California Air Resources Board

PUBLIC MEETING AGENDA

February 21 - 22, 2002
9:00 a.m. / 8:30 a.m.

02-1-1 Public Meeting to Consider a Health Update

02-1-2 Public Meeting to Consider a Retrospective on California's Air Quality Program

02-1-3 Public Hearing to Consider the Adoption of an Airborne Toxic Control Measure to Reduce Emissions of Toxic Contaminants from Outdoor Residential Waste Burning

02-1-4 Public Hearing to Consider Amendments to the California Alternative Fuels for Motor Vehicle Regulations

02-1-5 Public Hearing to Consider Adoption of Amendments to the Air Resources Board Voluntary Accelerated Vehicle Retirement (VAVR) Regulations

02-1-6 Public Meeting to Consider Research Proposals

02-1-7 Public Meeting to Consider Reallocating Rice Straw Demonstration Project Funds

Includes AcrobatTM ReaderTM

PC and Mac Compatible

California Environmental Protection Agency

ELECTRONIC BOARD BOOK

California Environmental Protection Agency

Air Resources Board

PUBLIC MEETING AGENDA

LOCATION:

California Environmental Protection Agency
Air Resources Board
Coastal Hearing Room, Second Floor
1001 I Street
Sacramento, CA 95814

This facility is accessible by public transit. For transit information, call: (916) 321-BUSS, website www.sacrt.com (This facility is accessible to persons with disabilities.)

February 21-22, 2002
9:00 a.m. / 8:30 a.m.

The Board Book is comprised of a number of individual documents, many of which are individually numbered. The Board Book itself is numbered in the top right and left hand corners. These numbers are reflected in the Table of Contents above.

CONTACT CLERK OF THE BOARD, 1001 I Street, 23rd Floor, Sacramento, CA 95814 **(916) 322-5594**
FAX: (916) 322-3928
ARB Homepage: www.arb.ca.gov

To submit written comments on an agenda item in advance of the meeting.
To request, in advance of the meeting, to be placed on the list to testify on an agenda item.
To request special accommodations for those persons with disabilities (at least 7 days prior to the meeting date please).
For persons with a hearing or speech impairment, please use our telephone device for the deaf
TDD: (916) 324-9531 or (800) 700-8326.

SMOKING NOT PERMITTED AT MEETINGS OF THE CALIFORNIA AIR RESOURCES BOARD

LOCATION:
California Environmental Protection Agency
Air Resources Board
Coastal Hearing Room, Second Floor
1001 I Street
Sacramento, CA 95814

California Environmental Protection Agency

Air Resources Board

PUBLIC MEETING AGENDA

This facility is accessible by public transit. For transit information, call: (916) 321-BUSS, website www.sacrt.com (This facility is accessible to persons with disabilities.)

February 21-22, 2002
9:00 a.m. / 8:30 a.m.

02-1-1 **Public Meeting to Consider a Health Update**

Staff will provide a brief update on one or more recent developments on research regarding the health impacts of air pollution.

02-1-2 **Public Meeting to Consider a Retrospective on California's Air Quality Program**

Staff will review the challenges and successes of California's air quality program over the last twenty years, highlighting key emission reduction measures adopted by the Board to protect public health. The Board has created a legacy of outstanding accomplishments that will continue to clean up California's skies into the 21st century. Future strategies will build on this legacy to further our air quality progress even as California grows.

02-1-3 **Public Hearing to Consider the Adoption of an Airborne Toxic Control Measure to Reduce Emissions of Toxic Contaminants from Outdoor Residential Waste Burning**

Staff will propose an airborne toxic control measure (ATCM) to reduce emissions of toxic air contaminants for outdoor residential waste burning. The proposed ATCM would eliminate the outdoor burning of residential waste materials other than natural vegetation, as well as the use of burn barrels. Limited exemptions would be allowed in very rural areas where waste pickup service is not available, the distance to an approved disposal facility is too far, and population density is very low. These exemption areas would be determined by the air district, with approval by both the air district board and the ARB. Exemptions could be renewed every five years. The prohibitions in the proposed regulation would become effective July 1, 2003.

02-1-4 **Public Hearing to Consider Amendments to the California Alternative Fuels for Motor Vehicle Regulations**

Staff will propose amendments to the compressed natural gas (CNG) and liquefied petroleum gas (LPG) motor vehicle fuel specifications.

(Agenda continued on next page)

CONTACT CLERK OF THE BOARD, 1001 I Street, 23rd Floor, Sacramento, CA 95814 **(916) 322-5594**
FAX: (916) 322-3928
ARB Homepage: www.arb.ca.gov

To submit written comments on an agenda item in advance of the meeting.
To request, in advance of the meeting, to be placed on the list to testify on an agenda item.
To request special accommodations for those persons with disabilities (at least 7 days prior to the meeting date please).
For persons with a hearing or speech impairment, please use our telephone device for the deaf
TDD: (916) 324-9531 or (800) 700-8326.

SMOKING NOT PERMITTED AT MEETINGS OF THE CALIFORNIA AIR RESOURCES BOARD

02-1-5 **Public Hearing to Consider Adoption of Amendments to the Air Resources Board Voluntary Accelerated Vehicle Retirement (VAVR) Regulations to Minimize Differences Between ARB and BAR VAVR Regulations and Allow Parts Recycling and Resale of Non-Emission-Related and Non-Drive Train Parts**

Staff will propose two amendments to the ARB VAVR regulations in response to input from stakeholders such as aftermarket parts manufacturers, dismantlers, local air districts and classic car collectors. Specifically, with respect to vehicle eligibility, staff will recommend that the ARB VAVR regulations be amended to match the Bureau of Automotive Repair regulations with only two exceptions. These exceptions include driving in reverse and the vehicle registration history. In addition, staff will recommend that the ARB VAVR regulations be amended to allow parts recovery for non-emission-related and non-drive train parts.

02-1-6 **Public Meeting to Consider Research Proposals**

Proposal No. 2504-223, entitled "Keeping Tahoe Blue through Ambient Air Quality Modeling: Aircraft and Boat Measurements of Air Quality and Meteorology Over Lake Tahoe," submitted by the University of California, Davis, for an amount not to exceed $133,382.

Proposal No. 2506-223, entitled "Keeping Tahoe Blue: Quantifying Atmospheric Nitrogen Oxides in the Lake Tahoe Basin," submitted by the University of California, Berkeley, for an amount not to exceed $175,036.

02-1-7 **Public Meeting to Consider Reallocating Rice Straw Demonstration Project Funds**

On May 25, 2000, the Board awarded $1.2 million to five Rice Fund projects for Fiscal Year 1999-2000. One of the projects withdrew from the Rice Fund making $100,000 available for other ARB approved projects. Staff will recommend reallocating $100,000 of Fiscal Year 1999-2000 Rice Fund monies to Broken Box Ranch.

CLOSED SESSION – LITIGATION

Daimler Chrysler and General Motors et al. v. California Air Resources Board and Michael Kenny, U.S. District Court for the Eastern District of California – Fresno Case No. CIV F-02-05017 REC SMS; and Daimler Chrysler, General Motors and Isuzu Motors et al. v. California Air Resources Board and Michael Kenny, Fresno County Superior Court No. 02 CE CG00039. The Board will hold a closed session as authorized by Government Code section 11126(e) to confer with, or receive advice from, its legal counsel regarding this litigation.

OPEN SESSION TO PROVIDE AN OPPORTUNITY FOR MEMBERS OF THE PUBLIC TO ADDRESS THE BOARD ON SUBJECT MATTERS WITHIN THE JURISDICTION OF THE BOARD

Although no formal Board action may be taken, the Board is allowing an opportunity to interested members of the public to address the Board on items of interest that are within the Board's jurisdiction, but that do not specifically appear on the agenda. Each person will be allowed a maximum of five minutes to ensure that everyone has a chance to speak.

THOSE ITEMS ABOVE WHICH ARE NOT COMPLETED ON FEBRUARY 21 WILL BE HEARD BEGINNING AT 8:30 A.M. ON FEBRUARY 22.

THE AGENDA ITEMS LISTED ABOVE MAY BE CONSIDERED IN A DIFFERENT ORDER AT THE BOARD MEETING.

SUMMARY OF BOARD ITEM

ITEM # 02-1-3: **PUBLIC HEARING TO CONSIDER THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE TO REDUCE EMISSIONS OF TOXIC AIR CONTAMINANTS FROM OUTDOOR RESIDENTIAL BURNING**

STAFF RECOMMENDATION: Approve the proposed control measure.

DISCUSSION: Residential waste burning is the practice of outdoor burning of residential wastes associated with one- and two-family homes. These household wastes include materials such as garbage, paper, cardboard, cloth, and processed wood. Typically, 55-gallon metal drums known as burn barrels are used for this burning. Emissions of dioxins, 1,3-butadiene, benzene, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls, as well as particulate matter, result from this practice.

The main focus of the proposed control measure is to address public exposure to dioxins, although emissions of other toxic air contaminants and particulate matter will also be reduced. Concerns about children's exposure to burn barrel emissions is particularly high due to the Office of Environmental Health Hazard Assessment's identification of dioxins and PAHs as two of the initial five toxic air contaminants that may cause infants and children to be especially susceptible to illness.

Current rules in 27 air districts allow the burning of some form of residential waste materials other than natural vegetation in all or part of the air district. Six air districts allow all forms of residential waste, including household garbage, to be burned in all or part of the air district. The remaining 21 air districts prohibit the burning of household garbage, but may allow the burning of other materials such as paper, cardboard, cloth or processed wood.

Staff proposes that the Board adopt an ATCM to prohibit the outdoor burning of residential waste materials other than natural vegetation, as well as the use of burn barrels. However, limited conditional exemptions would be allowed. The prohibitions in the proposed regulation would become effective July 1, 2003.

SUMMARY AND IMPACTS:

Approximately 722,000 households are located in the 27 air districts that allow the burning of some form of residential waste materials. Staff estimates that, in these air districts, approximately 108,000 households are actually burning some or all of their residential waste. With the inclusion of exemptions, staff estimates that approximately 41,000 households would be required to cease burning their residential waste, while the remainder could continue to burn materials allowed under current air district rules.

Staff evaluated the economic and environmental impacts of the proposed control measure. The proposed regulatory action may create some small, but unquantifiable costs to the California Integrated Waste Management Board for addressing potential impacts on waste diversion rates, the California Department of Forestry and Fire Protection for enforcement, and air districts for enforcement and public education and outreach. The proposed regulatory action may also result in non-mandatory costs to local agencies responsible for waste management to the extent they choose to provide expanded waste disposal services and to address waste diversion impacts.

The proposed control measure will require residents of households who are currently burning some or all of their waste to use alternative disposal methods. These costs are expected to range from $100 to $600 per year per household.

The proposed control measure was also evaluated in terms of potential impacts on waste diversion rates, landfill capacities, illegal dumping, illegal waste storage, and increased vehicle travel due to expanded waste service or self-hauling. The goal of the exemptions would be to allow burning in those areas where feasible alternatives to waste disposal do not exist and where population density is low, therefore minimizing the potential for adverse impacts in areas where they would most likely occur. Based upon the available information, ARB has determined that no significant adverse environmental impacts are anticipated to occur.

