

WHAT IS THE FEASIBILITY OF USING FUEL CELL VEHICLES IN A STATE LAW
ENFORCEMENT AGENCY BY 2009?

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Peace Officer Standards and Training

By

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This Command College 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 and 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 and adapting to it. A future study points the way.

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CHAPTER 1

ISSUE IDENTIFICATION

Introduction

More and more people are talking about hydrogen and fuel cells.¹ Many people have seen something about fuel-cell-powered cars in the newspaper or heard about hydrogen on TV. In the early 1900s, the country moved from horse-drawn transportation to vehicles powered by internal combustion engines. Today, the country is in the early stages of another revolution, moving from engines that use fossil fuels (oil and gasoline) to fuel cells that run on a clean fuel – hydrogen.²

A fuel cell is an electrochemical energy conversion device that converts hydrogen and oxygen into water, producing electricity and heat in the process. It is very much like a battery that can be recharged while power is being drawn from it. Instead of recharging using electricity, however, a fuel cell uses hydrogen and oxygen. The fuel cell will compete with many other types of energy conversion devices, including the gas turbine in a city's power plant, the gasoline engine in cars and the battery in laptops.

Fuel cells evolved from Sir William Grove's research in 1839. He was the true master of the fuel cell process and a very forward thinker for his time. He actually conceived the power potential of a fuel cell prior to the general understanding of electricity, and, unfortunately, his efforts were not successful. In 1932, Francis Bacon developed the alkaline fuel cell system with porous electrodes. Later in the 1960s, fuel cells became the mainstay for power generation on

¹ Conversation with Anthony Eggerts, UC Davis Director of Fuel Cell Research Program...November 22, 2003

² Ibid.

spacecraft. This technology is widely used on the current space shuttle mission flown by NASA following the extended successes in the Gemini and Apollo programs. Additionally, General Motors and numerous other automobile manufacturers have developed prototype vehicles for demonstration.³

How the PEM Fuel Cells Work

PEM fuel cells produce electricity directly from the electrochemical reaction between hydrogen fuel and oxygen from the air. Like car engines, PEM fuel cells turn fuel into power by doing something to the fuel to make it release energy. In a regular car engine, what happens is combustion; the fuel burns in tiny explosions that push the pistons up and down. When a fuel burns, it is being oxidized, That is, the fuel combines with oxygen and the result is thermal (heat) energy. In a regular car (internal combustion) engine, the energy contained in the fuel is converted into heat and subsequently into mechanical motion, called kinetic energy, which turns the wheel. In a fuel cell, the fuel is also oxidized but without burning.⁴

This "electrochemical" process releases much of the fuel's energy in the form of useful electricity and heat. An electric motor turns the wheels. A fuel cell power system has many components, but its heart is a fuel cell "stack." This stack is actually made of many thin, flat "cells" layered together. The term "fuel cell" is often used to refer to the entire stack, but strictly

³ Lawrence Tse and Duane Bong, [A Brief History of Fuel](http://www.visionengineer.com/env/fc_history.shtml) Web page, accessed January 6, 2004 at http://www.visionengineer.com/env/fc_history.shtml

⁴ Ibid.

speaking, it refers only to the individual cells. A single cell produces a small amount of electricity, but many cells stacked together can provide enough to power a vehicle.⁵

A single fuel cell consists of an “electrolyte membrane” sandwiched between two thin “catalyst layers,” which help start the reactions that produce electricity. When hydrogen is fed to a PEM fuel cell and encounters the first catalyst layer, called the anode, the hydrogen molecules release electrons and protons. The protons migrate through the electrolyte membrane to the second catalyst layer, called the cathode, where they react with oxygen to form water. The electrons, however, can’t pass through the electrolyte membrane to the cathode. Instead they must travel around it – this movement of electrons is an electrical current.⁶

A fuel cell power system doesn’t look, sound, or feel much like a regular engine; it doesn’t have as many moving parts; it’s nearly silent; it doesn’t get as hot; and it needs fewer mechanical parts to move the vehicle. PEM fuel cells are highly efficient! They can capture 50% or more of hydrogen’s energy to power a car. The internal combustion engines in today’s cars convert less than 20% of the energy in gasoline into power that moves the car.⁷ While automotive engineers have found ingenious ways to make internal combustion engines run more cleanly and efficiently, there’s a limit to how good these engines can ever be.

A PEM fuel cell vehicle running on pure hydrogen produces only water vapor. Internal combustion engines, which run mostly on gasoline, produce troublesome amounts of soot, oxides of nitrogen, and carbon dioxide that contribute to smog and global warming. Researchers are

⁵ Ibid.

⁶ Ibid.

⁷ Ibid

working to overcome a few key problems that must be solved before PEM fuel cells can be commonly used in automobiles. It's important to remember that fuel cell technology is still very new, while the internal combustion engine is 120 years old and is still being refined.

Government and industry scientists are working to develop new technologies that will:

- Reduce the cost of producing, delivering, and storing hydrogen.
- Reduce the cost of producing the PEM fuel cell stacks.
- Increase durability and reliability in extreme operating conditions.⁸

Over the years to come, society will have to make the necessary choice to embrace the new and evolving technology to prevent complete loss of fossil fuels and to prevent the environment from further devastation.

Comparison Between Gasoline and Fuel Cells

Combustion engines, like the turbine and the gasoline engine, burn fuels and use the pressure created by the expansion of the gases to do mechanical work. Batteries store electrical energy by converting it into chemical energy, which can be converted back into electrical energy when needed. A fuel cell provides a direct current (DC), voltage that can be used to power motors, lights or any number of electrical appliances.

There are several different types of each using a different chemistry, which are usually classified by the type of electrolyte they use.⁹ Some types of fuel cells show promise for use in power generation plants. Others may be useful for small portable applications or for powering

⁸ Ibid.

⁹ Fuel Cells 2000, Breakthrough Technologies Institute, Web page accessed January 6, 2004 at <http://www.fuelcells.org/>

cars. The proton exchange membrane fuel cell (PEMFC) is one of the most promising technologies. This is the type of fuel cell that will end up powering vehicles and maybe even houses.¹⁰

Hydrogen fuel cells have the potential to power cars, trucks, and buses without producing harmful emissions. Vehicles powered by fuel cells will be cleaner and quieter, and consume less energy than those powered by internal combustion engines. Fuel cells will provide energy without creating smokestack pollution. This adds up to energy savings for the consumer, energy security for the country, and a cleaner environment. Scientists are developing many different types of fuel cells, but the most promising for use in automobiles is the lightweight, relatively small polymer electrolyte membrane (PEM) fuel cell. The PEM fuel cell's low-temperature operation allows for it to start quickly and increases its durability.

The Department of the Energy, DOE, is working closely with its national laboratories, universities, and industry partners to overcome critical technical barriers to fuel cell commercialization. For instance, there is no easy way to store and transport hydrogen. Hydrogen has to be stored at high pressure and maintained at a relative low temperature and there is no real way for current vehicles to store enough hydrogen to extend the mileage range that would be comparable to gasoline cars. Current research and development is focused on the development of reliable, low-cost, high-performance fuel cell system components for transportation and buildings applications.¹¹

¹⁰ General Motors, Designing Vehicles for the Future, Web page accessed on January 6, 2004 at http://www.gm.com/company/gmability/adv_tech/400_fcw/

¹¹ Fuel Cell Vehicles, U.S. Department of energy web, accessed January 6, 2004, at <http://www.fueleconomy.gov/feg/fuelcell.shtml>.

It makes sense for law enforcement to lead the way among the government communities and embark in a partnership with automakers to utilize this new technology. Along with the technical challenges, there are additional social challenges that will have to be addressed for this program to succeed. Society will have to move beyond the stigmatism that hydrogen is unsafe. The typical person will recall the Hindenberg explosion and view the fuel cell vehicle with the same disdain. Additionally, the vehicles will look different than the normal passenger car.

