up in flames? So then, why try to put our law enforcement personnel in these types of "dangerous" vehicles? Or are they dangerous? AFVs are already making an impact within law enforcement organizations. In fact, several agencies are now making the transition to ethanol fuel to reduce increasing fuel costs. Other agencies have recognized the advances in technology and are now simply trying to keep up. Many in the community see the transition as a must, in that not "going green" could have a major impact on personal health and contribute to global warming [1]. This should cause anyone in public safety to pause and reflect; should law enforcement agencies "go green?"

The History of AFVs

Alternative fuels have been present in the automotive fuel market since the invention of motorized transport. Gasoline was not introduced as a motor fuel until the late 1800s. Prior to that, fuels such as electricity stored in lead acid batteries and the gas emitted from burning coal (a form of methane gas) were commonly used to power internal combustion engines. There were also other motor vehicles that ran on some form of ethanol, or other alcohols produced from biological material, as early as the beginning of the 20th century. In fact, Henry Ford fueled one of his first automobiles on ethanol in the 1880s [4].

Despite the availability of AFVs, they have had a minimal impact on the automobile industry. Primarily due to the development of refinery technology, AFVs were rejected in favor of gasoline vehicles because gasoline was more easily produced than other forms of fuel. Historically, it has also been less expensive for the consumer. Current increases in fuel costs, heightened awareness of the dangers of fossil fuel powered vehicle emissions, and federal mandates on air quality have once again energized research and development of AFVs into the automotive industry.

Health and Self-Reliance

In the recent past, the use of AFVs has been uncertain because consumer demand for them has not been established. Even now, there are a relatively small number of vehicles on America's roads. Of the roughly 250 million cars, trucks, SUVs, and minivans on the road, only about six million are capable of burning alternative fuel (E85). About half of these E85 ethanol flex-fuel vehicles are in commercial or governmental fleets [2]. AFVs, automobiles which operate on either an alternative fuel alone (dedicated AFVs), or a combination of alternative fuel and gasoline (flex fuel vehicles), are environmentally friendly and have the capability to provide both short and long term solutions to the United States' problem of dependence on foreign oil. Alternative fuels (hydrogen gas, electricity, compressed natural gas), are inherently less polluting than petroleum based fuels because their chemical make-up is less complex. This allows alternative fuels to burn more completely in the engine and, thus, creates less emission (for hydrogen powered vehicles, the only emissions are water and heat). With continuous increases in gasoline prices and health concerns attributed to fossil fuel powered vehicles,

the federal government's mission to become less dependent on foreign sources of oil has created significant economic incentives to purchase AFVs [3].

To give you an idea on our country's dependency on foreign oil, consider the following: the reason for the current high price of crude oil has nothing to do with oil scarcity, in fact, the production cost in the Middle East is less than $5 per barrel, yet by the Organization of the Petroleum Exporting Countries' (OPEC) restrictions on the output of oil, a barrel has recently sold for up to $78.00. Due to increases in crude oil consumption, the price of oil has also increased. Forty-four percent of the oil consumed in this country in 1995 came from foreign sources. By the year 2015, that number is expected to be 61 percent. Unfortunately, and at the consumer's expense, OPEC simply holds back output in order to support the elevated price of crude oil. In fact, OPEC today barely produces more crude oil than it did in 1977 [15]. So what can we do about it? As was done in the 1970s, the American people must conserve and find substitutes for oil and therefore drive down prices-can you say AFVs? Many manufacturers plan to expand this market segment substantially, a move touted by environmentalists as a prime means to reduce pollution. Impending legislation has served to accelerate this potential change as auto builders' work to stay ahead of the curve.

Existing and Pending Legislation

In an effort to reduce emissions, much legislation has been considered and enacted in the past three decades. There are several laws that have been enacted which have direct impact on alternative fuel usage in this country. These laws mandate either the development or implementation of alternative fuel usage by awarding special incentives for the use of alternative fuel vehicles. Increased pollution in the 1970s and

1980s served as a catalyst to promote and expand AFV technology. Seeing a need for improved air quality, the 1970 Clean Air Act (CAA) legislated these improvements by initiating National Ambient Air Quality Standards (NAAQS). To achieve NAAQS, vehicle emissions were also introduced in the CAA which targeted carbon monoxide, hydrocarbons, and oxides of nitrogen [3].

