1 of 2

URBAN CONSORTIUM YEAR 13

SUBMITTED BY:

THE CITY OF SAN DIEGO
OFFICE OF THE CITY MANAGER
GENERAL SERVICES DEPARTMENT
202 C STREET SUITE 11B
SAN DIEGO , CA 92101

PROJECT TITLE:

CALIFORNIA CLEAN AIR ACT - A COMPLIANCE STRATEGY FOR THE
CITY OF SAN DIEGO'S NON-EMERGENCY FLEET

UNIT:

TRANSPORTATION

PROJECT DIRECTOR:

TOMAS V. CARLOS
GENERAL SERVICES DEPARTMENT
EQUIPMENT DIVISION, DEPUTY DIRECTOR
2740 CAMINITO CHOLLAS, MS 42
SAN DIEGO, CA 92105
(619) 527-7560

PROJECT MANAGER:

ROBIN CURRIE
GENERAL SERVICES DEPARTMENT
2740 CAMINITO CHOLLAS, MS 42
SAN DIEGO, CA 92105
(619) 527-7558

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

PREFACE

1992 Urban Consortium Energy Task Force Publications

With staff, management, and business services provided by PTI, the Urban Consortium (UC) addresses the critical needs of large local governments through 3 task forces: Energy, Environment, and Telecommunications and Information. The Urban Consortium Energy Task (UCETF) was set up with the main objective to improve urban energy management and decision-making through applied research and technology transfer.

The UCETF focuses on developing and sharing new approaches and innovative solutions to energy management problems with local governments. Projects are organized in thematic units and co-managed by a member of the Task Force.

A description of the Units and projects included in the 1992 program are as follows:

ENERGY, ENVIRONMENT, ECONOMIC AND SOCIAL DEVELOPMENT

"Sustainability" is a planning goal to provide an integrative systems approach to meeting all our needs for today and tomorrow. Evaluating the needs of citizens and developing effective and efficient ways to meet those needs is a primary responsibility of local governments. Cities and counties are currently beset by a wide range of problems that in fact are symptoms of some common and pervasive ills. Our problems with energy, environment, economic and social development are related in a complex and interdependent way. These problems, therefore, cannot be effectively solved through a piecemeal approach without recognizing and addressing the interdependent relationships between these areas. The 1992 Energy, Environment, Economic and Social Development consist of:

Dade County, FL — A Long Term Urban Carbon Dioxide Emission Reduction Program

Pima County, AZ — Sustainable Community Implementation Partnership

Portland, OR — Sustainable Business Development Program

San Jose, CA — Negotiating a Demand Side Bid: The City of San Jose Case Study

San Jose, CA — "Green Aisle" Research Program

Santa Clara, CA — Fuel Cell Demonstration Partnership Program

Austin, TX — Sustainable Building Sourcebook

Chicago, IL — Downtown District Cooling: A 21st Century Approach

Chicago, IL — Role of Municipal Governments in the Design and Implementation of Energy Efficiency Codes and Standards Designed to Capture Lost Efficiency Opportunities

Seattle, WA — Coordination of Energy and Air Quality (CEAM)

St. Louis, MO — Earthways Home Project: An Educational Center for Sustainable Urban Development

Tucson, AZ — Minority Marketing for Resource Conservation

Washington, DC — Energy Auditor Training Course for High School Students

ENERGY EFFICIENT FACILITIES

Activities involving energy efficient facilities are part of a national effort to achieve maximum cost-effective energy productivity in the building sector. New technologies and management/administration practices to advance energy efficiency in facilities require major partnership efforts and transfer programs. Multifamily housing that has a large concentration of low-income families presents a unique challenge to lowering energy costs and maintaining energy efficient facilities. Both existing building stock and near-term new construction need to be made much more energy efficient if we are to meet local, state, and national objectives related to energy security, energy supply, and energy affordability. Space heating and cooling, lighting, water heating, refrigeration, cooking, ventilation, building envelope, energy efficient codes implementation, operation and maintenance (O&M), education, etc. are areas where opportunities exist to improve energy efficiency. The 1992 Energy Efficient Facilities Unit consists of:

Boston, MA — Energy Efficiency Outreach Partnership

Columbus, OH — Integrating Operations and Maintenance (O&M) for Energy Efficiency with O&M for Improving Indoor Air Quality

Hennepin County, MN — Integrated Rehab and Weatherization Program for Low Income Suburban Homeowners

Memphis, TN — Upgrade Energy Building Standards and Develop Rating System for Existing Low-Income Housing

New Orleans, LA — Utilization of Energy Efficiency to Support Homeownership Affordability

Detroit, MI — Energy Optimization of Water Distribution System

Montgomery County, MD — CFC Maintenance and Conversions in Chillers: The Commercial Building Response to the 1990 Clean Air Act

New York City, NY — Development of an Energy Services Corporation

Phoenix, AZ — Solar Cooling Demonstration Project

San Francisco — Energy Management Action Plan (EMAP)

TRANSPORTATION

It is frequently said that the goal of transportation strategies should be moving people, not vehicles. But in the day and age of satellite networks, cellular phones, and personal computers, we can redefine transportation as access to goods, services, and information to meet the needs of local governments and their citizens. Alternative transportation fuels are still a major piece in a very large and complex puzzle facing local governments that includes wide-reaching concerns about transportation. There are many factors related to transportation that affect local governments: increasing congestion, crumbling infrastructure of roads and bridges, unchecked urban/suburban sprawl, and the increased "paving over" of our communities that leads to urban heat islands. Federal, state, and urban governments each share in the responsibility and must play a role in providing a sustainable and multi-faceted transportation system that is based on comprehensive and integrated planning at all levels. The 1992 Transportation unit consists of:

Houston, TX — Public/Private Partnership to Identify Barriers & Provide Solutions to Implement Large Scale Fleet Natural Gas Vehicle Utilization

in Ozone Non-attainment Areas

New York City, NY — Energy and Economic Implications of Transportation Demand Management Strategies

Pittsburgh, PA — Natural Gas Infrastructure Development

Seattle, WA — Telecommuting for City Employees

Albuquerque, NM — A Fully Integrated Multi-Fuels Service Stations

Denver, CO — Technical Comparison Between Hythane (H₂/CNG) and CNG Fueled Vehicles

Las Vegas, NV — Reduction of Diesel Exhaust Emissions in Urban Mass Transit Vehicles with Alcohol Injection Systems

San Diego City, CA — California Clean Air Act - A Compliance Strategy for the City of San Diego's Non-Emergency Fleet

Reports from each of these research projects, including this report, are specifically designed to aid the transfer of proven experience to other local governments. Readers interested in obtaining additional reports or further information about the Urban Consortium Energy Task Force should contact:

**Energy R,D&C Program
Public Technology, Inc.
1301 Pennsylvania Avenue, NW
Suite 800
Washington, DC 20004**

**Tel: 1-800/852-4934 or
202/626-2400**

Fax: 202/626-2498

TABLE OF CONTENTS

CHAPTER 1 -- OVERVIEW	1
ABSTRACT	1
PROJECT PURPOSE	3
REPORT ORGANIZATION	3
CHAPTER 2 -- GENERAL BACKGROUND	5
VEHICLE ACQUISITION STRATEGY	5
Funding Vehicle Purchases	5
Time Frame For Acquiring Low Emission Fleet	6
CALIFORNIA CLEAN AIR ACT OVERVIEW	7
Reformulated Gasoline	8
Low Emission Vehicles Element	9
Clean Fuels Element	12
Program Rationale and Associated Costs	14
State Ambient Air Quality Standards	15
Transportation Control Measures	18
AB2766 Rideshare Project Proposal to Local APCD	21
EPA Fleet Credit Rules and TCM Exemptions	24
OTHER LEGISLATION IMPACTING FLEET OPERATION	25
Heavy Duty Vehicle Smoke and Tampering Inspection Program	25
Assembly Bill No. 2783	26
CHAPTER 3 -- FLEET CHARACTERISTICS	27
FLEET CLASSIFICATION METHODOLOGY	27
EMISSIONS PROFILE	29
FUTURE GROWTH	34
NEW APPLICATION REQUIREMENTS	34
CHAPTER 4 -- LOW EMISSION FLEET COST	35
COSTS OF EMISSION REDUCTIONS	35
FUELING CONSIDERATIONS	36
Clean Fuel Costs.	36
Costs to Retail Station Operators	38
Current Equipment Division Fueling Site Capabilities	38
Development of On-Site CNG Fill Stations.	39
Consideration of the Fuel Maker Option for CNG Fleet Support as an Interim Strategy	40
California Gasoline Reformulation - Phase I - Oxygenated Fuels	41
Reformulated Gasoline - Phase II	44
Diesel Fuel	45
PURCHASE OF DIESEL FUELED VEHICLES MEETING CCAA CERTIFICATION	47

TABLE OF CONTENTS

CHAPTER 4 -- LOW EMISSION FLEET COST (Cont'd)

OVERALL PROGRAM COSTS.	48
COST EFFECTIVENESS	49
MAINTENANCE COSTS.	49
TAXING DILEMMA	50
TAX INCENTIVES	52

CHAPTER 5 -- LOW EMISSION FLEET PERFORMANCE 54

FUEL REFORMULATION AND IMPACT ON PERFORMANCE	57
HEAVY DUTY DIESEL-DERIVED NATURAL GAS ENGINE AVAILABILITY	59

CHAPTER 6 -- STRATEGIES FOR ACQUIRING A LOW EMISSION FLEET. . 60

METHANOL VEHICLES.	61
VEHICLE CONVERSIONS.	62
CALIFORNIA ENERGY COMMISSION DEMONSTRATION PROGRAM . . .	63
INTERACTION WITH LOCAL UTILITY/SDG&E	64
FUELING CONSIDERATIONS	66
TRAINING	66
PARTICIPATION HESITATION	69
CNG SAFETY ISSUES.	69
POLITICS	70

CHAPTER 7 -- SUMMARY. 72

ADDENDUM #1	CATALOG CUT BMW ELECTRIC PROTOTYPE VEHICLE	
ADDENDUM #2	RIDESHARING POSTER	
ADDENDUM #3	USAGE AND ASSIGNMENT RATES FOR FY 93	
ADDENDUM #4	CARB MOBILE SOURCE EMISSION STANDARD SUMMARY	
ADDENDUM #5	CEC-THE CALIFORNIA OXYGENATE REPORT NOTICE OF AVAILABILITY	
ADDENDUM #6	SCENARIO COST EFFECTIVENESS OF PROPOSAL TABLES	
ADDENDUM #7	CARB APPROVED FUEL CONVERSION SYSTEM	
ADDENDUM #8	KG 5000 CARB EMISSION TEST COMPARISONS	

TABLES

TABLE #	DESCRIPTION	PAGE #
1	Certification Categories For Low Emission Vehicle Element, California Clean Air Act	10
2	1994 Passenger Car Certification Standard (g/mi) Operating On Gasoline ¹	10
3	NMOG Standard (g/mi) for Flexible-and Dual -Fueled Passenger Cars when Operating on an Alternate Fuel and Gasoline at 50,000 Miles	11
4	Potential Emissions Reductions.	15
5	Current and Future Light-Duty Exhaust Emission Standards	17
6	Annual Minimum Average Vehicle Ridership (AVR) Targets	19
7	City of San Diego Classification Table.	28
8	Mobile Source Emission Survey Light and Medium Duty Vehicles	31
9	Mobile Source Emission Survey Waste Management Department, Heavy Duty Trucks	32
10	Mobile Source Emission Survey Heavy Duty Vehicles	33
11	Estimates of Retail, Public Refueling Fuel Prices in \$ Per Gallon - Years 1995 and 2002.	37
12	Capitol Cost to Equip a Gasoline Station As a Clean Fuel Retail Outlet.	38
13	Gasoline Specification Schedule of Implementation.	42
14	Cost Impact on Diesel Fleet Replacement 1995/97.	48
15	Current CNG Vehicles Service Record	56
16	Non-Emergency Fleet Replacement Schedule by Class.	60

CHAPTER 1 -- OVERVIEW

ABSTRACT

Historically, parts of California have had the worst air quality in the nation. The California Energy Commission began experimenting with alternate fuels in the 1970's in an effort to reduce harmful automobile emissions and hence, improve air quality. It is recognized that the costs to California which result from our air quality problems are immense. Ten to twenty billion dollars each year is the estimated damage in terms of health impacts, materials damages, lost agricultural crop output and forest damages. As the California population increases and health care costs escalate, the total monetary damages from air pollution will increase. The California Energy Commission goal to improve air quality became a mandate in 1988 with the passage of the California Clean Air Act (CCAA).

The CCAA requires a revised air quality strategy for the San Diego district since we do not meet State air quality standards for smog, carbon monoxide and nitrogen dioxide. Smog remains San Diego's major air quality problem, even though the annual number of days each year over the Federal standard has been reduced by 55 percent in the past ten years. Ten years ago about two-thirds of San Diego's smog was transported from Los Angeles. Today more than 60 per cent of the days San Diego exceeds the State standard are from locally generated smog. It is estimated that 57% of the reactive hydrocarbon emissions (which react with nitrogen dioxide in the presence of sunlight to form smog) is from cars, trucks and buses. The Air Pollution Control District (part of the County of San Diego) is the office that the Air Resources Board has put in charge of creating regulations and designing strategy to reduce polluting emissions.

The purpose of this project is to determine the full cost of acquiring and operating a municipal fleet which meets the mandates of the California Clean Air Act. With that information, a plan to meet the Clean Air Act (CCAA) requirements, which is both fiscally and environmentally sound, can be formulated by local government.

The California Clean Air Act (CCAA) requires manufacturers and fuel distributors to sell low emission vehicles and fuels. A low emission vehicle is a vehicle that has been certified by the Air Resources Board to meet one of four sets of exhaust emission standards. The budget and service delivery impacts of those requirements on fleet operators are not specifically known at this time. Those impacts must be identified, researched and developed into a coherent format so that local policy makers have a solid basis for making informed budget and service level decisions.

Even though the onus of compliance falls on the vehicle manufacturer or fuel supplier, local governments will face the associated higher costs. Escalating fleet maintenance and replacement costs alone, are a constant challenge for local governments. In addition, these rules may radically change the make-up and performance characteristics of municipal fleets.

A well planned approach to acquiring and operating a fleet of low emission vehicles ensures that the citizens of San Diego would have no interruption or decrease in municipal service delivery. Air quality in the entire region would benefit by reduced emissions from the municipal fleet.

PROJECT PURPOSE

The purpose of this project is threefold:

- A. To develop a long term budget strategy for acquiring a fleet of low emission vehicles.
- B. To identify and quantify vehicle acquisition and capital costs required by a low emission fleet.
- C. To reduce harmful emissions produced by City vehicles.

REPORT ORGANIZATION

This report has a total of seven chapters which covers the following topics:

Chapter 1 -- Overview

This is the introductory chapter that contains the Abstract, Project Purpose and Report Organization.

Chapter 2 -- General Background

This chapter will describe the existing vehicle acquisition strategy. An overview of the CCAA as well as other legislation that impacts the fleet will be included. This will establish the time frame for acquiring the low emission fleet.

Chapter 3 -- Fleet Characteristics

This chapter will outline existing fleet application and emissions profile. Future growth and new application requirements will also be discussed.

Chapter 4 -- Low Emission Fleet Cost

This chapter will discuss the economic cost of acquiring, operating, and maintaining a low emission fleet using available data from manufacturers, or when necessary from local vendor interaction.

Chapter 5 -- Low Emission Fleet Performance

This chapter will look at the potential of low emission fleets in accomplishing the intended goal of emission reduction.

Chapter 6 -- Low Emission Fleet Acquisition Strategy

This chapter will include a discussion of the strategies developed by the City for acquiring and operating a low emission fleet.

Chapter 7 -- Summary

This chapter will summarize and evaluate the results of the approach taken during the research project. This information will help other jurisdictions to formulate their own strategy for reducing emission levels in their own fleet.

Chapter 2

GENERAL BACKGROUND

This chapter will describe the existing vehicle acquisition strategy, and an overview of the CCAA. This information will establish the time frame for acquiring the low emission fleet.

VEHICLE ACQUISITION STRATEGY

The Equipment Division operates like other motive equipment leasing firms. The equipment is owned by the division and leased to other divisions. Usage rates (an hour or mileage charge) recover operation and maintenance costs. Annual assignment charges, flat fees collected bi-weekly, collect replacement costs which are based on the anticipated purchase prices at time of replacement. A forecasted inflator for Consumer Expenditures for Motor Vehicles and Parts as provided by the DRI/McGraw-Hill publication entitled **Review of the U.S. Economy** is used to factor the anticipated purchase price at the time of scheduled replacement.

Funding Vehicles Purchase

The Equipment Division has three funds. The operating fund (50030) is for the maintenance, repair, and operation of the City Fleet. The capitalization fund (50031) collects what is referred to as "assignment charges" for equipment replacement. A third fund (50033) collects money for additional or "unlike" vehicle replacements incorporated into

the existing fleet.

Instead of factoring in replacement costs that are not readily available for the "clean air" vehicles, the City created "reserves" with monies that were left unexpended in our operating fund at the end of each fiscal year. We reached agreement with the City Auditor that unexpended funds would be placed in reserve to offset the anticipated cost increases for purchasing vehicles meeting the mandates of the California Clean Air Act. To date, there are reserves for Conversion to Alternate Fuel in the amount of \$1,200,000 and \$200,000 for meeting Emission Standards.

Time Frame For Acquiring The Low Emission Fleet

The City of San Diego replaces 14% of its non-emergency fleet annually for an average replacement program cost of \$6,000,000. The City's Equipment Division will pay close attention to the availability of vehicles meeting the certification standards outlined in the CCAA. It will write vehicle specifications in order to ensure bids from vendors offering vehicles meeting the certification standards of LEV, ULEV etc. Maintaining the current level of replacement, it is estimated that the fleet will accommodate the CCAA certification requirements by the year 2000. (See Chapter Six, Table 16 - Non-Emergency Fleet Replacement Schedule By Class.)

OVERVIEW OF THE CALIFORNIA CLEAN AIR ACT

The California Clean Air Act (CCAA) was passed in 1988. It directed the California Air Resources Board (CARB) to achieve the maximum degree of emissions reductions possible from all mobile sources in order to meet the State ambient air quality standards. To meet these standards, the CCAA requires the CARB to take actions which are necessary, cost-effective, and technologically feasible. The required reduction in emissions is 55% for reactive organic gases (ROG), and 15% for oxides of nitrogen (NOx) from vehicles. A 1987 emissions inventory is used as the baseline year for comparison. CARB is also required to take actions to achieve the maximum feasible reductions for particulate matter, carbon dioxide, and toxic air contaminants from vehicular sources.

To accomplish these goals the CARB program has three elements; one, **reformulated gasoline**, to address the existing fleet, and two, introduction of **low emission vehicles** by original equipment manufacturers. If those low emission vehicles require fuels other than gasoline, fuel distributors will be required to sell those fuels.

The third element requires local air pollution control districts to adopt, implement and enforce **transportation control measures** (TCMs) to reduce emissions from mobile sources. They must also develop a plan for further reductions from stationary sources. For the purpose of this report, reformulated gasoline and the introduction of low

emission vehicles portions of the CCAA and how each impacts the City of San Diego's Non-Emergency Fleet will be discussed. A limited discussion on the impact of transportation control measures will also be provided.

Reformulated Gasoline

New gasoline specifications designed to reduce emissions from the existing fleet (pre-1994 model year) and also assist vehicle manufacturers in meeting future emission standards is the underlying approach used by the California Air Resources Board (CARB). These specifications will be introduced in two phases. Phase I eliminates leaded gasoline and provides new specifications for Reid Vapor Pressure (RVP), detergents and deposit control additives. RVP will be lowered to 7.8 psi during the smog control season, which is generally May through September. All gasoline sold in California after January 1, 1992 is required to meet these specifications.

California's more stringent requirements for reformulated fuels go into effect in 1992 for Phase I. The Phase II requirements are more restrictive regarding blend composition in 1996 than the Federal Environmental Protection Agency (EPA) requirements for the period 1995-2000.

Phase II specifications will take effect in the 1995-1996 time frame. This will give CARB and the gasoline producers time to test and develop ideas which will achieve the goal of meeting or exceeding Federal Clean Air Act standards. They are currently studying the effect of oxygenates on exhaust emissions and content limits of

aromatic hydrocarbons, olefin and benzene. Research, development and plant equipment costs will have significant impact on the price of Phase II gasoline. Cost impact of reformulated gasoline is discussed in Chapter 4.

Low Emission Vehicles Element

To further reduce motor vehicle emissions, CARB has developed a program which establishes new, stringent vehicle exhaust emission standards, the Low Emission Vehicles Element. Compliance will require advanced emission control technology. It is assumed, but not required, that vehicle manufacturers will use cleaner burning fuels to meet those tough emission standards. The Clean Fuels Element is proposed to meet that assumed need. This integrated approach was designed to provide flexibility and encourage the vehicle and fuel industries to work together.

This program will require the production of vehicles whose emissions are dramatically lower than any existing gasoline fueled vehicle. Again, it should be noted that a low emission vehicle is a vehicle that has been certified by the Air Resources Board to meet one of four sets of exhaust emission standards. The standards for a low emission vehicle are in order of increasing stringency and have four categories as shown on Table 1, page 10.