Project Goal

This project will establish a methodology and design of a plan for a mid-size state law enforcement agency to become the first to adopt fuel cell technology and to utilize these vehicles for daily operations.

Program Proposal

By the year 2009, law enforcement agencies will be very aware of fuel cell vehicles and should be in a position to take full advantage of this evolving technology. There are, however, significant challenges both technically, and culturally, that have to be addressed for this to occur. The California Department of Justice, DOJ, Division of Law Enforcement, DLE, is a mid-size state law enforcement agency and is in a key position to partner with the automotive industry. By developing a partnership with the automotive industry, the Department of Justice can possibly play a valuable part in the development of strategies and programs that address future

needs and advancements. Additionally, the industry may be willing to pay for some of the costs associated with replacing a fleet of vehicles with the new technology.¹²

It is anticipated that many of DOJ's special agents will not accept fuel cell vehicles well. "They are used to the stigmatism of having considerable horsepower and a vehicle that sounds and looks powerful."¹³ There is also no statewide support infrastructure to provide fueling and maintenance. Furthermore, there will be obvious concerns and costs associated with fueling capacities, training of maintenance personnel, engine performance and collision viability.¹⁴ If DOJ did take advantage of a partnership with the industry, many of these initial costs could be taken care of by the manufacturers.¹⁵ This approach could be very advantageous for DOJ in terms of providing a successful leadership example for citizens to model their behavior and opinions of fuel cell vehicles, which is why manufacturers would be interested in such a partnership.

The remainder of the project will explore the feasibility of law enforcement utilizing fuel cell vehicles by the year 2009. The next chapter will look at potential trends and events that may impact this issue over the next ten years.

¹² Ibid.

¹³ Conversation, January 2, 2004, Special Agent in Charge, Mike Calvert, DOJ, MSB

¹⁴ Conversation, December 22, 2003, Assistant Chief Ron Phillis, DOJ MSB

¹⁵ Ibid.Eggerts

CHAPTER 2

FUTURES FORECASTING

The chapter will address what societal trends and events in the future may have an impact on a state criminal justice agency adopting the use of fuel cell vehicles. To make this assessment, a Nominal Group Techniques, NGT, was used. An NGT is simply a group of individuals who have specific knowledge in areas which relate to the topic being evaluated. It's a process that provides for equal participation and avoids dominance by any one participant. The NGT process includes round robin discussions of trends and possible events that are identified by panel members. A trend is a societal component which could be an accepted opinion, an average price or even an age, which potentially changes as time passes. An event is something that happens. An example of an event would be the terrorist attack that occurred in New York City on September 11, 2001.

Panel members rate the level of each trend over time and determine the level of concern relative to the topic. Events are evaluated relative to their probability of occurrence and degree of impact on the issue. At the conclusion of the evaluation process by the panel, a cross impact analysis focused on how the identified trends might be impacted by the events.

What is the feasibility of using fuel cell technology in state law enforcement vehicles by 2009?

In March, 2004, a facilitated NGT panel was held to identify and forecast trends and events that could impact the issue stated above. There were nine panel members which included two engineers from the University of California, Davis Fuel Cell Technology Program; two Special Agents in Charge from the California Department of Justice; one traffic engineer from

Cal Trans; a local transportation executive; and three members of the California Highway Patrol, Multi-Disciplinary Accident Investigation Team (MAIT). A high school teacher provided note-taking services (Appendix A).

The panel was provided a packet which included: An explanation of trends and events with examples and charts. Before the discussion began, a clear definition of the NGT process was examined until there was mutual understanding by all panel members.

The following table represents six trends identified by the panel arranged in order along the left side. The table shows the level of change from five years ago to today, five years and then ten years in the future, using the average of the panelists' individual scores. Today is represented by an arbitrary value of 100. At the far right of the chart, the level of concern is indicated and rated from one to ten. One was regarded as having the least concern while ten indicated that the panel felt that this generated the most concern regarding the implementation of the use of fuel cell vehicles by the Department of Justice.

TREND CHART

TRENDS	-5 YEARS	TODAY	+ FIVE YEARS	+ TEN YEARS	1-10 LEVEL OF CONCERN
T1- Invest by auto manufacturers	75	100	120	150	8
T2- Invest by government	75	100	120	80	7
T3- Cost of fossil fuel	80	100	125	85	7
T4- Development of hydrogen transport	20	100	65	110	9
T5- Acceptance by agents	0	100	120	200	6
T6- Trust	0	100	110	200	8

Trend Analysis

T1 Investment in fuel cell technology by automobile manufacturers

Currently, automobile manufacturers are investing in the development of fuel cell technology. According to the representatives from UC Davis, the major companies are expending nearly one billion dollars a year on the new technology. They felt that this trend would definitely continue and increase year by year for the indefinite future. The remainder of the group also felt that the support from the automobile manufacturers would continue to influence the development of new ideas to address some of the challenges this technology presents as well as sway the population into trying something a bit different. The overall feeling of the group remained that automobile manufacturers would continue to invest heavily and that

their investments would increase as new technology addressed fuel storage and manufacture problems. In five years the investments would increase 20%, and in ten years the investments would be 50% higher than today.

The group assigned a level of concern of “8” believing that investment by automobile manufacturers would be very important for the program to become successful.

T2 Investment by the government in fuel cell technology

The panel indicated that the Bush administration has invested over one billion dollars in the development and testing of fuel cell vehicles to date. The group felt that the current status and development of fuel cells is somewhat dependent on the sponsorship of the government. The fact that the government has invested in this technology shows support for various reasons. Some members stated that the Bush administration simply wanted to show their support because they didn't want to be painted as the administration that “lathered its pockets” with oil money. They felt that this was a gesture to dispel rumor and allow the President to run on a platform in the upcoming election in support of the environment and new technology. Other members of the group stated that the Bush administration wanted to develop a partnership with the auto manufacturers for the furtherance of the technology stating that, “government has to support alternate fuels; they simply cannot bury their heads in the sand and not acknowledge the continued difficulty of marketing fossil fuel.”

With these arguments at hand, the panelists were all in agreement that over the next five years, the government will continue to invest in this technology, but they felt that this pattern would diminish in ten years. They determined that the auto manufacturers would more than

likely take on the expenditure of development as profits begin to be realized. Like the automobile manufacturers, the group felt that the government would increase funding by 20% in the next five years, but would pull back from investment in ten years to a level of 80 as compared to today.

The group assigned a level of “7” for concern because they felt active participation and funding by the government would generate a positive attitude for success and possibly encourage societal acceptance.

T3 Cost of fossil fuels

The entire group felt that this was one of the most important issues that would have an impact of the possible effect on this technology. Most members of the group felt that the current price of fuel would continue to go up as it has in the recent past. Most could remember when fuel prices were less than a dollar and there were a few who could remember when fuel actually sold for less than 30 cents per gallon. The group predominantly felt, that within the next five years, fuel prices would go up; this discussion focused on the U.S. involvement in the Arab countries and how OPEC has the market in a strangle hold. However, the group felt that prices of fuel would not continue to escalate much beyond the five year point because exploration of alternate sources and transportation technology would force OPEC and other fuel producers to become more competitive. As a result, the cost of fossil fuel would drop. And, as a result of the fuel cell vehicle, the demand for gasoline would go down. The entire group agreed that the demand related directly to the overall price. The group agreed that, in the next five years, prices

for gasoline would continue to go up to a level of 125 as compared to today, but would level off and possibly go down in ten years to 85.

The group assigned a level concern of “7” to this trend because they felt that the escalating cost of fossil fuels would drive further development of alternative fuel including hydrogen fuel cells.