Although the reasons behind these efforts might be health and or economic driven, federal and state restrictions on issues such as the release of greenhouse gases continue to develop. For example, Executive Order 13123 mandates federal facilities to reduce their energy consumption 35% from a 1985 baseline amount by 2010. California's Governor Arnold Schwarzenegger recently implemented a requirement that California utilities generate at least 20% of their electricity from renewable sources by 2010; and he wants to raise the mandate to 33% by 2020. Furthermore, the Governor passed legislation requiring automakers to sharply reduce greenhouse gas emissions from their vehicles. This will require companies to achieve engineering efficiencies that could also improve fuel economy and encourage more use of alternative fuels [5]. Basically, energy conservation efforts combined with environmental concerns (global warming) will continue to be a motivation for AFV use and technology research.

Currently, federal agencies and several states, including California, continue to seek ways to save energy and use renewable resources. In 1975, in the wake of the Arab oil embargo, Congress established the Corporate Average Fuel Embargo (CAFE) standards for passenger cars and light trucks, such as sport utility vehicles or SUVs. In March 2006, the National Highway Transportation Safety Administration (NHTSA) increased fuel efficiency requirements for light trucks from 22.2 miles per gallon (mpg)

to 24 mpg for the model year 2008. CAFE standards for passenger cars haven't changed since 1990 and currently stand at 27.5 mpg. The industry average for these vehicles, however, is slightly higher—approximately 29 mpg. Yet, the National Academy of Sciences (NAS), like Governor Schwarzenegger, feel this is not enough and estimate it is currently costing between 1,300 and 2,600 lives in one calendar year alone (1993).

In a landmark 2002 NAS study, it was discovered that fuel efficiency requirements set by politicians rather than by sound science prompted automakers to compromise safety and produce lighter cars to "even out" the gas guzzlers and satisfy CAFE requirements [16]. In the absence of clear guidelines from the Bush administration, Schwarzenegger has emerged as the nation's de facto carbon ambassador, carrying the green banner across the nation and the globe. In September 2006, the Governor signed legislation (Assembly Bill 32, Global Warming Solution Act) to reduce greenhouse emissions. Basically, it is a bill designed to lower emissions by requiring higher MPG for autos being driven in the state. Nine states have adopted California's standards to reduce fleet-wide global warming emissions from new vehicles by 25 percent in model year 2009, rising to 30 percent in model year 2016.

As a major boost to California's "green" efforts, on April 2, 2007, the Supreme Court ruled that the Clean Air Act gives the U.S. EPA the authority to regulate carbon dioxide and other global warming pollutants from cars. This decision is recognized to be a major turning point in our nation's fight to protect future generations from global warming. The Court ordered the U.S. EPA to reconsider its decision not to regulate carbon dioxide emissions from cars. In the meantime, the ruling will have major implications for rules to reduce global warming pollution from cars in California and nine

other states. Under the Clean Air Act, California may adopt tailpipe emissions standards that are stronger than the minimum federal standards; other states can then adopt California's standards [17].

These mandates will provide for even more incentive for manufacturers to explore the mass production of emission friendly AFVs. Increased production of AFVs will most likely reduce related vehicle costs, potentially introduce efficient patrol vehicles for the law enforcement community, and ultimately convert AFVs into the standard vehicle on the road.

Supply and Demand

History has demonstrated that increased fuel costs (due to alleged fuel shortages) are what really stimulate many motorists' interest in AFVs, and not necessarily environmental concerns. This was proven during the energy crisis of 1973 and 1979. During the crisis, there was a renewed interest for AFVs, primarily due to the inconvenience of dramatic oil prices increases and shortage of gasoline. However, as quickly as it began, the end of the energy crisis spelled the end of the attraction to AFVs [5]. Although AFV research efforts declined in the 1980s, the Persian Gulf War (1990-91), sparked renewed interest and investment that continues today. Currently, the instability of the world oil market, the oil price spike, and concerns of world oil reserves shortages have increased concern about oil scarcity and once again put AFV development at the forefront [6].