Transitional Low Emission Vehicles (TLEVs)
Low Emission Vehicles (LEVs)
Ultra Low Emission Vehicles (ULEVs)
Zero Emission Vehicles (ZEVs)

TABLE 1. Certification Categories For Low Emission Vehicle Element, California Clean Air Act.

Emissions standards for these categories differ from current standards in that they consider the vehicle and fuel systems to be component parts of a single system. They are also "reactivity adjusted" which means the low ozone-forming potential of cleaner fuels is recognized. Hydrocarbon standards are looked at in terms of ozone-forming potential rather than actual quantity. Because of this CARB has developed a Non-Methane Organic Gas (NMOG) standard as well as Carbon Monoxide (CO) and Oxides of Nitrogen (NOx) standards. The 50,000 mile certification standards (g/mi) for passenger cars operating on gasoline for 1994 are found on Table 2.

CATEGORY	NMOG	CO	NOx
Existing Standard	0.25	3.4	0.4
TLEV	0.125	3.4	0.4
LEV	0.075	3.4	0.2
ULEV	0.040	1.7	0.2

TABLE 2. 1994 Passenger Car Certification Standard (g/mi) Operating On Gasoline ¹

For vehicles operating on a fuel other than gasoline the NMOG emissions would be reactivity adjusted. In the case of flexible or dual-fueled vehicles the NMOG standard would also be adjusted.

CATEGORY	ALTERNATE FUEL*	GASOLINE
TLEV	0.125	0.25
LEV	0.075	0.125
ULEV	0.040	0.075

*BEFORE REACTIVITY ADJUSTMENT.

TABLE 3. NMOG Standards (g/mi) for Flexible-and Dual-Fueled Passenger Cars When Operating on an Alternate Fuel and Gasoline at 50,000 Miles²

Beginning with the 1994 model year, vehicle manufacturers will be required to certify portions of their sales fleet to TLEV, LEV, ULEV, or ZEV standards in order to meet an overall fleet standard. To meet that fleet standard they may produce any mix of conventional or alternatively fueled low emission vehicles (TLEVs, LEVs, ULEVs, ZEVs). Emissions averaging will be allowed among the vehicle categories to give the manufacturers some flexibility. The only mandatory production requirement begins in 1998 in the ZEV category, with a 2 percent yearly production figure. That requirement increases to 5 percent yearly in 2001 and then 10 percent in 2003.

The intention of the California Air Resources Board in mandating these strict emission standards is to push

technology, a strategy that has worked well for them in the past. They believe their emissions standards for TLEVs, LEVs, and ULEVs to be achievable with the use of advanced emission control technology alone. They imply that technology, not cleaner burning fuels is the most reliable approach for controlling emissions. CARB also believes that they have given adequate lead time for the development of electric powered ZEVs, given the state of current technology. Prototype electric vehicles are now in development by several large vehicle manufacturers. (See addendum #1.)

It should be understood that although CARB has mandated vehicle manufacturers to make part of their sales fleet TLEV, LEV, ULEV or ZEV, there is no mandate in the California Clean Air Act that fleet operators purchase these low emission vehicles. However, it should be noted that both the Senate and House versions of the National Energy Bill do include mandated percentage purchase requirements for municipal fleets beginning in 1998.

Clean Fuels Element

This element was designed to ensure that the fuels which manufacturers use to certify their low emission vehicles are readily available to the consumer. It is also assumed that many of the low emission vehicles will be dual-fueled. Those vehicles will be operated on gasoline if the cleaner burning fuel is not as easily available or competitively priced. To promote alternative fuel use, CARB is requiring gasoline suppliers to distribute minimum assigned volumes of each

cleaner fuel over a calendar quarter. "Distributed" means the gasoline supplier has moved the fuel into the wholesale marketing system.

The Clean Fuels Element also sets up a transferable credit system designed to give distributors some flexibility. Retail outlets will be required to provide infrastructure and make available for sale an adequate supply of certified cleaner fuels. They will be required to keep records for enforcement purposes. CARB will be responsible for determining the minimum volumes of each clean fuel to be distributed quarterly, overseeing the use of credits, develop specifications for cleaner fuels, and develop non-compliance penalties.

CARB considers the following fuels to be the clean fuels that vehicle manufacturers will use to certify their low emission vehicles:

- Methanol (M100, M85)
- Ethanol (as blended)
- Liquified Petroleum Gas (LPG)
- Compressed Natural Gas (CNG)
- Electricity

Except for electricity and CNG, these fuels will be subject to the clean fuel distribution requirements. All other requirements of the Clean Fuels Element would not be triggered until the projected number of vehicles are certified to that fuel. Electricity and CNG were omitted because they are distributed through regulated utilities.

Recently there has been a legal challenge filed against the California Air Resources Board over a regulation concerning Methanol M85 fuel. Apparently, a regulation adopted by the board on November 14, 1991, allows vehicles operating on M85, a blend of 85 percent methanol and 15 percent gasoline, to emit more pollutants than similar vehicles operating on gasoline. The Western States Petroleum Association (WSPA) an organization representing approximately 40 oil and gas companies, maintains that CARB's action mistakenly conveys the impression that M85 is an environmentally superior fuel and claims the regulation would worsen, not improve, air quality in the South Coast Air Basin and throughout the State. CARB representatives say the regulation will lead to improved emissions from alternative-fuel vehicles. However, a CARB spokesperson acknowledged that uncertainties in its work will require the agency to revise these regulations every three years.³

Program Rationale and Associated Costs

CARB adopted this approach because they feel it will satisfy their goal of air quality improvements at low monetary, safety and environmental costs.

Statewide emissions from on-road mobile sources (light and medium duty vehicles) would be reduced by about 29 tons per day of NMOG and 36 tons per day of NO_x in 2000. By 2010, NMOG emissions would be reduced by 185 tons per day and NO_x emissions by 248 tons per day. These reductions in 2010 represent 28 percent of on-road vehicular NMOG emissions and 18 percent of on-road vehicular NO_x.

Using 1987 as the baseline year, the potential reduction in statewide emissions from mobile sources expected from all CARB emission regulations is as follows:

POTENTIAL EMISSION REDUCTIONS

(tons/day)

Year	Non-Methane Organic Gases (NMOG)	Nitrogen Oxides (NO_x)	Carbon Monoxide (CO)	Particulate Matter (PM)
2000	29	36	14	0.4
2010	185	248	317	1.4

Table 4. Potential Emissions Reductions ⁴

The costs associated with this reduction in emission is detailed in Chapter 4 of this report.

State Ambient Air Quality Standards

Local air pollution control districts (APCD) in non-attainment areas were required to submit a plan for attaining and maintaining state standards for ozone, carbon monoxide, sulfur dioxide and nitrogen oxide to CARB by December 31, 1990 or June 30, 1991 where a district is affected by indirect pollutants. San Diego was granted attainment status for NO_x as of November, 1992.

APCDs are generally defined by county boundaries. San Diego's APCD is totally encompassed by the county boundaries, and is affected by migration of pollutants from the South Coast Basin and Tijuana, Mexico.

To achieve the emissions profile required by state standards, areas classified as serious or severe APCDs are required to meet a 5% annual reduction of air pollutants. In San Diego, a 65% reduction of reactive organic gases (ROG) and oxides of nitrogen are needed by 2000. New vehicle emission standards and stationary source controls are expected to achieve a 43% reduction in ROG and a 26% reduction in NOx. The reduction deficit of 22% ROG and 39% NOx will have to be made up by stationary source controls and Transportation Control Measures (TCM). ⁵

As has been the case for many years, California has been very aggressive in setting emission standards. The exhaust emission standards for the California are more stringent than the Federal Clean Air Act. Table 5 on the following page outlines the exhaust emission standards of the Federal and California Clean Air Acts.

**CURRENT AND FUTURE LIGHT-DUTY ^a
EXHAUST EMISSION STANDARDS ^b**

Standards		NMOG ^c	CO	NO ^x
Federal	Current	0.41 ^d	3.4	1.0
	Tier I ^e	0.25	3.4	0.4
	Tier II ^f	0.125	1.7	0.2
California ^g	Current	0.39	7.0	0.4
	CV	0.25	3.4	0.4
	TLEV	0.125	3.4	0.4
	LEV	0.075	3.4	0.2
	ULEV	0.040	1.7	0.2
^a < 3760 lb. loaded vehicle weight ^b g/mile at 50,000 miles ^c Non-methane Organic Gases ^d Total Hydrocarbons ^e Tier I standards will be phased in between 1994-1998 ^f Tier II standards may be phased in between 2003-2008 ^g CV=conventional vehicle (adopted for 1993); TLEV=transitional low emission vehicle; LEV=low-emission vehicle; ULEV=ultra low emission vehicle				

Table 5. Provided by State of California Transportation Fuels Office in Sacramento.

Transportation Control Measures (TCM)

Local Air Pollution Control Districts are required to develop and implement TCMs as an air pollution reduction strategy. The San Diego APCD is proposing regulation XIII that would require a reduction of employment-related commute trips by influencing a shift in travel mode to a mode other than the single-occupant motor vehicle. Government agencies will be the first to be targeted with TCM's. The proposed rules are in accordance with the employer-based Transportation Demand Management (TDM) strategies contained in the 1991 San Diego Regional Air Quality Strategy (RAQS). The Air Pollution Control District has collected a \$2/vehicle registration fee for the last 20 months, accruing an estimated \$5 million dollars. By law (AB 2766) this fee can be raised to \$4/vehicle and must be used for implementing the region's transportation control measures (of the Air Quality Plan) including a trip reduction program.

The California Clean Air Act requires a county-wide Average Vehicle Ridership (AVR) of 1.5 during weekday commute hours by 1999. The San Diego Air Pollution Control District has proposed that each employer achieve during the 6:00 a.m. to 10:00 a.m. Principal Travel Period (PTP) the annual Average Vehicle Ridership (AVR) for the county of San Diego as outlined in Table 6.

YEAR	FY94	FY95	FY96	FY97	FY98	FY99 & Beyond
AVR-Zone A	1.65	1.70	1.75	1.80	1.85	1.90
AVR-Zone B	1.50	1.55	1.60	1.65	1.70	1.75
AVR-Zone C	1.50	1.55	1.60	1.65	1.70	1.75

Table 6. Annual Minimum Average Vehicle Ridership (AVR) Targets

Zone A = Employers within the San Diego Centre City Planning Area
Zone B = Employers within an incorporated city in the County, but outside Zone A
Zone C = Employers within the unincorporated area of the County

The proposed Regulation XIII offered by the APCD did not reflect amended California Clean Air Act provisions. The CCAA now authorizes the District to provide employers and businesses with the opportunity to develop and demonstrate alternative strategies to achieve equivalent emissions reductions not otherwise required by the RAQS that compensate for shortfalls in Average Vehicle Ridership (AVR). The proposed targets listed in Table 6 were recognized as unfriendly to business and the County Board of Supervisors subsequently unanimously approved postponement of implementation for one year. The CCAA does not require a lone commuter reduction plan until 1995.

The City recognizes that APCD targets as outlined above are attainable and is working with the San Diego Association of Governments (SANDAG) towards proposal of a more reasonable trip reduction target. The City has had a Transportation Demand Management Ordinance in place since September 1989. This ordinance was designed to increase awareness of air quality and traffic mitigation objectives, and to provide an environment in which employers could gradually adjust to specific program targets and better understand the effort they will need to take in future years to continue trip reduction achievements. Staff continues to work with approximately 1,000 work sites with 50 or more employees in their efforts to limit their Employee Drive Alone Rate. It appears that car pooling (rather than use of mass transit) continues to be the most popular alternative to driving alone. The City of San Diego Traffic Demand Management Division has aggressively promoted ridesharing through its public education program.

The most significant and continuing public awareness initiative has been the design of the Kangaroo character, "Ridesharing can work for you too!" concept. The promotion refers the public to Commuter Computer, the local ride share agency, for free information. This concept has been used on billboards throughout the City and on the sides of Metropolitan Transit System buses and is available in colorful posters and information cards. (See addendum #2)

The City of San Diego has requested that the APCD waive the smog abatement plan requirement for itself and all City employers who have met trip reduction targets or who receive

approval on their trip reduction plan; APCD is pursuing this waiver with EPA officials. Should the request for waiver be denied, the City shall seek the opportunity to use a partial fleet of ULEV's to offset anticipated shortfalls in the Average Vehicle Ridership program. However, the EPA through the CARB has recently stated that purchase of certified clean fuel vehicles will not benefit fleet owners in regards to TDM. The EPA's stance is that credit is given at the point of manufacture and crediting at point of purchase would be a "double credit" on the same vehicle. They contend that only converted vehicles will apply as a credit towards TDM goals. This approach is obviously shortsighted as it reduces the demand side value of purchasing an environmentally attractive fleet.

The Equipment Division, in an effort to meet the Transportation Demand Management Standards, is also reviewing a proposal to adopt a four-day, ten-hour work schedule. This will effectively eliminate one round trip per work week, per employee. This work schedule would eliminate approximately 195,000 vehicle miles traveled per year.

AB2766 Rideshare Project Proposal to Local APCD

The Air Pollution Control District has solicited proposals for projects to be funded with the vehicle registration fee monies with first priority uses for those proposals which include trip reduction programs for employee commute trips. The City of San Diego has forwarded a proposal to the APCD for a project to be partially funded by these vehicle registration fees. The proposal involves a

major Operations Center (the Chollas Operations Station has approximately 800 employees) that is not directly served by public transportation, resulting in very high auto dependence by the work force. A survey of 288 of these employees indicated willingness of 160 (greater than 50%) to consider mass transit if it were available. Transit use on the order of 8 or 10 percent of the employees currently working at Chollas would result in 65 transit users. Using 240 work days per year and an average commute distance in the region of 12 miles at two trips per day we could possibly reduce 350,000 to 400,000 of vehicle miles traveled per year. Noting that the City already subsidizes 75% of the transit pass cost, this proposal is a viable option for reducing single vehicle occupancy. The proposal is as follows:

General Concept

Scope - A shuttle service, using two new alternative fueled passenger vans and two alternative fueled (CNG) vehicles converted from gasoline or diesel operation, to link the Chollas Operations Center to the downtown administration center as well as to nearby transit centers. An emergency ride home program will be implemented to encourage transit usage by employees. This will provide a free ride home to any employee who rideshares to work in the case of illness or emergency.

Objectives - To reduce 350,000 annual vehicle miles of employee drive alone travel while providing valuable information to transit planning and local government agencies on the feasibility of shuttle services to provide a "missing link" in the urban transit network.

Partnerships" and Cost-Sharing

1. San Diego Gas and Electric - (a) Local utility has agreed to contribute 50% of the costs of conversion for two gasoline fueled vehicles as well as 50% of the costs of two fueling units (b) SDG&E will pay the \$4,200 incremental increase towards the purchase of two (2) Dodge eight-passenger certified LEV vans.
2. MTDB - Metropolitan Transit Development Board - Has agreed to provide planning and operations staff support in the development of the shuttle's operating plan.
3. Commuter Computer - Local rideshare agency has agreed to provide staff support and material costs associated with marketing the program to City employees.

The total cost of this proposed shuttle is \$182,300 for start up and one year of operation. \$86,000 is being requested as the APCD share with \$17,600 as the Partner share. If the proposal is approved by APCD, the Equipment Division will expend \$78,700 towards the pilot program to promote the use of public transport.

The City is confident that this proposal meets APCD's high priority for programs that include trip reduction

measures. We view TDM as an important part of the strategy to meet CCAA requirements.

EPA Fleet Credit Rules and TCM Exemptions

The CCAA and the local APCD does not allow credits to be "banked" for future years. However, the Environmental Protection Agency has signed into law the final rules governing the fleet credit program on January 19, 1993 which appear to allow credits for both low emission vehicle purchase requirements and transportation control measurement elements of the Clean Air Act. Fleets covered by the Federal Clean Air Act of 1990 can earn credits by acquiring: more clean-fuel vehicles than required; vehicles with lower emissions than the statutory standards; or, by acquiring clean-fuel vehicles prior to the mandated phase-in periods.

The new EPA regulations requires that state programs allow credits to be "banked" for future years to be used in lieu of acquiring mandated clean-fueled vehicles or to be traded or sold to other covered fleets located in the same non-attainment area.

Again, it should be stressed that the EPA is fuel neutral and is defining a clean fueled vehicle based on exhaust emission standards. It is anticipated that new models powered by reformulated gasoline will be able to meet these new emission standards.

The EPA also finalized the fleet exemptions to transportation control measures (TCM) that state and local governments implement to control motor vehicle usage. This rule exempts clean-fuel vehicles from "temporal" TCMs, which restrict motor vehicle usage by the time, day of week, or week or month, in the 22 non-attainment areas specified in the Clean Air Act. The rule also reserves high-occupancy vehicle lane exemptions for inherently low-emission vehicles.⁶

OTHER LEGISLATION IMPACTING FLEET OPERATION

Heavy Duty Vehicle Smoke and Tampering Inspection Program

Although this program is not a part of the Clean Air Act, it is another in a string of regulations that work towards the same goal of reduced emissions and cleaner air. The purchase of opacity meters called for in the Heavy Duty Vehicle Smoke and Tampering Inspection Program has been deferred. This program became an enforceable law on January 1, 1992. Due to the \$2,625 price tag for the opacity meter and the \$1,550 Strip Recorder costs, the purchase has been postponed. The initial cost for non-compliance is \$300.00 per citation, with the possibility of a civil penalty of \$1,500 per day for each day the vehicle is in violation upon re-check of the offending vehicle. Although this is a stiff penalty, the effectiveness of our preventative maintenance program will limit the City's liability in this area.

Assembly Bill No. 2783

This bill was introduced by Assembly Member Sher who is also credited with AB2995, The California Clean Air Act of 1988.

This bill modified the California Clean Air Act to make modest relaxation in terms of minimum statutory requirements. This was achieved by adjusting the classification scheme and some individual requirements between tiers. An example is the ridesharing regulation. With the Sher Bill a business may substitute alternative methods of achieving the same equivalent emission reductions.

The bill is more flexible, rational, user friendly and less onerous. There is a slight possibility that under the new classification scheme, San Diego County may be upgraded from a severe to a serious category. Under the reclassification, (to serious from severe) Average Vehicle Occupancy targets could be reduced to 1.4 from 1.5.

However, the bill does state that no reimbursement is required by the State to the local agencies overseeing any clean air act regulations. This will impact the City in that the County Air Pollution Control District will increase fees if necessary in order to meet their expenses.

Chapter 3

FLEET CHARACTERISTICS

The San Diego Fire and Police Departments have their own fleets. The City's non-emergency fleet is diversified and supports all other city departments. Vehicles ranging from compact sedans and pick-up trucks to specialized equipment such as street sweepers, television vans, 6x6 dump trucks, refuse packers and other heavy construction motive equipment are included in the fleet. Equipment Division's mission is to provide and maintain these vehicles. Until recently all were fueled by either diesel or gasoline, with the exception of 20 methanol fueled vehicles that were part of a testing program for the State of California.

FLEET CLASSIFICATION METHODOLOGY

The City of San Diego has classified the non-emergency fleet by Gross Vehicle Weight using the **American Public Works Association Classification Table**. The vehicle classification table is on the following page.

Class #	Weight Parameter	Number in Class
1	6,000 lb & Less	564
2	6,001 to 10,000 lbs	502
3	10,001 to 14,000 lbs	15
4	14,001 to 16,000 lbs	34
5	16,001 to 19,500 lbs	5
6	19,501 to 26,000 lbs	238
7	26,001 to 33,000 lbs	100
8	33,001 lbs & Over	220
9	All Other Equipment	280

Table 7. - City of San Diego Vehicle Classification Table

Class 9 designation is used for vehicles and motive equipment that do not fall into the American Public Works Association categories. For instance, tractors, scooters, tow compressors, trailers, graders, wood chippers, etc. For use in this report we have identified 280 vehicles in this class 9, some of which run on diesel or unleaded fuels.

This classification system has sorted the fleet into 126 subclasses based on the APWA categories and the one additional Class 9 designation. This classification system lends itself to appropriate, equitable rate structuring that has satisfied individual customer needs. (See addendum #3 for a detailed classification table with usage and assignment charges, use and anticipated life by class.)

EMISSIONS PROFILE

A prudent approach towards meeting CCAA mandates would be to complete an emission profile of the existing fleet. The California Air Resources Board published a Mobile Source Emission Standards Summary which outlines vehicles in five categories. (See addendum #4.) City fleet information was separated by model year and gross vehicle weight according to the categories outlined in the emission standards summary. To get a picture of current emission from the city fleet, information from the 1992 fiscal year annual reported mileage is included. Where 1992 reported mileage was unavailable a class standard usage mileage was used. This provided a basis for determining which vehicles in the fleet were responsible for being the highest contributors towards photochemical smog (ozone).

Table 8 outlines the emission survey for light and medium duty vehicles. On the advice of the California Energy Commission all light and medium duty vehicles in this table are assumed to have gasoline powered engines for ease of computation.

Table 9 constitutes an emissions survey for our refuse packer and recycling truck fleet. Since these vehicles are both high mileage and heavy in weight (all are class 8, {33,301 GVW and up}) it was decided to do a separate emission survey for our Waste Management Fleet.