T4 Development of transportation of hydrogen

One of the primary challenges facing the universal use of fuel cell vehicles is the lack of fueling stations. The group felt that if an easy, safe and efficient means of fueling vehicles could not be developed, the concept had little chance of success. However, literature and the research members of the group made a very compelling case that a good percentage of the development money is making great strides in this area. Several concepts are being explored. The most compelling idea is that hydrogen would be produced at the actual fueling station. This concept is currently being tested and refined. Apparently, the process of hydrogen creation takes a considerable amount of energy and a great deal of room. The science representatives stated that solar power could meet this challenge. There was, however, discussion that the most effective way of producing hydrogen is done by the burning of fossil fuel, which seems to be counter-productive. The entire group felt that a safe means of delivery of hydrogen fuel is a necessary challenge the industry would have to overcome. They felt that with the emphasis and dollars invested today on the transportation of hydrogen fuel, the trend would generate new abilities. The group felt that in five years the level of development would not be sufficient to meet the

needs. However, in ten years the group felt that the development in technology would surpass needed levels.

The panel assigned a level of concern of “9” indicating that safe hydrogen transport was the most critical element for the implementation of fuel cell vehicles.

T5 Acceptance by agents of fuel cell vehicles

The majority of the group felt that agents within the Department of Justice would have a problem with this type of vehicle. They stated that agents would be used to the power and noise associated with gasoline vehicles, the passenger compartment makeup and the overall culture of the gasoline vehicle. They said that a transition of culture would have to take place before this technology could be accepted. Further discussion centered on the fact that agents would have to drive what was provided to them by the department. Reflection revealed that agents once drove the Concord vehicle, which was rated as extremely underpowered and had an assortment of shortcomings. The result was that agents simply drove what they were assigned and made do. Fuel cell vehicles, on the other hand, provide additional advantages, according to the industry representatives who were on the panel. They stated that the fuel cell vehicle would provide the power of a V-8 engine and be extremely quiet. In terms of surveillance, this vehicle would be outstanding because there would be absolutely no engine noise. The compartment could be conformed to almost any degree of likeness to a standard gasoline vehicle. The body could also be interchanged to be a pickup, passenger car or van depending on the specific need of the day.

Five years ago these vehicles were not an issue. This trend was predicated on fuel cell vehicles being available before 2009. The panel felt that the transition period initially would be a

bit strained resulting in a slight increase in the level of acceptance by agents at the five-year mark. In ten years the panel felt that the agents would fully accept the vehicle. The panel assigned a “6” level of concern because the level of acceptance would not be a deciding factor for implementation.

T6 Trust in fuel cell vehicles’ safety.

Panel members from UC Davis laid out specific challenges facing the industry in developing safe fuel cell cars and fuel cell fueling stations. The group was able to discuss the relative safety in a concise manner. Generally, there was significant concern that the perception of “driving a bomb” could not be overcome for a good deal of time. Members in the group mentioned the Hindenberg hydrogen dirigible incident. “Can you imagine being on a freeway with 70-MPH traffic with everyone driving bombs.”

Fortunately, the experts in the group pointed out the new advances in safeguarding the explosive characteristics of fuel cells. They discussed the relative properties of hydrogen being the lightest element on earth. When there is a collision most of the gas escapes instantaneously leaving every little volatile capability.

Trust was not an issue five years ago. The group voted that in a five-year period there would be a very low level of trust among the public. However, after the media’s acceptance and successful advertising, the public would fully trust this technology in ten years. The panel felt that the level of concern would be an “8” because the support from the public is necessary for the programs success.

Event Analysis

The following chart represents the results of the panel’s discussion of possible events, which are arranged along the left side. The second column represents the number of years from today when probability is greater than zero for the first time. The columns to the right across the top indicate years from present time. FIVE years in the future is represented + FIVE yrs.; ten years in the future is represented by + TEN yrs. The column under the “+ FIVE” indicates the panels’ opinion as to the percent of probability that the event will occur within five years. The column “+ TEN years” indicates the panels’ opinion as to the percent of probability that the event will occur within ten years. Both values represent the average of the panelists’ scores. The events are labeled as E-1 through E-6.

EVENT CHART

EVENT	+0	+FIVE	+TEN	1-10 Level of impact
E1, US at war over fossil fuel	1	100	100	+10
E2, Explosion at H2 storage facility	6	0	20	-8
E3, Terrorist attack gas storage	6	0	30	+8
E4, Gov drives fuel cell car	7	0	75	+9
E5, New science breakthrough	5	10	30	+10
E6, Cost of vehicles the same	8	0	10	+9

Events

E1 U.S. declares war with OPEC countries over oil

The panel discussed this event, reflecting the comparative events that are currently occurring in Iraq. The overall feelings centered around the military occupation and the eventful daily stories about the death of U.S. soldiers and Iraq citizens. The overall feeling of the group was that the U.S. is in a war over fossil fuel that was disguised as a war over terrorism. The group felt the next step was a declaration of war for oil. They felt that there was a 100% possibility in five years of the U.S. being involved in a war over fossil fuels. This would have a positive impact of 10 because a war over fossil fuels would emphasize the need for alternative fuels.

E2 Major explosion of fuel cell storage facility

The panel discussed the possibility of an explosive event occurring somewhere in the U.S. Generally, everyone admitted that since there were very few storage facilities existing in the United States, the likelihood of an actual explosion occurring would be very limited. However, with the potential advancement of this technology and the popularity of hydrogen fuels expanding, there may be a significant possibility of an explosive event occurring at a later date. The experts on fuel cell technology shared a few of the safeguards currently available, but they did not rule out the possibility of an explosive event occurring. They felt an event such as this would have a negative impact on this technology, but would promote overall development and safety.

The group decided that this event would not occur before the sixth year. The group decided that there was a 20% chance of a fuel cell facility exploding within ten years. This was determined to have a negative impact of eight because it would increase fear associated with hydrogen.

E3 Terrorists attack gasoline storage facility

The panel discussed the possibility of terrorists attacking a fossil fuel storage facility. Generally, the discussion centered around the current level of terrorist threats in the U.S. today. The group discussed the top terrorist targets and felt that, among others, oil refineries, fuel storage tanks and the transportation of this product would be easy targets for terrorists to exploit. The panel discussed the Galt storage facility and the relative ease that it could be destroyed. But, the panel felt that this could not happen before six years and had only 30% probability of occurrence in ten years. The panel assigned a positive impact of 8 to this event because, once again, society would realize the facility of fossil fuels.

E4 California Governor switches to fuel cell vehicle

The panel discussed the possibility of the California Governor actually switching to fuel cell vehicles. The panel discussed that Governor Arnold Schwarzenegger has been a very strong proponent of this technology. The UC Davis representatives stated that Schwarzenegger visited the fuel cell program in Davis and drove the vehicle, which was provided by Toyota as a test vehicle. The Governor was interviewed during a Channel 3 News story on fuel cell vehicles and offered his support. He said, “fuel cells are the wave of the future.” After this was discussed,

the group all felt that with the obvious support of the California Governor, DOJ should have fewer hurdles embracing fuel cell vehicles. The panel decided that this event could first occur in seven years, giving it a 75% probability of this occurring in ten years. The panel assigned a positive 9 as a level of impact.

E5 Fuel cell technology abandoned due to new scientific development

The panel discussed the possibility of a new, not yet thought of, technology developing that would take the front-runner position for the replacement of fossil fuels. Everyone agreed that fuel cells currently enjoyed the focus of government and the automobile industry, but they also admitted that new developments could change that focus. Panel experts informed the group that the investigation and development of electric cars, extended battery life and battery size is gaining in significance. The panel discussed the fact that hybrid vehicles are being mass-produced that incorporate both battery power and gasoline power. They are becoming very popular and their status has ascended recently. The panel also discussed magnetism, superconductor technology and so on, that would have a great impact if breakthroughs are made. The panel felt that in five years there was a 10 % probability of occurrence and a 30 % probability of occurrence in ten years. The panel assigned a negative 10 level of impact because all research money and interest would be taken by the new technology.