TITLE 17. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF A PUBLIC HEARING TO CONSIDER THE ADOPTION OF AN AIRBORNE TOXIC CONTROL MEASURE TO REDUCE EMISSIONS OF TOXIC AIR CONTAMINANTS FROM OUTDOOR RESIDENTIAL WASTE BURNING

The Air Resources Board (the "Board" or "ARB") will conduct a public hearing at the time and place noted below to consider the adoption of an airborne toxic control measure to reduce emissions of polychlorinated dibenzo-p-dioxins, dibenzofurans, and other toxic air contaminants from outdoor residential waste burning. The ARB is proposing to add section 93113 to title 17, California Code of Regulations (CCR).

DATE: February 21, 2002

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Coastal Hearing Room, Second Floor
1001 "I" Street
Sacramento, CA 95814

This item will be considered at a meeting of the Board, which will commence at 9:00 a.m. on Thursday, February 21, 2002, and may continue at 8:30 a.m. on Friday, February 22, 2002. This item may not be considered until February 22, 2002. Please consult the agenda for the meeting, which will be available at least 10 days before February 21, 2002, to determine the day on which this item will be considered.

The facility is accessible to persons with disabilities. If accommodation is needed, please contact the ARB's Clerk of the Board by February 6, 2002, at (916) 322-5594, or TDD (916) 324-9531 or (800) 700-8326 for TDD calls from outside the Sacramento area, to ensure accommodation.

INFORMATIVE DIGEST OF PROPOSED ACTION AND PLAIN ENGLISH POLICY STATEMENT OVERVIEW

Sections Affected: Proposed adoption of new section 93113, title 17, CCR.

Description of the Proposed Regulatory Action

Residential waste burning is the practice of outdoor burning of household wastes associated with one- and two-unit family homes. These household wastes include materials such as garbage, paper, cardboard, cloth, and processed wood. Typically, 55-gallon metal drums known as burn barrels are used for this burning. Residential waste burning generates a number of toxic air contaminants, including polychlorinated dibenzo-p-dioxins and dibenzofurans (collectively referred to as dioxins), benzene, 1,3-butadiene, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls. These toxic air contaminants may result in substantial health impacts including cancer and immune system damage. The Office of Environmental Health Hazard Assessment has identified dioxins and PAHs as two of the initial five toxic air contaminants that may cause infants and children to be especially susceptible to illness.

Other air pollutants found in smoke produced from residential waste burning include particulate matter and oxides of nitrogen. Most of the particulate matter emitted from residential waste burning is small enough to be inhaled and can be especially harmful to people with existing respiratory illness, the aged, and the very young. Exposure to such particles may worsen existing disease conditions and can produce symptoms ranging from breathing difficulties to increased respiratory infection and even death.

Individual air pollution control district and air quality management district (air district) rules address the types of residential waste that is allowed to be burned. Current rules in 27 air districts allow the burning of some form of residential waste other than natural vegetation in all or part of the air district. Six air districts allow all forms of residential waste to be burned in all or part of the air district. The remaining 21 air districts prohibit the burning of household garbage, but may allow the burning of other materials such as paper, cardboard, cloth, or processed wood.

Staff's proposal for the airborne toxic control measure would eliminate the outdoor burning of residential waste materials other than natural vegetation, as well as the use of burn barrels. However, limited exemptions would be allowed in very rural areas where waste pickup service is not available, the distance to an approved disposal facility is too far, and population density is very low. These exemption areas would be determined by the air district, with approval by both the air district Board and the ARB. Exemptions could be renewed every five years. The prohibitions in the proposed regulation would become effective July 1, 2003.

At the February 21, 2002 hearing, staff will recommend the adoption of the airborne toxic control measure for outdoor residential waste burning. The Board will discuss and consider staff's recommendation after hearing public comment.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSON

The staff has prepared a Staff Report: Initial Statement of Reasons (ISOR) for the proposed regulatory action, which includes the full text of the proposed regulatory language, and a summary of the environmental and economic impacts of the proposal.

Copies of the ISOR and the full text of the proposed regulation may be accessed on the ARB's web site listed below, or may be obtained from the ARB Public Information Office, 1001 "I" Street, Environmental Services Center, 1st floor, Sacramento, CA 95814, (916) 322-2990, at least 45 days prior to the scheduled hearing (February 21, 2002).

Upon its completion, the Final Statement of Reasons (FSOR) will be available and copies may be requested from the agency contact persons in this notice, or may be accessed on the ARB's web site listed below.

Further inquiries concerning the substance of the proposed regulation may be directed to the designated agency contact persons, Ms. Karen Magliano, Manager, Particulate Matter Analysis Section, at (916) 322-7137, or Ms. Christine Suarez-Murias, Air Pollution Specialist, at (916) 323-1495.

Further, the agency representative and designated backup contact persons to whom nonsubstantive inquiries concerning the proposed administrative action may be directed are Ms. Artavia Edwards, Manager, Board Administration & Regulatory Coordination Unit, at (916) 322-6070, or Ms. Marie Kavan, Regulations Coordinator, at (916) 322-6533. The Board has compiled a record for this rulemaking action, which includes all the information upon which the proposal is based. This material is available for inspection upon request to the contact persons.

If you are a person with a disability and desire to obtain this document in an alternative format, please contact the ARB ADA Coordinator at (916) 232-4916, or TDD (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area.

This notice, the ISOR and all subsequent regulatory documents, including the FSOR when completed, are available on the ARB Internet site for this rulemaking at http://www.arb.ca.gov/regact/reswstebrn.htm.

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred by public agencies and private persons and businesses in reasonable compliance with the proposed regulatory action are presented below.

Pursuant to Government Code sections 11346.5(a)(5) and 11346.5(a)(6), the Executive Officer has determined that the proposed regulatory action will not create costs or savings, to any state agency or in federal funding to the State, costs or mandate to any local agency or school district whether or not reimbursable by the State pursuant to part 7 (commencing with section 17500), division 4, title 2 of the Government Code, or other non-discretionary savings to State or local agencies.

Although not expressly mandated, the Executive Officer has determined that the proposed regulatory action may create discretionary costs to State and local agencies. Local jurisdictions responsible for providing waste disposal services may need to expand their services and facilities. However, these costs can be recaptured through waste collection service fees and tipping fees at approved disposal sites. Air districts and fire agencies may incur small, but unquantifiable, costs for enforcement, administration, and public education and outreach.

The proposed regulatory action will also have some impact on the requirement to divert 50 percent of waste from landfills by January 1, 2000 pursuant to sections 41780 through 41786 of the Public Resources Code. Some local jurisdictions may also incur costs if they choose to recalculate their baseline year for the purpose of determining waste diversion rates. However, it is possible that an increase in materials sent to recycling centers could offset increases in materials sent to landfills, thereby minimizing the impact on diversion rates.

The California Integrated Waste Management Board and the California Department of Forestry and Fire Protectors may incur some small, but unquantifiable costs relative to waste diversion activities and issuing burn permits, respectively. However, these tasks are part of the normal and routine operations of the agencies and are expected to be either recovered through permit fees or absorbed in the agency budgets.

In developing this regulatory proposal, the ARB staff also evaluated the potential economic impacts and/or benefits on representative private persons and businesses.

The Executive Officer has made an initial determination that the proposed regulatory action will not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states, or businesses directly affected. The proposed regulatory action may provide increased business opportunities for businesses associated with the collection, transfer, and disposal of municipal waste.

In accordance with CCR section 11346.3, the Executive Officer has determined that the proposed regulatory action will have no significant impacts on the creation or elimination of jobs within the State of California, no significant impacts on the creation of new businesses and the elimination of existing businesses within the State of California, and no significant impacts on the expansion of businesses currently doing business within the State of California.

The Board's Executive Officer has also determined, pursuant to Government Code section 11346.5(a)(3)(B), that the proposed regulatory action may affect a few small businesses by providing expanded business opportunities for waste pickup and disposal.

The Executive Officer has also determined that the proposed regulatory action will impose additional costs on representative private persons. The proposed regulatory action will require households who are currently burning some or all of their waste to use alternative disposal methods, such as contracting for curbside pickup or self-hauling their waste to a disposal or recycling facility. These costs are expected to range from $100 to $600 per year per household.

A detailed assessment of the economic impacts of the proposed regulation can be found in the ISOR.

Before taking final action on the proposed regulatory action, the Board must determine that no alternative considered by the agency, or that has otherwise been identified and brought to the attention of the agency, would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons or businesses than the proposed action.

SUBMITTAL OF COMMENTS

Interested members of the public may present comments orally or in writing at the hearing, and in writing or by e-mail before the hearing. To be considered by the Board, written submissions not physically submitted at the meeting must be received **no later than 12:00 noon, February 20, 2002,** and addressed to the following:

Postal mail is to be sent to:

Clerk of the Board
Air Resources Board
1001 "I" Street, 23rd Floor
Sacramento, California 95814

Electronic mail is to be sent to reswstebrn@listserve.arb.ca.gov and received at the ARB **no later than 12:00 noon, February 20, 2002.**

Facsimile submissions are to be transmitted to the Clerk of the Board at (916) 322-3928 and received at the ARB **no later than 12:00 noon February 20, 2002.**

The Board requests but does not require 30 copies of any written submission. Also, the ARB requests that written and e-mail statements be filed at least 10 days prior to the hearing so that ARB staff and Board Members have time to fully consider each comment. The ARB encourages members of the public to bring to the attention of staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

STATUTORY AUTHORITY AND REFERENCES

This regulatory action is proposed under the authority granted to the ARB in sections 39600, 39601, 39659, 39666, and 41700 of the Health and Safety Code. This action is proposed to implement, interpret, or make specific sections 39020, 39044, 39650 through 39669, 39701, and 41806 of the Health and Safety Code.

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, title 2, division 3, part 1, chapter 3.5 (commencing with section 11340) of the CCR. Following the public hearing, the ARB may adopt the regulatory language as originally proposed or with nonsubstantial or grammatical modifications. The ARB may also adopt the proposed regulatory language with other modifications if the modifications are sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action. In the event that such modifications are made, the full regulatory text, with the modifications clearly indicated, will be made available to the public for written comment at least 15 days before it is adopted.

The public may request a copy of the modified regulatory text from the ARB's Public Information Office, Environmental Services Center, 1001 "I" Street, 1st Floor, Sacramento, California 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

Kathleen Walsh

for Michael P. Kenny
Executive Officer

Date: December 20, 2001

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs see our Web-site at www.arb.ca.gov.