Increasing fuel costs have not only impacted communities but also law enforcement organizations whose primary duties include driving. For example, the California Highway Patrol expended 9.9 million gallons of gasoline in the 2004/2005

fiscal year at a cost of just under $20 million. With the exception of about 20 diesel-powered vehicles, all others operate on unleaded gasoline. With anticipated increases in CHP staffing and rising fuel costs, gas expenses will continue to impact the CHP's and law enforcement's budgets in general [7]. With today's technological advances, several eye catching, efficient, and affordable AFVs are being introduced into the market. What was once simply a fuel cost savings vehicle may become more of a "vital" vehicle due to their performance and positive environmental contributions. The CHP's example is a problem shared by all in policing. How could we cut costs on infrastructure while still fulfilling our mission? Finding ways to provide relief for tightening budgets may very well include incorporating AFVs into their motor vehicle fleets.

Assessing the Future – An Expert Panel Weighs In

In April 2006, a panel of experts convened to discuss the impact of AFVs in policing in the near future [8]. The panel consisted of a health/medical representative, an insurance claims adjuster, a alternative fuel automotive technician professor, a fire department captain, a fire marshall academy instructor, an automotive technician, a registered nurse, and a police officer. The panel concluded their work with observations and recommendations in the following subject areas:

- Increase in workers compensation claims due to vehicle emission exposures
- The public's expectation that law enforcement contribute towards the reduction of greenhouse gases/vehicles emissions
- Technological advances make alternate fuel vehicles viable for law enforcement use

- Increasing fossil fuel costs drive consumers to alternative fuel vehicles
- The popularity of alternative fuel vehicles leads to an increase in AFV involved traffic collisions, and hazardous exposures to first responders

Workplace Injury Claims are on the Rise-could AFVs help?

The illness of cancer has many unknowns, and for years, law enforcement personnel have been unable to attribute it to job specific events. However, like taxi drivers, law enforcement personnel working in urban settings find themselves in emissions-polluted environments on a daily basis (the interior of their patrol vehicles). This facilitates inhaling dangerous microscopic soot into the lungs which can ultimately result in cancer [11]. It is very possible this connection may result in an increase of work related claims. In addition to fuel conservation, this alone may prompt agency heads to transition to AFVs and lead a movement that will encourage the motoring public to follow suit.

The public expects public safety agencies to contribute towards the reduction of harmful pollutants

For years, environmentalists have called for cleaner air quality restrictions. Citing concerns related to motor vehicle pollution such as: negative impacts to the ozone layer, acid rain, and global warming, greenhouse gas regulations are again at the forefront of government discussions. For the sake of creating healthier environments and reducing fuel costs, public bus agencies have made great strides in alternate fuel modifications to their fleets; the public will expect law enforcement to do the same.

Technological advancements greatly improves the appearance/performance of AFVs

Initially; technology limited alternate fuel vehicles to smaller, "gutless" mechanisms. For example, the first hybrid vehicles (vehicles that use both electric power and internal combustion) for sale in the United States were the Honda Insight and Toyota Prius, both considered small and underpowered vehicles [14]. With expanding consumer interest for more attractive, family friendly alternate fuel vehicles, two flex fuel full size sedans (2007 Ford Crown Victoria FFV and the 2006 3.5L Chevrolet Impala), and one SUV type vehicle (Chevrolet Tahoe 5.3L) compatible with the needs of law enforcement profession are already on the market.

