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October 23, 1990

Transportation and Community Development
Sacramento, California

Honorable Members in Session:

**SUBJECT: CLEAN ALTERNATIVE FUELS PARTICIPATION AND PROJECTS - INFORMATIONAL REPORT**

## SUMMARY

The Fleet Management Division of the Department of General Services is presenting this informational report to provide an update and overview of the progress of clean alternative fuels. In addition to this report, a brief slide presentation of the various alternative fuels will also be shown when this report is heard by the Committee.

## BACKGROUND

The Fleet Management Division continues to monitor new technical developments and progress of vehicles which use or can use currently available alternative fuels. These vehicles and techniques are needed to address the air quality problems in the Sacramento region, as well as reducing our dependency on petroleum products. Significant progress is being made in the areas of alternative fueled light duty vehicles. Over the last year, the dedicated Methanol Ford Escorts given to the City by the State of California, have been driven in excess of 60,000 miles with relatively few problems. They have provided mechanical staff the ability to develop resources and techniques required to repair these vehicles. The Fleet Management Division received authorization from the City Council to purchase fuel flexible methanol vehicles and was directed to explore other forms of alternatively powered vehicles on July 10, 1990. (Fuel flexible means the vehicle is able to run on a mixture of 85% methanol/15% gasoline or up to 100% gasoline.) Five (5) fuel flexible methanol Ford Crown Victorias have been delivered to the City and are being placed in the City car pool. An additional five (5) Chevrolet Luminas have been ordered for use in specialized areas in the Fire Department and selected activities in the Police Department. The use of these vehicles will provide additional information and history on the use of methanol as an alternative fuel and its reduced exhaust emissions. Additional fuel flexible methanol vehicles and models will be made available by automobile manufacturers in higher quantities in 1991, with up to ten thousand of these vehicles being available by the 1993 model year.

In addition to the methanol fueled vehicles, Fleet Management has negotiated an agreement with Pacific Gas and Electric to convert two (2) Animal Control pickups and two (2) Parking Enforcement scooters to compressed natural gas (CNG). Pacific Gas and Electric has agreed to provide the CNG at one of their existing fuel facilities on Front Street. At this time we are waiting for a final proposal from Pacific Gas & Electric on installation times, cost to retrofit, and the pump price of the CNG.

General Motors has also announced that it will provide, on a limited basis, some factory produced, CNG fueled, 3/4 ton pickups in the 1991 model year. Fleet Management will stay abreast of the progress of these vehicles for placement in the City Fleet. Limited use of these vehicles will provide information on whether our concerns about the high costs and reliability of compression stations is valid, and if the higher NOx emmissions are within acceptable levels for our region.

The Fleet Management Division has also been working with the Sacramento Municipal Utility District and the Sacramento Air Quality Control District to investigate the feasibility of using electric vehicles for certain modes of transportation. We have solicited and received a proposal from Cushman Motors to provide a prototype electric Parking Enforcement unit; however, the range and speed at this time is not sufficient to meet Parking Controls requirements. In a further attempt to explore the use of battery operated vehicles in this low speed, stop and go environment, the Fleet Management Division solicited and received a proposal from an electric vehicle conversion company to retrofit an existing Parking Enforcement scooter. Their unit provides up to a 60 mile range and speeds in the 30 to 40 mile per hour range. Fleet Management hopes to finalize this conversion by January 1991.

In addition to these alternative fuel projects, Fleet Management has participated in numerous workshops and panels promoting the implementation of cleaner alternative fuels and low emission gasoline and diesel vehicles; worked on driver training and car pooling projects; promoted energy conservation measures to reduce energy consumption and air pollution caused by vehicles. The implementation of our emission testing program was structured to test all gasoline powered City vehicles at least once per year to assure that they meet the clean air standards. To maximize the energy resources available, the Fleet Management Division is in the process of preparing guidelines and energy saving tips for all City employees to increase the energy efficiency of their vehicles through better driving habits. We are also exploring car pooling for City employees and the use of City fuel flexible methanol Ford station wagons for car pooling efforts.

Also attached for your information is a paper on a presentation given at the American Public Works Association Congress and Equipment Show in September 1990.

**FINANCIAL DATA**

Funds for the purchase of vehicles or equipment relating to alternative fuels programs or pilot projects, will come from the approved Fleet Management Operating and Equipment Replacement Budget. Fleet Management will continue to seek out programs/projects that can also provide financial assistance.

**POLICY CONSIDERATIONS**

None.

**MBE/WBE EFFORTS**

No impact.