State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

Public Hearing to Consider

ADOPTION OF THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE TO REDUCE EMISSIONS OF TOXIC AIR CONTAMINANTS FROM OUTDOOR RESIDENTIAL WASTE BURNING

To be considered by the Air Resources Board on February 21, 2002, at:

California Environmental Protection Agency
Air Resources Board
Coastal Hearing Room
1001 "I" Street
Sacramento, California

Air Resources Board
P.O. Box 2815
Sacramento, California 95812

State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

PROPOSED AIRBORNE TOXIC CONTROL MEASURE TO REDUCE EMISSIONS OF TOXIC AIR CONTAMINANTS FROM OUTDOOR RESIDENTIAL WASTE BURNING

Staff Report

Prepared by:

Planning and Technical Support Division:
Christina Suarez-Murias
Bruce Oulrey
Patrick Gaffney
Tony Servin, P.E.

Stationary Source Division:
Greg Harris
Michele Houghton
Michelle Komlenic

Reviewed by:

Karen Magliano, Manager, Particulate Matter Analysis Section
Robert Effa, Chief, Air Quality Data Branch
Robert Fletcher, Chief, Planning and Technical Support Division

January 2002

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Residential waste burning is the practice of outdoor burning of household wastes associated with one and two family homes.[1] These household wastes include materials such as garbage, paper, cardboard, cloth, and processed wood. Typically, 55 gallon metal drums, known as burn barrels, are used for this burning. The smoke and ash created by these fires contain many harmful pollutants, including polychlorinated dibenzo-p-dioxins and dibenzofurans (collectively referred to as dioxins), polycyclic aromatic hydrocarbons (PAHs), benzene, 1,3-butadiene, and polychlorinated biphenyls (PCBs), as well as particulate matter.

The main focus of the proposed ATCM is to address public exposure to dioxins, although emissions of other toxic air contaminants and particulate matter will also be reduced. The Air Resources Board (ARB) has identified dioxins as the most potent toxic air contaminant identified to date, based on its potential to cause cancer and affect immune systems (ARB, 1986). Concerns about children's exposure to burn barrel emissions is particularly high due to the Office of Environmental Health Hazard Assessment's (OEHHA) recent identification of dioxins and PAHs as two of the initial five toxic air contaminants that may cause children to be especially susceptible to illness (OEHHA 2001d).

Dioxins are formed through the incomplete combustion of materials containing carbon and chlorine. Residential waste materials such as plastics and paper contain both of these substances, and therefore form dioxins when burned. The relatively low temperatures present in the burn barrels during combustion are particularly conducive to dioxin formation. Dioxins can contaminate air, water, food, and soil where they may last in the environment for many years. Dioxins can also accumulate in the fat of fish and animals, and are then passed on to people when contaminated food is eaten. Because dioxins can be passed through mothers milk, children are especially vulnerable. Children may also be more sensitive to dioxin exposure because of their rapid growth and development (U.S. EPA 2001b).

Currently, eight districts prohibit the burning of residential waste other than natural vegetation. Natural vegetation is not included because the amount of dioxins generated is substantially less than household wastes and the form of the dioxins generated is less toxic (OEHHA, 2001e). In the remaining 27 air pollution control districts or air quality management districts (air districts), some form of burning of residential waste other than natural vegetation is allowed in all or part of the air district. Six air districts allow all forms of residential waste to be burned, including household garbage, in all or part of the air district. The remaining 21 air districts prohibit the burning of household garbage, but allow the burning of other materials such as paper or cloth. The portions of these 27 air districts where non-vegetative burning is allowed represent approximately seven percent of the State's population.

1 Health and Safety Code section 41800 prohibits the use of fire to dispose of waste at other than one or two family dwellings.

In order to reduce the public health impacts of residential waste burning, we are proposing an airborne toxic control measure (ATCM) to regulate both the materials that can be burned and the method of burning. The ATCM would eliminate the burning of residential waste other than natural vegetation, and the use of burn barrels across the State. Exemptions would be granted for some regions of the State based on specified criteria including availability of waste disposal services, distance to approved landfills and transfer stations, and population density. The following sections provide additional information on the development of the proposed regulation and its impacts.

1. What authority does the ARB have to control emissions of toxic air contaminants?

This control measure is developed under the authority of the California Toxic Air Contaminant Identification and Control Program, established under California law by Assembly Bill 1807 and set forth in Health and Safety Code sections 39650 through 39675. The Board identified dioxins as a toxic air contaminant (TAC) and potential human carcinogen at its July 1986 Board hearing (ARB, 1986). The Board determined there was not sufficient scientific evidence available to identify a threshold level of exposure below which no adverse health effects are likely to occur. Other substances that are produced during the burning of residential waste include benzene, 1,3-butadiene, PAHs, and PCBs. The ARB has also formally identified these compounds as TACs (ARB, 1984; ARB, 1992; ARB, 1993a).[2]

Following the formal identification of a substance as a TAC, Health and Safety Code section 39665 requires the ARB, with the participation of the air districts, and in consultation with affected sources and interested parties, to prepare a report on the need and appropriate degree of regulation for that substance. Once the ARB has evaluated the need and appropriate degree of regulation for a TAC, Health and Safety Code section 39666 requires the ARB to adopt ATCMs to reduce emissions of that TAC. When adopting ATCMs, Health and Safety Code section 39666 requires that any control measure for a TAC without a Board-specified threshold level be designed to reduce emissions to the lowest level achievable through the application of best available control technology or a more effective control method if necessary to reduce risk.

A needs assessment for dioxins was conducted between 1988 and 1990 as part of the ARB's development of the ATCM for emissions of dioxins from medical waste incinerators (ARB, 1990).[3] This staff report is a supplement to that original needs assessment for dioxins based on new information about the potential emissions from outdoor residential waste burning. The new information is based on data collected by the United States Environmental Protection Agency (U.S. EPA). The U.S. EPA began a reassessment of dioxins exposure and human health effects (U.S. EPA, 2001b). Based on national inventories for 1987 and 1995, the U.S EPA reported that the burning of residential waste represents one of the largest uncontrolled sources of dioxins in the

---

2 California Code of Regulations, title 17, sections 93000 and 93001.
3 California Code of Regulations, title 17, section 93104

environment (U.S EPA, 2001a). The U.S. EPA has taken action to reduce emissions of dioxins from medical waste incinerators and municipal waste incinerators under sections 111 and 129 of the federal Clean Air Act.

2. How prevalent is the practice of residential waste burning and what are the emissions of dioxins and other toxic air contaminants?

Due to the potentially overlapping nature of air district rules, local ordinances, and fire agency prohibitions, it is difficult to estimate the true number of households burning their residential waste in California. Information on waste disposal practices is also limited in some areas, and the relationship between availability of service and an individual household's decision to burn any or all of its waste is not always clear cut. For example, even though some households have regular waste pickup for their household garbage, they may still be burning their paper and cardboard. Also, some households that do not have waste pickup service dispose of their household waste by means other than burning. However, based on discussions with air district staff and waste management agencies, we have developed our best estimate of the number of households that could be burning their non-vegetative waste in California.

Approximately 82,000 households are located in the portions of the six air districts that have no prohibitions on the materials that can be burned. In these six air districts, we estimate that about 15,000 households may be burning their residential waste, including household garbage. An additional 641,000 households are located in the remaining 21 air districts where burning of other waste materials is allowed. We further estimate about 93,000 households may be regularly burning materials such as cardboard and paper in these 21 air districts. In general, these estimates are based on our discussions with the affected air districts. In total, approximately 108,000 households may be burning some or all of their residential waste.

The U.S. EPA has developed emission factors for residential waste burning conducted in burn barrels (U.S. EPA, 1997a; Lemieux 2000). Using these factors and an average waste generation rate of 2,137 pounds of waste per household per year (CIWMB, 2000), the average household burning residential waste could generate between 0.005 and 0.15 grams of total dioxins per year. Based upon these emission levels, the U.S. EPA has reported that residential waste burning is one of the largest uncontrolled source of dioxins in the United States (U.S. EPA 2001a). It is also important to recognize that while these numbers appear small, dioxins in even small quantities pose health hazards and there is no threshold below which exposure to dioxins has been deemed safe.

3. What are the potential health impacts associated with exposure to dioxins and other toxic air contaminants from residential waste burning?

Exposure to dioxins may result in both cancer and non-cancer health effects to the individuals conducting the burning, as well as to surrounding residents. Non-cancer effects from exposure to dioxins include headaches, dizziness, rapid heartbeat, damage to the immune system, and liver and kidney damage. Dioxins are the most carcinogenic air pollutant identified by the ARB (ARB, 1986). Because dioxins can be passed through mothers milk, young children are especially vulnerable. Children may also be more sensitive to dioxin exposure because of their rapid growth and development (U.S. EPA, 2001b).

Health effects of other toxic air contaminants generated during residential burning such as benzene, 1,3-butadiene, PAHs, and PCBs include skin, eye and respiratory irritation, fatigue, neurological and immune system effects, and cancer. In addition to these TACs, smoke from residential burning contains particulate matter that can worsen existing disease conditions and can produce respiratory and cardiac effects, especially among sensitive populations such as the elderly and the very young (Pope, 1999; Samet, 2000). Particulate matter is a criteria pollutant with standards set by both the State and federal government. As required by the Children's Environmental Health Protection Act (Senate Bill 25, Escutia, 1999), ARB and the Office of Environmental Health Hazard Assessment (OEHHA) are reviewing the State PM10 standards for their ability to adequately protect public health, including that of infants and children. Recommendations for revised standards will be presented to the Board in the spring of 2002.

The risk assessment conducted to assess the potential health impacts from residential waste burning found potential cancer risks ranging between less than 10 to about 2,300 chances in a million at the near-source location (a near-source location is defined as a minimum modeled distance of 20 meters from the burning activity). The lower end of this range includes the potential cancer risk from inhalation, soil ingestion, skin absorption, and breast milk exposure pathways (OEHHA, 2001c). The upper end of the range estimates potential cancer risks across all included exposure pathways (i.e., the four minimum pathways discussed above plus crop, meat, and milk ingestion).

The dioxins emitted from the burning of residential waste materials can have near-source impacts on individuals in a household conducting the burning and on nearby neighbors. As discussed previously, the impacts on young children are of special concern. In addition, there is also a broader community impact from the dioxins generated from this source. Dioxins are ubiquitous throughout the environment, due to the cumulative emission impacts from many sources, including residential waste burning. Dioxins emitted from a source have a half-life in the atmosphere of several days (Balkanski et al., 1993). Eventually, the dioxins in the air are deposited onto vegetation, waterways, and the soil. Once there, dioxins are highly persistent, with the half-life in the soil surface estimated at 9 to 15 years, and in the soil subsurface at 25 to 100 years (Paustenbach et al., 1992). Dioxins can also accumulate in the fat of fish and animals, and are then passed on to people when contaminated food is eaten. It is estimated that 90 percent of dioxin intake for a typical person comes from dietary intake of animal fats (Gilman & Newhook, 1991).

A more detailed discussion of health impacts is presented in Chapter V.