Table 10 constitutes an emissions survey for heavy duty vehicles. The annual mileage of each sub-class was divided by 30 MPH in an effort to assume grams per brake-horsepower hour which is how all standards were to be expressed according to the California Air Resources Board **Mobile Source Emission Standards Summary** that was adopted on January 31, 1992.

Table #8 Mobile Source Emission Survey Light and Medium Duty Vehicles
Survey Based on Average Certification Values

<u>Vehicle Type</u>	<u>Years</u>	<u>Weight GVW</u>	<u>Number of Vehicles</u>	<u>Ozone Forming Pollutants (THC + NOx)</u>	<u>***</u>	<u>Annual Miles Driven</u>	<u>Annual Emissions Grams per Year</u>	<u>Annual Emissions Pounds Per Year</u>	<u>Annual Emissions Pounds per Vehicle</u>
Passenger Car	(a) 1983-88		40	0.840	g/m	211,982	178,065	392	9.81
	(b) 1989-92		73	0.412	g/m	566,938	233,578	514	7.05
Light Duty Trucks	(c) 1983-87	4,000 - 6,001	116	1.120	g/m*	904,850	1,013,432	2,232	19.24
	(d) 1988	Under 6,001	42	1.104	g/m	352,870	389,568	858	20.43
	(e) 1989- Present	Under 6,001	296	0.610	g/m**	2,449,353	1,494,105	3,291	11.12
Medium Duty Trucks	(f) 1983-87	6,001- 8,500	42	1.077	g/m***	299,032	322,057	709	16.89
	(g) 1988	6,001- 8,500	10	1.280	g/m****	70,185	89,837	198	19.79
	(h) 1989- Present	6,001- 8,500	144	1.210		1,258,387	1,522,648	3,354	23.29

*Assumes 85 Model Year Sales-Weighted Certification Emissions with 31% Increase to reflect actual fleet makeup.

**Assumes 90 Model Year Sales-Weighted Certification Emissions.

***Assumes 85 Model Year Sales-Weighted Certification Emissions.

****The process allows vendors to certify within a given range of pollutants. Although 1988 standard is higher than 1987, the 1988 range is acceptable.

Certification Values - Actual Project Emissions provided by Vendor to the Environmental Protection Agency and California Air Resources Board.

These figures were provided by Gary Yowell, ARB Certification Engineer

Table 9 Mobile Source Emission Survey
Waste Management Department – Heavy Duty Trucks
Survey Based on Southern California Rapid Transit
District – – – – – Chassis Dynamometer Testing

<u>Vehicle Type</u>	<u>Years</u>	<u>GVWR Weight</u>	<u>Number of Vehicles</u>	<u>Ozone Forming Pollutants (THC + NOx)</u>	<u>Annual Miles Driven</u>	<u>Annual Emissions Grams per Year</u>	<u>Annual Emissions Pounds Per Year</u>	<u>Annual Pounds per Vehicle</u>
Heavy Duty Trucks Diesel	(u) 1980–86	33,200 – 60,480	78	33.81 gram/mile*	1,006,298	34,022,935	74940.39	960.77
	(q) 1987–90	28,000 – 58,080	73	31.85 gram/mile	894,883	28,502,024	62779.79	860.00
	(r) 1991– Present	42,000 – 59,000	11	30.00 gram/mile	134,857	4,045,710	8911.26	810.11
Total Vehicles			162			Total Pounds	146,631.43	
Total Tons FY92							73.32	

Ozone Forming Pollutants Based On Chassis Testing of M100 Refuse Hauler
Using 3306 Engine 1991 Model Year

* – Extrapolated Based on 1988 and 1989 Certification Values.

THC = Total Hydrocarbons – Family of compounds containing carbon and hydrogen found especially in fuels. Some of these compounds are major air pollutants.
NOx = Nitrogen Oxides – Gases formed primarily from atmospheric nitrogen and oxygen when combustion takes place. Reacts with volatile organic compounds to form ozone. Nationwide 45% NOx emission are from mobile sources.

Table # 10 – Mobile Source Emission Survey Heavy Duty Vehicles

Based On Average Certification Values

<u>Vehicle Type</u>	<u>Years</u>	<u>GVWR Weight</u>	<u>Number of Vehicles</u>	<u>Ozone Forming Pollutants (THC +NOx)</u>	<u>Annual Miles Driven</u>	<u>Estimated Grams Per Brake HP Hour</u>	<u>Annual Emissions Grams per Year</u>	<u>Annual Emissions Pounds Per Year</u>	<u>Pounds Per Vehicle</u>
Heavy Duty Trucks Diesel	(6) 1972–79	Over 8,500	3	8.32 g/bhp–hr**	19,667	656	22	1	.30
	(u) 1980–86	Over 8,500	26	6.24 g/bhp–hr*	210,514	7,017	234	8	.30
	(q) 1987–90	Over 8,500	86	5.92 g/bhp–hr	903,428	30,114	178,276	393	4.57
	(r) 1991–Present	Over 8,500	64	5.60 g/bhp–hr	336,779	12,893	72,199	159	2.48
Heavy Duty Trucks Gasoline	(5) 1969–79	Over 14,000	13	9.67 g/bhp–hr**	48,341	1,611	15,582	34	2.64
	(t) 1980–86	8,500–14,000	97	8.72 g/bhp–hr**	497,088	16,570	144,487	318	3.28
	(j) 1987	8,501–14,000	29	6.70 g/bhp–hr	230,877	7,696	51,563	114	3.92
	(k) 1987	Over 14,001	13	7.60 g/bhp–hr	84,179	2,806	21,325	47	3.61
	(l) 1988–90	8,501–14,000	155	5.73 g/bhp–hr	1,323,746	44,125	252,835	557	3.59
	(m) 1988–90	Over 14,001	131	6.10 g/bhp–hr	1,259,700	41,990	256,139	564	4.31
	(n) 1991–Present	8,501–14,000	66	4.76 g/bhp–hr	488,483	16,283	77,506	171	2.59
	(p) 1991–Present	Over 14,001	4	4.81 g/bhp–hr	26,377	879	4,229	9	2.33

Certification Values – Actual Projected Emissions provided by Vendor to the Environmental Protection Agency and California Air Resources Board.

** – Certified values provided by Duc Nguyen, Air Resources Board

* – Extrapolated based on 1988 and 1989 certification values.

Certified values provided by Gary Yowell, California Energy Commission, ARB Certification Engineer

FUTURE GROWTH

Historically, the City of San Diego has experienced a 2% growth rate of the non-emergency fleet. However, with the downturn in the California economy most of the previously approved additional motive vehicle acquisitions have been deferred per the direction of the City Manager.

When there is an upturn in the economy, it is expected that the acquisition rate will return to normal. Aside from the purchase of additional vehicles, right-sizing equipment dictates that we buy higher Gross Vehicle Weight and move towards further incorporation of diesel engines.

NEW APPLICATION REQUIREMENTS

With technological advances in the industry, vehicles are becoming more specialized. It is anticipated that the use of alternative fueled vehicles will be expanded to portions of the fleet other than light duty. At this time there are some experimental applications of CNG technology for refuse packers, street sweepers and fork lifts. As these vehicles become available and are proven effective and economically feasible, the City will include these applications in its alternative fuel program.

It is understood that CNG vehicles are better for an indoor application as there is less carbon monoxide production. Fork lifts are an excellent application for CNG power, and we intend to apply this standard to future fork lift purchases.

Chapter 4

LOW EMISSION FLEET COST

COSTS OF EMISSION REDUCTIONS

The costs associated with this reduction in emissions will be borne by vehicle and fuel industries as well as the consumer. In the area of emission reduction costs, the CARB estimates outlined in the Proposed Regulations for Low-Emission Vehicles and Clean Fuels report of August, 1990, are much lower than actual market place costs.

For instance, CARB estimates additional costs for conventional fueled vehicles or TLEVs to be \$70 for fuel preparation systems. An additional \$170 is estimated for electrically heated catalysts in LEVs and ULEVs. An additional \$200 for a fuel composition sensor in vehicles at the TLEV level is estimated. For LPG vehicles, a \$600 increase for fuel control and storage system is estimated. An estimated increase of \$1,000 for CNG vehicles is anticipated by CARB. ⁷

At the LEV level, costs for methanol and ethanol vehicles was estimated to be \$70 for fuel preparation systems. Electronic fuel injection for CNG vehicles will be at least \$200 and \$100 for LPG vehicles. ULEV standards will require electrically heated catalysts in methanol, ethanol and LPG vehicles at a cost of \$170. At this time it is assumed that technological advances in battery production will keep the incremental cost of ZEVs at \$1,350 by the year 2000.

Although CARB estimated an increase of \$1,000 for CNG vehicles, it has been our experience through participation in a California Energy Commission Program that the increase costs for purchase of 3/4 ton pick up trucks was \$3,500 per vehicle. This "real life" costing obviously proposes a considerable negative cost impact in fleet replacement costs. Since there is limited experience in the operation of a CNG fleet, it is difficult to compute the return on investment for these vehicles that meet the TLEV certification requirements. Although the 1992 model year vehicles purchased through the CEC demonstration program meet the TLEV certification requirements, GMC did not get them certified through CARB due to time constraints.

FUELING CONSIDERATIONS

Clean Fuel Costs

Using the prices developed in the AB234 Report, (Draft, August 1991), published by the California Energy Commission, CARB has adopted estimates for alternative fuels, per gallon equivalent in the years 1995 and 2002. These estimates are shown on Table 11, on the following page.

FUEL	<u>\$/GALLON GASOLINE EQUIVALENT</u>	
Gasoline	1995	2002
Unleaded	\$1.27	\$1.39
Premium	\$1.43	\$1.54
Reformulated Gasoline	\$1.27-\$1.43	\$1.56
Methanol (M-85)	\$1.67	\$1.56-\$1.86
Ethanol (E-85)	\$1.67-\$2.55	\$2.45
Natural Gas	\$0.92	\$1.01
Propane	\$1.13	\$1.22
*Electricity	\$1.54	\$1.20

Table 11. Estimates of Retail, Public Refueling Fuel Prices in \$ Per Gallon - Years 1995 and 2002.⁸

*The electricity costs are listed in MM/BTU in the 234 Report. Heather Raitt, Energy Analyst, CEC, Energy Technology Development Division, provided the \$/gallon gasoline equivalent figure.

These estimates are in 1990 dollars for retail, public refueling fuel prices. They include Phase 1 and 2 reformulations for gasoline, off-peak rates for electricity, and methanol produced in large quantities at new plants.

Costs to Retail Station Operators

The chart below outlines CARBs estimated capital costs of installation to retail station operators.

Fuel	Installment Costs
Methanol or Ethanol	\$50,000 to \$70,000
LPG	\$40,000 to \$75,000
CNG	\$250,000
Gasoline	\$50,000 to \$70,000

Table 12. Capitol Cost to Equip a Gasoline Station As a Clean Fuel Retail Outlet⁹

Our assumption is that retail stations are owned by major oil companies, which have the ability to finance these improvements. Small, independent station owners are given a longer time for compliance.

According to Paul Wuebben, Clean Fuels Officer, South Coast Air Quality District, it could cost between \$250,000 to \$500,000 to install a CNG station capable of accommodating 100 vehicles per day.

Current Equipment Division Fueling Site Capabilities

The Equipment Division currently has six fueling stations to support our gasoline and diesel powered fleet.

The fuel usage is monitored by vehicle in an effort to correctly collect costs by class to pass on operating costs to the individual user. An E. J. Ward Compu Add Computer using UNIX software tracks all fuel issues from our service stations.

In addition to six on site computerized fueling sites, there are approximately twelve non-automated fueling sites. Fuel usage at these non-automated sites is entered in the data base from manual fuel entry logs. Approximately 5% of all fuel issues are manually recorded.

Development of On Site CNG Fill Stations

For purposes of lowering overall exhaust emissions, the Equipment Division is giving serious consideration to purchases of CNG powered vehicles. Fueling of CNG vehicles is a major concern. It is understood that the approximate cost of one slow fill unit which can be modified to fuel two vehicles on a daily basis is \$5,000. The slow-fuel apparatus will again be a preliminary approach for several reasons. one being that the E.J. Ward computer is incapable of tracking fuel distribution from a slow fill unit.

As the comfort level with CNG fueled vehicles increases and the consequent CNG fueled portion of the fleet increases, it is apparent that a fast fuel or at least a combination fast/slow fueling site will be necessary.

Construction of a fast fuel site will be a capital improvement budget item requiring the approval of the City Manager and Council. As the percentage of CNG vehicles increases, the plan is to install fast fuel stations at the three main fuel sites.

Consideration of the Fuel Maker Option for CNG Fleet Support As An Interim Strategy

According to Sam Blundell of Fuel Maker Inc., there are currently 2000 Fuel Makers C3 in use today worldwide. Six hundred of these are in the United States. They are a computer controlled, highly sophisticated piece of fueling equipment. Although the original focus was residential customers, now the focus is on fleet market. Twenty to thirty vehicles in a fleet or a decentralized fleet is an appropriate application of Fuel Makers. This may be a good interim answer.

The estimated cost of operating a vehicle is 30-50 dollars per hour. An average of 15 to 20 minutes down time is estimated for fueling. This means that \$.50 to \$1.00 per gallon is added to the cost of fueling. On site slow fueling translates to a considerable savings.

Fuel Makers use 1 to 1.3 KW per hour to run. They are designed to minimize electric consumption. However, the 1 to 1.3 KW per hour computes to an additional \$.10 per therm (or gallon of CNG) dispensed.

Another advantage of the Fuel Maker is that payment of fuel is due after the Fuel Maker is used, not before as in gasoline purchases for fleet fueling. There is no need for maintaining an inventory on site.

The Fuel Maker units will operate for 2000 hours before a \$150.00 maintenance cost will be incurred. When looking at all aspects of fueling a CNG fleet, the Fuel Maker is a viable answer for vehicles that are not returned to an operations station on a daily basis. The drawback of a Fuel Maker is that the E.J. Ward computer is incapable of tracking the individual fuel costs by vehicle.

California Gasoline Reformulation - Phase I- Oxygenated Fuels

As part of the California Clean Air Act requirements, the California Air Resources Board was directed to take whatever actions are necessary to achieve a 55% reduction in emissions of volatile organic compounds by December 31, 2000. As part of their program to achieve this goal, they are requiring changes in gasoline composition. The table on the following page reflects the schedule of implementation for mandated gasoline specifications.

TABLE GASOLINE SPECIFICATION SCHEDULE OF IMPLEMENTATION		
Time Period	Oxygen Content (CARB)	Oxygen Content (EPA)
Phase I (Winter Only) 1992 to 1995	1.8% - 2.2% (Entire State)	* Minimum 2.7 % (Non-attainment Areas Only)
Phase II (Year-round) April 1995 to March 1996	EPA Regulations Apply	2.0% (Ozone Areas Rated Severe or Extreme)
March 1996 to January 1998	1.8% - 2.2% (Entire State)	* 2.0% (Ozone Areas Rated Severe or Extreme)
January 1998 and Thereafter	1.8% - 2.2% (Entire State)	* 2.0% (Ozone Areas Rated Severe or Extreme other ozone areas optional)

* Does not apply to California if EPA waiver is approved.

Table 13. Gasoline Specification Schedule of Implementation.

Effective November 1, 1992 through March 1, 1993, it is mandated that unleaded gasoline be oxygenated in an effort to reduce carbon monoxide in San Diego County. Although the Federal Clean Air Act requires all gasoline sold in the non-attainment areas of the U.S. to contain 2.7 percent oxygen by weight, CARB requires an oxygen content between 1.8 and 2.2 percent by weight for all counties in California.¹⁰ (Initially Imperial County was excluded, but now the regulation is statewide.)

The supplier can use two different classes of compounds as oxygenated gasoline blending agents: ethers and alcohols. Methyl tertiary butyl ether (mtbe) appears to be the oxygenate of choice.¹¹ (CARB does not allow a 10% ethanol mix, which makes California vendors ineligible for the Federal government tax credit on 10% mix).

The Federal requirements allow for waivers to be granted under certain conditions. Waivers may be granted by the EPA in cases of either an inadequate supply of the oxygenate or an inadequate distribution system. CARB requested and was granted that its program replace the Federal program in the state. By virtue of that approval, EPA waivers in case of inadequate oxygenate supply or storage capacity do not apply in California. Although projected cost increases to produce oxygenated gasoline appeared to be modest (3 to 8 cents per gallon), anticipated or actual shortages in supply of a product that is in high demand and has no viable substitute would drive up prices.¹² With the introduction of Phase I fuel, the City of San Diego experienced an immediate cost increase of ten cents per gallon. Gasoline usage for this

time period in 1991-1992 is 551,500 gallons, which translates to a \$55,150 increase in fuel costs.

The California Energy Commission recently sent out a notice of availability for *The California Oxygenate Report* (Publication Number P300-93-002) which summarizes the worldwide, United States, and California market outlook for oxygenated fuels which are required by Federal and State air quality laws and regulations. (See addendum #5.) This notification stated that "the U.S. will have sufficient supplies of oxygenates for the carbon monoxide (CO) non-attainment areas during the required wintertime driving season. To meet the demand for the oxygenates would, however, require off-season production and storage of the alcohols and ethers to cover the seasonal demand. This projected demand for oxygenates will be met with the present and planned increases in production capacity."

Reformulated Gasoline Phase II

The petroleum industry is required to produce Phase II reformulated gasoline beginning March 1, 1996. In addition to the Phase I changes this gasoline will require substantial reductions in sulfur, olefins, aromatics, benzene and a further reduction in Reid Vapor Pressure. CARB Phase II gasoline is a step beyond the requirements of the year 2000 Federal RFG.

With respect to additional costs of gasoline to meet the CARB Phase II requirements, the CARB estimated additional costs of \$0.05-\$0.15 per gallon. ARCO, in a recent

announcement, has indicated that they have developed a reformulated gasoline, EC-X, which has comparable emission characteristics as M-85. In addition, ARCO has stated that EC-X is expected to cost about 16 cents per gallon more to produce than conventional gasoline.¹³

According to Paul Wuebben, Clean Fuels Officer for the South Coast Air Quality District, a low estimate for Phase II price increases will be 16 to 20 cents per gallon. Using a speculated cost increase of 18 cents per gallon, the impact on operating costs based on historical diesel fuel usage and estimated increase to our diesel fleet (1.4 million gallons of diesel) will be \$252,000 annually.

The California Oxygenate Outlook report states "if areas with ozone conditions not classified as extreme to severe are required to use reformulated gasoline, a tight supply situation could exist. If the EPA manages the entry of "opt-in" areas outside the mandated areas, however, then the reformulated gasoline market should not experience a shortfall of supplies. In the 1997 time frame and beyond, the development of additional oxygenates and alcohol supplies will nevertheless be necessary to avoid a supply shortfall."

Diesel Fuel

New regulations of the sulfur and aromatic content of diesel for use in San Diego County are effective October 1, 1993. (Aromatics are hydrocarbon compounds that when burned combines with nitrogen oxide in the atmosphere to form ozone or smog.) The sulphur content will go from .5 to .05 by

weight. The CARB has taken the additional step of requiring that all on-highway diesel sold in the state meet a stricter aromatic standard that is 70% lower than the federal mandate. Large refineries must produce a maximum of 10 percent by volume with 20 percent by volume for small refineries. Changing the diesel fuel means refiners will use more costly "recipes" and spend money to alter refining procedures. Higher costs will be passed along to consumers. The new standard is intended to reduce NOx and particulate emissions from on-highway mobile diesel sources which currently account for 21 percent and 38 percent, respectively, of mobile source pollutants. The cost of making diesel could increase by 11 to 28 cents per gallon for large refiners and 16 to 70 cents per gallon for small refiners. The cost disadvantage to small refiners may render them unable to compete in California's diesel market.¹⁴

Unocal has announced it will stop providing diesel to California when the new rules take effect on October 1, 1993. This reduction in competition could cause the price of the cleaner burning diesel fuel to escalate even further than expected. The City of San Diego's non-emergency fleet is made up of 448 diesel vehicles using approximately 1,482,800 gallons of diesel fuel annually. Increased diesel fuel prices would significantly impact our operating costs.

The cost increases considered above are in addition to a State fuel tax increase of one cent per gallon for each year 1993 through 1996. It is estimated by a member of the APCD that these reformulated fuels will be 40% less polluting.

PURCHASE OF DIESEL FUELED VEHICLES MEETING CCAA CERTIFICATION

Higher costs are anticipated for the purchase of FY94 replacement diesel engines. January 1994 is the date for compliance on updated diesel emission requirements. In order to meet Clean Air Act certification requirements, a conservative average increase of \$3,200 for each diesel engine is expected, (according to information provided by a sales manager of Dion International Trucks in San Diego).

The fleet has 46 diesel powered vehicles that were fully depreciated and not replaced on schedule prior to fiscal year 1993, ending June 30, 1993. This delay in replacement will result in added costs of \$147,200 to \$262,200 depending on whether or not the vehicles are replaced with 94 or 95 models. Thirty-seven diesel fueled vehicles have been identified as part of the replacement program for FY94 and are scheduled for purchase at a total increased cost of \$118,400.