**RECOMMENDATION**

This report is for Committee information and requires no formal action.

Respectfully submitted,

Frank Mugartegui
Director of General Services

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November 6, 1990

Attachment

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LEGISLATIVE UPDATE

THE PRACTICAL APPLICATION OF ALTERNATIVE FUELS

Presented by

R.E. "Gene" Moore, Fleet Manager

City of Sacramento, California

at the

International Public Works Congress

and Equipment Show

St Louis, Missouri

September 11, 1990

Revised 9/25/90

I. Why Alternate Fuels?

A. Air Quality, Health and Environmental Issues

B. Energy Security - Decreasing Our Dependency on Foreign Imports

C. Economic Impacts

II. Operational Status of Alternate Fuel Technology

A. Light Duty Vehicles

1. Compressed Natural Gas Vehicles
2. Electric Vehicles
3. Propane Vehicles
4. Methanol Vehicles

B. Heavy Duty Vehicles

1. Buses
2. Trucks

III. Implementing Alternate Fuel Technology in a Fleet Environment

A. Participating in a Demonstration Program

B. Benefits for the Fleet Manager

C. Fuel Infrastructure

1. Availability and Cost

2. In-house Vs Commercial

IV. Future Considerations

## WHY ALTERNATE FUELS?

Alternate fuel technology is being explored and developed in order to address major air quality, environmental, health, and energy security issues. Air pollution is a fact of life for more than 100 million people in over one hundred cities throughout the United States. The biggest contributor to this urban pollution is the automobile. Overall, vehicle exhausts account for 66% of the country's total carbon monoxide pollution, 43% of its nitrogen oxides, and 34% of its hydrocarbons. 1

Even though pollution control devices on conventional fuel-burning vehicles have significantly reduced emissions over the past two decades, emissions are still a problem. The use of alternate fuels and vehicles could offer cities additional ways to fight air pollution.

In addition to improving air quality, diversification of fuel sources should ultimately improve energy security and reduce our vulnerability to oil supply disruptions and rapid price escalations. A good example of this would be the August, 1990 invasion of Kuwait by Iraq, and the resulting immediate jump in fuel prices. The added environmental benefit that alternate fuels generate less global warming than petroleum-based fuels reinforces the importance of developing an alternate fuel infrastructure.

An implementation plan for alternate fuels should not favor any particular alternative. Clearly, opportunities must be created for each alternate fuel to enter the market place, as each fuel offers a benefit to either air quality economics or energy security.

As currently developed, alternate fuel technologies have two extra costs - the extra cost of the vehicles and the extra cost of the fuel. Vehicles using propane, natural gas, and electricity tend to have higher initial costs. Propane and CNG vehicles currently need to be retrofitted, and require special tanks. Natural gas needs to be compressed to 3,000 psi and requires a special high pressure fueling station. Electric vehicles require batteries and related equipment which is still very expensive. However, in each case, the base fuel, and thus the energy used by these vehicles, is cheaper than gasoline.

## OPERATIONAL STATUS OF ALTERNATE FUEL TECHNOLOGY

### LIGHT DUTY VEHICLES

Compressed Natural Gas Vehicles: Reports of fleet users and suppliers describing their experiences with CNG have been contradictory. Some companies have committed themselves to expanding their test fleet of CNG vehicles due to encouraging preliminary results. Other companies have decided to curtail their involvement with this technology.

United Parcel Service (UPS) and the Union Gas Company of Brooklyn, New York have just completed a joint, two-year alternate fuel project using natural gas as a vehicle fuel in 10 UPS parcel delivery vehicles converted by Brooklyn Union. According to UPS, the natural gas vehicles offered a number of advantages: lower fuel cost; cleaner burning; safer fuel tanks, especially in an accident; and reduced vehicle maintenance.2

The disadvantage of CNG lies in the capital outlay for the compressor stations

and the vehicle conversions, approximately $1,500-$2,300 per vehicle, as vehicle manufacturers currently do not offer CNG vehicles as original equipment. In addition, CNG vehicles must make trade-offs between range, weight, cargo space, and performance.

A dual-fuel 1989 Buick LaSabre using advanced conversion technology was loaned to the California Energy Commission (CEC) by California gas utilities. CEC will begin its own demonstration of the use of compressed natural gas in light-duty vehicles this year. The demonstration will include up to 150 vehicles placed at about 10 sites.