E6 Cost of fuel cell vehicles matches gasoline-powered vehicle

The panel discussed the possibility of hydrogen fuel cell vehicles actually being comparable in cost to gasoline vehicles. Once again, the experts provided interesting facts for

discussion. They stated that the current cost of the fuel cell vehicle at UC Davis is over one million dollars. They stated that this vehicle was just a prototype and was hand-built. They further stated that “any vehicle that was built in this fashion would be very expensive,” not quite one million dollars. They indicated that one reason that the vehicle is so expensive is because the actual fuel cell incorporates a “platinum” screen, which is very expensive. They said that alternate, less expensive materials are being developed, but nothing as effective as the platinum has been discovered yet.

Once the vehicle is in mass production, costs will drop tremendously, but may not reach the cost of the current gasoline vehicles in the near future. Generally, the group felt that cost of fuel cell vehicle would drop in five years and again in ten years, but in still would not equal the cost of gasoline vehicles. The possibility of fuel cell vehicles equaling the cost of gas vehicles was only 10 % in ten years. The panel assigned a positive level of 9 impact because the advantages of owning a fuel cell vehicle could be obtained at a more affordable price.

Cross Impact Analysis

After identifying trends and events, four members of the original panel met the next day to conduct a cross impact analysis. The following chart represents the sub-panels estimate of how the events would impact the trends. The average of the four scores was utilized.

The trends are arranged across the horizontal axis while the events are arranged along the vertical axis. The scale indicating the varying degrees of impact is indicated as ranging from -10

to 10. As such, the matrix boxes which display a high number, either positive or negative, indicate a significant positive or negative impact. Accordingly, boxes which display low numbers indicate a small impact.

CROSS IMPACT TABLE

Trends/ Events	T1- investment by auto makers	T2- investment by government	T3-Cost of fossil fuel	T4- effective transport of H2	T5-Agents acceptance	T6-Trust in safety
E1-War over oil/gas	6	6	-10	+4	+5	+4
E2- Hydrogen storage expl.	-7	-7	0	-8	-10	-10
E3- Terrorist attack gas	+4	+5	-8	+6	+6	+2
E4-Gov. Drives	+2	+2	-3	+4	+9	+7
E5-New Dev. Tech.	-10	-10	-8	-9	-8	-6
E6-Cost same as gas	+10	+10	+8	+9	+3	+6

Cross Impact Analysis Determinations

The analysis was prepared by comparing the various trends and events, which were determined by the panel. Once the relative comparisons were made regarding the trends and events they were placed within the matrix which assists the reader in determining how the panel felt regarding the potential events impacts on the identified trends relative to fuel cell vehicles being used by a state law enforcement agency.

E1 The country going to war over fossil fuel was discussed at length by the panel and the members felt that this event definitely should be included in this analysis even though most of the members felt that the country is currently at war with Iraq over oil. However, a blatant war against some other country was determined to be the talking point for analysis. The group felt that a war over fossil fuels would have a relatively positive effect on the investments in fuel cells by both private (T1) and government groups (T2). Additionally, the group felt that this event would result in a positive effect on the development of storage, acceptance by agents (T5) and trust in safety of the product (T6). However, all the panel members agreed that this event would have a strong negative impact, on the cost of fossil fuel.

E2 The panel discussed the possibility and resulting effect on the various trends if a hydrogen fuel storage facility were to explode. The panel discussed the matter and felt that this event would have a resounding negative effect on all trends except the cost of fossil fuel. Some members argued stating that this event would have a positive effect, but after discussion, an agreement was reached that this event would have no effect on the

cost of fossil fuels.

E3 The panel discussed the possible terrorist attack on a gasoline storage facility and remembered the individuals who had plans to explode the Galt Gasoline storage facility. Their efforts were discovered and their plans were thwarted. This event, however, brought a sense of reality to the discussion as the group applied this event to the individual trends. The group agreed that this event would have a strong positive effect on all of the trends except the cost of fossil fuel. They felt that terrorist attacking a gasoline storage facility would have a strong negative effect on the cost of gasoline.

E4 The group discussed the trends and how they would be effected if the Governor of the state of California were to switch all of his vehicles over to fuel cell vehicles. They felt that a of the trends would have a marginal positive levels of impact with the exception of “agent personnel acceptance and trust in the technology. The group felt that both of these trends would have a very strong impact if this were to occur. The only negative impact was the cost of fossil fuel. The group felt that this event would have a marginal negative impact.

E5 The group discussed the development of a new technology that was found to be a better alternative to travel. All members agreed after a short discussion that this event would have a very strong negative effect on all of the identified trends in this analysis.

E6 The panel considered the possibility of a fuel cell vehicle actually costing the same as a gasoline powered vehicle. In this discussion the group unanimously felt that this event would have a very strong positive effect on all identified trends.

Scenarios

The following scenarios were created to allow the planner the opportunity to view the future from three different perspectives. The positive and negative scenarios involve the incorporation of fuel cell technology for the “positive scenario” and the failure to incorporate fuel cell technology for the “negative scenario.” There is also a “surprise free” scenario which incorporates an imagined future.

Positive Scenario

In November of 2009, the press conference was attended by several civic leaders as well as representatives from as many television channels and newspapers as the room could hold. The Attorney General stood at the podium with a sense of pride and admiration for the opportunity to share the past revelations and study results. He positioned the microphone to the center of the podium and the reverberant squeak rang out through the crowd as a warning that something official was about to take place. The attendees at the front gathered their writing pads, and the microphones were tuned as the address was about to begin.

“Friends, we are gathered here today to recap the successes of a program that has grown from technology, from environmental scanning, from a single idea, from the need to address environmental issues. We are gathered here to, quite frankly, congratulate

ourselves on a successful endeavor.” The speaker rolled back on his heels as a slight chuckle was heard across the room. “I know that you might think that all politicians take every opportunity to congratulate themselves. Well, in this case, I am taking that opportunity, but not only to congratulate myself but to congratulate the people in my organization who made us the leaders, made us a viable partner with future industry and a valued associate of planetary conservatism.”

“As you know, we had to seek a new direction following the terrorists attack on our country’s fossil fuel reserves and our battle in the Middle East against rising prices controlled by OPEC nations which has led to war. I empowered my staff to do something daring and set an example for the future of state government.”

The chuckles left the room and were replaced with a calming sense of understanding. The speaker stated, “Some months ago, my staff approached me with the idea that we should partner with industry and be the first agency to embrace fuel cell technology. I will now admit that I was very skeptical and presented many roadblocks. I advised them that if they could overcome the roadblocks, I would approve of the transition. Well, they not only overcame the roadblocks, of expense and fuel availability, they devised a methodology to become leaders in the use of this new important technology. For this effort, I would like to sincerely congratulate them. Currently, the California Department of Justice has partnered with the automobile manufacturers for a reasonable price and is now the only public agency in the United States who operates solely on fuel cell vehicles. We operate over 1000 vehicles statewide at a very low cost and do not hurt the environment. Today, we stand as an example to all other agencies and the public that this technology works. The only by-product is water. Drops of water

flow from our fuel tanks while others produce hydrocarbons that choke our elderly and children.” The crowd applauded; television cameras positioned for a close-up as the Attorney General finished his clear and reverent statement with a great deal of pride, feeling that the Democratic nomination for the Governorship was in his back pocket.