To meet mandates of 1995 and 96 model years, diesel engines will be using electronic control fuel injection and possibly catalytic converters or particulate traps, or a combination of the three. Although the Engine Manufacturers Association, the Motor Vehicle Manufacturing Association and the Automotive Engineers Association are groups working on meeting the mandates for diesel engines outlined in the CCAA, no set decisions have been made on the issue at this time. However, our free enterprise system would lead one to conclude that a hefty price increase in diesel engines in

1995 can be anticipated. Hard pricing from manufacturers is unavailable at this time, since the industry is in a shuffling mode - awaiting an industry leader to set prices. This is the "real world" scenario. An educated guess from Dion's International Trucks is an additional \$2,500 increase on top of the \$3,200 increase from the 1994 model year. Impact on the San Diego diesel fleet replacement program using the projected \$5,700 increase per vehicle is as follows:

Model Year	Vehicles Scheduled for Replacement	Total Cost Impact by Year
1995	39	\$222,300
1996	60	\$342,000
1997	62	\$353,400

Table 14. Cost Impact on Diesel Fleet Replacement 1995/97

OVERALL PROGRAM COSTS

It is difficult to determine a total program cost because of the built in-flexibility. The combinations of fuels and technology are too numerous and variable to accurately predict results. CARB developed five vehicle/fuel scenarios with estimated annual program costs in 2000 and 2010 for program evaluation purposes. CARB has estimated annual statewide costs ranging from 130 to 910 million dollars annually using five scenarios that they developed which reflect vehicle/fuel combinations that might occur.

COST EFFECTIVENESS

Cost effectiveness is determined by both the cost per pound of pollutants reduced as a result of this program and by the cost per potential cancer case avoided by reducing the amount of pollutants in the air. Because ozone precursors and toxic pollutants are covered by these regulations, CARB divided the program cost between those two outcomes. According to CARB, 20-40 cancer cases will be avoided yearly. Costs associated with each cancer case avoided range from \$5 to \$50 million. These estimates are based on standard values developed by CARB.¹⁵ (See addendum #6 for scenario/cost tables.)

MAINTENANCE COSTS

Maintenance savings (increased oil and spark plug life are two possibilities) is a potential monetary benefit. Documented proof is currently lacking, though anecdotal and theoretical evidence suggest the possibility of some savings.

General Motors Corporation has stated that oil sampling reports have suggested that oil changes intervals in their GMC dedicated CNG trucks can be lengthened. However, the manufacturers initial recommendation is to maintain oil changes at gas-powered recommended intervals.

A potentially large cost savings is that associated with the elimination of underground gasoline/diesel storage tank inspection, maintenance and replacement.

According to the California Energy Commission, Transportation Technology and Fuels Office, it has been reported (through the CNG light duty vehicle demonstration program) that CNG vehicles require a longer than normal break-in period for the engine. According to General Motors Corporation, the GMC vehicles in the CEC Pilot Program have chrome rings, not MOLY (steel alloy) rings that are used in gasoline powered vehicles. Apparently the oil stays so clean that there are no microscopic particles that would normally score the cylinder walls. Consequently more oil is burned initially and it is of the utmost importance to check oil levels regularly during the break-in period for the trucks.

TAX DILEMMA

When trying to anticipate the total cost of operating a low emission fleet meeting the CCAA requirements, it is important to not overlook the taxation process. As an example, although current figures show CNG fuel to be more cost effective than gasoline, it is anticipated that when fleets are converted to CNG the State will recognize the potential for increased revenues through taxation of CNG fuel. Currently, the State of California has two separate collection options for CNG fuel tax, as follows:

- 1) Purchase an annual sticker for each vehicle. The cost is based on GVW. For the 3/4 Ton Sierra Pick-up Trucks the cost would be approximately \$100.00.

- 2) Pay \$.07 cents per standard cubic foot at the point of purchase.

The Equipment Division has determined the \$100.00 annual sticker to be the most cost effective approach for our twenty CNG powered CNG trucks.

It is interesting to note that when a Shell Oil Company recently opened a CNG fuel site in the North County they were faced with a measurement dilemma. San Diego Gas & Electric Company sells to their customers by the therm. However, the State Board of Equalization taxes the sale by the standard cubic foot (using an equation of 4.33 lbs per therm), and the local County of San Diego Weights and Measures office tells Shell to sell by the pound.

Currently, the California Department of Agriculture, Division of Weights and Measures has a committee working towards development of a statewide standard measurement. Committee members include oil company, utility and government representatives.

This lack of standardization is problematic when trying to facilitate the purchase of a fleet certified to the CCAA standards. Because the alternative fuels industry, such as relatively new and is challenged with trying to integrate both newly developing and existing technology, there is a marked lack of consensus among vendors supporting the clean fuel effort. The problem is reflected in the low availability of off-the-shelf equipment in this industry, such as the form of engine components and compressors.¹⁶

For example, it is only now that a new standard design for dispenser hookups for fueling CNG vehicles (called SHUBE) is compatible with Hanson and Sherix dispensers. Prior to SHUBE hookups, the driver of a CNG vehicle would have to determine what type of hookup was used at the sporadically located fueling infrastructure sites. This involves a cost to productivity and increases general dissatisfaction and lack of willingness to participate in a clean fueled fleet. This lack of standardization must be addressed on many fronts for clean fueled vehicles to be widely accepted.

TAX INCENTIVES

Currently, there is a State sales tax exemption on the incremental increase for vehicles certified as TLEV or LEV. For example if a gasoline powered vehicle cost \$10,000, and a flexible fuel comparable vehicle cost \$12,000, sales tax will only be collected on \$10,000 with no tax liability for the \$2,000 incremental increase. This sales tax exemption is handled at the point of purchase by the vendor.

A second incentive is through an income tax credit. Purchase of certified Transition Low Emission Vehicles or Low Emission Vehicles are eligible for an income tax credit for up to 55% of the incremental increase in the purchase price of the vehicle, not to exceed \$4,000. The State of California has had four separate tax incentives bills before its legislature in the past year for the purchase of alternate fueled vehicles. It is unfortunate that none of the four were enacted.

On the Federal level, the National Energy Bill (HR776) has an entire section on alternate fuels (Title 4). It addresses the issue of incentives such as tax reductions (\$4 million in available monies); availability of fueling facilities; mandating state and local incentive programs; possible exemptions of tolls, local and state taxes and special parking in public buildings for AFV's.

Chapter 5

LOW EMISSION FLEET PERFORMANCE

The City of San Diego is currently participating in a compressed natural gas light duty vehicle demonstration program sponsored by the California Energy Commission. Twenty dedicated CNG trucks were purchased through this program and our low emission fleet performance experience is limited to these recently acquired vehicles. The first vehicle was placed into service on December 23, 1992 and the 20th vehicle was placed in service on March 18, 1993.

Although it is early in the process for extensive data regarding the low emission fleet performance, our earliest experience here indicates that the 20 CNG Sierra's have some kinks to be worked out. We have experienced injector valve reliability problems with some; all twenty trucks have had fuel injectors replaced under warranty. We have recently been advised by GMC that they have developed retrofit kits that can be used by the dealers to modify the fuel delivery system. These changes include complete replacement of the injector valves with a new design; replacement of a PROM (Programmable Read Only Memory) chip in the electronic control unit (this replacement will stabilize the engine performance when idling) and installation of a 7 micron fuel filter in the fuel delivery system.

Table 15 reflects the repairs necessary on the 20 CNG pickups to date. All repairs have been made under warranty by the local GMC representative. However, shuttling the

vehicles back and forth between the vendors and the City's maintenance yards has had personnel cost impacts. Each time a vehicle is transported, two employees are required for the transport. In cases where the vehicle wouldn't start, the truck was towed into the vendor's shop. A consequence of towing these vehicles has been that all three vehicles that were towed now have bent frames. They were towed from the back, which is in accordance with the GMC's service manual instructions. The frame is bent between the cab and the bed. The only thing these trucks with bent frames have in common is that they are CNG powered. It would appear reasonable to suspect that the fact that they are CNG fueled vehicles is the reason for the frames bending. The questions that arise are whether the weight of the tank caused the damage or if a design flaw is to blame. These vehicles were originally gasoline powered and General Motors had a subcontractor modify them to be dedicated CNG fueled vehicles.

VEHICLE NUMBER	IN- SERVICE DATE	RE- PLACE IN- JECTORS	REPEAT IN- JECTOR RE- PLACE- MENT	REPLACE PROM BOARD	IN- STALL IN- LINE FUEL FILTER	UPDATE KIT (RE- CALL)	MISC.
209-001	12-23-92	X		X	X	X	
209-002	01-11-93	X		X	X	X	Spark Plug, Rotor and Hose
209-003	01-19-93	X	X				
209-004	12-22-92	X	X				
209-005	01-25-93	X					
209-006	01-20-93	X		X	X	X	
209-007	03-18-93	X		X	X	X	
209-008	02-05-93	X		X	X	X	
209-009	01-22-93	X	X	X	X		
209-010	01-15-93	X		X	X	X	
209-011	01-27-93	X		X	X	X	Replace Power Steering Pump
209-012	01-13-93	X	X	X	X	X	
209-013	01-28-93	X		X	X		
209-014	01-27-93	X					
209-015	02-03-93	X		X	X	X	
209-016	02-03-93	X		X	X	X	
209-017	01-27-93	X		X	X	X	
209-018	01-27-93	X		X	X	X	
209-019	02-04-93	X		X	X	X	
209-020	03-17-93	X	X	X	X	X	Replace fuse to low pressure sole- noid & repair leak at pressure regu- lator

Table 15. Four Month Maintenance Record of 20 Dedicated CNG Vehicles

General Motors advertised driving range of 200 miles is overly optimistic. Experience demonstrated that the range is closer to 100 miles. One driver experienced a driving range closer to 70 miles. Each CNG tank has an electrically activated solenoid valve, and sometimes one of these valves is not connected properly and thereby reduces range. When a significant drop in range is experienced, the first thing to check is the connectors on each CNG tank.

In an effort to make the vehicles operationally viable, we added additional tanks. The cost of the tanks are \$1550.00 each and we had them installed locally by Hawthorne Equipment Company. (Our local utility SDG&E financed the additional tanks as part of their Alternative Fuels Marketing Program.) It was noted by drivers that when the tank was installed in the bed of the truck and then a tool box was installed behind the tank, the rear view capability was reduced. In response to this complaint, the cross-bed tool box is being removed and "saddle boxes" are being installed on each side of the vehicle from the wheel well to the tailgate. This provides the driver with the necessary storage space and allows for unencumbered rear view capability. It should be noted that overall, feedback from the drivers of the trucks has been positive.

FUEL REFORMULATION AND IMPACT ON PERFORMANCE

According to Chevron Corporation, reformulated and oxygenated gasolines should have no effect on vehicle performance or warranty coverage. However, it is noted that reformulated and oxygenated fuel may result in a small reduction in fuel mileage. The auto industry is a strong supporter of reformulated gasoline.

Recently there has been some concern regarding the potential for lubricity problems in regard to low-sulfur diesel. Paul Henderson is a manager of product design and a

development engineer at Stanadyne Automotive Corp., Windsor, CT, a major supplier of diesel pumps and injectors. In an article in Automotive Fleet Magazines April, 1993, he cited recent incidents in Sweden where low-sulfur regulations resulted in numerous diesel fuel pump seizures, because of reduced lubrication. It was stated that should refiners opt to meet diesel fuel content regulations without regard to lubricity, fleet managers might have to resort to aftermarket additives to ward off premature pump and injector failures.

In fact, the International Standards Organization, Society of Automotive Engineers (SAE) and Diesel Fuel Injection Equipment Manufacturers Association are pushing the use of lubricating additives when low-sulfur diesel regulations take effect. A proposal made at the March 1993 SAE Convention in Detroit will adapt a jet fuel testing procedure to quantify diesel lubricity properties.

HEAVY DUTY DIESEL-DERIVED NATURAL GAS ENGINE AVAILABILITY

Hercules Engines of Canton, Ohio, currently has a 5.6 liter 190 horse power engine for use in a 14,500 and up to 30,000 GVW equipment. This is the first dedicated CNG fueled engine, and Hercules anticipates certification by April, 1993, from CARB. Gary R. Smith of Hercules Engines states that testing at the Southwest Research Institution in Texas has indicated that this Hercules engine is capable of meeting or exceeding the 1994 California emission standards for heavy duty, diesel-derived, natural gas engines. He states that a minimum 10 percent fuel consumption advantage over other conversion engines is expected.¹⁷ One of these engines is currently operating in a street sweeper owned by the Department of Sanitation in New York City.

The May, 1993 issue of Natural Gas Fuels Magazine reported that a converted natural gas powered Mack refuse truck has been driven cross-country from San Antonio, Texas to Boston, Mass. The converted vehicle is a Mack MR chassis with Mack's 12 liter E7 engine. The natural gas engine that was installed in the truck exceeds diesel power by as much as 10 percent. Southwest Research Institute, who did the conversion, believes that natural gas-powered vehicles are a good fit for the refuse industry, because landfill gas, which is mostly methane, can be refined and compressed at the landfill site and the gas then used to power the refuse hauling trucks.

Chapter 6

STRATEGIES FOR ACQUIRING A LOW EMISSION FLEET

A review of the current fleet as it stands in December 1992 reflects the following replacement schedule by weight class. The year designation is fiscal year, which for the City of San Diego is from July 1 through June 30.

	P*	93	94	95	96	97	98	99	00	01	02	03
Class 1	2	31	20	55	84	67	19	197	63	12	0	0
Class 2	14	34	26	22	64	41	81	104	96	44	2	0
Class 3	2	0	1	0	1	1	2	0	4	2	1	0
Class 4	11	12	4	11	4	0	0	2	1	0	0	0
Class 5	4	4	0	0	0	0	0	0	0	0	0	0
Class 6	30	44	9	8	46	15	34	24	22	24	5	0
Class 7	14	15	3	1	10	5	29	12	13	9	2	0
Class 8	5	9	12	17	25	40	32	43	8	22	3	1
Class 9	44	25	20	26	13	25	30	38	41	18	16	4
Total	126	85	90	139	247	198	227	420	250	13	29	5

Table 16. Non-Emergency Fleet Replacement Schedule By Class

* The Column P reflects vehicles that were fully depreciated prior to FY/93 and are still on active status.

METHANOL FUELED VEHICLES

Flexible Fuel Vehicles are available (burning both methanol & unleaded gasoline) through the California State Energy Commission. Due to budgeting constraints, the City of San Diego decided to postpone involvement in this program. We currently have methanol fueling capabilities at our Chollas Operations Station. Since methanol burning vehicles

are known to produce 50% less hydrocarbon emissions, serious consideration is being given towards the purchase of FFV using both methanol and gasoline. This will be part of the strategy for fleet acquisition in regards to meeting CCAA standards.

The California Energy Commission has stated that 2000 flexible-fuel 1993 Ford Tauruses have been ordered by commercial fleet owners. These have increased fuel tanks of 20.7 gallons, so the driving range is similar to a gasoline-powered Taurus. These vehicles are equipped with an electronic instrument panel, not available on other Taurus models. These panels contain a fuel mixture gauge indicating the percentage of methanol in the fuel mixture being used and a driving distance to empty.

Currently, Chrysler has Flexible Fuel Vehicles available without a price premium for the 1993 model year. These are the Dodge Spirit and Plymouth Acclaim. They are mid-sized sedans with a 104" wheelbase. These are methanol M85; that is, they can run on a mix of 85% methanol and 15% gasoline or any combination up to 100% gasoline. These vehicles have fuel tanks and lines that are stainless steel and include some engine modifications. They require Flexible Fuel Oil which runs slightly higher in cost than regular oil. Although the service manual calls for no deviation from normal maintenance procedures, it was verbally recommended that oil changes be made at 3700 miles, a practice that should affect maintenance cost somewhat. The fuel tank for the methanol FFV is 18 gallons capacity in an effort to increase range since methanol fuel travels half the distance as the same volume of gasoline.

Chrysler is committed to building 2500 of these FFV for the Federal Government; most of these vehicles will end up in the State of California. Chrysler is willing to build as many as they have orders for at no extra cost for the FFV package through model year 1993.

A recent survey by the National Association of Fleet Administrators indicated that a shortage of methanol fueling stations may jeopardize the long-term acceptance of these flexible-fueled vehicles.

VEHICLE CONVERSIONS

According to the Clean Air Act, conversion of an existing or new gasoline or diesel-powered vehicle to a clean-fueled vehicle will be treated the same as the purchase of a clean fuel vehicle for the purposes of complying with the fleet program. Currently, the City has one 1991 Chevrolet Caprice that was converted to a dual-fuel vehicle, using gasoline and CNG. Further consideration is being given to converting several sedans and light duty vehicles when we have the fueling situation in hand. See addendum #7 for a list of CARB approved Fuel Conversion Systems.

It is understood that converted vehicles experience a five to ten percent loss in power going from gasoline to CNG. Currently, converted vehicles do not have optimized engine modification as does the OEM alternative fuel vehicles.

It is unknown the effect on the warranty a conversion has on vehicles. This question must be addressed prior to any decision regarding any substantial increase in conversions to the fleet.

Recently, the City was approached by Carburetion Labs International Inc. regarding the possibility of converting diesel vehicles to dual fuel CNG. Their product, which is a conversion kit, is unique in that it uses natural gas in combination with diesel. Results of this patented mixing device (KG5000D) in terms of reducing polluting emission are impressive. Addendum #8 represents the data extracted from official CARB test results.

CALIFORNIA ENERGY COMMISSION DEMONSTRATION PROGRAM

As mentioned in Chapter 5, the City of San Diego is participating in the California Energy Commission - Compressed Natural Gas Light Duty Vehicle Demonstration Program, in an effort to gain experience in dealing with alternative fueled vehicles that meet the Clean Air mandates. Twenty, 3/4 ton GMC Sierra dedicated CNG pick-up trucks have been purchased. All are on site.

The California Energy Commission sponsored a demonstration program in 1993 offering to pay 50% of the incremental cost with the expectation that local utilities would match with the additional 50% incremental costs towards the purchase of dedicated CNG vehicles. As part of the on-going strategy to increase the numbers of alternative fueled vehicles, we anticipated participating in the 1993 demonstration program. This would have allowed us to increase the number of clean fueled vehicles in our fleet without incurring additional incremental purchase price expenses for CNG vehicles. However, the State was late in mailing the proposals and the City was unable to make the purchase commitment prior to the manufacturers closing order date for the vehicles.

INTERACTION WITH LOCAL UTILITY/SDG&E

Currently, the local gas company, San Diego Gas and Electric, has a reimbursement program which permits SDG&E to pay for 50% of the incremental added costs for purchase of CNG vehicles. SDG&E cannot reimburse incentive money for the California Energy Commission vehicles since CEC is already paying for the full \$3,685 incremental cost of the 20 vehicles. SDG&E is precluded by the PUC from paying incentive money where the recipient would realize more than 100% of the actual incremental costs. However, submission of the incentive application was not in vain, since SDG&E did agree to apply the monies towards the cost of additional fuel cylinders on the CEC vehicles (thus eliminating the limited

driving range problem), or for use in contributing towards the purchase of on-site fueling equipment.

The City intends to make use of the SDG&E program offering a 50% rebate as incentive to switch to CNG fueled vehicles. The incentive program with SDG&E is available through 1993. They have requested a two year extension for the program from the PUC and it is likely that the extension will be granted.

SDG&E is willing to support the costs of City fueling sites. Options include 100% up front expenditure by SDG&E for installation of a combination slow/fast fuel site. There is a \$250,000 cost limit to this proposal. SDG&E would recoup their investment through charging the city the retail value of a therm of CNG fuel (approximately \$.70 per therm or \$.81 per gallon). A fair time frame for SDG&E to recoup their investment would have to be worked out. Should the number of CNG vehicles in the fleet increase dramatically and SDG&E receives a fair return on their investment in a timely manner, the per therm charge would drop to the wholesale cost.

Since there is a reserve available for absorbing the costs of clean fueling expenditures, it appears that a more prudent approach would be to wait for the numbers of CNG fueled vehicles in the fleet to increase and then pay for the site on our own. This would allow us to pay a reduced cost per therm (uncompressed rate) of approximately \$.45 per therm (this includes a \$.10 per therm electricity cost for running the compressor unit.) The realized savings in the long run may far outweigh the fiscal impact of a major expenditure in the short term.

FUELING CONSIDERATIONS

The San Diego area does not have the benefit of a large CNG public fueling infrastructure, consequently, San Diego Gas and Electric is allowing owners of CNG vehicles the use

of their fueling sites throughout the city. This is an interim fueling arrangement since it will eventually become necessary to have fueling capabilities on site as the fleet of CNG fueled vehicles increases.

SDG&E has loaned the City the use of three Fuel Maker units which allow on-site fueling at our Chollas operations station. The purchase of several Fuel Makers as an interim solution to fueling at Chollas is currently being considered.

TRAINING

Although the Clean Air Act requires manufacturers to produce clean air vehicles and fuel vendors to supply clean air fuels, there is no program outlined for training mandates for mechanics working on these alternatively fueled vehicles or for drivers of the alternatively fueled vehicles.

This oversight is being dealt with at the College of the Desert in Palm Desert, California. Mr. Paul Schutt is spearheading the development of a curriculum for contract training services. He brings with him expertise on emission controls from a wide variety of industries. The Community College Chancellors Office has approved expenditures of between one and two million dollars to create a curriculum for training mechanics in the art of maintaining alternatively fueled vehicles. This training curriculum will be available for use as a model statewide when the numbers of clean air fueled vehicles increase to the point of necessitating training to meet the demands of the clean fuel vehicle users. Mr. Schutt is also working with the state Bureau of Automotive Repair and the Department of Commerce/Bureau of Licensing towards creating a certification process that will be used to prove a mechanic's ability to work on CNG vehicles. An Employment Training Program Grant is available through the State Employment Office to cover the cost of this training. Approximately 1% of funds collected by the State Employment Office is placed in a fund that is used to re-train individuals to meet the needs of changing

technology before a job loss has occurred.