4. What are the requirements of the proposed ATCM?

The proposed control measure would minimize emissions of dioxins and other toxic air contaminants such as benzene, 1,3-butadiene, PAHs, and PCBs, and the criteria pollutant, particulate matter, from residential waste burning by addressing both the materials which can be burned and the method of burning. The proposed ATCM prohibits the burning of residential waste, other than natural vegetation, anywhere in the State except for areas that qualify for a temporary exemption based upon specified criteria. The use of burn barrels would also be prohibited statewide, except in exempt areas, as a means of ensuring that burn barrels are not used for the burning of prohibited residential waste. The ATCM would require the use of ignition devices approved by the Air Pollution Control Officer of the air district. It would also prohibit the burning of allowable combustibles as defined in the regulation, unless it is a permissive burn day in the air district where the residential burning takes place. The prohibitory provisions of the regulation would be effective on July 1, 2003. During the time before the prohibitions become effective, the ARB will work with air districts to carry out public education and outreach efforts prior to implementation.

With the concurrence of the ARB, air districts may specify geographic areas that will be exempt from the prohibitions in the ATCM if they meet specified criteria including, but not limited to, all of the following:

1) no available waste pickup service, considering reasonable cost and frequency of service; and
2) greater than a reasonable distance from an approved transfer station or disposal facility or a communal or community dumpster, considering road miles or time traveled, road conditions, terrain, weather conditions, reasonable tipping fees, and hours of operation; and
3) low population density per census tract or other appropriate sub-unit of the county area.

Those areas that meet these exemption criteria would be allowed to burn only those materials that are currently allowed under air district rules, and would be allowed to use burn barrels, or other incinerator type devices to dispose of the waste. Requests for Exemptions would be submitted to the ARB by March 1, 2003. These exemptions would be approved by both the Board of the air district and the Executive Officer of the ARB. Exemptions must be justified and renewed every five years.

5. What are the potential economic impacts of the proposed ATCM?

The proposed regulatory action may create some costs to the California Integrated Waste Management Board for addressing potential impacts on waste diversion rates, and the California Department of Forestry and Fire Protection for enforcement. The proposed regulatory action may also result in nonmandatory costs to local agencies responsible for waste management to the extent they choose to provide expanded waste disposal services and to address waste diversion impacts. The proposed regulation may also result in some small, but unquantifiable, costs to air districts for enforcement and public education and outreach. However, costs for public education and outreach would be addressed through preparation of materials by the ARB. Most air districts have enforcement programs due to existing rules addressing the burning of residential waste. The proposed regulation is not expected to increase the enforcement workload.

In developing this regulatory proposal, we evaluated the potential economic impacts and/or benefits on businesses. The proposed regulatory action will not have a significant adverse economic impact on businesses, including the ability of California businesses to compete with businesses in other states. The proposed regulatory action however, may provide increased business opportunities for waste pickup services, landfill operators, and recycling center operators to provide expanded waste disposal services. Some of these may be small businesses. Additional discussion of potential economic impacts is provided in Chapter VII.

6. Will consumers have to pay more for waste disposal due to the proposed ATCM?

Consumers who are currently burning their residential waste may have to pay more to dispose of these materials. The proposed ATCM will require them to obtain waste management services or to self-haul their waste to landfills or transfer stations. In some areas, new waste service routes may need to be developed. In other areas, new customers may be added to existing routes. The increased cost will vary depending upon the costs of obtaining waste management service in their area.

We estimate that a consumer who did not previously contract for waste service could incur new yearly costs for waste pickup of $96 to $420. These costs would be less for households that already are disposing of a portion of their waste through waste pickup service. Alternatively, some consumers may elect to self-haul their waste to landfills and transfer stations. Staff estimates that a consumer who previously burned all of their waste could incur yearly disposal costs of $78 to $520 for landfill or transfer station tipping fees to self-haul their waste materials. Fuel costs to transport the waste could amount to an additional $78 dollars per year per household. These costs could be reduced in areas where recyclable materials, such as plastics and paper, are separated, and which can often be dropped off for no cost. Consumers who had previously been self hauling only a portion of their waste, and burning the rest, would incur lower additional yearly costs.

7. What are the potential environmental impacts of the proposed ATCM?

The ARB is committed to evaluating community health impacts of proposed regulations, and to addressing environmental justice concerns. Because some communities experience higher exposures to toxic air pollutants due to cumulative impacts and other factors, it is a priority of the ARB to ensure that full protection is afforded to all Californians.

The proposed ATCM is designed to reduce emissions of dioxins and other TACs from residential waste burning, resulting in reduced exposures to these emissions for those communities and individuals currently allowed to burn residential waste, with associated lower potential health risks. The proposed ATCM will also reduce emissions of particulate matter from residential waste burning.

The proposed ATCM was also evaluated in terms of potential impacts on waste diversion rates, landfill capacities, illegal dumping, illegal waste storage, and increased vehicle travel due to expanded waste service or self-hauling. In evaluating impacts, we considered the role of exemptions in the proposed regulation. The goal of the exemptions would be to allow burning in those areas where feasible alternatives to waste disposal do not exist and where population density is low; therefore mitigating the potential for adverse impacts in areas where they would be most likely to occur.

While the waste that is no longer burned will result in increased materials deposited at landfills and have an impact upon waste diversion rates, these impacts can be mitigated through efforts to decrease waste generation and increase recycling and composting, and through a strong public education and outreach campaign regarding the availability of alternative waste disposal options. In addition, some jurisdictions can qualify for rural reduction programs with lower required diversion rates, or can develop new baseline waste generation rates to better reflect the previously burned waste. Based upon the available information, ARB has determined that no significant adverse environmental impacts should occur.

8. What public outreach was conducted in developing the ATCM?

For this assessment we developed an extensive outreach program that involved State and local regulatory agencies, waste management agencies and service providers, fire protection agencies, and other interested parties. These entities participated in the development and review of the necessary surveys and draft reports, conference calls, working group meetings, workshops, and the proposed regulation. Outreach efforts also provided participants a forum in which to address their concerns. As part of this process, ARB outreach activities included:

- conducting six public workshops in December 2001;
- scheduling an additional ten public workshops for January 2002;
- using newspaper advertisements and media advisories for workshops;
- mailing workshop notices to over 4,000 people;
- preparing and distributing two fact sheets;
- developing and maintaining a residential burning web site;
- holding over 20 individual meetings with waste management agencies, fire protection agencies, air districts, and the Regional Council of Rural Counties; and
- convening eleven meetings of the Residential Burning Working Group.

RECOMMENDATION

We recommend that the Board adopt the proposed regulation set forth in Appendix A. The proposed regulation would eliminate residential waste burning, excluding natural vegetation, and burn barrel usage except in some very rural areas of the State. The proposed ATCM is based upon staff's evaluation of the best available control method for dioxin emissions from this source. We considered the emissions and associated health risks of residential waste burning, the availability and cost of alternative methods of disposal, and the economic and environmental impacts of the proposed regulation. As a result of this evaluation, with the incorporation of recommended exemptions, staff considers the proposed ATCM to be environmentally, technically, and economically feasible, resulting in a safe, effective, and less-hazardous alternative to burning.

I. INTRODUCTION

A. Overview

Residential waste burning, for the purpose of this document, is defined as the outdoor burning of wastes, other than natural vegetation, generated by a single or two family residence. The United States Environmental Protection Agency (U.S. EPA) has identified residential waste burning as a major source of polychlorinated dibenzo-*p*-dioxins and dibenzofurans (collectively referred to as dioxins). Dioxins in particular are the most potent carcinogens identified to date by the Air Resources Board (ARB or Board) as toxic air contaminants (TACs). In addition to dioxins, many other toxic air contaminants are generated from residential waste burning, including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), benzene, and 1,3–butadiene. These toxic air contaminants may result in substantial health impacts, ranging from headaches, dizziness, rapid heartbeat, damage to the immune system, and liver and kidney damage, to cancer. Because dioxins can be passed through mothers milk, children are especially vulnerable.

Particulate matter is also generated from residential waste burning. Most of the particulate matter emitted from residential waste burning is small enough to be inhaled and can be especially harmful to people with existing respiratory illness, the aged, and the very young. Exposure to such particles may worsen existing disease conditions and can produce symptoms ranging from breathing difficulties to increased respiratory infection and even premature death (Pope, 1999; Samet, 2000).

The Board identified dioxins as a TAC and a potential human carcinogen at its July 1986 Board hearing (ARB, 1986). The Board determined that there was not sufficient scientific evidence available to identify a threshold level of exposure below which no adverse health effects are likely to occur. Once dioxins were identified as TACs in 1986, the ARB was required under the Toxic Air Contaminant Identification and Control Program to: 1) prepare a report on the need and appropriate degree of regulation for the compounds, and 2) adopt regulations to reduce emissions of the compounds. These regulations are called airborne toxic control measures (ATCMs) or control measures. In this report, we use the terms regulation, control measure, and ATCM interchangeably. State law requires that such control measures for TACs without a Board-specified threshold exposure level be based on the best available control technology or a more effective control method in consideration of cost and risk.

This Initial Statement of Reasons for the *Proposed Airborne Toxic Control Measure to Reduce Emissions of Toxic Air Contaminants from Outdoor Residential Waste Burning* presents information on the toxic air contaminant identification and control process, the report preparation process, and previous identification and control (regulatory) activities for dioxins. We then present physical characteristics of dioxins and other TACs and information on sources and ambient concentrations. This is followed by a discussion of typical waste burning activities across the State, and information on exposure and health effects for dioxins and other TACs. Finally, we present the proposed control measure, and its health, economic, and environmental impacts.

B. Purpose

On March 23, 2000, the Board adopted revisions to the State's Smoke Management Guidelines for Agricultural and Prescribed Burning. At that time, the Board also directed staff to assess the impacts of outdoor residential waste burning. We convened a residential burning working group and performed a preliminary analysis of outdoor residential waste burning. Our analysis included: 1) a survey of all the air districts in the State to assess existing regulations and practices regarding residential waste burning and burn barrel use; 2) a preliminary screening risk assessment to quantify health risks associated with dioxins and other toxic compounds emitted from residential waste burning; 3) meetings with the California Integrated Waste Management Board (CIWMB) to assess existing waste management services across the State and the potential for expanding service; and 4) discussions with fire management agencies within the State to identify potential fire safety and resource management issues.

We presented our analysis to the Board at its June 28, 2001, meeting. Based upon the prevalence of burning and the screening risk assessment, we recommended adding residential waste burning to ARB's Clean Air Plan and developing an ATCM. Two witnesses, including the Chair of the California Air Pollution Control Officers Association (CAPCOA), urged ARB to develop an ATCM to ban residential waste burning and the use of burn barrels. As a result, the Board directed staff to proceed with developing an ATCM and report back to the Board in 2002.

Following the June 28, 2001, Board meeting, we continued to refine our waste burning/burn barrel use analysis. We contacted air districts, the CIWMB, and local waste management agencies and service providers statewide to enlist their help with characterizing the potential for and costs to expand waste management services. We also worked with land management and fire safety representatives to address any potential concerns they might have with banning waste burning and the use of burn barrels.