To answer questions of law enforcement profession compatibility and fuel efficiency, Police Fleet Manager Magazine personnel borrowed a 2006 Chevrolet Impala powered by the 3.5L V-6 engine from GM Fleet, and put 1,000 miles on it [9]. This Impala is E85 fuel compatible, therefore classifying it as an AFV. It has ample head, shoulder, elbow, hip, knee and legroom for most officers. Its redesigned dash even creates much more room for the passenger. It has excellent seats, with seat back bolsters and seat cushion bolsters which offer good lateral support. As for driving impressions and advantages, the E85 powered Impala produced better performance than the same car powered by gasoline. The performance of the police package Impala is well-documented. The 200 hp 2005 and older Impala with the 3.8L V-6 hits 60 mph in 8.8 seconds and 100 mph in 25.3 seconds. The 240 hp 2006 Impala with the 3.9L V-6 reaches 60 mph in 8.8 seconds and 100 mph in 23.6 seconds. Running on E85, the 211 hp 3.5L V-6 Impala hits 60 mph in 9.1 seconds but reaches 100 mph in a comparatively

sizzling 22.9 seconds! At lower speeds, the 3.5L Impala is about as responsive as the old 3.8L V-6 version. At higher speeds, the 3.5L Impala feels like the new 3.9L V-6 version. When running on unleaded gasoline or E10, gasohol (a mixture of 10% ethanol and 90% gasoline), the Impala gets much better fuel economy than all other admin-oriented sedans.

High gas costs make AFVs more attractive

The panel noted that increased fuel costs is not something new for U.S. motorists (the fuel crisis of the late 70s early 80s was discussed). What is different this time around is an era where the U.S. government is looking to become less dependent on foreign oil. The September 11, 2001, terrorist attacks swayed American sentiment on continued financial support to the many countries in the Middle East (including purchasing foreign oil). The Middle Eastern war that has and continues to claim thousands of American soldier casualties, and significant technological advances in alternate fuel vehicles has resulted in the production of practical alternate fuel vehicles. At this time, AFVs may be here to stay.

AFVs on the roadways may result in hazardous exposure to first responders

Naturally, the popularity of alternate fuel vehicles will lead to an increase in alternate fuel vehicle involved traffic collisions, and potential hazardous exposures to "first responders." The panel raised concerns associated with the increase of alternate fuel vehicles on the road and how it would result in an increase of alternate fuel vehicles involved in traffic collisions, exposing first responders to potentially hazardous situations. For example, cutting the wrong electrical wire during an extrication could result in the first responder being electrocuted; leaking hydrogen in confined spaces could

explode with minimal spark. Even sparks from common static and invisibly burning hydrogen gas could expose rescue workers to severe burns and other injuries. Their concerns are legitimate and are addressed in the California Fuel Cell Partnership, Emergency Response Guide [10].

Issues discussed include the flammability of hydrogen gas, shock hazards related to the cutting of high voltage power cables associated with electric motors (the cables serve as a conduit for 200-400 volts), inhalation hazards as a result of burning, acid leaking batteries (AFV batteries are significantly larger than standard batteries and are composed of acid-lead). Although hydrogen gas is lighter than air and would rise and harmlessly dissipate during a leakage, if confined, something as insignificant as common static could ignite the gas and cause an explosion. Furthermore, hydrogen gas is odorless, colorless, tasteless, and burns invisibly and without smoke. For unsuspecting first responders, this can result in significant burns and or suffocation. Also, when you consider that wearing common items such as: jewelry, including a watch, could enhance your chances of being shocked (these items are highly conductive) when dealing with electric powered AFVs, first responder's concerns are very legitimate! For the well being of law enforcement personnel, proper training and equipment will be critical when dealing with AFVs involved in traffic collisions.