Initially, we were told by California Energy Commission staff that General Motors Corporation was scheduling an eight hour training session in the San Diego area as part of the support for the CNG trucks. This was to include in-depth training on maintenance, repair and diagnostics for the CNG vehicles that were purchased through the CEC Demonstration Program. Recent conversation with GMC alternate fuels program managers in Detroit indicate that this training has been cancelled. This absence of support from GMC is perceived as a lack of commitment by the vendor towards the success of the CNG program.

Here in San Diego the Equipment Division Trainer is creating a program for our mechanics, so that they become proficient in the repair and upkeep of flexible as well as dedicated CNG vehicles. We are trying to address the need for additional training for both mechanics and drivers of CNG vehicles, since use of these vehicles is not commonplace. Periodic inspection of high pressure on-board CNG storage tanks to comply with current Department of Transportation (DOT) regulations is mandatory. Our Equipment Trainer has created an introductory course for the drivers of alternate fueled vehicles.

We have secured a 15 minute training film titled, **"Natural Gas Vehicle"**, (Form No. X92NGVF) from GMC Truck Service Publications. The film, along with an operation and diagnostic reference manual (GMC TT-92-00T-2) and a service manual supplement, Natural Gas Powered Sierra GMC Truck 1992, was provided free of charge. The film and manuals essentially give the maintenance crew pertinent information regarding CNG vehicles. It also has a test used as a learning tool for the mechanic that GMC will score and return.

General Motors Corporation has also provided us with a copy of a second training film titled, **"Natural Gas Fuel System - Overview & Diagnosis"**, (length: 55:33 GMCTT 92-08-

01) which has been incorporated into our training effort.

PARTICIPATION HESITATION

There is some hesitation on the part of customers to get involved with the dedicated CNG trucks. The driving range and the lack of on-site fueling capability is cause for alarm in terms of the impact on productivity. City employees who are predisposed to be environmentally concerned are targeted for participation since they would actively and willingly participate in this pilot program.

CNG SAFETY ISSUES

Differences in safety are of concern to users for many reasons. An extensive training effort is designed to alleviate these concerns. "A study of the safety issues of CNG use conducted by the Los Alamos National Laboratory for DOE in 1983 concluded that CNG fuels were safer than gasoline due to the high rate of dispersion and the relatively greater concentration of lower flammability".¹⁸ The Air Resources Board has stated that although there is a potential for accidents during fueling of CNG vehicles or explosions in severe auto accidents, natural gas is less flammable than gasoline and has not resulted in problems more severe than those associated with gasoline.

There are several safety component issues to CNG fueled vehicles. The first is how to safely handle a pressure vessel (tank); how do you accurately test and mount the vessel? The second component is how to properly fuel the CNG vehicles. This may seem like a simple issue, however, it is

important to realize that CNG is a new technology for our on-site mechanics and service station personnel, and that this technology is moving so fast that even as training manuals are printed they become obsolete. Management and labor unions will have a vested interest in making sure employees stay safe and, of course, management has a vested interest in

limiting any potential liability associated with the new technology.

A twelve minute film, "CNG CYLINDER ABUSE TEST", has been obtained and this film will be viewed by all Equipment Division personnel at safety tailgate meetings, and by the drivers of the CNG vehicles.

POLITICS

The City Council has expressed interest in an alternate fuel vehicle program. The lack of on-site fueling demands that we do not promulgate specifications specifically for vehicle purchases which include CNG alternate fueling requirements for FY93.

However, in FY94 we will rewrite compact pick-up truck specifications to include an addendum that calls for a price for the six cylinder engine models which is more adaptable to conversion to CNG flexible fueling capabilities. We plan to add one paragraph requesting an addendum to our van and compact pickup and sedan specifications requesting an alternate price for CNG dedicated or flexible fueled vehicles. There is only a limited window of opportunity to make use of the rebate program offered by SDG&E, towards the purchase of alternate fueled vehicles. This rebate opportunity, combined with the interest of the City Council in an alternate fuel program, dictates participation.

CHAPTER 7 -- SUMMARY

In the review of the mandates of the California Clean Air Act it was noted that even though compliance falls on the vehicle manufacturer and the fuel suppliers, local governments will face the associated higher costs. The California Clean Air Act may change the make-up and performance characteristics of municipal fleets. The objective of this report is a planned approach for acquiring a low-emission fleet without interrupting or decreasing municipal service delivery. To that end, the anticipated impact on costs led to the creation of "reserve accounts" to offset the increase in the purchase price of vehicles supplied by manufacturers meeting Clean Air Act certification standards. Maintaining the reserve accounts in the face of recessionary budget shortfalls has proven to be a herculean task because money is needed to offset projected budget deficits. However, the intent and justification for the reserve remains a well-defined, rational example of fiscal prudence.

The intent to reduce harmful emissions produced by city vehicles necessitated completion of an emission profile of the existing fleet. This was accomplished by use of the Mobile Source Emission Standards Summary as published by the California Air Resources Board. The fleet was separated by model year and gross vehicle weight using categories outlined in the Emission Summary. Because the fleet is so diversified, it was determined that to make the process manageable the survey would be based on average certification values rather than the individual value of each model year. The emission survey does noticeably increase the smog producing factors with the age of the vehicle. The survey logically suggest that:

- 1) the older the vehicle the more smog producing tendency.

- 2) the more miles driven the more ozone forming pollutants accrued.

The low emission fleet cost still remains a question. Major truck producers refuse to discuss anticipated price increases at this time. All price increases used for this report were given by local suppliers simply as educated guesses.

A review of the low emission fleet performance, by virtue of a very short testing period of four months with the 20 CNG vehicles on-site from the California Energy Commission Demonstration Program, suggests that perhaps mandating manufacturers to advance technologies has its shortcomings. Our experience indicates that the GMC 3/4 ton CNG trucks were prematurely distributed by the manufacturer. The short driving range and questionable reliability, combined with the lack of infrastructure to support the alternative fueled vehicles dictate a much closer look at the benefits of these CNG powered vehicles. As indicated in this report, cost for fast fill CNG station is prohibitive at this time, when our intention is a 2% increase of light duty purchase through the 1997 model year. The slow-fill (time-fill) fueling approach remains a more viable alternative at present.

Literature from fuel suppliers indicates that the research into and the development of reformulated gasoline is progressing and may present a viable option to meeting CCAA guidelines. Fuel producers suggest that vehicle performance will not be impacted. However, there has been some recent concerns regarding the impact on maintenance costs and the use of low-sulfur diesel. Fuel costs and availability remains a consideration. It is anticipated that the reformulation process will increase fuel costs and may reduce miles per gallon.

The CNG powered vehicles in future model years need to be better engineered. Design consideration should include driving range and dependability. As dependability and

driving range increase, the City of San Diego will no doubt increase its projected purchases of these CNG vehicles in an effort to reduce smog-producing emissions in the San Diego Basin.

It is apparent that the success of the compliance strategy for meeting mandates of the California Clean Air Act is dependent on numerous factors, not the least of which is the quality of product provided by vehicle manufacturers. Although CNG vehicles are identified as a means of managing an environmentally attractive fleet, it is imperative to seek the right level of risk and resource commitment to initiate, develop and sustain a CNG fleet.

There are no easy answers - there are pitfalls in both directions. Under-investment denies the City the opportunity to prove the viability of a cleaner, less polluting fleet. On the other hand over-investment could lead to chasing results that may not occur.

Zeroing in on a compliance strategy when the target appears to be in an almost constant state of flux is understandably problematic. As an example, the Heavy Duty Vehicle Smoke and Tampering Inspection Program is currently being considered for nullification through the State legislature. Currently there are numerous bills before the Legislature in Sacramento that with passage will continue to affect the City in regard to mandates of the CCAA and subsequent policy decisions.

Yet another example is the earning of purchase credits that satisfy the Clean Air Act. No credits or exemptions will be granted until a state's implementation plan is approved by the EPA. The local APCD had included credits for purchase of clean fueled vehicles in their Transportation Demand Management Plan only to be told by CARB that the EPA was not allowing credits for purchase of clean-fueled vehicles at the point of purchase. However, credits are deemed appropriate for converted vehicles. The refusal to

allow credits appears to be in direct conflict with published Environmental Protection Agency policy that TDM exemptions are intended to serve as an incentive to fleets to begin acquiring clean-fuel vehicles prior to the mandated phase-in period beginning in 1999. The lack of consensus on this issue between the Federal and State Regulating Agencies only adds to the confusion and delays the process of converting to a clean-fuel fleet.

Advanced technology, finite resources and accelerating change dictate a wait-and-see approach. In light of the changing legislation, the City's approach of wait-and-see and slowly incorporating alternate fueled vehicles into the mix is deemed prudent. The City will continue to keep harmful emissions produced by City vehicles as low as possible through close adherence to the scheduled maintenance program.

Conversion technology on the diesel, heavy duty portion of the fleet is still under scrutiny and the City awaits reduced costs and advanced technology before any major program commitment.

ENDNOTES

1. Proposed Regulations for Low-Emission Vehicles and Clean Fuels, California Air Resources Board, 1990, page 20.
2. Ibid. page 22.
3. Natural Gas Fuels Magazine, January 1993, page 7.
4. Proposed Regulations for Low-Emission Vehicles and Clean Fuels, California Air Resources Board, 1990, page 60.
5. Ibid, pages 1-72.
6. Automotive Fleet Magazine, February, 1993, EPA Finalizes Fleet Credit Rules and TCM Exemptions, page 13.
7. Proposed Regulations for Low-Emission Vehicles and Clean Fuels, California Air Resources Board, 1990, page 63.
8. AB 234 Report Costs & Availability of Low Emission Motor Vehicles and Fuels, August 1991, page 5.
9. Proposed Regulations for Low-Emission Vehicles and Clean Fuels, California Air Resources Board, 1990, page 66.
10. Fuels Report, California Energy Commission, December 1991 P300-91-018, page 16.
11. Ibid, page 17.
12. Ibid, page 16.
13. AB 234 REPORT Cost & Availability of Low-Emission Motor Vehicles and Fuels, California Energy Commission, August, 1991 (draft). page 11.
14. Fuels Report, P300-92-018, California Energy Commission, December, 1991 pages 17 - 21.
15. Proposed Regulations for Low-Emission Vehicles and Clean Fuels, CARB, 1990 page 70.
16. Natural Gas Fuels Magazine, September 1992, page 20, Ready To Run; Nowhere To Fuel.
17. Utility Fleet Magazine, March 1992, page 19 - Redesigning Engines for Alternative Fuels, by Gary R. Smith.
18. E.P.A. Special Report: Analysis of the Economic and Environmental Effects of Compressed Natural Gas as a Vehicle Fuel, Volume II, Heavy-Duty Vehicles, April 1990" from "Gaseous Fuel Safety Assessment for Light-Duty Automotive Vehicles." M.C. Krupka, A.T. Peaslee, and H.L. Laquer, Los Alamos National Laboratory, November 1983. Prepared for the Department of Energy.

ADDENDUM #1

The E1, BMW's first thoroughbred electric car, has been joined by its American cousin, the E2. Presented at the 1992 Greater Los Angeles Auto Show, the E2 is a new concept car based on the E1, but tailored specifically to meet the requirements of the U.S. market.

Legislative initiatives adopted in the U.S. to improve air quality will have a dramatic impact on motoring in the not-too-distant future. California's Low Emissions Standards, enacted in 1991, require a percent of all automobiles sold in 1998 to be electric-powered vehicles. That requirement will rise to 5 percent in 2001 and to 10 percent in 2003. The adoption of California's standards by nine northeastern states and the District of Columbia means that approximately 290,000 electric vehicles will be sold in the U.S. by 2001. If the 40 remaining states adopt the same rules, electric vehicle sales in 2001 would be mandated to 850,000.

1:5 scale modeling development

Full size modeling buck sub-structure construction

Rough clay application

Full size clay for design review

Preliminary Dinoc application on full size clay

Finish Dinoc application to final design

Designworks USA's facility in Newbury Park, California

In developing an electric vehicle to meet American legislative requirements, driving conditions, and styling taste, BMW AG sought the assistance of Designworks/USA, a Newbury Park, California, design consultancy in which BMW AG has a 50 percent share.

The result of this collaboration is the prototype of a comfortable four-passenger sedan that is exactly as wide as the E1, 14.2 inches longer and 2 inches lower than its European counterpart. Weighing about 2205 pounds, 220 pounds heavier than the E1, the E2 delivers impressive performance. Powered by an electric motor producing approximately 32kW (43 HP), the E2 is anticipated to accelerate to 31 mph in 6.5 seconds and to 50 mph in 15.6 seconds. It is estimated to reach a top speed of 75 mph, and its typical range under normal driving conditions should be 161 miles.

The E2 is based upon the same technical philosophy for emission-free motoring found in the E1. The electric motor is mounted on the rear axle with direct drive to the rear wheels; the battery is placed beneath the rear seats. The entire floor assembly is made of aluminum; the body panels are derived from a recyclable material, and parts and components have been recycled from other automobiles. The standard of safety offered by both the E1 and the E2 rivals that of BMW's larger model series, and the E2's styling is typically BMW - elegant, fresh and youthful.

ADDENDUM #2

Ridesharing can work for you too!

*Hop on and arrive
refreshed*

Developed by the City of San Diego, Transportation Demand Management Department in conjunction with the San Diego Regional Transportation Council

Call
237-POOL
for free
information

ADDENDUM #3
Usage and Assignment Rates for FY 93

New Class	Description	Life	Hr/Mi	Ave Use by Class	93 Usage Rate	FY 93 Assign
101	Compact Sedans	8	MI	5,621	0.25	\$1,250
101P	Compact Sedans – Pool	8	MI	8,312	0.30	
102	Intermediate Sedans	8	MI	7,562	0.27	\$1,440
103	Full Sedans	8	MI	6,010	0.30	\$1,480
103P	Full Sedans – Pool	8	MI	5,284	0.36	
103CNG	Sedan, Full CNG	8	MI	6,010	0.30	\$1,480
106	Mini Vans	8	MI	9,763	0.27	\$1,875
107	Compact Pickups	8	MI	8,297	0.25	\$1,250
107P	Compact Pickups – Pool	8	MI	8,586	0.30	
108	Compact Pickups 4 x 4	8	MI	7,452	0.33	\$1,500
108P	Compact Pickups 4x4 – Pool	8	MI	3,193	0.45	
109	Compact Flatbeds	8	MI	7,725	0.25	\$1,450
109P	Compact Flatbeds, Pool	8	MI	1,385	0.30	
110	Pickups ½ T	8	MI	10,914	0.27	\$1,700
110P	Pickups 1/2 Ton – Pool	8	MI	15,821	0.32	
111	Lifeguard Pathfinders (4x4)	3	MI	8,297	0.25	\$8,060
112	Lifeguard Pickups (4x4)	3	MI	8,297	0.25	\$8,060
201	Van/Panel Truck	8	MI	7,037	0.29	\$2,300
202	Van Passenger	8	MI	8,020	0.29	\$2,500
202P	Van Passenger – Pool	8	MI	6,173	0.39	
203	Van, Redi	8	MI	8,784	0.35	\$2,900
204	Van, Hi Cube	8	MI	7,988	0.32	\$2,600
205	Pickup 1 T Crew (4 x 4)	8	MI	6,408	0.44	\$3,300
206	Pickup ½ T (4 x 4)	8	MI	8,611	0.34	\$2,250
206FI	Pickup ½ T (4 x 4) – Fiesta Island	8	MI	9,132	0.34	\$2,250
207	Pickup 3/4 T	8	MI	7,283	0.36	\$1,750
207P	Pickup 3/4 T – Pool	8	MI	16,228	0.43	
208	Pickup 3/4 T (4 x 4)	8	MI	6,916	0.38	\$2,200
208P	Pickup 3/4 T (4 x 4) – Pool	8	MI	4,966	0.67	

ADDENDUM #3
Usage and Assignment Rates for FY 93

New Class	Description	Life	Hr/Mi	Ave Use by Class	93 Usage Rate	FY 93 Assign
209	Pickup 3/4 T – CNG		MI		0.36	\$1,750
211	Pickup 1 T Crew	8	MI	7,389	0.40	\$2,585
212	Service Truck 3/4 T	8	MI	8,099	0.37	\$2,100
212G	Service Truck 3/4 T, Golf Course	4	MI	8,099	0.37	\$4,200
213	Service Truck 3/4 T Crew 4x4	7	MI	5,376	0.40	\$2,850
214	Service Truck 1 T	8	MI	10,710	0.47	\$2,250
215	Service Truck 1 T (4 x 4)	7	MI	9,744	0.44	\$4,000
216	Flatbed Truck, Under 2 T	10	MI	8,136	0.58	\$1,900
217	Dump Truck 1½ CY	8	MI	12,746	0.41	\$2,800
217G	Dump Truck 1½ CY, Golf Course	4	MI	12,746	0.41	\$5,600
218	Weed Spray Truck, 1 ton	8	MI	6,606	0.45	\$3,225
219	Paint Spray Light	7	MI	8,623	0.63	\$3,900
220	Survey Truck	8	MI	5,890	0.50	\$2,400
222	Service Truck, Crew (4 x 4)	8	MI	13,314	0.44	\$3,350
223	Light Utility (4 x 4)	8	MI	4,789	0.45	\$2,450
224	Van, Stepside Light	8	MI	11,649	0.35	\$2,600
302	Van, Step Side Heavy	8	MI	1,352	0.35	\$2,800
303	Van, Television	10	MI	1,158	2.20	\$17,000
304	Flatbed Dump Truck, light	10	MI	2,936	0.72	\$1,950
305	Ladder Truck	8	MI	9,039	1.20	\$10,000
401	Service Truck, Leak	5	MI	36,160	0.92	\$5,400
402	Sweepers, Rebuilt	7	MI	8,237	3.65	\$12,350
402P	Sweepers, Rebuilt – Pool	7	MI	757	4.38	
403	Emulsion Truck	8	MI	6,940	0.50	\$2,700
502	Welder Truck	10	MI	4,250	0.85	\$1,950
601	Dump Patch Truck	8	MI	11,791	0.70	\$4,600
602	Dump Compressor, 2 CY	7	MI	6,213	1.00	\$5,900
603	Dump Truck, 3 CY Gasoline	8	MI	7,622	0.75	\$4,025
603P	Dump Truck, 3 CY Gasoline – Pool	8	MI	5,488	0.90	

ADDENDUM #3
Usage and Assignment Rates for FY 93

New Class	Description	Life	Hr/Mi	Ave Use by Class	93 Usage Rate	FY 93 Assign
604	Dump Truck, 5 CY	7	MI	4,786	0.80	\$6,200
604P	Dump Truck, 5 CY – Pool	7	MI	9,231	0.96	
605	Welder Truck, Large	10	MI	2,292	0.86	\$4,300
606	Flatbed Dump Truck, Medium	10	MI	6,943	0.73	\$4,500
607	Flatbed Truck	8	MI	4,555	0.70	\$4,500
607P	Flatbed Truck – Pool	8	MI	2,955	0.84	
609	Crew Truck	10	MI	5,840	0.80	\$3,375
610	Sewer Rodders	8	MI	7,613	0.90	\$5,900
611	Pump Out Truck	8	MI	11,508	0.50	\$2,500
612	Paint Spray Truck, Heavy	8	MI	9,026	0.63	\$4,200
613	Telsta, Heavy	8	MI	12,833	1.20	\$11,000
614	Service Compressor Truck, Light	8	MI	7,528	1.00	\$7,500
615	Boom Truck, Light	8	MI	8,706	1.20	\$12,000
617	Compressor Truck, Heavy	8	MI	12,372	0.79	\$4,000
618	Fuel Tankers	8	MI	2,238	0.48	\$2,500
619	Lube Truck	8	MI	365	0.48	\$2,400
620	Sand Blast Truck	8	MI	3,501	1.00	\$6,750
701	Dump Truck, 3 CY, Diesel	8	MI	7,804	0.83	\$5,250
701P	Dump Truck, 3 CY, Diesel – Pool		MI			
702	Dump Truck, 5 CY, Diesel	8	MI	7,037	0.83	\$5,725
703	Dump Truck, (4 x 4) 5 CY	8	MI	8,705	0.85	\$7,000
704	Drain Cleaner – 28,000 GVW	7	MI	4,755	1.00	\$4,000
706	Book Mobile	15	MI	7,969	1.90	\$4,500
707	Flatbed Truck – 26,500+ GVW	7	MI	5,735	0.85	\$3,000
708	Flatbed Dump Truck, Heavy	8	MI	8,502	0.88	\$5,025
710	Recycling Truck, RTI	10	MI	7,688	1.18	\$8,050
711	Wrecker, Light	15	MI	1,227	1.00	\$2,000
712	Service Compress Truck, Heavy	8	MI	8,939	0.75	\$6,275
713	Crane Truck	8	MI	1,783	2.00	\$12,000