C. Regulatory Authority

The California Toxic Air Contaminant Identification and Control Program (Program), established under California law by Assembly Bill 1807 (Chapter 1047, Statutes of 1983) and set forth in Health and Safety Code sections 39650 through 39675, is designed to protect public health by reducing emissions of TACs. This law mandates the identification and control of air toxics in California and complements the State's criteria air pollutant program. The identification phase of the Program requires the ARB, with the participation of other State agencies, to evaluate the health impacts of, and exposure to, substances and to identify those substances that pose the greatest health threat as TACs. ARB's evaluation is made available to the public and is formally reviewed by the Scientific Review Panel (SRP) established under Health and Safety

Code section 39670. Following ARB's evaluation and the SRP's review, the Board identified dioxins as TACs at its July 1986 Board hearing. The Board determined there was not sufficient scientific evidence available to support the identification of a threshold exposure level (ARB, 1986).

A threshold level can be defined as a level of pollutant exposure below which no adverse health effects are likely to occur. In their evaluations of dioxins, staff from the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA) recommended that dioxins be treated as having no threshold exposure level because: 1) all dioxins are potential human carcinogens, and 2) currently, there is insufficient evidence available to designate an exposure level below which no significant adverse health impacts are anticipated.

Following the identification of a substance as a TAC, HSC section 39665 requires the ARB, with participation of the air districts, and in consultation with affected sources and interested parties, to prepare a report on the need and appropriate degree of regulation for that substance.

A needs assessment for dioxins was conducted between 1988 to 1990 as part of the ARB's development of the Airborne Toxic Control Measure for Emissions of Dioxins from Medical Waste Incinerators (title 17, California Code of Regulations, section 93104) (ARB, 1990). During that assessment, the ARB identified numerous sources of dioxins, including incineration of medical waste, recycled waste oil, hazardous waste, sewage sludge, municipal waste, and woodwaste.

Subsequent to that report, the U.S. EPA also began a reassessment of dioxins exposure and human health effects (U.S. EPA, 2001b). Based on national inventories for dioxins representing 1987 and 1995, the EPA report suggested that the burning of household waste is one of the largest uncontrolled sources of dioxin emissions in the environment.

D. Regulatory Activities

1. Airborne Toxic Control Measures

Once the ARB has evaluated the need and appropriate degree of regulation for a TAC, State law (Health and Safety Code section 39666) requires the ARB to adopt regulations to reduce emissions of the TAC to the maximum extent feasible in consideration of cost, risk, and other factors specified in Health and Safety Code section 39665. To date, the ARB has developed eleven ATCMs for a variety of TACs. In 1990, the ARB adopted a control measure to reduce emissions of dioxins from medical waste incinerators by 99 percent. At that time, medical waste incinerators were one of the largest known sources of dioxins in California. As a result of this regulation, the number of medical waste incinerators in the State dropped sharply from about 150 to less than 15. In 1994, the U.S. EPA adopted a control measure to regulate municipal waste incinerators by the year 2000 (U.S. Federal Register, 1994). In California, there are only three operating municipal waste incinerators. Each of these control measures incorporate the use of best available control technology. In the case of dioxins, best available control technology to minimize or eliminate the formation of dioxins is achieved through careful control of combustion conditions, including maintaining combustion temperatures at approximately 1000^{O} C for a minimum of one second. This type of controlled combustion is not feasible for small residential burning sources such as backyard burn barrels or piles.

2. National Emission Standards for Hazardous Air Pollutants

In the federal Clean Air Act Amendments of 1990, the U.S. EPA identified dioxins as hazardous air pollutants (HAPs) because they were either known to have or may have adverse effects on human health or the environment. Health and Safety Code section 39658(b) requires the Board to designate federal HAPs as TACs, and the Board did so in 1993 (ARB, 1993a). Therefore, dioxins are TACs both because they have been identified by the Board through the Toxic Air Contaminant Identification and Control Program and because they are HAPs.

3. SB 25 Children's Environmental Health Protection Act Air Toxics Priorities List

The California Children's Environmental Health Protection Act (SB 25, Escutia; chaptered 1999), requires the California Environmental Protection Agency to specifically consider children in developing criteria for evaluating TACs. The law requires OEHHA to evaluate available information on TACs and develop a listing of up to five TACs that "may cause infants and children to be especially susceptible to illness." The initial listing was made final in October 2001. Dioxins and PAHs are two of the top five compounds initially listed. The listing will be updated periodically (OEHHA, 2001d).

II. PUBLIC OUTREACH AND REPORT PREPARATION

A. Outreach Efforts

Outreach and public participation are important components of ARB's needs assessment and report preparation process. For this assessment we developed an extensive outreach program that involved State and local regulatory agencies, waste management agencies and service providers, fire protection agencies, and other interested parties. These entities participated in the development and review of the necessary surveys and draft reports, conference calls, working group meetings, workshops, and the proposed regulation. Outreach efforts also provided participants a forum in which to address their concerns. ARB outreach activities included:

- establishing a Residential Burning working group which held 11 meetings and conference calls between October 2000 and December 2001. The working group consists of over 50 people;

- conducting six public workshops in December 2001 at the following locations and times:

    - Sacramento, Sacramento County – December 4, 2001
    - Yreka, Siskiyou County – December 5, 2001
    - Alturas, Modoc County – December 6 2001
    - Susanville, Lassen County – December 7, 2001
    - Hollister, San Benito County – December 10, 2001
    - Alpine, San Diego County – December 17, 2001

- scheduled ten public workshops for January 2002 at the following locations:

    - Nevada City, Nevada County – January 7, 2002
    - Auburn, Placer County – January 7, 2002
    - Jamestown, Tuolumne County – January 9, 2002
    - Willows, Glenn County – January 10, 2002
    - Oroville, Butte County – January 15, 2002
    - Mariposa, Mariposa County – January 16, 2002
    - Placerville, El Dorado County – January 17, 2002
    - Eureka, Humboldt County – January 22, 2002
    - Redding, Shasta County – January 23, 2002
    - Yuba City, Yuba County – January 23, 2002

- mailing or faxing working group agendas, minutes, draft surveys, survey analyses, draft and final reports to over 50 people;

- making newspaper display ads available for all workshop locations, as well as providing local media advisories in advance of all workshops;

- developing and distributing two fact sheets;
- mailing workshop notices to over 4,000 people;
- meeting with waste management agencies and service providers on: 1) the existing waste collection and disposal services available in those districts; 2) the ability to expand service; and 3) associated costs for expanded service;
- meetings with California fire protection organizations, including the Sacramento Valley Fire Marshals Association, California Office of the State Fire Marshal, the Placer County Residential Burning Committee, and the California Department of Forestry and Fire Protection (CDF) to discuss fire safety issues;
- meetings with the Regional Council of Rural Counties on issues related to waste disposal and environmental and economic impacts; and
- making information available through a residential burning web site.

1. Public Involvement

As described below, we worked with affected stakeholders and organizations interested in minimizing exposure to dioxins and other toxic air pollutants emitted from residential waste burning. These groups included the Regional Council of Rural Counties and the County Supervisors Association of California, as well as the general public. To increase the general public's participation in this assessment, we have made information available via the ARB's Internet web site:

http://www.arb.ca.gov/smp/resburn/resburn.htm

The web site provides background information on the ATCM development process, including fact sheets, workshop dates and locations, and electronic links on residential waste burning air toxic emissions and health effects.

2. Industry Involvement

Waste management agencies and service providers were consulted in the development of this report and in evaluating the availability of alternative waste disposal options. Comments and suggestions were provided by these groups from across the State during the development of surveys and subsequent analysis. Industry involvement in the process has also included:

- approximately 200 telephone conversations and email exchanges;
- meetings with local waste management agencies in five of the six air districts that currently allow the burning of household garbage; and

- completion of a waste management questionnaire on current and future availability and cost of waste management services for the six air districts in California that currently allow the burning of household garbage.

3. Government Agency Involvement

Other local, State, and federal agencies with an interest in dioxins emissions associated with residential waste burning and use of burn barrels have been involved in the assessment process to promote statewide consistency in addressing public health concerns and providing a multi-media perspective. These agencies include: air districts, the California Environmental Protection Agency's (Cal/EPA's) CIWMB and OEHHA, CDF, the State Fire Marshal, and the U.S. EPA.

We have apprised the air districts of our activities through CAPCOA meetings, and have also worked with them to gather information on how the air districts regulate residential waste burning and burn barrel use. This work has included informational surveys and telephone calls to the air districts, and participation by many air districts in the Residential Burning Working Group.

B. Data Collection Tools to Assist in Report Preparation

Between October 2000 and October 2001, ARB staff conducted three surveys to gather information associated with residential waste burning and the use of burn barrels to support development of the ATCM. The three surveys were: 1) the Air District Rules Survey (Rules Survey); 2) the ATCM Concept Survey (ATCM Survey); and 3) the Burn Barrel Use Survey (Burn Barrel Survey). A fourth data collection tool utilized in September 2001 was the Waste Management Services Questionnaire (Waste Management Questionnaire).

1. Rules Survey

The Rules Survey was conducted in October 2000. This survey was sent to all air districts in the State to assess air district rules and practices associated with residential waste burning. The survey requested information on current rules regulating residential burning, complaints and workload associated with residential burning, and suggestions for State and local efforts to improve management of residential burning. All 35 air districts in the State responded to the survey. The survey highlighted the variability in how residential waste burning is regulated throughout the State. Many air districts also reported that addressing complaints from residential waste burning represented a significant workload.

2. ATCM Survey

The ATCM Survey was sent to members of the Residential Burning Working Group in September 2001, with further input from CAPCOA in November 2001. The working group is made up of representatives from the 27 air districts around the State that allow some residential waste burning other than natural vegetation. The ATCM survey gathered information about the air district's perspectives regarding how the ATCM should be structured and implemented. Issues that were addressed included the types of materials that should be included, the need for and the form of any exemptions, and the implementation schedule. All 27 of the air districts responded to the survey and provided input.

3. Burn Barrel Survey

The Burn Barrel Survey was sent to 21 air districts in the State that allow residential waste burning but not residential garbage burning. It requested information on the estimated number of burn barrels in each of the 21 air districts and the percentage of barrels in each air district estimated to have illegal materials burned in them. Responses were received from all 21 of the air districts surveyed.

4. Waste Management Questionnaire

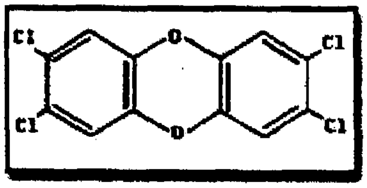
The Waste Management Questionnaire was sent to agencies responsible for waste management in the six air districts that allow the burning of household garbage in September 2001. It gathered information on the availability of service in each area, costs for service, and any obstacles that might be encountered to address the additional waste that could no longer be burned under the proposed ATCM. Written or verbal information was obtained from waste management agencies in all six air districts.