Electric Vehicles: These vehicles are by far the cleanest of the clean-fuel vehicles options. Electric vehicles (EV'S) have virtually no emissions, and although this is offset to some degree by emissions from the electric power plants which provide energy for EV's, the overall net emissions appear to be extremely small. Analyses of Southern California test fleets have proven that electric vehicles, when substituted for gasoline-powered vehicles, have reduced the primary components of urban smog, nitrogen oxide and hydrocarbon, by 98% and 64% respectively.3

Earlier attempts to introduce electric vehicles in the 1960's and 1970's were unsuccessful because EV batteries and drivetrains were not sufficiently developed. EV technology has shown good progress in the last five years, with limited commercial fleet uses already developed, tested and ready for introduction. The more advanced technology is currently being developed.

The "G-Van", which was jointly developed by The Electric Power Research

Institute, Vehma International, Chloride EV Systems, and General Motors Corporation, with support from Southern California Edison Company, is the first American made, modern electric vehicle to be produced in volume and distributed through a nationwide network. It is based on the GM Griffon - a British-made electric van that has logged over seven million miles in fleets around the world. It has an improved lead-acid battery, a range of approximately 60 miles per charge, and a top speed of over 52 mph.

There are basically three "types" of electric vehicles; (1) the all-electric vehicle; (2) the electric vehicle with a range extender (similar to a Honda generator) which recharges the battery as it is driven; and (3) the hybrid electric vehicle. The hybrid uses electricity as one major fuel source, but also has an internal combustion engine to use when the electric charge is depleted, or when the vehicle is in non-urban areas. The California Energy Commission is funding the design and construction of a prototype hybrid electric vehicle. Additionally, the Commission, in cooperation with California electric utilities and local government agencies, is planning a demonstration of electric vehicles in local government fleets.

A necessary component for the success of the electric vehicle is an adequate resource supply. California currently enjoys a higher supply that demand for electricity. In addition, this demand fluctuates on a daily and annual basis. The utility companies are trying to convince customers to use electricity during "non-peak" or evening hours; and as an incentive, are offering lower prices during these time periods.

Electric vehicles could be fueled or "recharged" during the evening hours,

making this fuel source even more cost competitive. California's non-peak electricity supply was evaluated and determined to be able to support 5 million electric vehicles in the state for both the 1993 and 2000 time periods.4

The negative aspects of electric vehicles include their limited range, and the still-high cost of the current prototype vehicles. Added to this is the uncertainty of this technology's development, support infrastructure, and the general public's unfamiliarity the EV's.

Propane Vehicles: Liquid petroleum gas or propane has been used in vehicles since the early 1920's and currently powers almost 500,000 vehicles in the United States. Therefore, not only is there a substantial infrastructure in place, but the technologies for storing and dispensing LPG are advanced. Using a current price of approximately 55 cents per gallon for LPG. On the assumption that is takes around 1.6 gallons of propane to drive the same distance as with a gallon of diesel, actual fuel cost is 88 cents per equivalent gallon.

Propane does not burn as cleanly as CNG, but its emissions are well below current diesel emissions. Cost of storage tanks is less than for CNG or LNG and the combined weight of the tanks and the fuel for a given range is comparable to diesel.

The Los Angeles Times has been running a fleet of propane trucks since 1971 and has some engines which have gone 600,000 to 900,000 miles between overhauls.

If mishandled, it can be more dangerous that gasoline or diesel. Propane

vapors are heavier than air and tend to collect in low spots in explosive concentrations. Collisions that cause leaks might create dangerous situations quickly. The California Advisory Board on Air Quality and Fuels concluded that..."the potential risks of propane in widespread use need more study..."5

Propane vehicles must also be retrofitted, therefore negating manufacturer support or warranty. To begin to command a solid portion of the alternate vehicle market, this vehicle needs to be mass produced by the manufacturer and warranted.

Methanol Vehicles: A methanol vehicle seems to have the best potential for widespread use in the transportation sector. It is fundamentally the same as a gasoline car, and methanol is a liquid that fits reasonably well into our current liquid fuel economy.

The California Energy Commission (CEC) has been working with methanol fuel technology since the late 1970's. They began with demonstrations of low-level alcohol/gasoline blends in four unmodified Honda CVC's. Next, they had the engines and fuel systems in eight Ford Pintos converted to demonstrate neat methanol and ethanol fuels. In 1981, they started the first demonstration of new, factory designed cars to use neat methanol and ethanol - with 41 VW Rabbits and 40 Ford Escorts.