ADDENDUM #3
Usage and Assignment Rates for FY 93

New Class	Description	Life	Hr/Mi	Ave Use by Class	93 Usage Rate	FY 93 Assign
714	Tractor Truck, 5th Wheel, Light	10	MI	4,565	1.20	\$3,250
715	Sprinkler Tanker	8	MI	6,711	0.60	\$5,725
716	Dump Truck, Front Loader 29000 GVW	8	MI	12,045	0.75	\$9,900
717	Sweeper	6	MI	11,864	4.20	\$15,800
718	Boom Truck, Heavy	8	MI	4,280	1.16	\$11,000
717A	Sweeper, Airport	10	MI	57	4.00	\$9,000
802	Dump Truck, (6 x 6)	8	MI	12,941	0.90	\$14,600
803	Dump Truck, 8-10 CY	8	MI	15,366	0.85	\$8,500
804	Dump Truck, 10-12 CY	10	MI	17,119	0.85	\$10,400
805	Transfer Truck	10	MI	6,890	0.85	\$13,500
806	Roll-Off Truck	10	MI	17,959	0.70	\$8,750
807	Water Tanker	8	MI	429	4.10	\$6,475
808	Aerial Truck	8	MI	3,397	2.15	\$16,625
809	Truck Tractor, 5th Wheel, Heavy	10	MI	8,035	1.25	\$4,500
809P	Truck Tractor, 5th Wheel, Heavy - Pool	10	MI	6,825	1.50	
810	Drain Cleaner, 54,000 GWV	7	MI	8,575	2.50	\$23,000
811	Refuse Packer RL, 25 CY	10	MI	14,992	1.96	\$12,775
812	Refuse Packer SL, 37 CY	10	MI	10,513	2.85	\$12,950
813	Refuse Packer, SL Automated	10	MI	1,020	2.90	\$14,975
814	Recycling Truck, 40 CY/SL	10	MI	14,516	1.18	\$11,100
816	Refuse Packer RL, 20 CY	10	MI	18,661	1.30	\$9,475
817	Refuse Packer SL, 18 CY	10	MI	11,004	1.30	\$9,425
818	Wrecker, Heavy	20	MI	15,350	1.50	\$5,625
819	Special Compress Truck	10	MI	10,079	0.90	\$5,625
820	Dump Truck, Front Loader -33,000 GVW	8	MI	15,190	1.00	\$10,275
821	Beach Packer	5	MI	5,701	3.00	\$22,500
822	Recycling Truck, FL	10	MI	12,766	1.18	\$13,275
901	Tractor Dozer	8	HR	200	14.00	\$12,000
902	Tractor, Heavy	8	HR	682	9.50	\$8,000

ADDENDUM #3
Usage and Assignment Rates for FY 93

New Class	Description	Life	Hr/Mi	Ave Use by Class	93 Usage Rate	FY 93 Assign
902P	Tractor, Heavy – Pool	8	HR	863	11.80	
903	Tractor, Medium	8	HR	996	10.55	\$4,625
903P	Tractor, Medium – Pool	8	HR	331	13.10	
904	Tractor, Light	8	HR	392	7.00	\$3,200
904P	Tractor, Light – Pool	8	HR	891	8.70	
904G	Tractor, Light – Golf Course	4	HR	392	7.00	\$5,154
905	Tractor, Excavator	10	HR	1,980	5.50	\$33,000
906	Tractor, Beach	8	HR	1,044	21.00	\$6,850
907	Screen, Beach	8	HR	259	35.00	\$6,675
908	Paint Striper, Heavy	7	MI	8,743	2.05	\$17,500
909	Scooters	8	MI	1,950	0.73	\$1,375
909G	Scooters, Golf Course	4	MI	195	0.73	\$2,508
910	Tow Compressor	12	HR	216	7.00	\$1,225
910P	Tow Compressor – Pool	12	HR	1,309	8.40	
911	Wood Chipper	10	HR	568	3.70	\$1,800
912	Fork Lift	10	HR	157	7.70	\$1,375
913	Hydro Hammer	8	HR	97	10.00	\$7,000
914	Tractor, Lawn Mower	7	HR	325	9.28	\$4,000
914G	Tractor, Lawn Mower, Golf Course	4	HR	325	9.28	\$8,183
914M	Tractor, Lawn Mower, Rotary	4	HR	325	0.34	\$3,744
915	Trailer, Utility	10	HR	422	0.75	\$250
915P	Trailer, Utility Pool	10	HR	154	0.90	
916	Trailer, Light Duty	10	HR	551	0.75	\$550
917	Trailer, Medium	10	HR	611	1.75	\$1,100
917P	Trailer, Medium – Pool	10	HR	4	2.19	
918	Milling Machine	8	HR	548	3.40	\$15,000
920	Trailer Rodder	15	HR	62	3.00	\$1,250
921	Compact, Vacuum Sweeper	8	MI	109	5.00	\$9,000
922	Grader, Medium	8	HR	591	9.00	\$8,000

ADDENDUM #3
Usage and Assignment Rates for FY 93

New Class	Description	Life	Hr/Mi	Ave Use by Class	93 Usage Rate	FY 93 Assign
923FI	Tractor, Light	8	HR	135	10.00	\$8,050
924	Roller	10	HR	361	2.30	\$7,000
926	Trailer, Special	10	HR	1,718	2.00	\$1,450
927	Trailer, Heavy Duty	10	HR	1,631	2.25	\$1,450

ADDENDUM #4
THE CALIFORNIA AIR RESOURCES BOARD

Mobile source emission standards summary

A summary of mobile source emission standards adopted as of January 31, 1992

Contents	Page
New Vehicle Standards	
Passenger cars	
1966-79 gasoline	1
1980-92 gasoline and diesel	1
1993 and later gasoline, diesel and methanol	3
low-emission vehicle categories	3
fleet average NMOG requirements	4
Light-duty trucks	
1966-79 gasoline	5
1980-92 gasoline and diesel	6
1993 and later gasoline, diesel and methanol	7
low-emission vehicle categories	8
fleet average NMOG requirements	10
Medium-duty trucks	
1978-94 gasoline and diesel	11
1995 and later gasoline, diesel, and methanol	13
low-emission vehicle requirements	13
low-emission vehicle standards	14
Heavy-duty vehicles	
1969-86 gasoline and diesel	17
1987 and later otto-cycle	17
1987 and later diesel	18
Motorcycles	
1978 and later	19
Additional vehicle emission control requirements	
1970 and later evaporative emissions	21
1982 and later diesel particulate emissions	21
1993 and later formaldehyde emissions	21
low-emission vehicle formaldehyde standards	22
On-board diagnostic system requirements	23
Off-Road Sources	
Small utility engines	
1994 and later	25
Heavy-duty off-road diesel cycle engines	
1996 and later	26

Additional information

For complete information on certification, test procedures, or requirements for small volume manufacturers please consult Title 13, Chapter 3 of the California Code of Regulations.

Prepared by the California Air Resources Board, Mobile Source Division, Program Information Office. For additional copies please call (818) 575-6858.

New Vehicle Standards

Passenger Cars

A passenger car is any vehicle designed primarily for transportation of persons and having a design capacity of 12 persons or less.

1966-79 Gasoline passenger cars

Manufacturers certifying new vehicles to the following standards must demonstrate compliance at 50,000 miles. All standards are expressed in grams per mile unless otherwise noted. See additional standards listings for other emission requirements.

Year		HC	CO	NOx	Notes
1966-67		275ppm	1.5%	---	7 mode test
1968-69	50-100 CID	410	2.3	---	▪
	101-140 CID	350	2.0	---	▪
	over 140 CID	275	1.5	---	▪
From the 1970 model year all emissions are measured in grams per mile (g/m).					
1970		2.2 g/m	23 g/m	---	▪
1971		2.2	23	4.0 g/m	▪
1972		1.5	23	3.0	▪
		3.2	39	3.2	CVS-72
1973		3.2	39	3.0	▪
1974		3.2	39	2.0	▪
1975-76		0.9	9.0	2.0	CVS-75
1977-79		0.41	9.0	1.5	▪

1980-92 Gasoline and Diesel passenger cars

Primary standards

Manufacturers certifying new vehicles to the following standards must demonstrate compliance at 50,000 miles. In 1981 and 1982, manufacturers had the choice of certifying new vehicles to option 1 or option 2 listed below. Manufacturers must certify a minimum of 50% of their 1989 and 85% of their 1990-92 vehicles to the primary 0.4 g/m NOx standard. Those vehicles certified to the optional 0.7 g/m NOx standard are subject to a 7-year/75,000 mile recall for selected emission control parts. See additional standards listings for other emission requirements.

Year	Hydrocarbons		CO	NOx	Notes
	non-methane	total			
1980	0.39 g/m	0.41 g/m	9.0 g/m	1.0 g/m	
1981	---	0.41	3.4	1.0	option 1
1982	0.39	0.41	7.0	0.4	▪
1981	0.39	0.41	7.0	0.7	option 2
1982	0.39	0.41	7.0	0.7	▪
1983-88	0.39	0.41	7.0	0.4	optional
	0.39	0.41	7.0	0.7	
1989-92	0.39	0.41	7.0	0.4	optional
	0.39	0.41	7.0	0.7	

Optional 100,000 mile Gasoline and Diesel passenger car standards

Manufacturers have the option of certifying new vehicles to the following 50,000/100,000 mile standards. Manufacturers must demonstrate compliance with both the 50,000 and 100,000 mile standards for hydrocarbons and carbon monoxide and a 100,000 mile NOx standard. For the 1989 and later model year, only diesel passenger cars may certify to these standards. When applicable, manufacturers can certify vehicles to either non-methane or total hydrocarbon standards.

Year	Mileage	Hydrocarbons		CO	NOx
		non-methane	total		
1980	50,000 miles	0.39 g/m	0.41 g/m	9.0 g/m	1.5 g/m
	100,000	0.46		10.6	1.5
1981	50,000	0.39	0.41	3.4	1.5
	100,000	0.46		4.0	1.5
1982-83	50,000	0.39	0.41	7.0	1.5
	100,000	0.46	---	8.3	1.5
1984-88	50,000	0.39	0.41	7.0	1.0
	100,000	0.46	---	8.3	1.0
1989-92	100,000	0.46	---	8.3	1.0

1993 and later Gasoline, Diesel and Methanol passenger cars

Manufacturers must certify a minimum of 40% of their 1993, 80% of their 1994 and 100% of their 1995 and later passenger cars plus light-duty trucks to the primary standards, with the remainder certifying to the secondary standards. 1993 vehicles certified to the 0.7 g/m NOx standard are subject to a 7 year/ 75,000 mile recall for selected emission control parts. Manufacturers choosing to certify diesel passenger cars to the optional standards must demonstrate compliance at 100,000 miles. Beginning in model year 1994, manufacturers are also required to meet a fleet average NMOG requirement. See additional standards listings for other emission requirements.

Year	Mileage	NMHC	CO	NOx	Notes
1993-94					
primary	50,000 miles	0.25 g/m	3.4 g/m	0.4 g/m	
	50,000	0.25	3.4	0.7	
	100,000	0.31	4.2	---	1993 option only
secondary	50,000	0.39	7.0	0.4	
	50,000	0.39	7.0	0.7	optional
	100,000	0.46	8.3	1.0	diesel option
1995 and later					
primary	50,000	0.25	3.4	0.4	
	100,000	0.31	4.2	---	
	100,000	0.31	4.2	1.0	diesel option

Low-Emission Vehicle Categories

Low-emission vehicles are vehicles operating on any fuel that have been certified by the Air Resources Board to meet the following exhaust emission standards. These emission standards are used to compute the fleet average NMOG. The emissions of alternate fueled vehicles may be adjusted to account for the lower reactivity of the NMOG emissions. Flexible-fuel and dual-fuel vehicles must also certify to the gasoline standards. See additional standards listings for other emission requirements.

50,000 mile standards	NMOG	CO	NOx
Low-emission vehicles			
Transitional Low-Emission Vehicle (TLEV)	0.125 g/m	3.4 g/m	0.4 g/m
Low-Emission Vehicle (LEV)	0.075	3.4	0.2
Ultra Low-Emission Vehicle (ULEV)	0.040	1.7	0.2
Zero Emission Vehicle (ZEV)	zero	zero	zero
Gasoline standards for flexible and dual-fuel low-emission vehicles			
Transitional Low-Emission Vehicle (TLEV)	0.250 g/m	3.4 g/m	0.4 g/m
Low-Emission Vehicle (LEV)	0.125	3.4	0.2
Ultra Low-Emission Vehicle (ULEV)	0.075	1.7	0.2

100,000 Mile Standards

	NMOG	CO	NOx
Low-emission vehicle standards			
Transitional Low-Emission Vehicle (TLEV)	0.156 g/m	4.2 g/m	0.6 g/m
Low-Emission Vehicle (LEV)	0.090	4.2	0.3
Ultra Low-Emission Vehicle (ULEV)	0.055	2.1	0.3
Zero Emission Vehicle (ZEV)	zero	zero	zero

Gasoline standards for flexible and dual-fueled low-emission vehicles

Transitional Low-Emission Vehicle (TLEV)	0.310 g/m	4.2 g/m	0.6 g/m
Low-Emission Vehicle (LEV)	0.156	4.2	0.3
Ultra Low-Emission Vehicle (ULEV)	0.090	2.1	0.3

Fleet average NMOG requirements

In addition to the individual model year exhaust emission standards, a manufacturer's fleet average NMOG emissions must not exceed the following levels. Compliance with the fleet average requirements is met by averaging the vehicles certified to the primary, secondary or optional standards with vehicles certified to the low-emission vehicle categories. In order to receive credit for the lower NMOG of a low-emission vehicle category, a vehicle must meet the CO and NOx standard for the category to which it is certifying. NMOG emissions include oxygenated and non-oxygenated hydrocarbons. Beginning in 1998, a minimum percentage of each manufacturer's sales will be required to be zero-emission vehicles.

Year	NMOG	Percentage of ZEV's required
1994	0.250 g/m	
1995	0.231	
1996	0.225	
1997	0.202	
1998	0.157	2%
1999	0.113	2%
2000	0.073	2%
2001	0.070	5%
2002	0.068	5%
2003 and later	0.062	10%

Light-Duty Trucks

A light-duty truck is any motor vehicle rated at 6000 pounds gross vehicle weight or less which is designed primarily for purposes of transportation of property or is a derivative of such vehicle, or is available with special features enabling off-street or off-highway operation and use.

1966-79 Gasoline light-duty trucks standards

Manufacturers certifying new vehicles to the following standards must demonstrate compliance at 50,000 miles. For 1979 vehicles the standards are dependent on equivalent inertia weight. See additional standards listings for other emission requirements.

Year		HC	CO	NOx	Notes
1966-67		275ppm	1.5%	---	7 mode test
1968-69	50-100 CID	410	2.3	---	▪
	101-140 CID	350	2.0	---	▪
	over 140 CID	275	1.5	---	▪
From the 1970 model year all emissions are measured in grams per mile (g/m).					
1970		2.2 g/m	23 g/m	---	▪
1971		2.2	23	4.0 g/m	▪
1972		1.5	23	3.0	▪
		3.2	39	3.2	CVS-72
1973		3.2	39	3.0	▪
1974		3.2	39	2.0	▪
1975-76		0.9	9.0	2.0	CVS-75
1977-79	0-3999	0.41	9.0	1.5	▪
	0-3999 FWD	0.41	9.0	2.0	
	4000-5999	0.5	9.0	2.0	

1980-92 Gasoline and Diesel light-duty trucks standards

Manufacturers certifying new vehicles to the following standards must demonstrate compliance at 50,000 miles. For 1979-87 vehicles the standards are dependent on equivalent inertia weight, and for 1988-92 vehicles the standards are based on loaded vehicle weight. Manufacturers must certify a minimum of 50% of their 1989 and 85% of their 1990-92 vehicles to the primary 0.4 g/m NOx standard. Those vehicles certified to the optional 1.0 g/m NOx standard are subject to a 7-year/75,000 mile recall for selected emission control parts. See additional standards listings for other emission requirements.

Year	Weight (lbs.)	Hydrocarbons		CO	NOx	Notes
		non-methane	total			
1980	0-3999	0.39 g/m	0.41 g/m	9.0 g/m	1.5 g/m	
	0-3999 FWD	0.39	0.41	9.0	2.0	
	4000-5999	0.50	0.50	9.0	2.0	
1981-82	0-3999	0.39	0.41	9.0	1.0	
	4000-5999	0.50	0.50	9.0	1.5	
1983-87	0-3999	0.39	0.41	9.0	0.4	
		0.39	0.41	9.0	1.0	optional
	4000-5999	0.50	0.50	9.0	1.0	
1988	0-3750	0.39	0.41	9.0	0.4	
		0.39	0.41	9.0	1.0	optional
	3751-5750	0.50	0.50	9.0	1.0	
1989-92	0-3750	0.39	0.41	9.0	0.4	
		0.39	0.41	9.0	1.0	optional
	3751-5750	0.50	0.50	9.0	1.0	

Optional 100,000 mile Gasoline and Diesel light-duty truck standards

Manufacturers have the option of certifying new vehicles to the following 50,000/100,000 mile standards. Manufacturers must demonstrate compliance with both the 50,000 and 100,000 mile standards for hydrocarbons and carbon monoxide and a 100,000 mile NOx standard. For the 1989 and later model year only diesel light-duty trucks may certify to these standards. When applicable, manufacturers can certify vehicles to either non-methane or total hydrocarbon standards. For 1979-87 vehicles the standards are dependent on equivalent inertia weight, and for 1988-92 vehicles the standards are based on loaded vehicle weight.

Year	Weight (lbs.)	Mileage (miles)	Hydrocarbons		CO	NOx
			non-methane	total		
1981-83	0-3999	50,000	0.39 g/m	0.41 g/m	9.0 g/m	1.5 g/m
		100,000	0.46	—	10.6	1.5
	4000-5999	100,000	0.50	0.50	9.0	2.0
1984-87	0-3999	50,000	0.39	0.41	9.0	1.0
		100,000	0.46	—	10.6	1.0
	4000-5999	100,000	0.50	0.50	9.0	1.5
1988	0-3750	50,000	0.39	0.41	9.0	1.0
		100,000	0.46	—	10.6	1.0
	3751-5750	100,000	0.50	0.50	9.0	1.5
1989-92	0-3750	100,000	0.46	—	10.6	1.0
	3751-5750	100,000	0.50	0.50	9.0	—

2 of 2

1993 and later Gasoline, Diesel and Methanol light-duty truck standards

Manufacturers must certify a minimum of 40% of their 1993, 80% of their 1994, and 100% of their 1995 and later light-duty trucks plus passenger cars to the primary standards, with the remainder certifying to the secondary standards. 1993 vehicles certified to the 0.7 g/m NOx standard are subject to a 7 year/ 75,000 mile recall for selected emission control parts. Manufacturers choosing to certify diesel passenger cars to the optional standards must demonstrate compliance at 100,000 miles. Beginning in model year 1994, manufacturers are also required to meet a fleet average NMOG requirement. See additional standards listings for other emission requirements.

Year	Weight	Mileage	NMHC	CO	NOx	Notes
1993-94						
Primary	0-3750 lbs.	50,000	0.25 g/m	3.4 g/m	0.4 g/m	
		50,000	0.25	3.4	0.7	1993 option only
		100,000	0.31	4.2	—	
		100,000	0.31	4.2	1.0	diesel option
	3751-5750	50,000	0.32	4.4	1.0	
		100,000	0.40	5.5	—	
		100,000	0.40	5.5	1.5	diesel option
secondary	0-3750	50,000	0.39	9.0	0.4	
		50,000	0.39	9.0	0.7	optional
		100,000	0.46	10.6	1.0	diesel option
	3751-5750	50,000	0.50	9.0	1.0	
		100,000	0.50	9.0	1.5	diesel option
1995 and later						
	0-3750	50,000	0.25	3.4	0.4	
		100,000	0.31	4.2	—	
		100,000	0.31	4.2	1.0	diesel option
	3751-5750	50,000	0.32	4.4	0.7	
		100,000	0.40	5.5	—	
		100,000	0.40	5.5	1.5	diesel option

Low-emission vehicle categories for light-duty trucks

Low-emission vehicles are vehicles operating on any fuel that have been certified by the Air Resources Board to meet the following exhaust emission standards. These emission standards are used to compute the fleet average NMOG. The emissions of alternate fueled vehicles may be adjusted to account for the lower reactivity of the NMOG emissions. Flexible-fuel and dual-fuel vehicles must also certify to the gasoline standards. See additional standards listings for other emission requirements.