III. PHYSICAL CHARACTERISTICS, SOURCES, AND AMBIENT CONCENTRATIONS OF DIOXINS AND OTHER TOXIC AIR CONTAMINANTS

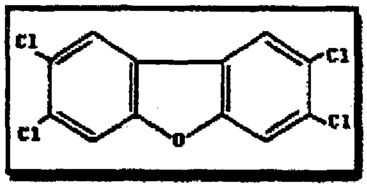
A. Dioxins

1. Background

"Dioxins" is a generic term used to denote any of a family of compounds that are derived from dibenzo-p-dioxin, or a mixture of such compounds. The basic structure of all dioxins consists of two benzene rings joined to each other by two oxygen atoms (see Diagram below). A closely related family of compounds are the dibenzofurans. They have structures and properties similar to dioxins and are often found in association with them. These compounds are collectively referred to as dioxins. Dioxins are classified into groups termed homologues on the basis of the number of chlorine atoms in the molecule. Thus, tetrachloro-dibenzo-p-dioxins and dibenzofurans contain four chlorine atoms, pentachloro-dibenzo-p-dioxins and dibenzofurans contain five chlorine atoms, and so on. Within each homologue, individual isomers are characterized by the location of the chlorine atoms on the rings.



2,3,7,8 Tetrachlorodibenzo-p-dioxin



2,3,7,8 Tetrachlorodibenzo furan

CHLORINATED DIOXINS/DIBENZOFURANS OF CONCERN

	Dioxins	**Dibenzofurans**
Tetrachloro	2,3,7,8	2,3,7,8
Pentachloro	1,2,3,7,8	1,2,3,7,8 2,3,4,7,8
Hexachloro	1,2,3,4,7,8 1,2,3,6,7,8 1,2,3,7,8,9	1,2,3,4,7,8 1,2,3,6,7,8 1,2,3,7,8,9 2,3,4,6,7,8
Heptachloro	1,2,3,4,6,7,8	1,2,3,4,6,7,8 1,2,3,4,7,8,9

NOTE: The numbers indicate the position of chlorine atoms on the dioxin or dibenzofuran molecule.

There are 75 different polychlorinated dibenzo-p-dioxins and 135 polychlorinated dibenzofurans, differing from each other by the number and location of chlorine atoms on the molecule.

2. Physical Characteristics

The mixture of dioxins emitted from combustion sources are in both the gaseous and particulate phase. The persistence of these substances may be a function of the phase into which they are emitted. The gas/solid phase partition factor is influenced by flow rate, temperature, and dimensions of the sampling. These substances do not appear to degrade when sorbed to solids (ARB, 1986). It is believed that the hexa through hepta chlorinated congeners are sorbed to particulates, whereas, the tetra and penta congeners partition to the vapor phase (Bidleman, 1988).

Dioxins are highly persistent under normal environmental conditions, particularly when adsorbed on soils or other substrates. The half-life of 2,3,7,8 Tetrachlorodibenzo-p-dioxin has been reported to be approximately 25 to 100 years in subsurface soil and 9 to 15 years at the soil surface (Paustenbach et al., 1992). Several researchers have reported global transport of dioxins in the atmosphere (Denison, 2000; Commoner et al., 2000). Dioxins are degraded by sunlight in solution under laboratory conditions, but the extent to which dioxins are degraded by sunlight in the atmosphere is unknown (ARB, 1986). Gas-phase dioxins may be degraded by reaction with hydroxyl (OH) radicals and direct photolysis. Particulate-associated dioxins are removed from air by wet and dry deposition. The average half-life for particles in the lower atmosphere is several days, whether particle-associated or gaseous (Balkanski et al., 1993).

3. Sources and Emissions

Dioxins are formed as products of incomplete combustion when chlorine and complex mixtures containing carbon are present. Conditions which have been associated with formation of dioxins during combustion include: 1) poor gas-phase mixing; 2) low combustion temperatures; 3) oxygen-starved conditions; 4) high particulate matter loading; 5) particulate matter-bound copper; 6) presence of hydrogen chloride and/or chlorine; and 7) significant gas-phase residence time in the 250-700^{o}C temperature range. Dioxins are emitted from incinerators that burn residential waste, medical waste, municipal solid waste, hazardous waste sewage sludge, tires, and metal smelting operations when the feedstock contains dioxin precursors (Bumb et al., 1980; U.S EPA, 1997a; U.S. EPA, 1997b; U.S. EPA, 2001a; U.S EPA, 2001b; ARB, 1990).

Dioxins are also formed in small quantities as unwanted combustion byproducts in certain industrial processes associated with the manufacture of polychlorinated biphenyls (PCBs). Other possible sources of dioxins are sawmills, wire and scrap metal reclamation incinerators, black liquor boilers, cement kilns, cofiring wastes, transformer fires, wood stoves/fireplaces, and agricultural burning. Dioxins can form in wood through chlorination of phenolic compounds present in wood, paper pulp, or through the combustion breakdown of pentachlorophenol, a pesticide used to inhibit mold growth in lumber. 2,3,7,8-Tetrachlorodibenzo-p-dioxin is produced as an unwanted contaminant during the manufacture of pesticides, such as chlorophenols, and their derivatives such as 2,4,5-trichlorophenoxyacetic acid (ARB, 1997). Dioxins have also been detected in fly ash and stack gas of various combustion processes (Tiernan, 1983).

Dioxins adsorbed on airborne particulate or in industrial effluent are deposited on the soil and eventually bind to other organic substances and bottom sediment in lakes and rivers. Although dioxins are encountered in both the vapor and particulate phases, it has been suggested that ingestion results in 90 percent of human exposure (Gilman & Newhook, 1991). Atmospheric dioxins deposit on vegetation which farm animals consume. Humans then ingest crops, fish, meat, and dairy products and thus accrue a body burden of dioxin. Subsistence fisherman can have unusually high levels of dioxin (U.S. EPA, 1989a; Hites, 1991). Secondary exposure, due to such soil and water pollution, may be as significant as atmospheric exposure and could substantially increase total risk (ARB 1986). Dioxins in very small concentrations are ubiquitous in the environment and it is likely that some of the primary sources are not yet known. Dioxins have been found worldwide, even in remote areas (ARB, 1986).

The U.S. EPA 's national emissions inventory for dioxins in 1987 and 1995 is shown in Table III-1 (U.S. EPA, 2001a). U.S. EPA's best estimate of releases of dioxins to air, water and land from reasonably quantifiable sources suggests an approximate 77 percent decrease between 1987 and 1995, due primarily to reductions in air emissions from municipal and medical waste incinerators. In 1990, the ARB adopted a control measure to reduce emissions of dioxins from medical waste incinerators by 99 percent. At that time, medical waste incinerators were one of the largest known sources of dioxins in California. As a result of this regulation, the number of medical waste incinerators in the State dropped sharply from about 150 to less than 15. In 1994, the U.S. EPA adopted a control measure to regulate municipal waste incinerators by the year 2000 (Federal Register, 1994). Based upon the most recent source emissions data, U.S. EPA estimates that uncontrolled combustion, such as burning of residential waste, is expected to become the largest quantified source of dioxin emissions to the environment in the United States (U.S. EPA, 2001b).

Table III-1. Inventory of Environmental Releases (grams/year TEQ*) of Dioxins From Known Sources in the United States for 1987 and 1995

Inventory of Sources of Dioxin-Like Compounds in the United States- 1987 and 1995	1987 Emissions (g TEQdf-WHO98/yr)	1995 Emissions (g TEQdf-WHO98/yr)	*Percent Reduction 1987 - 1995*
Municipal Solid Waste Incineration, air	8877.0	1250.0	86%
Backyard Refuse Barrel Burning, air	604.0	628.0	-4%
Medical Waste Incineration, air	2590.0	488.0	81%
Secondary Copper Smelting, air	983.0	271.0	72%
Cement Kilns (hazardous waste burning), air	117.8	156.1	-33%
Sewage Sludge/land applied, land	76.6	76.6	0%
Residential Wood Burning, air	89.6	62.8	30%
Coal-fired Utilities, air	50.8	60.1	-18%
Diesel Trucks, air	27.8	35.5	-28%
Secondary Aluminum Smelting, air	16.3	29.1	-79%
2,4-D, land	33.4	28.9	13%
Iron Ore Sintering, air	32.7	28.0	14%
Industrial Wood Burning, air	26.4	27.6	-5%
Bleached Pulp and Paper Mills, water	356.0	19.5	95%
Cement Kilns (non-hazardous waste burning)	13.7	17.8	-30%
Sewage Sludge Incineration, air	6.1	14.8	-143%
EDC/Vinyl chloride, air	NA	11.2	NA
Oil-fired Utilities, air	17.8	10.7	40%
Crematoria, air	5.5	9.1	-65%
Unleaded Gasoline, air	3.6	5.6	-56%
Hazardous Waste Incineration, air	5.0	5.8	-16%
Lightweight ag kilns, haz waste,air	2.4	3.3	-38%
Commercially Marketed Sewage Sludge,land	2.6	2.6	0%
Kraft Black Liquor Boilers, air	2.0	2.3	-15%
Petrol Refine Catalyst Reg., air	2.24	2.21	1%
Leaded Gasoline, air	37.5	2.0	95%
Secondary Lead Smelting, air	1.29	1.72	-33%
Paper Mill Sludge, land	14.1	1.4	90%
Cigarette Smoke, air	1.0	0.8	20%
EDC/Vinyl chloride, land	NA	0.73	NA
Primary Copper, air	0.5	0.5	0%
EDC/Vinyl chloride, water	NA	0.43	NA
Boilers/industrial furnaces	0.78	0.39	50%
Tire Combustion, air	0.11	0.11	0%
Drum Reclamation, air	0.1	0.1	0%
Carbon Reactivation Furnace, air	0.08	0.06	25%
TOTALS	13,998	3,255	77%
Percent Reduction from 1987 to 1995		77%	

NA = Not Available; (+) = reduction from 1987 to 1995; (-) = increase from 1987 to 1995; (0) = no change from 1987 to 1995.

(U.S. EPA, 2001a)

* Toxic Equivalent – a quantitative measure of the combined toxicity of a mixture of dioxin-like chemicals

4. Ambient Concentrations

Limited data are currently available to characterize ambient concentrations of dioxins in California. The ARB commissioned a study to assess the ambient concentrations of dioxins in the South Coast Air Basin (Hunt et al. 1990). 2,3,7,8-Tetrachlorodibenzo-p-dioxin levels were non-measurable at some sites and 0.0086 pg/m^3 at West Long Beach (monitor near a petroleum refinery) and 0.034 pg/m^3 at the CalTrans site (monitor near a highway intersection) (U.S. EPA, 1993a).

A study to assess ambient concentrations of dioxins was also conducted in Fresno, California in 1991. The majority of the atmospheric burdens of dioxins are represented by non 2,3,7,8-substituted species which are not of toxicological importance. However, the reported range for 2,3,7,8-Tetrachlorodibenzo-p-dioxins was 0.012 to 0.027 pg/m^3 and for 2,3,7,8-Tetrachlorodibenzo-p-furans was 0.041 to 0.134 pg/m^3. It is thought that combustion sources (including wood stoves as shown by high retene concentrations) are responsible for these concentrations (ARB, 1993b).