Risks and Benefits

After reading the hazards associated with AFVs listed above, one would ask "Do the risks listed above outweigh the benefits of going green?" Choosing to ignore the environmental hazards associated with fossil fuel emissions could also cause significant

negative effects on our employees' health. Consider the following; during the course of three weeks in April and May 2003, Scientist Ms. Surbjit Kaur and her colleagues at Imperial College London conducted a survey dealing with pollution exposure to taxi, car, and bus passengers, as wells at to cyclists and walkers. The survey found that those traveling in cars and taxis were exposed to more air pollution than any other form of transportation. Specifically, passengers in these vehicles inhaled more than 108,000 ultra fine particles—microscopic soot 10,000 times smaller than a centimeter that is particularly dangerous because of its ability to penetrate deep into the lungs [11]. This harmful exposure can also be compared to other career ending inhalation hazards such as: continuous exposure to smoke during structure fires, respiratory system damage as a result of inhaling chemicals during a spill, or lung cancer that results from working in confined, grimy environments such as those found in coal mines.

Like urban taxi drivers, law enforcement personnel can spend at least eight hours a day in a vehicle's cabin, with exhaust in front and behind their vehicles. This is in addition to exposure to pollutants in the course of their work, whether it be at a long-term closure/investigation (fires, hazardous material spills, accidental methamphetamine lab discoveries), or simply out on patrol. Unfortunately, the study found that opening the vehicle's windows can hamper in your efforts to reduce the inhalation of pollutants by inviting even more in. Furthermore, the fact patrol vehicles are used by officers up to three shifts a day, day in and day out, only complicates the matter. The survey indicated similar conditions exist in the taxi cab industry, therefore the high exposure rate. It should be noted that exposure results improved (exposure decreased) when the same vehicles, even when used repeatedly in similar conditions, were kept in a good clean

condition (meaning no smoking in the vehicle, vacuuming the interior frequently, and no transporting of hazardous materials in the cabin area).

Going "Green"

The use of alternative fuel vehicles has become more popular, cost friendly, and a viable solution to the high prices at the gas pump. In this country, we have already seen a significant increase of AFVs on the roadways; due consumer demand, the popularity of AFVs will continue to grow. Furthermore, with the federal government's challenge to the American people to become less dependent on foreign oil, and pending mandates that may require law enforcement to conform to "green house" standards, AFVs are here to stay. For our health, we should all consider how we might embrace these less polluting vehicles and incorporate them into our fleets.

Take, for example, E85 powered vehicles. With corn being the main source for E85, their emissions are less pollutant than those emitted by fossil fuel powered vehicles. What's more, vehicles powered by E85 typically produce better performance than the same car powered by gasoline. With an octane rating of 100 to 105, the engine's power train control module can allow more aggressive cam timing, and spark advance before it detects ping (pre-detonation). With regard to repair and maintenance of E85 powered vehicles, because ethanol runs cleaner than gasoline, the engine and exhaust system maintenance expense may actually be less. The only immediate increase in operating costs will result with the use of synthetic engine oil. The E85 engine requires this type of engine oil due to the concern unburned ethanol, especially during rich, cold starts may migrate past the piston rings and damage the engine. The unburned ethanol could also

run down into the crankcase and dilute the engine oil [9]. Other than the initial shock of having to pay approximately $4.00 more per quart than standard motor oil, synthetic engine oils have no downsides and may be an overall better lubricant for any type of engine [8].

Incorporating AFVs into our fleets with a minimum of disruption is the next key step. For the sake of this article, the following plan will focus on the necessary steps the California Highway Patrol (CHP) would have to take to integrate green vehicles into the fleet. The first and most likely strategy to apply would be to start small and limit the implementation of AFVs to Headquarters only, at least initially. The vehicles assigned to Headquarters' are for personnel with non-primary patrol duties (detectives, commanders, background investigators, senior volunteers, PIOs). Having them participate in the AFV pilot project first will quickly identify and remedy any performance problems that arise. From there, the project could be expanded and used a central focal point for statewide implementation.

Into the Workplace

Appropriate training and awareness campaigns for AFV's owners and first responders will be critical. Specifically, some of the potential training needs deal with AFVs involved in traffic collisions include: the release of highly flammable gases, shock, inhalation and explosion hazards. It goes without saying that all of these could be deadly to the vehicle's occupants and to emergency responders.