Negative Outlook, Los Angeles 2040

“Mommy, can I go outside in a few minutes.” Samantha’s mother looked on remembering when she was a little girl...how she could run in the fields...play soccer, have picnics. “Sorry honey...you know today, all day is a no breathing day...you’ll have to wait until tomorrow...the city has scheduled a sky scrubbing rain, you’ll have at least two hours to play with your friends. “Mommy, how did it used to be? How was the sky in the olden days? Did you have to wait for the government to rain in the skies to go out and play?”

Her mother looked sad as she leaned back in her rocking chair on the porch of their moderately appointed home. Their porch had UV shielding and non-penetrating windows that would allow only filtered sunlight and absolutely no Ozone. “Sweetheart, not too long ago...I know it seems like olden days...your grandfather worked on a new and vibrant technology that could have changed the world. He felt that it was the only way to deal with the cost of rising fuel prices and our continued was with the Middle East Countries. It was called ‘fuel cell technology.’ Fuel cell vehicles would have eventually become more accepted if they were used and our society would have realized that they were actually very safe. Anyway, it was promising and would have replaced the gasoline

engine and done away with most of the air problems of the day and, honey you would be able to play outside now anytime you wanted.”

The little girl with golden hair and beautiful smile filled her mother’s lap as she jumped forward. “No mommy...I could go outside and not have to worry about dying. I wouldn’t have to wear my protective suit...no helmet...oh mommy...you know how fast I could run if I didn’t have to wear that heavy old suit. All the kids at school could really play outside...anytime...tell me more about when you were young.”

“Well honey, we had a thing called recess; the bell would ring in the classroom and we would line up at the door and the teacher would dismiss us and we could run out onto the playground. I used to love to try and catch boys...we would play kinda a special tag...I used to try to catch the boys I liked.” “Is that how you caught daddy.” “No I met your daddy in a air recondition shelter ten years ago when the quality of the air began forcing all living things underground. He was very handsome and very nice...”

“Mommy, I sure miss daddy.” “I know honey...so do I...” If he hadn’t been caught in that awful traffic jam...his car gave out and the air filtering system failed...your poor daddy loved us both...but he was caught out in the air for too long and lost his life trying to get home to us.”

“Why did this happen. It’s not fair.” “Your grandfather was furious when the government decided not to accept the new alternate fuel. The gasoline fuels have led us to war, death from suffocations like your father and holds us prisoners in our own homes. “Mommy, I just wish those people would have listened to grandpa.” “So do I sweetheart.”

Surprise Free Scenario

In December 2009, the Chief of the Bureau of Investigation, Kevin Sinor rolled back in his executive chair and called in the Assistant Chief and said, “Well at this point I think it is way too late.” Why do you say that, the automobile manufacturers are still offering that grant money to get fleets up and running?” “Have you looked at your E-mail today. The federal agencies, FBI, Homeland Security and others have taken all the available grant money that was set aside for law enforcement to transition to fuel cell vehicles. With the raging war in Iran OPEC is strangling us with gas prices. With gas prices at their present level we can’t make it though the year. We are going to have to shut down investigations. We can’t pay these terrible prices and the environmental groups are killing us with propaganda.” Both of the two executive looked down at the charts and tried to decide what areas to cut.

“We just can’t keep cutting programs to maintain our fleet; pretty soon we will have cars, but no people to drive them, and we can’t afford to have people driving the cars anyway. The Assistant Chief rolled his eyes and said, “Why don’t we contact the auto industry and plead to get us some level of partnership so we can get through this.” “What would you say to them?” “Well, we could say that it would be in their interest to work with us because we can show the public that hydrogen vehicles are safe and...” “We have had that chance and we blew it off. The federal agencies and CHP took all the money and we, as usual, didn’t react soon enough and tried to just maintain status without looking out ahead and scanning our future.” “Oh, wasn’t that something we discussed in Command College?” “Sure was!”

This chapter has looked at trends and events that could impact the implementation of fuel cell vehicles over the next five to ten years. The next chapter will develop a strategic plan for the implementation of this technology in state vehicles.

CHAPTER 3

STRATEGIC PLANNING

This chapter will provide the reader with the opportunity to explore the implementation process of fuel cell vehicles in a state law enforcement agency. This is best examined through strategically evaluating the strengths, weaknesses, opportunities and trends within the targeted agency. This phase of project development is critical, in that it will allow the framers and administrators who will make the final decisions regarding the program a clear picture of the challenges implementation of this program will have. The model agency is the California Department of Justice, Division of Law Enforcement, DOJ, DLE.

Currently, the department spends between 28 to 30 thousand dollars per vehicle and maintains a fleet of over 650. The vehicles are equipped with undercover systems, microphones, radios, storage mechanisms for shoulder weapons and emergency vehicle equipment, which adds an additional 10 to 12 thousand dollars. They are driven approximately 20 thousand miles per year. Agents are required to respond to emergencies and work locations from their individual residences. Insurance ranges from \$ 475.00 to \$ 500.00 per year for each vehicle. It is anticipated that the insurance would be significantly more for the first fuel cell vehicles in the department's fleet. However, at this point, an estimate on that cost is not yet possible.

Obvious Challenge

Initially, the California Department of Justice will have to deal with the fact that there is no support infrastructure in place to meet the everyday needs of operating a fleet of alternative fuel vehicles. Individuals will have to be hired and or trained, to deal with this problem. It is anticipated that the industry will have support personnel in large cities throughout California; however, transportation from the various office locations to the specialized service facilities in each major city will pose a significant problem.

Although, most experts agree that the manufacturers will have support personnel at the various dealerships and be very willing to comply with our departmental needs.

Within the next five to seven years it is anticipated that there will be mechanical support facilities in all major cities; relatively few “filling stations” that would meet the requirements for fleet operation. To address this problem the Department of Justice will have to develop their own state owned and operated hydrogen storage stations. This will entail developing partnerships and sharing the costs with other the manufacturers and other state agencies who would like to make the switch to hydrogen vehicles.

Additionally, a regional concept would be explored to share these costs with city and county agencies.

Once this is accomplished and there is a means to accommodate the maintenance of the vehicles and a reasonable means to fuel them in a timely manner, the California Department of Justice and any other agencies that make this transition will, in the long run, save our environment as well as meet our transportations needs. The design of the new vehicles will also allow for great flexibility in that one chassis can accommodate many different configurations of vehicles such as sedan, stations wagon, pickup or even

van type styles.

Vision

A successful measure of this program would be to view the California Department of Justice, Division of Law Enforcement, Bureau of Investigation, in the year 2009. By that time, the bureau and its various programs, would utilize fuel cell vehicles for daily operational purposes. The five regional offices, which are located in Sacramento, San Francisco, Fresno, Los Angeles and San Diego, would use fuel cell vehicles for daily operations. Each of the five regional offices would have the ability to have the mechanical support and capability to maintain the fuel cell vehicles operationally.

The first step in strategic planning is to do an organizational analysis. The following will use the SWOT model to assess the organizations current receptivity to fuel cell vehicles. Internal strengths and weaknesses will be identified as well as external threats and opportunities. These are factors which will help or hinder implementation of the proposed change.

Internal Agency Strengths, Using Fuel Cell Cars by 2009

Flexibility- DOJ has responsibility statewide. As such, DOJ can take advantage of anticipated regional maintenance facilities. In other words, many local agencies will not be able to take advantage of this technology because support facilities may not be in a location that will service their particular department. DOJ can take advantage of any facility statewide.

Assigned Vehicles- Agents take ownership and maintain their vehicles personally. This situation would significantly help this program succeed because greater care is given for personally assigned vehicles because agents are evaluated by their supervisor on the care and maintenance of their assigned vehicle. DOJ agent assigned vehicles are typically driven well in excess of 100 thousand miles as compared to pool vehicles which are typically replaced at 90 thousand miles because they are treated very poorly pool vehicle drivers.