Light-duty trucks

(0-3750 lbs.) 50,000 mile standards

	NMOG	CO	NOx
Low-emission vehicle standards			
Transitional Low-Emission Vehicle (TLEV)	0.125 g/m	3.4 g/m	0.4 g/m
Low-Emission Vehicle (LEV)	0.075	3.4	0.2
Ultra Low-Emission Vehicle (ULEV)	0.040	1.7	0.2
Zero Emission Vehicle (ZEV)	zero	zero	zero

Gasoline standards for flexible and dual-fuel low-emission vehicles

Transitional Low-Emission Vehicle (TLEV)	0.250 g/m	3.4 g/m	0.4 g/m
Low-Emission Vehicle (LEV)	0.125	3.4	0.2
Ultra Low-Emission Vehicle (ULEV)	0.075	1.7	0.2

(0-3750 lbs.) 100,000 mile standards

	NMOG	CO	NOx
Low-emission vehicle standards			
Transitional Low-Emission Vehicle (TLEV)	0.156 g/m	4.2 g/m	0.6 g/m
Low-Emission Vehicle (LEV)	0.090	4.2	0.3
Ultra Low-Emission Vehicle (ULEV)	0.055	2.1	0.3
Zero Emission Vehicle (ZEV)	zero	zero	zero

Gasoline standards for Flexible and dual-fuel low-emission vehicles

Transitional Low-Emission Vehicle (TLEV)	0.310 g/m	4.2 g/m	0.6 g/m
Low-Emission Vehicle (LEV)	0.156	4.2	0.3
Ultra Low-Emission Vehicle (ULEV)	0.090	2.1	0.3

(3751-5750 lbs.) 50,000 mile standards	NMOG	CO	NOx
Low-emission vehicle standards			
Transitional Low-Emission Vehicle (TLEV)	0.160 g/m	4.4 g/m	0.7 g/m
Low-Emission Vehicle (LEV)	0.100	4.4	0.4
Ultra Low-Emission Vehicle (ULEV)	0.050	2.2	0.4
Zero Emission Vehicle (ZEV)	zero	zero	zero
Gasoline standards for flexible and dual fuel low-emission vehicles			
Transitional Low-Emission Vehicle (TLEV)	0.320 g/m	4.4 g/m	0.7 g/m
Low-Emission Vehicle (LEV)	0.160	4.4	0.4
Ultra Low-Emission Vehicle (ULEV)	0.100	2.2	0.4
(3751-5750 lbs.) 100,000 mile standards			
Low-Emission Vehicle standards			
Transitional Low-Emission Vehicle (TLEV)	0.200 g/m	5.5 g/m	0.9 g/m
Low-Emission Vehicle (LEV)	0.130	5.5	0.5
Ultra Low-Emission Vehicle (ULEV)	0.070	2.8	0.5
Zero Emission Vehicle (ZEV)	zero	zero	zero
Gasoline standards for Flexible and Dual fuel Low-Emission vehicles			
Transitional Low-Emission Vehicle (TLEV)	0.400 g/m	5.5 g/m	0.9 g/m
Low-Emission Vehicle (LEV)	0.200	5.5	0.5
Ultra Low-Emission Vehicle (ULEV)	0.130	2.8	0.5s

Fleet average NMOG requirements

In addition to the individual model year exhaust emission standards, a manufacturer's fleet average NMOG emissions must not exceed the following levels. Compliance with the fleet average requirements is met by averaging the vehicles certified to the primary, secondary or optional standards with vehicles certified to the low-emission vehicle categories. In order to receive credit for the lower NMOG of a low-emission vehicle category, a vehicle must meet the CO and NO_x standard for the category to which it is certifying. NMOG emissions include oxygenated and non-oxygenated hydrocarbons. Beginning in 1998, a minimum percentage of each manufacturer's sales will be required to be zero-emission vehicles.

Year	0-3750 lbs.	3751-5750 lbs.	% ZEV required
1994	0.250 g/m	0.320 g/m	(0-3750 lbs. only)
1995	0.231	0.295	
1996	0.225	0.287	
1997	0.202	0.260	
1998	0.157	0.205	2%
1999	0.113	0.150	2
2000	0.073	0.099	2
2001	0.070	0.098	5
2002	0.068	0.095	5
2003 and later	0.062	0.093	10

Medium-duty Vehicles

A medium-duty vehicle is defined as any pre-1995 heavy-duty vehicle having a manufacturer's gross vehicle weight (GVW) of 8,500 pounds or less, or any 1995 and later model year heavy-duty vehicle having a GVW of 14,000 pounds or less. Manufacturers may elect to certify pre-1995 vehicles up to 10,000 pounds GVW as medium-duty vehicles.

1978-94 Gasoline and Diesel medium-duty vehicles

Manufacturers certifying new vehicles to the following standards must demonstrate compliance at 50,000 miles. For medium-duty vehicles before 1978, see the heavy-duty vehicle standards. For 1981-87 vehicles the standards are dependent on equivalent inertia weight, and for 1988-94 vehicles the standards are based on loaded vehicle weight. 1983-88 NOx standards are based on a production average. 1983-88 medium-duty vehicles that certify to the 1.0 g/m NOx standard are subject to a 7-year/75,000 mile recall for selected emission control parts. Manufacturers must certify a minimum of 50% of their 1989 and 85% of their 1990-93 medium-duty vehicles (0-3750 lbs LVW) to the primary 0.4 g/m NOx standard. See additional standards listings for other emission requirements.

Year	Weight (lbs.)	Hydrocarbons		CO	NOx	Notes
		non-methane	total			
1978-79	all	0.9 g/m	—	17 g/m	2.3 g/m	
1980	all	0.9	0.9	17	2.3	
1981-82	0-3999	0.39	0.41	9.0	1.0	
	4000-5999	0.50	0.50	9.0	1.5	
	6000-8500	0.60	0.60	9.0	2.0	
1983-87	0-3999	0.39	0.41	9.0	0.7	
		0.39	0.41	9.0	1.0	optional
	4000-5999	0.50	0.50	9.0	1.0	
	6000-8500	0.60	0.60	9.0	1.5	
1988	0-3750	0.39	0.41	9.0	0.7	
		0.39	0.41	9.0	1.0	optional
	3751-5750	0.39	0.41	9.0	1.0	
	5751-8750	0.50	0.50	9.0	1.0	
1989	0-3750	0.39	0.41	9.0	0.4	primary
		0.39	0.41	9.0	0.7	
	3751-5750	0.50	0.50	9.0	1.0	
	5751-8750	0.60	0.60	9.0	1.5	
1990-94	0-3750	0.39	0.41	9.0	0.4	primary
		0.39	0.41	9.0	0.7	
	3751-5750	0.50	0.50	9.0	1.0	
	5751-8750	0.60	0.60	9.0	1.5	

Optional 100,000 miles Medium-duty vehicle standards

Manufacturers may choose to certify medium-duty vehicles to these optional emission standards. Manufacturers must demonstrate compliance with both the 50,000 and 100,000 mile standards. When applicable, manufacturers can certify vehicles to either non-methane or total hydrocarbon standards. For 1979-87 vehicles the standards are dependent on equivalent inertia weight, and for 1988-92 vehicles the standards are based on loaded vehicle weight. 1989 and later standards are only applicable to diesel medium-duty vehicles. See additional standards listings for other emission requirements.

Year	Weight (lbs.)	Mileage (miles)	Hydrocarbons		CO	NOx
			non-methane	total		
1981-82	0-3999	50,000	0.39 g/in	0.41 g/m	9.0 g/m	---
		100,000	0.46	---	10.6	1.5 g/m
	4000-5999	50,000	0.50	0.50	9.0	---
		100,000	---	---	---	2.0
	over 5999	50,000	0.60	0.60	9.0	---
		100,000	---	---	---	2.3
1983	0-3999	50,000	0.39	0.41	9.0	---
		100,000	0.46	---	10.6	1.5
	4000-5999	50,000	0.50	0.50	9.0	---
		100,000	---	---	---	2.0
	over 5999	50,000	0.60	0.60	9.0	---
		100,000	---	---	---	2.0
1984-87	0-3999	50,000	0.39	0.41	9.0	---
		100,000	0.46	---	10.6	1.0
	4000-5999	50,000	0.50	0.50	9.0	---
		100,000	---	---	---	1.5
	over 5999	50,000	0.60	0.60	9.0	---
		100,000	---	---	---	2.0
1988	0-3750	50,000	0.39	0.41	9.0	---
		100,000	0.46	0.41	10.6	1.0
	3751-5750	50,000	0.50	0.50	9.0	---
		100,000	---	---	---	1.0
	over 5750	50,000	0.60	0.60	9.0	---
		100,000	---	---	---	2.0
1989-94	0-3750	100,000	0.46	---	10.6	1.0
		3751-5750	50,000	0.50	9.0	---
		100,000	---	---	---	1.0
	over 5750	50,000	0.60	0.60	9.0	---
		100,000	---	---	---	2.0

1995 and later medium-duty vehicle standards

Manufacturers certifying new vehicles to the following standards must demonstrate compliance to the 50,000 and 120,000 mile standards. Standards are based on loaded vehicle weight (LVW). The particulate standards are for diesel medium-duty vehicles. The following standards are further modified by more stringent medium-duty low-emission vehicle phase-in standards. For the 1995 model year only, manufacturers may certify a maximum of 50% of their vehicles to the applicable 1994 model year standards and test procedures. See additional standards listings for other emission requirements.

1995 and later

Weight (lbs.)	Mileage (miles)	NMOG	CO	NOx	PM
0-3750	50,000	0.25 g/m	3.4 g/m	0.4 g/m	---
	120,000	0.36	5.0	0.55	0.08 g/m
3751-5750	50,000	0.32	4.4	0.7	---
	120,000	0.46	6.4	0.98	0.10
5751-8500	50,000	0.39	5.0	1.1	---
	120,000	0.56	7.3	1.53	0.12
8501-10,000	50,000	0.46	5.5	1.3	---
	120,000	0.66	8.1	1.81	0.12
10,001-14,000	50,000	0.60	7.0	2.0	---
	120,000	0.86	10.3	2.77	0.12

Medium-duty low-emission vehicle requirements

Beginning in 1998, a minimum percentage of all medium-duty vehicles will be required to be certified as low-emission vehicles. Manufacturers which sell LEVs, ULEVs, and ZEVs prior to 1998 would be eligible to earn credits. Credits may be earned beginning in the 1992 model year by meeting the LEV or ULEV standards. Credits earned could be applied to the production requirements starting in the 1998 model year.

Year	LEV	ULEV
1998	25%	2%
1999	50	2
2000	75	2
2001	95	5
2002	90	10
2003	85	15

Low-Emission and Ultra-Low-Emission medium-duty vehicle standards

To certify as a low-emission vehicle (LEV) or ultra-low-emission vehicle (ULEV) with the Air Resources Board, the exhaust emissions from new 1992 and later alternate fueled medium-duty vehicles shall not exceed the following standards. The emissions of alternate fueled vehicles may be adjusted to account for the lower reactivity of the NMOG emissions. Flexible-fuel and dual-fuel vehicles must also certify to the gasoline standards. See additional standards listings for other emission requirements.

Low-emission vehicle standards

LEV category

Weight (lbs.)	Mileage	NMOG (miles)	CO	NOx	PM
0-3750	50,000	0.125 g/m	3.4 g/m	0.4 g/m	---
	120,000	0.180	5.0	0.6	0.08 g/m
3751-5750	50,000	0.160	4.4	0.7	---
	120,000	0.230	6.4	1.0	0.10
5751-8500	50,000	0.195	5.0	1.1	---
	120,000	0.280	7.3	1.5	0.12
8501-10,000	50,000	0.230	5.5	1.3	---
	120,000	0.330	8.1	1.8	0.12
10,001-14,000	50,000	0.300	7.0	2.0	---
	120,000	0.430	10.3	2.8	0.12

ULEV category

Weight (lbs.)	Mileage	NMOG (miles)	CO	NOx	PM
0-3750	50,000	0.075 g/m	1.7 g/m	0.2 g/m	---
	120,000	0.107	2.5	0.3	0.04
3751-5750	50,000	0.100	2.2	0.4	---
	120,000	0.143	3.2	0.5	0.05
5751-8500	50,000	0.117	2.5	0.6	---
	120,000	0.167	3.7	0.8	0.06
8501-10,000	50,000	0.138	2.8	0.7	---
	120,000	0.197	4.1	0.9	0.06
10,001-14,000	50,000	0.180	3.5	1.0	---
	120,000	0.257	5.2	1.4	0.06

Gasoline standards for flexible and dual-fueled Low-Emission Vehicles

LEV category

Weight (lbs.)	Mileage	NMOG (miles)	CO	NOx	PM
0-3750	50,000	0.25 g/m	3.4 g/m	0.4 g/m	---
	120,000	0.36	5.0	0.6	0.08
3751-5750	50,000	0.32	4.4	0.7	---
	120,000	0.46	6.4	1.0	0.10
5751-8500	50,000	0.39	5.0	1.1	---
	120,000	0.56	7.3	1.5	0.12
8501-10,000	50,000	0.46	5.5	1.3	---
	120,000	0.66	8.1	1.8	0.12
10,001-14,000	50,000	0.60	7.0	2.0	---
	120,000	0.86	10.3	2.8	0.12

ULEV category

Weight (lbs.)	Mileage	NMOG (miles)	CO	NOx	PM
0-3750	50,000	0.125	1.7	0.2	---
	120,000	0.190	2.5	0.3	0.04
3751-5750	50,000	0.160	2.2	0.4	---
	120,000	0.230	3.2	0.5	0.05
5751-8500	50,000	0.195	2.5	0.6	---
	120,000	0.280	3.7	0.8	0.06
8501-10,000	50,000	0.230	2.8	0.7	---
	120,000	0.330	4.1	0.9	0.06
10,001-14,000	50,000	0.300	3.5	1.0	---
	120,000	0.430	5.2	1.4	0.06

Heavy-duty engines and vehicles

A heavy-duty vehicle is any vehicle with a gross vehicle weight rating of over 6000 pounds, excluding light-duty trucks and 1978 and later medium-duty vehicles.

1969-86 Heavy-duty engines and vehicles

These standards apply to 1969 and newer gasoline vehicles and 1973 and newer diesel vehicles. 1969-78 emission standards are measured using the non-dispersive infrared method (NDIR). For 1979 only, manufacturers had the choice of using the NDIR method standard or the heated flame ionization detection method (HFID) standard, both are equivalent in stringency. From 1980 emissions are measured with the HFID method. All 1969-83 tests are steady state and 1984-86 vehicles could be certified to either a steady state standard or a transient standard. 1985 and newer diesel vehicles must be certified to the transient standard. All standards are expressed as grams per brake-horsepower-hour (g/bhp-hr) unless otherwise noted. See additional standards listings for other emission requirements.

Year		HC	CO	NOx	HC and NOx
1969-71		275 ppm	1.5%	---	---
1972		189	1.0	---	---
From 1973 model year all standards are measured in grams per brake horsepower hour (g/bhp-hr)					
1973-74		---	40 g/bhp-hr	---	16 g/bhp-hr
1975-76		---	30	---	10
1977-78		---	25	---	5
1979		1.0 g/bhp-hr	25	7.5 g/bhp-hr	---
	HFID method	1.5	25	7.5	---
	NDIR method	1.0	25	7.5	---
1980-83		---	25	---	5
		1.0	25	---	6.0
		---	25	---	5
1984-86	steady state	0.5	25	---	4.5
	transient	1.3	15.5	5.1	---

1987 and later Otto-Cycle engines

These standards apply to gasoline, methanol, and all applicable gaseous-fueled engines except those engines derived from existing diesel-cycle engines. All vehicles are certified using the transient test procedure. Manufacturers of gasoline, natural gas, or liquefied petroleum gas engines may choose to certify to the total or the optional non-methane hydrocarbon standard. All standards are expressed as grams per brake-horsepower-hour (g/bhp-hr) unless otherwise noted. See additional standards listings for other emission requirements.

Year	Weight lbs.	Hydrocarbons		CO	NOx
		Total	non-methane		
1987	8501-14,000	1.1	---	14.4	10.6
	over 14,000	1.9	---	37.1	10.6
1988-90	8501-14,000	1.1	---	14.4	6.0
	over 14,000	1.9	---	37.1	6.0
1991 and later	8501-14,000	1.1	0.9	14.4	5.0
	over 14,000	1.9	1.7	37.1	5.0

1987 and later Diesel engines

These standards apply to diesel, methanol, and all applicable gaseous-fueled engines including those engines derived from existing diesel-cycle engines. All vehicles are certified using the transient test procedure. Manufacturers of diesel, natural gas, or liquefied petroleum gas engines may choose to certify to either the total or the optional non-methane hydrocarbon standard. All standards are expressed as grams per brake-horsepower-hour (g/bhp-hr) unless otherwise noted. See additional standards listings for other emission requirements.

Year	HC	NMOG	CO	NOx	Particulates
1987 optional	1.3	—	15.5	5.1	—
1987-90	1.3	—	15.5	6.0	0.60
1991-93	1.3	1.2	15.5	5.0	0.25
1991-93 urban bus engines	—	—	—	—	0.10
1994 and later	1.3	1.2	15.5	5.0	0.10

Additional heavy-duty engine and vehicle requirements

The opacity level of smoke for 1988 and later model year heavy duty diesel engines is 20% during engine acceleration, 15% during engine lugging, and 50% during the peaks in either mode. The smoke opacity test procedure is described in Title 40, CFR, Part 86, Subpart I.

Carbon Monoxide emissions from engines utilizing exhaust after treatment technology shall not exceed 0.5 percent of the exhaust gas flow at curb idle. This is effective for 1987 and later model years.

Motorcycles

A motorcycle is a motor vehicle other than a tractor having a seat or saddle for the use of the rider and designed to travel on not more than three wheels in contact with the ground and weighing less than 1500 pounds, except that four wheels may be contact with the ground when two wheels function as a sidecar.

1978 and later Motorcycles

These standards are expressed as grams per kilometer (g/km). Motorcycle engine displacement is measured in cubic centimeters (cc). Standards for 1985 and later motorcycles, 280 cc or greater must be met on a corporate average basis.

Year	Displacement (cc)	HC	CO
1978-79	50-169	5.0 g/km	17 g/km
	170-749	X g/km	17
	over 750	14.0	17
1980-81	50 and over	5.0	17
1982-2/85	50-279	1.0	12
	280 and over	2.5	12
3/85-1987	50-279	1.0	12
	280 and over	1.4	12
1988 and later	50-279	1.0	12
	280-699	1.0	12
	700 and over	1.4	12

$$X = 5.0 + 0.0155(D - 170)$$

D=Engine displacement

Additional Emission Requirements

1970 and later Evaporative Emissions Standards

Evaporative emissions standards were based upon the carbon trap procedure until 1977, which became obsolete when the Sealed Housing Evaporative Determination (SHED) test procedure was adopted for 1978 and later model years. The SHED standards, which are based on hot soak and diurnal emissions, apply to all 1978 and later gasoline, 1983 and later liquid petroleum, and 1993 and later methanol passenger cars, light-duty trucks, medium-duty vehicles, heavy-duty vehicles.

Year	Test type	Hydrocarbons
1970-71	carbon trap	6.0 g/test
1972-77	carbon trap	2.0
1978-79	SHED	6.0
1980-94	SHED	2.0

Beginning in 1995, in addition to the hot soak and diurnal emission standards, a running loss standard will be phased in over a four year period for the "useful life" of the vehicles. The useful life is defined in Title 13 of the California Code of Regulations. These standards do not apply to petroleum fueled diesel vehicles.

Year	Hydrocarbons	
	diurnal + hot soak	running loss
1995 and later	2.0 g/test	0.05 g/m

1982 and later Diesel particulate matter standards

Diesel passenger cars and light-duty trucks are subject to the following 50,000 mile particulate exhaust standards. Medium duty vehicle particulate standards vary according to the test weight classification and low-emission vehicle category of the vehicle, for further information please see medium-duty vehicle section.

Year	Particulate matter
1982-84	0.6 g/m
1985	0.4
1986-1988	0.2
1989 and later	0.08

1993 and later Formaldehyde standards

Manufacturers of methanol and flexible fueled passenger cars, light-duty trucks and medium-duty vehicles must comply with the following formaldehyde standards at 50,000 miles. The standards are in milligrams per mile.

Vehicle Type	Weight (lbs.)	Formaldehyde
Passenger cars	All	15 mg/m
Light-duty trucks and	0-3750	15
Medium-duty vehicles	3751-5750	18
Medium-duty vehicles	5751-8750	22
	8751-10,000	28
	10,001-14,000	36

Low-Emission Vehicle Formaldehyde Exhaust Emission Standards

Passenger cars, light-duty trucks and medium-duty vehicles that have been certified by the Air Resources Board as low-emission vehicles must also meet the following formaldehyde standards. The standards are in milligrams per mile.

Vehicle Type	Weight (lbs.)	Mileage (Miles)	Category	Formaldehyde
PC and LDT	All 0-3750	50,000	TLEV	15 mg/m
			LEV	15
			ULEV	8
		100,000	TLEV	18
			LEV	18
			ULEV	11
LDT	3751-5750	50,000	TLEV	18
			LEV	18
			ULEV	9
		100,000	TLEV	23
			LEV	23
			ULEV	13
MDV	0-3750	50,000	LEV	15
			ULEV	8
		120,000	LEV	22
			ULEV	12
MDV	3751-5750	50,000	LEV	18
			ULEV	9
		120,000	LEV	27
			ULEV	13
MDV	5751-8500	50,000	LEV	22
			ULEV	11
		120,000	LEV	32
			ULEV	16
MDV	8501-10,000	50,000	LEV	28
			ULEV	14
		120,000	LEV	40
			ULEV	21
MDV	10,001-14,000	50,000	LEV	36
			ULEV	18
		120,000	LEV	52
			ULEV	26

Methanol heavy-duty vehicle formaldehyde standards

year	Formaldehyde
1993-95	0.10 g/bhp-hr.
1996 and later	0.05 g/bhp-hr.