Since 2002, the CHP has processed 200 claims for on-duty cancer related illnesses. It should be noted that in the year 2002, State Compensation Insurance Fund (SCIF) deemed cancer claims to be presumptive illnesses, however, exactly how

employees are acquiring these carcinogenic illnesses remains a mystery. As a possible explanation, consider the previously listed pollution study conducted by Scientist Surbjit Kaur. Considering law enforcement personnel can also spend up to eight hours a day in a patrol vehicle's cabin inhaling exhaust from other vehicles, or at scenes where they inhale pollutants produced by the environmental surroundings (forest fires, chemical spills, or other types of roadway construction/demolition projects), it is very possible this may be a link to the work related cancer claims.

Unfortunately, an issue that may hamper successful implementation of AFVs in law enforcement is determining how much the transition may cost. Expenses related to the implementation include: purchasing alternate fuel vehicles that are suitable for the profession, training of vehicle mechanics, maintenance, affordability and the availability of alternate fuels (finding gas stations that carry E85 continues to be a challenge). For example, alternate fueling stations are still scarce in Southern California with only one public, full-service, alternate fueling station located in San Diego. Law enforcement agencies might respond to this issue by retrofitting its current gas pumps to accommodate alternate fuels. Furthermore, docking ports for electric vehicles could be easily adapted to current facilities. Although immediate costs related to an agency's transition to AFVs may have a negative impact on their budget, as previously mentioned, engine maintenance costs will decrease as E85 and other types of cleaner burning fuels such as E10, runs cleaner than gasoline and therefore results in less engine and exhaust system maintenance.

Something else to consider, and because AFVs truly compatible for law enforcement are still only on the drawing board, partnering with vehicle manufacturers to

design a patrol vehicle could not come at a better time. Vehicle manufacturers are experimenting with the development of stylish, attractive, and affordable AFVs anyway, why not take advantage and help test their vehicles in order to "iron out the wrinkles". Take for example the 2007 Mazda RX-8 Hydrogen RE (pictured below). The RX-8 was recently displayed at the opening of Norway's first hydrogen

fueling station. It was the first time the rotary-engine vehicle was officially on display outside of Japan, where it has been available for lease since earlier this year. Mazda is banking on getting rotary engine hydrogen powered vehicles to the showroom floor before the more efficient (and more technologically complicated) hydrogen fuel cell vehicles are released. Real-world testing of the RX-E Hydrogen RE has been going on with the vehicles leased to first two energy-related corporate customers for a few months, and Mazda said it hopes to have about 10 RX-8 Hydrogen RE cars to local government and energy companies in Japan by the end of the year.

Much like the Ford Mustang and Chevrolet Camaro used by some law enforcement agencies, the RX-8 is a two door vehicle that can accommodate up to four passengers. It can run on either petrol (a petroleum-derived liquid used as fuel in internal

combustion engines) or hydrogen, which is stored in liquid form in a second fuel tank (see picture below). When it is running on hydrogen, the only thing coming out the

exhaust is water vapor [12]. Nevertheless, law enforcement officials could be concerned with the limited trunk space. It is also slower than the gasoline powered RX-8, and less practical as it only gets a 60-mile range. Law enforcement officials and vehicle manufacturers could come together to overcome, and ultimately create a dependable vehicle that not only looks fast, but goes fast.

Other opportunities for the development of a law enforcement patrol vehicle are available right in our backyard. For instance, officials from the Georgia Institute of Technology and Carbon Motors Corporation – a new U.S. automaker that has announced plans to locate in Georgia – have taken the first step toward collaboration that would develop the world's first vehicle built expressly for law enforcement agencies (picture of planned law enforcement vehicle below). The photo below is a first-generation concept of what the vehicle might look like. Of course, as they progress, the performance specs and particulars will be the subject of great scrutiny to the professional community.

"In this era of enhanced homeland security concerns, law enforcement first responders require the most appropriate specialized equipment delivered to them in the most efficient way possible so our women and men in uniform can patrol our communities in a more effective and safe manner," said William Santana Li, chairman and CEO of Carbon Motors. "With more than 200 law enforcement agencies nationwide, we have developed a list of 74 critical criteria that law enforcement vehicles need to meet. This vehicle will be different in almost every way to truly meet the needs and desires of law enforcement" [13].