Agent Support- In June 2004, a survey was conducted of Special Agent who were assigned to the California Bureau of Investigation and the Bureau of Narcotic Enforcement. Of the 300 agents who were surveyed 80 % were concerned with the escalating prices of fossil fuels and stated that they would desire to explore some alternative type of vehicle providing they did not have to sacrifice vehicle performance or safety.

Internal Agency Weaknesses, Using Fuel Cell Cars by 2009

Internal Purchasing- Length of time to process and change purchasing of vehicles, justifications and policies.

Budget- Not enough financial resources available to purchase the vehicles and the support infrastructure.

Phasing Out Inventory- Dealing with the transition of gasoline to fuel cell vehicles. At this juncture, the department will have to deal with two completely different vehicles.

We will have to essentially have two separate programs in terms of maintenance.

Training- Training operators to safely operate new vehicles and the proper maintenance of the vehicles.

Storage- Currently, DOJ does not have the capacity to maintain and store alternate vehicle shells, nor does DOJ have the capacity to change the alternate shells. It is anticipated that van shells as well as passenger cars will be available for enforcement purposes.

Fear- Although the survey of the 300 agents conducted revealed that most agents are very supportive, some were very resistant. Additionally, some management level personnel are very non-supportive of the idea and fully believe that the change to this type of transportation should take place in the private sector before a public agency takes it on. Some individuals feel that the technology could be very unsafe, reflecting on the Hindenberg incident.

External Opportunities, Using the Fuel Cell Cars by 2009

Environment- A growing concern by the public has established large organizations who deal with the protection of the environment. Groups like the Sierra Club are extremely supportive of fuel cell vehicles.

Technology - UC Davis researchers report that almost every automobile manufacturer is devoting great sums of money for the development of new technology to overcome the

cost of fuel cell storage. Additionally, DOJ will enhance the investigation and development of new evolving technology to address the storage problem of hydrogen fuels, the fuel cell cost, size and overall support structure in California.

Economic- Fossil fuel cell costs will continue to rise and create an even larger market for fuel cell vehicles.

Political- There will be new opportunities for the political arena to embrace this technology. Lobbyists will partner with manufacturers and support appropriate legislation to enable the fuel cell vehicles to establish a foothold in society.

External Threats, Using Fuel Cell Vehicles by 2009

Environment- It is anticipated that the disposal of fuel cells may pose a problem for the environment.

Technology- The development of an alternate unknown technology could rival fuel cell vehicles and become a potential threat.

Economic- For the predicted future, DOJ has very little budget money that can be spent on alternative programs. There will be extreme opposition to divert money from existing programs to support a fuel cell vehicle program. Once fuel cell vehicles become fully recognized and the public adjusts to them, the entire support structure that does not

support fuel cell vehicles will be unemployed. Thousands of Californians would then oppose implementation,

Stakeholder Analysis

As seen in the strengths and weaknesses portion the success or failure of DOJ effectively using fuel cell vehicles is almost entirely dependent on the individuals this technology affects. The stakeholders identified represent individuals from within DOJ and individuals outside of DOJ. A snail darter is a term that has come to mean unexpected

A survey of 300 sworn personnel included Special Agents, Special Agent Supervisors and Special Agents in Charge to determine how they would react to utilizing fuel cell vehicles for their enforcement and investigative operations. After their initial questions were answered, the following results were tabulated: Of the individuals surveyed, approximately 85% were in favor of utilizing the new vehicles while 15% were very resistant and felt that the fuel cell vehicles would always be too expensive to operate.

Special Agent personnel

These individuals will be the primary end users and will represent the possible snail darter scenario. In general, most agents were supportive of the use of fuel cell cars providing the infrastructure requirements are met. However, there are some individuals, approximately 15% of those surveyed, that were adamant that fuel cell vehicles would always be too expensive and that the trade off to assist the environment is not worth the

compromise. As a result, these individuals represent approximately 80 to 100 end users who could work very diligently at preventing the project from being successful. The new vehicles will require the end users to be open to new operating conditions and potentially travel greater distances for fueling service and maintenance. If they present cases where the overall success of investigations will be negatively impacted by the use of these vehicles their discord could spread throughout the agency. On the other hand, if management sends a clear message to all personnel that the vehicles will be utilized and to follow their directions up with training and uniform commitment, the program will have a better chance of success.

Special Agent Supervisors

These individuals are the first level of supervision and will play a significant role in the success of this program. They will be required to support agent personnel and the new vehicles. They will be the ones responsible for approving and assuring the agents are trained properly. They will be the first-line of contact regarding management of agents' time and expenditures regarding vehicle maintenance issues. They are a potential snail darter as well because they have greater influence on approval of the vehicles because they have greater contact with a much larger number of personnel than Special Agents. It is anticipated that they will generally be in support of the program.

Special Agent in Charge

This position is DOJ front-line manager level and they are in charge of the regional offices. Their support is absolutely crucial. The Special Agents in Charge who

participated in the NGT for this project were very supportive. They could see the tremendous advantages of this project far outweighed the weaknesses. They were particularly interested in the flexibility of the design of the vehicles and had great appreciation for the vehicles operating without the normal sounds of a gasoline engine.

Department of Justice Civilian Managers

These individuals are extremely important to the programs success. These individuals in this classification will act as leaders in the support function of sworn personnel. Essentially, they will be in charge of purchasing the vehicles, arranging for storage, shipment of maintenance items, classification of priorities and many other functions not identified. These individuals may have the opportunity to become snail darters as the other individuals have. It is anticipated that these individuals will support the program.

The California Attorney General

The Attorney General will be responsible for the implementation of the program and take the greatest political risk if the Department of Justice decides to go forward and, likewise, the Attorney General could gain significant political support if the program is successful and duplicated among other agencies and the general public. The Attorney General will likely support this program.

Automobile Industry

Clearly, the automobile industry has a great deal at stake. During discussions with Toyota Corporation, they expressed great interest in developing a pilot program for

a law enforcement agency like DOJ. In their view, the cost of discounting vehicles to get DOJ up and running would be far outweighed by the gains. They also felt that DOJ could be supported in terms of maintenance and fueling costs for the same reason. They feel that if a notable public agency is willing to partner with them, they would gladly defer a good deal of the costs because of the positive advertisement benefit. This partnership will greatly enhance the implementation of the project.

Individuals who commit crime

Agent personnel will be required to use the new vehicles for the purpose of investigation as before. The criminals who are investigated will not be accustomed to the new vehicles and their response will be a measure of the success of a quieter, more adjustable vehicle. As has been stated, agents will be able to switch a vehicle from a passenger car to a van with little effort. This ability will enhance agent's versatility and diminish the possibility of those who are being investigated discovering the identity of vehicles and agents during undercover operations.

Maintenance Personnel

Individuals will have to be trained to fuel the vehicles safely, to conduct operations such as fuel cell replacement, and all routine equipment. These individuals who are trained will be obtaining a new career path and new skills sets that few people have and will become sought after by all who deal with this new program. Maintenance personnel should be the individuals who show the greatest support for the program. They will likely be against the change from the gasoline-powered vehicles. Many of them

could feel that this new technology could take away their positions if they cannot obtain the training to work on the new vehicles.

Agents' Families

The agents at home support will go a great distance in developing a positive outlook for the success of the program. These individuals are potential snail darters who could constantly give the agents negative feedback regarding the overall safety of the new vehicles. If this were to occur, steps will have to be made to align support from DOJ in the form of education of the new vehicles. The families will likely support the program because they will go along with the individuals who are assigned to use the new vehicles.