The ARB is currently developing an air quality monitoring and testing program to collect ambient data for dioxins, furans, and dioxin-like PCBs in California known as the California Ambient Dioxin Air Monitoring Program (CADAMP). The CADAMP monitoring will take place at a total of nine locations in the State (five in the San Francisco Bay Area and four in the South Coast Air Basin). Monitoring will begin in January 2002 and will continue for two years.

B. Benzene

Benzene is a clear, colorless, volatile, highly flammable liquid with a characteristic sickly, sweet odor. It is chemically characterized by six carbon atoms linked in a planar symmetrical hexagon (equal C-C bond lengths) with each carbon atom attached to a hydrogen atom. The electronic structure of that geometry makes benzene unusually stable. It does react with other compounds mainly by the substitution of a hydrogen atom (U.S. EPA, 1993b). Benzene is soluble in water and miscible with alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride, glacial acetic acid, acetone, and oils (Merck, 1989).

The predominant sources of total benzene emissions in the atmosphere are gasoline fugitive emissions and gasoline motor vehicle exhaust. Mobile sources contribute 85 percent and industry related stationary sources 15 percent of the emissions. Approximately 70 percent of mobile source benzene emissions can be attributed to on-road motor vehicles, with the remainder attributed to non-road mobile sources (U.S. EPA, 1993b).

Although benzene is not present in household products except in small amounts in some automotive and cleaning products, it is a widely used industrial chemical. In 1985, it was the 16th highest-volume chemical produced in the United States. It is used in the manufacture of medicinal chemicals, shoes, dyes, detergents, explosives, linoleum, oil cloth, and artificial leather. Benzene is a solvent for waxes, fats, resins, paints, plastics, and fast drying inks. Other uses are as a raw material in the synthesis of organic compounds such as cyclohexane, styrene, phenol, and rubber. Tobacco smoke also contains benzene (ARB, 1997). Benzene emissions occur from residential burning, agricultural burning, forest management burning, and wildfires. These emissions can vary significantly from year to year (ARB, 1984). The primary stationary sources that have reported emissions of benzene in California are crude petroleum and natural gas mining, petroleum refining, and electric service (ARB, 1997).

C. 1,3-Butadiene

1,3-Butadiene is a flammable, colorless gas with a pungent, aromatic, gasoline-like odor. It is insoluble in water, slightly soluble in methanol and ethanol, and soluble in organic solvents such as benzene and ether (U.S. EPA, 1989b). 1,3-Butadiene is a gas at most environmental temperatures and is very volatile even at lower temperatures (ARB, 1997).

In California, the majority of 1,3-butadiene emissions are from incomplete combustion of gasoline and diesel fuels. Mobile sources account for approximately 96 percent of the total annual emissions statewide for quantified sources. Vehicles that are not equipped with functioning exhaust catalysts emit greater amounts of 1,3-butadiene than vehicles with functioning catalysts (ARB, 1992).

Other sources of 1,3-butadiene include petroleum refining, styrene-butadiene copolymer production, and biomass burning, including residential wood combustion, agricultural burning, and managed forest fires. The largest use of 1,3-butadiene in the United States is in the production of synthetic elastomers, which include: styrene-butadiene copolymer, acrylonitrile butadiene-styrene resin, polybutadiene, neoprene, and nitrile rubber. Products commonly made from the styrene-butadiene copolymers include tires, mechanical rubber goods, and latex. Latex is commonly used in foam products, paints, carpet and textile backing, paper coatings, and adhesives. The second major national use of 1,3-butadiene is in the production of adiponitrile, the raw material used in nylon 6,6 production (ARB, 1992). The primary stationary sources that have reported emissions of 1,3-butadiene are petroleum refining, manufacturing of synthetics and man-made materials, and oil and gas extraction (ARB, 1997).

D. Polycyclic Aromatic Hydrocarbons

Polycyclic organic matter (POM) consists of over 100 compounds and is defined by the Federal Clean Air Act as organic compounds with more than one benzene ring that have a boiling point greater than or equal to 100° C.

POM can be divided into the subgroups of polycyclic aromatic hydrocarbons (PAHs) and PAH-derivatives. PAHs are organic compounds that include only carbon and hydrogen with a fused ring structure containing at least two benzene (six-sided) rings. PAHs may also contain additional fused rings that are not six-sided. PAH-derivatives also have at least two benzene rings and may contain additional fused rings that are not six-sided rings. However, PAH-derivatives contain other elements in addition to carbon and hydrogen (CAPCOA, 1993).

In general, POM exists as a gas when its molecular weight is below 230 grams per mole, and is a particle above this molecular weight. This means that compounds with two rings (e.g., naphthalene) exist as a gas. Compounds with three to four rings (e.g., pyrene) exist either as a gas or particle depending on the temperature and pressure. Compounds with five rings (e.g., dibenzo[a,h]anthracene, benzo[a]pyrene) exist as particles in the atmosphere (ARB, 1997).

PAHs are primarily planar, nonpolar compounds that melt well above room temperature (U.S. EPA, 1987). Generally, PAHs exist as colorless, white, or pale yellow-green solids that are attached to particulate matter. PAHs may also exist as solids in soil or sediment. Benzo[a]pyrene is a PAH and is soluble in benzene, toluene, and xylene, but practically insoluble in water (ARB 1997). PAH-derivatives include nitro-PAHs, amino-PAHs, and oxygenated PAHs (phenols, quinones, and heterocyclic aromatic compounds containing sulfur and oxygen (Finlayson-Pitts and Pitts, Jr., 1986).

POM is produced by the incomplete combustion of fossil fuels and vegetable matter. PAHs have been detected in motor vehicle exhaust, smoke from residential wood combustion, and fly ash from coal-fired electric generating plants (Finlayson-Pitts and Pitts, Jr., 1986). The primary stationary sources that have reported emissions of benzo[a]pyrene in California are petroleum refineries, industrial machinery manufacturers, and the wholesale trade in petroleum and petroleum products. The primary stationary sources that have reported emissions of PAHs in California are paper mills, manufacturers of miscellaneous wood products, and petroleum refining (ARB, 1997).

E. Polychlorinated Biphenyls

There are 209 possible polychlorinated biphenyl (PCBs) isomers. PCBs vary in appearance from mobile, oily liquids to white, crystalline solids to hard, non-crystalline resins. They are thermally stable, resistant to oxidation, acids, bases, and other chemical agents, and have excellent dielectric properties. PCBs are colorless crystals in the pure form. The melting point is depressed when PCBs are mixed. PCBs are practically insoluble in water, and soluble in oils and organic solvents. When heated to decomposition, they emit toxic fumes of hydrochloric acid and other chlorinated compounds (NTP, 1991).

Since 1974, all uses of PCBs in the United States have been confined to closed systems such as electrical capacitors, electrical transformers, vacuum pumps, and gas-transmission turbines. PCBs are no longer produced in the United States except for limited research and development applications (NTP, 1991). Sources of PCBs are landfills containing PCB waste materials and products, destruction of manufactured articles containing PCBs in municipal and industrial waste disposal burners, and gradual wear and weathering of PCB-containing products (ARB, 1997).

Other sources in California that have reported emissions of PCBs are adhesives and sealants, fabricated rubber products, commercial prints and lithographs, and ground or treated mineral facilities, electric services, and refuse systems. The primary stationary sources that have reported emissions of PCBs in California are crude oil pipelines, wholesale trade in miscellaneous durable goods, and hydraulic cement manufacturers (ARB, 1997).

IV. SUMMARY OF RESIDENTIAL WASTE BURNING PRACTICES AND EMISSIONS

During the control measure development process, the practice of residential waste burning, the use of burn barrels, and associated toxic air emissions were examined for California. This chapter presents these findings, based on information collected from the literature, surveys of air districts, waste management agencies, fire protection agencies, and ARB analysis.

A. Residential Waste Burning Practices

The types of materials that can be burned based on current air district rules are shown in Table IV-1. Table IV-1 also lists prohibitions on the use of burn barrels. Eight air districts restrict the materials that can be burned to natural vegetation. These eight air districts represent approximately 79% of the statewide population. Current rules in 27 air districts allow the burning of some form of household wastes other than natural vegetation in all or part of the air district. Non-vegetative waste materials may include, but are not limited to, household garbage, plastics, paper, cardboard, cloth, and treated wood products.

Roughly 2.2 million people (722,400 households), about 7% of California's population, live in the portions of the 27 air districts that allow the burning of such wastes. The remaining 14% of the population live in the portions of these 27 air districts where only the burning of vegetation is allowed. Six of the 27 air districts allow the burning of all materials, including household garbage, in all or part of the district. The remaining 21 air districts prohibit the burning of household garbage, but may allow the burning of various materials such as paper, cardboard, cloth, and wood products. However, further restrictions on allowable materials may occur due to local ordinances within cities in some of these air districts. These additional prohibitions could be imposed by city ordinance, through local fire agency regulations, or through adoption of certain portions of the Uniform Fire Code which address the use of incinerators and allowable materials. In addition, six of the 21 air districts prohibit the use of burn barrels in all or part of the air district. These local restrictions would further reduce the number of households that are allowed to burn certain materials.

Due to the potentially overlapping nature of air district rules, local ordinances, and fire agency prohibitions, it is difficult to estimate the true number of households burning their residential waste in California. Information on waste disposal practices is also limited in some areas, and the relationship between availability of service and an individual household's decision to burn any or all of its waste is not always clear cut. For example, even though some households have regular waste pickup for their household garbage, they may still be burning their paper and cardboard in order to reduce waste disposal costs. Also, some households that do not have waste pickup service dispose of their waste by means other than burning. However, based on discussions with air district staff and waste management agencies, we have developed our best estimate of the number of households that could be burning their non-vegetative waste in California.

Table IV-1. Air District Rules on Residential Burning

Air District	Garbage Burned	Materials Allowed to be Burned*	Burn Barrels Allowed
Great Basin	ENTIRE AIR DISTRICT	G V P C	Yes
Modoc County	ENTIRE AIR DISTRICT	G V P C	Yes
Monterey Bay Unified	PART OF AIR DISTRICT	G V P C	Yes
Kern County	PART OF AIR DISTRICT	G V P C	Yes
Sacramento Metro	PART OF AIR DISTRICT	G V P C	Yes
San Diego County	PART OF AIR DISTRICT	G V P C	Yes
Calaveras County	NO	V P C	Yes
Mariposa County	NO	V P C	Yes
Northern Sierra	NO	V P C	Yes
Lassen County	NO	V P C	Yes
Siskiyou County	NO	V P C	Yes
Colusa County	NO	V P C	Yes
Feather River	NO	V P C	Yes
Tehama County	NO	V P C	Yes
Imperial County	NO	V P C	Yes
Lake County	NO	V P	No
El Dorado County	NO	V P	Yes
Amador County	NO	V P	Yes
Tuolumne County	NO	V P	Yes
North Coast Unified	NO	V P	Yes
Mendocino County	NO	V P	Yes
Northern Sonoma County	NO	V P	Yes
Placer County	NO	V P	Yes
San Luis Obispo County	NO	V P	Portions Only
Butte County	NO	V P	Yes
Glenn County	NO	V P	Yes
Shasta County	NO	V P	Yes
Bay Area	NO	V	Yes
Antelope Valley	NO	V	No
Mojave Desert	NO	V	No
San Joaquin Valley	NO	V	No
Santa Barbara County	NO	V	No
South Coast	NO	V	Yes
Ventura County	NO	V	Yes
Yolo-Solano	NO	V	Yes

* Materials Burned: G = Household Solid Waste (Garbage/Rubbish)
V = Any kind of Vegetation
P = Paper and Cardboard
C = Cloth

Approximately 82,000 households are located in the portions of the six air districts that have no prohibitions on the materials that can be burned. In these six air districts, we collected information on the availability of waste service, the prevalence of self-hauling practices, as well as air district estimates of likely burners. Based on this information, we estimate that about 15,000 households may be burning their residential waste, including household garbage. This is shown in the third column of Table IV-2. However, as discussed above, even some of the households with waste pickup service, or those that self-haul, may still be burning some of their waste materials, such as paper and cardboard.