Parallel to this demonstration, cost studies were conducted for each fuel. These studies indicated that production of ethanol in California was no' cost-competitive with ethanol from the Midwest. The studies also indicated that ethanol was not cost-competitive with methanol.6

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In 1983, the CEC expanded its program further to place over 500 methanol Ford Escorts in public and private fleets throughout California. These were the first production run methanol fueled vehicles by a large American automobile manufacturer. At this point, available technology was limited or "dedicated" to operate only on methanol fuel. (Methanol fuel is composed of 85% methanol and 15% unleaded gasoline.) These vehicles have accumulated about 25 million miles in fleet service with not unusual operational difficulties.7

The current program that the CEC is implementing is the light-duty Fuel Flexible Vehicle Demonstration Program. Fuel flexible vehicles (FFV"s) will automatically adjust to operate on alcohol fuels or gasoline, or any combination of these fuels. The CEC's goal is to place 5,000 FFV's with government and private fleets throughout California by 1993.

FFV's will probably have an easier time gaining acceptance with the general public because of their capability of using any combination of methanol and gasoline. This will be particularly invaluable until the methanol infrastructure in solidly in place and methanol is widely distributed everywhere.

California has been operating fuel flexible vehicles since 1987, beginning with the Ford Crown Victoria. In 1990, 210 Ford Crown Victoria FFV's will be placed into service with government and private fleets in California. In December 1988, General Motors entered the program with Chevy Corsica variable fuel vehicle (VFV). At this time, where are 20 Corsica VFV's operating with fleets.

In the Fall of 1989, Nissan loaned the CEC its first FFV. In June, 1990, the CEC took possession of a Chrysler mini-van, referred to as a Gasoline Tolerant Vehicle (GTMV). This technology is being demonstrated in cooperation with the South Coast Air Quality Management District (SCAQMD), which is assisting Chrysler in its efforts.

Future demonstration programs planned by the, CEC include the Chevrolet Lumina VFV, slated for delivery in November 1990; the Ford Taurus FFV in the Spring of 1991; and the Volkswagen in 1991.

HEAVY-DUTY VEHICLES

Along with the demonstration of methanol in light-duty vehicles in 1983, the California Energy Commission began a demonstration of methanol in heavy-duty engines. In Marin County, California a General Motors/Detroit Diesel Corporation bus and a MAN transit bus are still in operation with the Golden Gate Transit District. These buses have each accumulated over 80,000 miles in revenue service and have demonstrated substantial reductions in particulates and NOX.

The early methanol buses experienced frequent failures of glow plugs and injectors. However, the technology has advanced rapidly and these problems appear to be solved.

The Southern California Rapid Transit District has over 30 buses in their fleet - new buses operating on methanol, new buses operating on compressed natural gas, and buses retrofitted to operate on methanol and AVOCET (an additive).

Another California transit district, Riverside Transit Agency, is operating 3 methanol buses as part of their fleet.

The largest of the California Energy Commission's vehicle demonstration fleets is the School Bus Demonstration Program. It is funded by $100 million dollars in California Petroleum Violation Escrow Account dollars, and is designed to replace up to 1,000 of California's oldest school buses with safe, efficient, and cleaner buses.

Phase I of this demonstration will place 50 methanol, 10 compressed natural gas and 103 advanced diesel buses with up to 15 California school districts this year. Phase II, expected to get underway this year, will place up to 400 additional buses throughout California by 1992. The final phase, Phase III, will provide additional buses for fleets throughout California.

Based on the results of the earlier bus demonstrations, the Energy Commission began a demonstration of methanol in heavy-duty trucks. In the Los Angeles Basin, the South Coast Air Quality Management District and the California Energy Commission are currently spending $2.4 million dollars annually on heavy duty alternative fuels demonstration projects. Most of the experiment involves methanol-powered vehicles. In an effort to demonstrate the feasibility of different fuels and to gain information about the economics, emissions, and maintenance aspects, the Commission pays for the engines, installation, technical support, record keeping, and part of the installation of the fueling facilities.

To meet the 1993 mandated emission standards for heavy duty diesel vehicles,

engine manufacturers are researching several options: current engines with particulate traps, straight diesels with combustion improvements, and alternative fuels for local driving. Many manufacturers are working to develop "clean diesel" that will meet or exceed the emission standards for 1993 and beyond.