Alternative Strategies

As a result of the preceding stakeholder analysis and strengths and weakness assessment, the following alternative strategies have been identified:

Strategy Number One

This program would be funded by DOJ's normal funding mechanism. The same amount of annual money will be expended for new vehicle replacement with the caveat of spending the necessary funds for the purchase of five fuel cell vehicles. These vehicles would be used as a pilot program and housed out of the Sacramento Regional offices of CBI and BNE. This strategy would place the vehicles very close to the UC Davis primary research facility for maintenance and necessary evaluations and solutions as they develop. This would be very necessary due to the initial lack of infrastructure support across the state. As the fuel cell industry develops, the vehicles could then be

assigned to different regions. Initially, the Sacramento area would be the primary area of assignment followed by the Los Angeles area then the San Diego area. DOJ has offices in all three locations.

Strategy Number Two

An alternate approach would be for the department to rely totally on various automobile manufacturers to supply their product. This would require extensive front loading in that DOJ would have to create a sense of competition between the top vehicle producers and offer the agency as a means to evaluate the individual vehicles and determine which ones fit the particular needs. The manufacturer's expense would include the cost of a vehicle and the cost to maintain that vehicle over a predetermined test period.

Strategy Number 3

The third consideration could include the department purchasing a small number of test vehicles to be used throughout the state. The vehicle assignment locations would depend on where they could be serviced without too much down time. Fueling will continue to be a very restrictive issue providing a statewide fueling infrastructure is not in place.

Analysis of Programs

In all three strategies, there exists a relative amount of risk and weakness. As in strategy number three, the department would be against spending budgetary money on a

new vehicle that did not have a statewide means of support. In other words, without the ability to fuel and conduct needed maintenance, the department would not invoke this plan. The state garage houses the maintenance personnel, and is managed by the Department of General Services. They could be extremely resistant to expending budgetary money on DOJ's pilot program. Currently, DOJ is responsible for maintaining its own fleet of vehicles and the state garage does not get involved. The Governor's office could redirect resources to support this program, but that scenario would be very unlikely.

Summary

Clearly, there are a number of issues that would have to be addressed for the implementation of fuel cell vehicles. As pointed out in the preceding analysis, DOJ would have to be almost completely supported by the automobile manufacturing industry. The individual stakeholders in all scenarios would play a significant role in deciding which strategy to implement. Strategy number one would seem to offer the most flexibility for the department as well as the automobile manufacturer. It offers the most concise opportunity for the department as well as the industry to take the responsibility for the alternate fuel vehicles to succeed. With much of the support and challenges identified, the department would be required to transition from the current status to the future.

The next chapter will develop a transition management for the implementation of fuel cell vehicles in the Department of Justice using strategy one.

CHAPTER 4

IMPLEMENTATION AND TRANSITION

The utilization of fuel cell vehicles by a state criminal justice agency by the year 2009 will take extensive work and the flexibility of individuals who will be responsible for implementation. To meet that end, an analysis of the critical mass, or minimum commitment of key personnel needed for this proposal to be implemented, was done.

Below is a critical mass commitment chart which illustrates who the key stakeholders are and how they need to change to make the project successful. The critical mass members are positioned along the vertical axis. The necessary change that must occur is indicated along the horizontal axis. The X represents the current position of the identified individual and the O represents where the person has to be moved.

CRITICAL MASS COMMITMENT CHART

Critical Mass Stakeholder	Block Change	Let Change Happen	Help Change Happen	Make Change Happen
Director of DLE		X		
	O			
Chief of CBI and BNE		X		
	O			
Attorney General		X		
	O			
Special Agents		X		
	O			
Automobile Industry			X	O

Critical Mass Analysis

Division of Law Enforcement Director- The DLE Director is currently in a position to let this program happen. However, for the program to be successful, the DLE Director would have to move to a position of helping the change happen. This could be accomplished by providing the director with information and briefing regarding the technology and enlisting assistance in developing a partnership with the various manufacturers. Once the director is exposed to the overall advantages of fuel cell vehicle, and the environmental safety, it is anticipated that they will assist in making the program successful.

Chief of CBI- The Chief of CBI and the Chief of BNE are in the position of letting the program happen. It is anticipated that they must be moved to the position of making the change happen for the program to be successful. This could be accomplished by involving them in the same strategy as the Director. As key officials of the department, it is anticipated that they will become a strong team with the Director when negotiating with the various automobile manufacturers.

The Attorney General- The Attorney General is currently in the let it happen category but could easily be moved to the help it happen category. The positive impact on the environment and the chance to use new technology would promote a positive political image for a politician.

Special Agents- Special Agents are in the let it happen category and could be moved to the help it happen category by exposing them to the flexibility of the new vehicles. The vehicles have quiet operation capability which would be extremely beneficial during surveillance and undercover operations. They have the ability to change from passenger car to van or pickup configurations.

Automobile Manufacturer- The Automobile manufacturers are in favor of this proposal and are in the category of helping this program happen. They have agreed to offer any technical assistance and discussed the possibility of providing vehicles at reduced costs for initial operations. This commitment would have to be finalized by the chief executive officers of DOJ and a partnership would have to be made. The manufacturers would then be in a position to greatly assist DOJ and would be in the make it happen category.

Transition Planning

As identified in the stakeholder chapter, it is clearly evident that two of the greatest challenges of this project will be dealing with stakeholder acceptance of the new fuel cell vehicles and the budget to buy the vehicles and support them. Meetings with the Toyota Corporation revealed that they would partner with DOJ and defer some of the start-up costs and ongoing maintenance costs. They were very willing to do this because they have identified that their greatest problem is overcoming the resistance of the general public against fuel cell technology.

Through their surveys, they have found that many people feel that the fuel cell vehicles are unsafe and always seem to reflect on the volatility of hydrogen. As a result,

they will be glad to partner with DOJ and hope that the relative stigmatism that a public police agency could bring instant credibility to their new vehicles.

The first steps to be taken during implementation would require a direct communication pathway to be established between the auto manufacturer and the department. This would probably require an expert assigned to the department as a troubleshooter to make sure the implementation stage maintains on track. This individual would be responsible to train department employees, help establish the initial fueling strategies, and maintenance schedules.

The transition of leadership is anticipated to be relatively minimal. Essentially, the program, as described, would not impact the leadership stakeholder unless the program completely failed and the vehicles were found not to lend themselves well to law enforcement usage. Politically, for the department's chief executive, the Attorney General, a failure of the program would be politically troubling. However, it is very likely that he will become a strong advocate and possibly structure his political reputation on using environmentally friendly technology.

It is anticipated that fuel cell vehicles will be available for distribution as proposed by 2009. With that time frame all identified barriers should be addressed and most stake-holders should be satisfied with the state of this technology. However, there are generally anticipated un-foreseen problems which may develop. That is why a keen sense of partnership must be established and maintained between the industry and the department. Initially, the program will need to establish a set of guidelines for evaluating success and direction. As in many programs that embrace new and evolving technology, the success of this program depends on changes. The technology is not in place for

simple restorative factors such as fueling stations; maintenance shops, parts stores, equipment adaptation for radios, sirens and red lights etc. The challenge will be to continually evaluate the department's needs and work directly with the manufacturers to define ways to short-cut and front-load unanticipated problems of tomorrow so we can demonstrate success in our future.