Conclusion

Law enforcement leaders have a terrific opportunity to capitalize on the benefits of technological advancement as consider AFV's and the creation of a suitable law enforcement vehicle. Furthermore, agencies would save in fuel and maintenance related costs, and in the process address potential health hazards to their employees' environmental surroundings. Their willingness to take the lead in the implementation of AFVs within their fleets may produce the needed spark to encourage other public safety agencies and communities to follow suit. One step at a time, AFVs could become the primary vehicle on the roadways and ultimately reduce pollution caused by gasoline

powered vehicles. The intuitive leader would seriously consider a regional pilot project approach, and if successful be considered a visionary among law enforcement professionals.

On the other hand, doing nothing to address environmental concerns, costs and potential health hazards to our employees, is unacceptable. Besides, due to the federal government's challenge to become less dependent on foreign oils, pending mandates may require public safety agencies to conform to "greenhouse gas" standards, so law enforcement heads might as well get a head start. To go green is to go smart. Those at the forefront will blaze the path for others, and prove once again that law enforcement's mission to "protect and serve" can extend beyond the traditional. It can set the course for their communities; and, in return benefit from the display of their leadership.

REFERENCES

1. Ed Grabianowski, 2005, How Stuff Works, Introduction to How Global Warming Works.
2. Chuck Giametta, 2006, How E85 Ethanol Flex Fuel Works, http://www.auto.howstuffworks.com
3. Cynthia A. McFadden, 1997, Society of Automotive Engineers, Alternative Fuel Vehicles: Should the Federal Government Bridge the Economic Gap?
4. A General Introduction to Alternative Fuel Vehicles, June 17, 1997, http://www.energy.ca.gov/afvs/reports/1999-11_500-99-013.PDF
5. Maxwell, Timothy T. and Jesse C. Jones. Alternative Fuels Emissions, Economics, and Performance. Warrendale, PA: Society of Automotive Engineers, 1995.
6. Ronald Brownstein "The Nation; Ronald Brownstein / WASHINGTON OUTLOOK; California's Energy Strategy Holds Lessons for Bush :[HOME EDITION]." Los Angeles Times, April 23, 2006.
7. Scott Alder, R&D, FMS Gasoline Responses, May 5, 2006.
8. Ernest Sanchez, April 26, 2006, San Bernardino CHP, Nominal Group Technique Interview.
9. Police Fleet Manager Magazine-Hendon Publishing, September-October 2006, http://www.pfmmag.com
10. California Fuel Cell Partnership, Emergency Response Guide, Fuel Cell Vehicles and Hydrogen Fueling Stations, Published August 2004, Version 2.0

11. Ms. Surbjit Kaur, Exposure visualization of ultra fine particle counts in a transport microenvironment, Atmospheric Environment, 2006, pages 386-398
12. Car Magazine, posted August 24, 2006, http://www.carmagazine.co.uk/print.php?sid=116
13. Georgia Tech Website, April 21, 2006, http://www.gatech.edu/news-room/release.php?id=946
14. Wikipedia, Alternative Fuel Vehicle, http://en.wikipedia.org/wiki/Alternative_fuel_cars
15. Mr. Jim Saxton (R-NJ), Chairman, Joint Economic Committee, November 2005, OPEC and the High Price of Oil, A Joint Economic Committee Study, http://www.house.gov/jec/publications/109/11-17-05opec.pdf
16. Mr. Joe Barton (R-Texas), Chairman, US House Committee On Energy and Commerce, May 2006, Reforming Fuel Economy Standards Will Save Gasoline, Jobs and Lives, http://republicans.energycommerce.house.gov/108/home/05-10-06%20CAFE%20Fact%20Sheet.pdf
17. Elizabeth Shogren, April 2, 2007, High Court Rebukes EPA on Emissions, Environment, http://www.npr.org/templates/story/story.php?storyId=9293462