Chevron has just introduced a reformulated diesel fuel that reduces exhaust emissions enough to meet the EPA 1993 requirements. The new fuel is called Chevron Special Diesel and it can be used by all diesel vehicles. In addition to improving emissions, it enhances certain aspects of vehicle performance such as easier engine starting and smoother and quieter running. The new fuel costs approximately 2 cents more a gallon and is available at 70 retail and 3 terminal locations in the Los Angeles Basin - a region identified as having the nation's worst air quality problem.8

Currently, there are several heavy-duty, alternate fuel demonstration programs in progress throughout the United States and Canada with manufacturers such as Cummins, Caterpiller, International, Detroit Diesel Corporation, and Ford. The applications include refuse hauling, longhaul flatbed, dump trucks, local tractor-trailer, beverage distribution, utility line trucks, and intercity tractor tankers. The fuels being tested include compressed natural gas, liquefied natural gas, liquefied petroleum gas, methanol, and combinations or blends of one or more of these technologies.

During the next twenty years, methanol, ethanol, CNG, LNG, propane, reformulated gasoline and clean diesel will all play a role in the heavy duty engine alternate fuel arena. As with the light duty vehicles, the successful

alternate fuel will be the one that is adaptable to user demands, is reliable, cost effective and truly leads to cleaner air.

## IMPLEMENTING ALTERNATE FUEL TECHNOLOGY IN A FLEET ENVIRONMENT

Introducing alternate fuel vehicles into a fleet environment demonstration program appears to be the most effective way to encourage auto manufacturers to produce these vehicles. Demonstration programs can address the problem of air pollution, allow time for adequate fueling infrastructures to be developed, and provide vital experience and data so critical to the advancement of alternate fuels.

Participating in a demonstration program benefits the fleet manager in several ways. Not only is he obtaining alternate fuel vehicles at the lowest possible cost, but his is also assured that the FFV's are covered by a manufacturer's new vehicle warranty comparable to warranties covering conventional gasoline-powered vehicles.

In California, the Energy Commission is also providing ongoing technical assistance to participating fleets for the duration of the program. In the situation where vehicle manufacturer or fuel supplier support cannot satisfy problems for the fleet manager, the Energy Commission has agreed to provide CEC staff and methanol technical support contractor services to resolve methanol-related problems.

The Energy Commission has also agreed to provide a methanol fuel station network. To support the increasing number of methanol vehicles, the Commission

has entered into public-private partnerships with several major oil companies. The first of these companies was ARCO. Soon after, Chevron joined the demonstration, followed by Shell, Mobil and Exxon.

In these partnerships, the Energy Commission purchased the necessary equipment, and the oil company agreed to establish a pump at public fueling facilities and operate that pump for a minimum of 10 years. The Commission expects to have 50 methanol fueling facilities with these companies by the end of 1991. These facilities will be vital if the FFV program is to expand beyond the public fleet arena to the general public.

In addition to providing a network of fueling stations throughout California, CEC established the California Fuel Methanol Reserve. The purpose of the Reserve is to provide an adequate supply of methanol at a reasonable cost. The Reserve includes 4 methanol producers, guaranteeing 8 million gallons of methanol fuel. The price of methanol through the Reserve is currently $.43 gallon, FOB terminal.9 Terminals are located in Richmond in Northern California and in San Pedro in Southern California.

If a fleet manager in the California demonstration program elected to install and operate his own methanol fuel storage and dispensing system, then he could join the California Methanol Fuel Reserve. This would provide him with consistent access to methanol fuel of known quality at favorable and stable prices. In the process of upgrading its underground storage tanks, the City of Sacramento insured that these tanks were "methanol compatible" in order to provide for future storing and dispensing of methanol fuel.

In conclusion, it is clear that several events need to occur before alternate fuel vehicles are produced and sold in large numbers. Government should insist upon and support the research and development of alternate fuel technology. In addition, government and private fleet operators need to be provided with incentives to enter into demonstration programs and to place large purchase orders for alternate-fueled vehicles with auto manufacturers. These demonstration programs will provide the experience and data that are so vitally needed to advance commercially attractive alternative fuel technologies.

FOOTNOTES

1. Canon, "Alternative Transportation Fuels Fight Urban pollution",p.15.

2. Deierlein, "Alternate Fuels: The Current Status",p. 32.

3. Los Angeles Department of Water and Power. Going Electric,p. 2.

4. California Energy Commission, AB 234 Report,p. 14.

5. California Advisory Board on Air Quality and Fuels - Executive Summary,p. 14.

6. California Energy Commission Transportation and Fuels Office.

7. Ibid.

8. Go West, "Product Focus",p. 74.

9. California Energy Commission Transportation and Fuels Office.

ACKNOWLEDGEMENTS

This report was prepared by Virginia Henry, Administrative Analyst with the City of Sacramento.

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Mr. Peter Cipolla, Regional Transit Chief Operations Officer, to give an oral report regarding Regional Transit Use of Alternative Fuels.