Summary

The industry's greatest challenge lies in the "acceptance of the public."¹⁶ Apparently, the industry of automobile manufacturers have identified these challenges and are directing strategies to overcome the buyer's bias against the radical new changes available. For instance, the new alternative fuel vehicles produced by Toyota and Honda utilize gasoline and batteries are termed as "gateway vehicles." They are much more efficient than gasoline vehicles and offer the "feel" of fuel cell vehicles.¹⁷

Law enforcement has the opportunity to provide automobile manufacturers the initial market for fuel cell vehicles. One of the greatest challenges faced by this industry is society's acceptance of different powered and different looking vehicles. Law enforcement could lead the way to acceptance. Citizens would see law enforcement agencies driving fuel cell vehicles on a daily basis. If that happens, the public will see the advantages and believe what they will be hearing during the automobile commercials;

¹⁶ Ibid.Eggerts

¹⁷ Ibid.

manufacturers are expected to promote fuel cell vehicles from every future form of media, news, movies, Internet and any public agency that is willing to take their offer.¹⁸

¹⁸ Ibid.Eggerts

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

The goal of this project has been to develop a methodology and establish a plan for a mid-size state law enforcement agency to become the first to adopt fuel cell vehicles and to utilize them for daily operations.

Fuel cells have become an important enabling technology for the hydrogen economy and have the potential to revolutionize the way the nation is powered, offering cleaner, more-efficient alternatives to the combustion of gasoline and other fossil fuels. In the future, law enforcement, along with other governmental agencies, will have to embrace this technology either by necessity or by choice. Current information says that there is a limited amount of fossil fuels. As a result, society may be forced to make the change sometime in the future because fossil fuel may not be available.

It is anticipated that the cost of fossil fuels will constantly rise as the fossil fuel resource diminishes. Our scientists have developed ample studies, which show that the combustion engine is bad for the environment and the health of our citizens.¹⁹ Manufacturers are developing fuel cell vehicles and vying for a partnership with government agencies to share their technology. As described in Chapter 2, a panel of subject matter experts worked together to determine and evaluate existing trends and possible events that might have an impact on the success of establishing fuel cell vehicles in a state law enforcement agency. The analysis of the trends and possible events yielded relative assurance that this program could be very effective providing it was implemented

¹⁹ Conversation with Anthony Eggerts, UC Davis Director of Fuel Cell Research Program...November 22, 2003

appropriately. Clearly, there are a number of issues that would have to be addressed for this program to be successful.

Chapter 3 focused on strategic planning which determined that DOJ would have to be almost completely supported by the automobile manufacturing industry. The individual stakeholders in all possible implementation scenarios would play a significant role in deciding which plan to implement. Plan number one was determined to be the most flexible for the department as well as the automobile manufacturer. It offers the most concise opportunity for the department as well as the industry to take the responsibility for the alternate fuel vehicles to succeed. With much of the support and challenges identified the department would be required to transition from the current status to the future.

The analysis of how DOJ could transition to a future was presented in Chapter 4. The first steps to be taken during implementation would require a direct communication pathway to be established between the auto manufacturer and the department. This would probably require an expert assigned to the department as a troubleshooter to make sure the implementation stage maintains on track. This individual would be responsible to train department employees, help establish the initial fueling strategies, and maintenance schedules.

The transition of leadership is anticipated to be relatively minimal. Essentially, the program would not impact the leadership stakeholder unless the program completely failed and the vehicles were found not to lend themselves well to law enforcement. Politically, for the department's chief executive, the Attorney General, a failure of the program would be politically troubling. However, it is very likely that he will become a

strong advocate and possibly structure his political reputation on using environmentally friendly technology. The industry's greatest challenge lies in the "acceptance of the public."²⁰

Apparently, the industry of automobile manufacturers have identified these challenges and are directing strategies to overcome the buyer's bias against the radical new changes available. For instance, the new alternative fuel vehicles produced by Toyota and Honda that utilize gasoline and batteries are termed as gateway vehicles. They are much more efficient than gasoline vehicles and offer the feel of fuel cell vehicles.²¹

Law enforcement has the opportunity to provide automobile manufacturers the initial market for fuel cell vehicles. One of the greatest challenges faced by this industry is society's acceptance of different powered and different looking vehicles. Law enforcement could lead the way to acceptance. Citizens would see law enforcement agencies driving fuel cell vehicles on a daily basis. If that happens the public will see the advantages and believe what they will be hearing during the automobile commercials; manufacturers are expected to promote fuel cell vehicles from every future form of media, news, movies, Internet and any public agency that is willing to take their offer.²²

²⁰ Ibid.Eggerts

²¹ Ibid.

²² Ibid.Eggerts

How Will DOJ Benefit by Driving Fuel Cell Vehicles?

Fuel cells are an important enabling technology for the hydrogen economy and have the potential to revolutionize the way the nation is powered, offering cleaner, more-efficient alternatives to the combustion of gasoline and other fossil fuels. In the future, law enforcement, along with other governmental agencies, will have to embrace this technology either by necessity or by choice. Current information says that there is a limited amount of fossil fuels. As a result, society may be forced to make the change sometime in the future because fossil fuel may not be available. It is anticipated that the cost of fossil fuels will constantly rise as the fossil fuel resource diminishes. And, of course, our scientists have developed ample studies, which show that the combustion engine is bad for the environment and the health of our citizens.²³

Manufacturers are developing fuel cell vehicles and vying for a partnership with government agencies to share their technology. They feel that they must overcome a hydrogen scare stigmatism with the general public and recognize that a partnership with a governmental agency will assist them in making fuel cell vehicles more popular. As such, many manufacturers are willing to fund vehicles, maintenance and support for an interim period while the technology catches on. The overall benefit for the Department of Justice, DOJ, to get involved at the forefront of this technology is that DOJ will be recognized as a leader and innovator. The department's budget will be augmented by companies like "Toyota"²⁴ and the vehicles also offer the flexibility of having one power

²³ Conversation with Anthony Eggerts, UC Davis Director of Fuel Cell Research Program...November 22, 2003

²⁴ Ibid.

unit with several different configurations. For instance, one power unit car frame could be coupled with a van body, a sedan body or even a pickup body.

DOJ has an opportunity to become one of the first governmental agencies to embrace fuel cell technology which will have a long term positive effect on our environment and offer tremendous flexibility for police operations.

BIBLIOGRAPHY

Calvert, Mike, Special Agent in Charge MSB, Interview, January 2, 2004

Eggerts, Anthony, Interview UC Davis Director of Fuel Cell Research, November 2003.

Phillis, Ron, Assistant Chief, MSB, December 22, 2003.

Staff Author, Technologies Institute, Fuel Cells 2000, Web page accessed January 6,

2004, at <http://www.fuelcells.org/>

Staff Author, General Motors, Designing Vehicles for the Future, Web page accessed on

January 6, 2004 at http://www.gm.com/company/gmability/adv_tech/400_fcv/

Tse, Lawrence and Bong, Duan, A Brief History of Fuel Web page, accessed January 6,

2004 at http://www.visionengineer.com/env/fc_history.shtml

U.S. Department of Energy web, accessed January 6, 2004, at

<http://www.fueleconomy.gov/feg/fuelcell.shtml>.

APPENDIX “A”

Nominal Group Technique

Trends and events discussed that were not used: The selection process was accomplished by utilizing the averaging methodology to decide which trends and events were utilized.

Trends:

Population change in California

Education change of citizens

Change in automobile collisions

Change in the number of elderly driving

Change of attitude toward law enforcement

Funding for UC research facilities

Funding for highway design

Roles of department shift

Climate change

Funding for DOJ

Events:

Department of Justice eliminated by Governor’s budget

Creation of Department of Public Safety

Terrorists attack state Capital

Hydrogen fuel station explodes

Hydrogen found to be too expensive

Containment of hydrogen in cars found to be very volatile

DOJ agents reassigned to CHP

Hydrogen production breakthrough by using electrolysis

Fuel cell cars cheaper than gasoline cars

The U.S. President buys first fuel cell car for his personal use

European Countries outlaw gasoline cars and use fuel cell cars

Sierra Club and other environmental groups combine

Global warming found to be exclusively caused by the burning of fossil fuel