On-Board Diagnostic System Requirements

Beginning with the 1988 model-year, passenger cars, light-duty trucks and medium-duty vehicles with feedback control systems and three-way catalyst systems are required to be equipped with an on-board diagnostic (OBD I) system. There will be a phase in period of three years.

Beginning with the 1994 model-year, passenger cars, light-duty trucks and medium-duty vehicles with feedback control systems and three-way catalyst systems are required to be equipped with an on-board diagnostic (OBD II) system. There will be a phase in period of two years

Off-road sources

Utility Engines

Utility engines are engines used in lawn and garden equipment and other general utility equipment.

Standards adopted by the Air Resources Board apply to small utility and lawn and garden equipment that is powered by gasoline or diesel engines rated at 25 horsepower or less. Standards are based on total engine displacement in cubic centimeters (cc).

1994 and later small utility engines

All standards are expressed in grams per brake-horsepower-hour (g/bhp-hr). Handheld equipment is subject to separate emission standards. Handheld equipment is defined as equipment in which the operator is required to fully support the equipment's weight for the equipment to properly perform its design function or equipment that requires the capability of operating in any position to properly perform its design function. No new engines shall be produced for sale to replace pre-1994 model equipment after January 1, 1999, unless those engines comply with the 1994 model emission standards.

Non-handheld equipment

Year	Displacement	HC and NOx	CO	Diesel PM
1994-98	less than 225 cc	12.0 g/bhp-hr	300 g/bhp-hr	0.9 g/bhp-hr
	225 cc and greater	10.0	300	0.9
1999 and later	all	3.2	100	0.25

Hand held equipment

Year	Displacement	HC	CO	NOx
1994-98	less than 20 cc	220 g/bhp-hr	600 g/bhp-hr	4.0 g/bhp-hr
	20cc to less than 50 cc	180	600	4.0
	50 cc and greater	120	300	4.0
1999 and later	all	50	130	0.25

Heavy-duty off-road diesel cycle engines

The heavy-duty off-road engines subject to regulation are those diesel cycle engines greater than 175 horsepower, that are designed to be used in, but not limited to use in, the following applications: agricultural tractors, backhoes, excavators, dozers, log skidders, trenchers, motor graders, portable generators and compressors, and other miscellaneous applications.

Specifically excluded from the heavy-duty off road engine category are: locomotive engines, engines used to propel marine vessels, stationary internal combustion engines, transportable engines subject to district permitting rules which have been operated at a location for a period of one year or more on January 1, 1997, and stationary or transportable gas turbines for power generation.

1996 and later heavy-duty diesel engines

All standards are expressed in grams per brake-horsepower-hour, off-road steady state cycle test. Engines greater than 750 horsepower are subject to separate standards. Compliance with the standards is based upon the date of production of the engine, not the date of sale. No new engines shall be produced for sale to replace pre-1996 model equipment after January 1, 2000, unless those engines comply with the 1996 model emission standards.

175-750 horsepower engines

Year	HC	CO	NOx	PM
1996-2000	1.0 g/bhp-hr	8.5 g/bhp-hr	6.9 g/bhp-hr	0.4 g/bhp-hr
2001 and later	1.0	8.5	5.8	0.16

Engines greater than 750 horsepower

Year	HC	CO	NOx	PM
2000 and later	1.0 g/bhp-hr	8.5 g/bhp-hr	6.9 g/bhp-hr	0.4 g/bhp-hr

Additional heavy-duty off-road diesel engine requirements

The opacity level of smoke from 1996 and later engines is as follows:

175-750 horsepower engines

Year	Mode: Lugging	Acceleration	Peak level
1996-2000	15% opacity	20% opacity	50% opacity
2001 and later	15	20	35

engines greater than 750 horsepower

Year	Mode: Lugging	Acceleration	Peak level
2000 and later	15% opacity	20% opacity	50% opacity

ADDENDUM #5

STATE OF CALIFORNIA THE RESOURCES AGENCY

PETE WILSON, Governor

CALIFORNIA ENERGY COMMISSION

1516 NINTH STREET
SACRAMENTO, CA 95814 5512

NOTICE OF AVAILABILITY

CALIFORNIA OXYGENATE OUTLOOK

The California Oxygenate Report summarizes the worldwide, United States, and California market outlook for oxygenated fuels which are required by federal and state air quality laws and regulations. These fuels include alcohols (methanol and ethanol) that can be used as neat or near neat fuels, and alcohol-derived ethers such as methyl tertiary butyl ether (MTBE), tertiary amyl methyl ether (TAME) and ethyl tertiary butyl ether (ETBE) that are used to increase the oxygen content of gasoline.

The report concludes that the U.S. will have sufficient supplies of oxygenates for the carbon monoxide (CO) nonattainment areas during the required wintertime driving season. To meet the demand for the oxygenates would, however, require off-season production and storage of the alcohols and ethers to cover the seasonal demand. This projected demand for oxygenates will be met with the present and planned increases in production capacity.

By the mid-1990's, reformulated gasoline (requiring two percent oxygen by weight) will be mandated for areas with extreme to severe ozone levels for year around use. This mandate will place additional demand on the alcohol and ether markets. The report concludes that the availability of oxygenates for reformulated gasoline used in the mandated areas can be met with the planned capacity increases based on announced plans by industry.

If areas with ozone conditions not classified as extreme to severe are required to use reformulated gasoline, a tight supply situation could exist. If the EPA manages the entry of "opt-in" areas outside the mandated areas, however, then the reformulated gasoline market should not experience a shortfall of supplies. In the 1997 timeframe and beyond, the development of additional oxygenates and alcohol supplies will nevertheless be necessary to avoid a supply shortfall.

The report is now available from the Commission's Publications Unit. Copies may be obtained by writing to:

California Energy Commission
Publications Unit
1516 9th Street, MS 13
Sacramento, California 95814

Single copies of the *California Oxygenate Report* (Publication Number P300-93-002) are available at no cost. Additional copies may be purchased for \$5.60 each, including postage. Full payment must accompany the order. To expedite the order, please: (1) return this notice with the reverse side completed (number of copies and total cost); and (2) include the enclosed mailing label with address written or typed in the appropriate area.

Mailed to Lists 24, 72, 74, 75

California Energy Commission

DATE _____

IMPORTANT..PLEASE INCLUDE A SELF-ADDRESSED MAILING LABEL

- o Please allow four to six weeks for delivery
- o Your payment must accompany this order
- o Documents and Publications prices are subject to change without prior notice
- o There is a charge for bulk orders of any specific No Charge (NC) publication

ADDENDUM #6 Research Evaluation Summary-Proposed Regulations for Low-Emission Vehicles and Clean Fuels, August 13, 1990, CARB pg72

Low Emission Vehicle/Clean Fuels Possible Scenarios	Cost Per Pound of Ozone Precursors Reduced	
	Gasoline @ \$1.35	Gasoline @ \$1.45
Scenario A--TLEVs, LEVs, ULEVs, use gasoline. ZEVs use electricity	\$.70	\$.55
Scenario B--TLEVs, LEVs, ULEVs, use methanol. ZEVs use electricity	\$3.30	\$1.50
Scenario C--TLEVs use gasoline. LEVs use methanol. ULEVs use CNG. ZEVs use electricity	\$2.50	\$.75
Scenario D--TLEVs use gasoline. 80% of LEVs use methanol. 20% of LEVs use ethanol. 50% of ULEVs use CNG. 50% of ULEVs use LPG. ZEVs use electricity.	\$4.90	\$3.20
Scenario E--TLEVs, LEVs use gasoline. ULEVs use CNG. ZEVs use electricity.	\$.40	\$.02

Low Emission Vehicle/Clean Fuels Possible Scenarios	Cost Per Potential Cancer Case Reduced (in millions)	
	Gasoline @ \$1.35	Gasoline @ \$1.45
Scenario A--TLEVs, LEVs, ULEVs, use gasoline. ZEVs use electricity	6-11	4-9
Scenario B--TLEVs, LEVs, ULEVs, use methanol. ZEVs use electricity	26-53	12-24
Scenario C--TLEVs use gasoline. LEVs use methanol. ULEVs use CNG. ZEVs use electricity	21-40	6-12
Scenario D--TLEVs use gasoline. 80% of LEVs use methanol. 20% of LEVs use ethanol. 50% of ULEVs use CNG. 50% of ULEVs use LPG. ZEVs use electricity.	39-78	25-50
Scenario E--TLEVs, LEVs use gasoline. ULEVs use CNG. ZEVs use electricity.	3-6	.08-.15

Table Estimated Cost Effectiveness of Proposal fn: 3

ADDENDUM #7

CALIFORNIA AIR RESOURCES BOARD

APPROVED

LIST OF MANUFACTURERS
OF FUEL CONVERSION SYSTEMS

Compressed Natural Gas Conversions:

IMPCO CARBURETION, INC.
16919 Gridley Place
Cerritos, CA 90701
(310) 860-6666

STEWART & STEVENSON
5840 Dahlia Street
Commerce City, CO 80022
(303) 287-7441

VIALLE U.S.A.
(formerly Vialle Autogas System)
9101 Ely Road
Pensacola, FL 32514
(606) 868-4626

CARBURETION LABS
515 N.E. 190 Street
Miami, FL 33179

N.G.V. DEVELOPMENT
2250 Cherry Ino. Circle
Long Beach, CA 90805
(310) 630-5788

ALGAS CARBURETION
16101 Vallen Drive
Houston, TX 77041
(713) 466-0056

Liquified Petroleum Gas Conversions:

IMPCO CARBURETION, INC.
16916 Gridley Place
Cerritos, CA 90701
(310) 860-6666

OHG, INC.
10065A Greenleaf Avenue
Santa Fe Springs, CA 90670

VIALLE U.S.A., INC.
(formerly Vialle Autogas System)
9101 Ely Road
Pensacola, FL 32514

ALGAS CURBURETION
16101 Vallen Drive
Houston, TX 7704
(713) 466-0056

ADDENDUM #8

KG5000D CARB EMISSION TEST COMPARISONS

TESTING SUMMARY

ABBV	DESCRIPTION	gpm BEFORE	gpm AFTER	PCT DIFF
NMHC	Non-Methane Hydrocarbons	0.560	0.348	-37.9%
CO	Carbon Monoxide	1.830	0.957	-47.7%
NOx	Nitrous Oxide	9.151	5.717	-37.5%
PARTIC	Particulates	0.627	0.436	-30.4%
OPAC	% Opacity	9.8	5.1	

NOTE: Data extracted from official CARB test results.

Report and Information Sources

Additional copies of this report, "California Clean Air Act - A Compliance Strategy for the City of San Diego's Non-Emergency Fleet" are available from:

**Publications and Distribution
Public Technology, Incorporated
1301 Pennsylvania Avenue, N.W.
Washington, D.C. 20004**

For additional information concerning this project, please contact:

**Robin Currie
General Services Department
2740 Caminito Chollas, MS 42
San Diego, CA 92105
(619) 527-7558**

**DG/92-330
06/93/150**

Publications Price List--UCETF Reports

ITEM #	TITLE	PRICE
90-331	Hydraulic Waste Energy Recovery: A Technical Report	15.00
90-318	A Regulatory Framework for Alternative Fuels and Transportation Management Services	15.00
90-316	Alternative Vehicle Fuels: A Demonstration Project	15.00
90-314	Energy Efficiency in Public Housing	15.00
89-330	Analysis of Programmatic Fleet Conversion to Ethanol Blends	15.00
89-325	An Alternative Fuels Evaluation System for Fleet Vehicles	15.00
89-323	Dual Fuel Conversion Demonstration and Technology Transfer Project	10.00
89-321	Summary of Low and Moderate Income Residential Energy Conservation Programs	15.00
89-315	A Case Study in the Pursuit of Urban Energy Efficiency	15.00
89-314	Communicating with the Public About Environmental Health Risks: A Case Study	13.00
89-313	Evaluation and Comparison of Selected Household Hazardous Waste Collection Facilities	15.00
89-311	Yard Waste Recycling Study: A Pilot Study	15.00
89-310	Sludge Storage Lagoon Biogas Recovery and Use, Volume 1	15.00
89-307	Proceeding: 1989 Electric Utility Franchise Conference	20.00
89-306	Reducing Electricity Demand Through Energy-Related Efficient Construction	15.00
89-304	Modernization of Lighting in Municipal Auditoriums	15.00
89-303	Wastewater Treatment Process Energy Optimization	13.00
89-301	Implementation of Alternative Technologies through the Assessment of Energy Markets	14.00
88-322	Marketing Energy Efficiency Programs to Commercial and Industrial Firms: Lighting Incentives and	15.00
88-321	Urban Energy Management Today: Ten Year Compendium of UCETF Programs	10.00
88-319	Integrating Energy Efficiency Into Municipal Purchasing Decisions: Computerizing Procurement	15.00
88-318	Household Hazardous Waste: Implementation of a Permanent Collection Facility	20.00
88-317	Hazardous Waste as an Energy Manager's Issue	15.00
88-316	Household Hazardous Waste Management Planning	15.00
88-312	Summary of Small Business Energy Conservation Programs	15.00
88-310	The Earth-Coupled Heat Pump: Utilizing Innovative Technology in Single Family Rehabilitation	15.00
88-309	Energy Planning for Economic Development	18.00
88-308	Conversion of Resource Recovery Steam to Hot and Chilled Water Systems	10.00
88-306	HVAC Equipment Replacement for Best Size and Efficiency, Transfer Report	15.00
88-305	Cogeneration and Cooling in Small Scale Applications	15.00
88-304	Energy Master Planning: Innovative Design and Energy Analysis Services for New Commercial	22.00
88-303	Energy Efficient Building Design: Guidelines for Local Government	15.00
88-302	Direct Digital Control of Air Washer Cooling System	15.00
88-301	Feasibility Study of Transportation Management Strategies in the Poplar Corridor, Memphis, Tennessee	18.00
87-327	Energy Efficient Urban Cooling Technologies: 1st National Conf.	20.00
87-324	Memphis Area Rideshare	15.00
87-317	Joint City Government/Utility Partnerships to Reduce Business Costs	15.00
87-314	The Impact of Budgetary Incentives on Energy Management	15.00

Publications Price List--UCETF Reports

ITEM #	TITLE	PRICE
87-313	Computer Assisted Control for Municipal Water Systems, Phase II	20.00
87-312	Economic Development Through Energy Technology Transfer	15.00
87-311	Electric Utility Franchise Guide	20.00
87-310	Hidden Link: The Energy and Economic Development, Phase II	15.00
87-307	Municipal Underground Storage Tanks: An Energy Manager's Guide	18.00
87-306	Integrating Energy Efficiency into Mun. Purchasing Decisions	20.00
87-305	Energy Enhancement in New Residential Construction	40.00
87-302	Thermal Energy Storage: Application Guide for Local Governments	20.00
87-301	HVAC Equipment Replacement for Best Size & Efficiency	20.00
86-315	Balancing Single Pipe Steam Heating Systems	20.00
86-314	Inhibition of Respiration in Activated Sludge by High Carbon Dioxide Concentration	7.50
86-313	Water Supply System Energy Conservation Through Computer Control	18.00
86-312	Energy Cost Reduction Through Wastewater Flow Equalization	20.00
86-311	High Efficiency Gas Furnace Modification in Low Income Housing	15.00
86-310	Hidden Link: Energy and Economic Development, Phase I	15.00
86-307	Disposal Techniques with Energy Recovery for Scrapped Vehicle Tires	20.00
86-306	District Heating Marketing: Analysis of a Twelve City Survey	20.00
86-305	Technology Transfer for Residential Energy Programs in New Construction and Existing Housing	15.00
86-304	Technology Transfer for Residential Energy Efficiency	15.00
86-302	Neighborhood Energy Efficiency & Reinvestment	15.00
86-301	On-Site Municipal Fuel Cell Power Plant: Feasibility and Application Guide	15.00
85-326	Resource Recovery for Urban Yard Waste	18.00
85-323	Energy Monitoring and Controlling in Municipal Facilities	10.00
85-320	Transportation Management for Business Relocation	15.00
85-319	District Heating in Denmark	10.00
85-318	Computer-Assisted Control for Municipal Water Systems, Phase I	18.00
85-317	Financing Energy Efficient Housing as a Community Economic Development Tool	15.00
85-316	Modular District Heating Planning as a Development Tool	15.00
85-314	Alternative Techniques for Dev. of Energy Efficient Residences	15.00
85-312	Shared Savings and Low Income Homeowners	18.00
85-311	Measures and Investment Options for Community Energy Conservation	18.00
85-310	Planning for Energy Efficiency in New Commercial Buildings	15.00
85-308	Residential Space Heating with Wood	15.00
85-307	Thermal Storage Strategies for Energy Cost Reduction	18.00
84-325	Shared Savings in the Residential Market	
84-324	Methanol Use in Vehicle Fleet Operations: Barriers	20.00
84-322	Energy Management and Technology for Urban Governments	15.00
84-321	Hydrate Process for Waste Water Treatment Plant Sludge Dewatering	15.00

Publications Price List--UCETF Reports

ITEM #	TITLE	PRICE
84-320	Development of Computerized Inventory and Maintenance System for Municipal Street Lights	15.00
84-315	Facilities Energy Monitoring System	15.00
84-314	Application of Mini-Van Technology to Vanpool Services	18.00
84-312	Implementation Methods for an Integrated Energy System	10.00
84-311	Feasibility of Water-Based District Heating and Cooling	15.00
84-310	Budgetary Incentives for Municipal Energy Management	22.00
84-309	Central Energy Systems Applications to Economic Development	20.00
84-308	On-Site Cogeneration for Office Buildings	15.00
84-306	Analysis of Municipal Bus Operations for the Advancement of Fuel Cell Technology	15.00
84-305	Computer Based Maintenance	15.00
84-304	Innovative Finance Plans for Privately Owned Waste/Vol. 2	15.00
84-303	Innovative Finance Plans for Privately Owned Waste/ Vol. 1	15.00
84-301	Coordinating Preventive Maintenance with Energy Management	15.00
83-319	The Rehabilitation and Retrofit of Older Houses to Superinsulated Standards	15.00
83-318	Developing Sources and Techniques for Alternative Financing of Energy Conservation	20.00
83-316	Hydrate Process for Dewatering Sewage Sludge	10.00
83-315	Financial Planning for District Heating: Brooklyn Navy Yard	15.00
83-314	Memphis Area Rideshare On-Line Information System	18.00
83-313	Renovation Opportunities for Steam District Heating Systems	18.00
83-312	Initial Assessment of District Heating and Cooling	20.00
83-311	Energy Conservation Through Computerized Automation	18.00
83-309	Development of an Energy Park: Issues and Implementation Options	15.00
83-308	Alternative Uses for Digester Methane Gas	25.00
83-307	Innovative Financing and Incentive Package to Reduce Energy	15.00
83-305	Multi-jurisdictional Planning for District Heating and Cooling	10.00
83-303	Improving Energy Management and Accountability in Municipal Operations	15.00
82-320	Utilization of Felled City Trees as Supplemental Boiler Fuel	7.50
82-319	Methanol Use in Vehicle Fleet Operations: Comparisons	15.00
82-317	Microcomputer Tools for Trans. and Residential Energy Conservation	20.00
82-316	Reduction of Impediments to Alternative Energy Use	20.00
82-315	Reducing Regulatory and Financial Impediments to Energy Conservation	20.00
82-314	Integrating Energy Management with Economic Development	20.00
82-313	Energy Conservation and Economic Development	10.00
82-310	Municipal Technologies	20.00
82-307	Strategies to Improve Community Energy Use Practices	10.00
82-306	Energy Conservation In Water Treatment	
82-305	Development of an Energy Action Plan: Participating Approach	15.00
82-303	Energy Economic Development	20.00

Publications Price List--UCETF Reports

ITEM #	TITLE	PRICE
82-302	Public Housing Energy Efficiency Through Private Financing	10.00
82-300	Developing an Energy Management Tracking System	
81-328	Matching End Use Energy Needs to Source Possibilities	20.00
81-327	Development of a Hydrogen-Fueled Mass Transit Vehicle s	15.00
81-326	Operational and Maintenance Guidelines for Reducing Energy Consumption	
81-324	Energy Management for Small Business	10.00
81-320	Energy Data Gathering, Analysis, and Review System	20.00
81-318	Fuel Management and Planning System for Local Government	25.00
81-316	Production of Ethanol from Cellulosic Fraction	
81-313	Metro-Dade County Comprehensive Energy Emergency Plan	
81-311	Developing Energy Emergency Preparedness	15.00
81-310	Simplified Methodology for Community Energy Management	20.00
81-309	Energy Management: The Public Sector	15.00
81-307	Municipal Technical Assistance-Energy Monitoring	6.00
81-306	New Technology Demonstration	10.00
81-305	Technology Transfer: Unit Report from the Energy Task Force	15.00
81-304	Development of Local Energy Management Preparedness	10.00
81-303	Municipal Energy Management	10.00
80-314	Methodology for Energy Impact Analysis of Urban Development Projects	15.00
80-313	Evaluation of Landfill Gas as an Energy Source	15.00
80-309	Decision Process for the Retrofit of Municipal Buildings	20.00
80-308	Primary Urban Energy Management Planning Methodology	7.50
80-306	Local Government Use of Thermography for Energy	15.00
79-300	Planning for and Purchasing Computer Technology	6.50

DATE

FILMED

2/28/94

END