An additional 641,000 households are present in the remaining portions of the 21 air districts where burning of other waste materials is allowed. Because these households are already required to dispose of their household garbage through non-burning alternatives, we assumed that all of these households must either have waste pickup service, or are self-hauling. Therefore, the decision to burn is based more on the additional cost to dispose of additional materials such as paper and cardboard, as well as the practical ease of doing so, rather than alternative disposal methods.

The estimate of the number of households actually burning residential waste in these 21 air districts (in third column) is based upon estimates provided by the air districts, CDF, and local jurisdictions. Each agency may have used different methods to develop its estimate. Some air districts used information on waste service availability and judgement based on compliance inspections. In other air districts, the estimated number of households burning is based upon the number of permits issued for residential burning by CDF and other local fire agencies. In some cases, this may represent an underestimate because not all households obtain permits outside of the summer controlled burn season, and because a number of different agencies issue permits, making tracking difficult. However, based upon the information provided by these agencies, we estimate approximately 93,000 households may be burning materials such as cardboard and paper in these 21 air districts.

In total, approximately 108,000 households may be actually burning some or all of their residential waste in the 27 air districts. A breakdown by county of the number of households allowed to burn under air districts rules, as well as our best estimate of the number of households actually burning is provided in Table IV-2. The first six air districts in the table are allowed to burn all forms of waste in all or part of the air district. The remaining 21 air districts do not allow the burning of household garbage, but do allow the burning of other residential waste materials. The first column in the table gives the total population in each of the 27 air districts, including areas prohibited from burning. The second column shows the number of households that are allowed to burn residential waste. The third column shows the number of households estimated to be actually burning residential waste.

However, many air districts also experience varying degrees of illegal garbage burning. Illegal garbage burning represents a substantial percentage of air quality complaints from the public for many air districts (ARB, 2001). Some air districts report that as many as 100 percent of burn barrels inspected have illegal materials in them. It is difficult for air districts to observe and cite illegal burning because they cannot see the materials in the burn barrels from a distance.

Table IV-2. Estimate of Households Burning by Air District

Air District	Total Population in Air District (2000 census)	ARB Estimate of Number of Households Allowed to Burn Waste	Local estimate of Number of Households Actually Burning Waste Outdoors
Great Basin	32,006	10,700	2,000
Kern County (east)	120,000	6,000	250
Modoc County	9,449	3,200	3,000
Monterey Bay Unified	710,598	39,000	3,600
Sacramento Metro	1,223,499	7,600	5,000
San Diego County	2,813,833	15,300	1,500
Amador County	35,100	11,700	1,800
Butte County	203,171	67,700	1,300
Calaveras County	40,554	13,500	2,500
Colusa County	18,804	6,300	2,000
El Dorado County	156,299	52,100	5,000
Feather River	139,149	46,400	3,600
Glenn County	26,453	8,800	2,800
Imperial County	142,361	47,500	5,000
Lake County	58,309	19,400	250
Lassen County	33,828	11,300	2,500
Mariposa County	17,130	5,700	2,000
Mendocino County	86,265	28,800	13,000
North Coast Unified	167,047	55,700	23,600
Northern Sierra	116,412	38,800	4,000
Northern Sonoma County	65,400	21,800	500
Placer County	248,399	82,800	2,000
San Luis Obispo County	246,681	16,200	500
Shasta County	163,256	54,400	2,000
Siskiyou County	44,301	14,800	6,500
Tehama County	56,039	18,700	6,000
Tuolumne County	54,501	18,200	6,000
TOTAL	7,028,844	722,400	108,200

B. Amount of Residential Waste Generated in California

On average, the typical household in California is comprised of approximately three people and generates between 3 and 11 pounds of garbage per day. The range takes into account factors such as the number of residents living in a household, physical household size, family income, location within the State, recycling characteristics, and time of year. The best estimate of residential waste generation is 5.9 pounds per day per household, based on the average waste disposal rates for each California county and assuming three people per household. This amounts to 41 pounds per household per week, and 2,137 pounds (970 kg) per household per year (CIWMB, 2000). Typical California residential waste constituents and estimates of their relative proportions are listed in Table IV-3 below. New York residential waste composition, the basis of the U.S. EPA tests described below, is also shown for comparison.

Table IV-3. Typical California Residential Waste Constituents

Material Type	California Percentage*	New York Percentage
Paper	44%	63%
Glass	7%	9%
Metals	8%	9%
Plastics	14%	12%
Food Waste	11%	7%
Other Materials (Wood, textiles, paint, etc.)	16%	0%

* Adjusted for removal of leaves, grass, and other organic materials

C. Emission Estimates for Residential Waste Burning

In order to assess the magnitude of emissions from residential waste burning, the U.S. EPA conducted a number of tests to characterize the emissions of dioxins and other TACs generated during the burning of household waste in burn barrels (EPA, 1997a). In an initial series of tests, four test burns were conducted to simulate the typical waste generated by a recycling and non-recycling household. The waste materials burned represented the typical percentages of materials disposed of by residents in New York State. Waste materials included paper, plastics, food waste, textiles, glass and ceramics, and metal and aluminum cans. A comparison of the percentages of waste materials in the New York tests to California waste materials is provided in Table IV-3. The California and New York waste compositions compare well, with slightly more paper in the New York waste, and more plastics and other materials such as wood and paint in the California mix. The materials were burned in a standard 55 gallon metal drum (sandblasted free of paint), with a series of air holes punched near the bottom for ventilation. The tests took place in a burn hut that included instrumentation to measure temperature and emissions.

These initial results showed significant emissions of dioxins and other TACs. However, there was also significant variability in the dioxin emissions between tests. Therefore, eighteen further tests were conducted to examine the factors influencing the emissions of dioxins from residential waste burning in burn barrels (Lemieux, 2000). These further test results indicated that dioxin emissions from burn barrels were likely dependent upon variations in the distribution of the waste materials which were actually burning at a given time within the burn barrel, even when an identical waste mix was burned each time. However, dioxin emissions were significant, across the range of measured values.

We used these test results to estimate the yearly emissions of dioxins and other TACs from residential garbage burning for a single household using a burn barrel. The emission factors developed by U.S. EPA were combined with residential waste generation rates and waste composition described above. Due to the variability in emission rates, composite emission factors for dioxins were developed representing each set of tests. The emission factors for the other pollutants are based on the original tests. The residential waste combustion rate was 10.4 pounds per hour, and the burn duration was 78 minutes, in accordance with the U.S. EPA test protocol.

The emission factors, and calculated emissions are provided in Table IV-4 for both series of tests. The emission factors are reported in terms of milligrams of pollutant per kilogram of trash burned, as well as grams per second, while emissions are reported in terms of grams per household per year. The emissions represent total mass. In the case of dioxins, the individual isomers of dioxins and furans were measured and summed to the total.

Table IV-4. Toxic and PM10 Emissions from Residential Waste Burning

Pollutant	Average Emissions Factor (mg/kg burned)	Average Emissions (grams/second)	Average Emissions (grams/ household/year)
Dioxins (Series 1 1997 Testing)	0.16	2.06E-07	0.15
Dioxins (Series 2 2000 Testing)	0.005	6.10E-09	0.005
1,3-Butadiene	141.2	1.85E-05	137.0
Benzene	979.7	1.28E-03	950.0
PAHs	45.0	5.89E-05	43.5
PCBs	0.13	1.65E-07	0.12
PM10	1.23E+04	1.60E-02	1.12E+04

As shown in the table, the average household burning residential waste could generate between 0.005 and 0.15 grams of dioxins per year. These emissions are based on a household that burned a complete mix of waste materials and likely represents the high end of expected emissions. While these numbers appear small, it is important to recognize that even small amounts of TACs can be hazardous to health. In addition, there is no threshold below which exposure to dioxins has been deemed safe. In addition, unlike medical and municipal waste incinerators, the temperatures at which residential burning takes place (typically between 50° C and 600° C) do not achieve the temperatures needed to minimize or eliminate the production of dioxins.

V. POTENTIAL HEALTH IMPACTS OF DIOXINS AND OTHER TOXIC AIR CONTAMINANTS FROM RESIDENTIAL WASTE BURNING

A. An Overview of Health Risk Assessment

A health risk assessment (HRA) is an evaluation or report that describes the potential a person or population may have of developing adverse health effects from exposure to an emission source. Some health effects that are evaluated could include cancer, developmental effects, or respiratory illness. The exposure pathways that can be included in an HRA depend on the toxic air pollutants that a person (receptor) may be exposed to, and can include breathing, the ingestion of soil, water, crops, fish, meat, cow's milk, and eggs, and dermal exposure. The consumption of mother's milk can be evaluated for an infant receptor. When multiple exposure pathways are considered in an HRA, the evaluation is called a multi-pathway assessment.

For this HRA, we evaluated the potential multi-pathway health impacts for polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (collectively referred to as dioxins), benzene, 1,3-butadiene, PAHs, and PCBs. Multi-pathway assessments are traditionally conducted when lipophilic (fat-loving), semi-volatile, or low volatility compounds such as dioxins, PAHs, and PCBs are emitted.

To develop this HRA, we followed a four-step process. The four steps are Hazard Identification, Dose-Response Assessment, Exposure Assessment, and Risk Characterization.

1. Hazard Identification

In the first step, we identified the pollutant(s) of concern and the type of effect, such as cancer or respiratory effects.

For this assessment, the pollutants of concern have been formally identified under the AB 1807 Program as TACs. The ARB formally identified dioxins, benzene, 1,3-butadiene, PAHs, and PCBs as TACs under California's Toxic Air Contaminant Identification and Control Program (ARB, 1986; ARB, 1984; ARB, 1992; ARB, 1993a). This identification was done through an open public process as specified under Health and Safety Code sections 39650 through 39662. In addition, dioxins, benzene, 1,3-butadiene, PAHs, and PCBs are listed as hazardous air pollutants under the Federal Clean Air Act (42 U.S.C. 7412).

The HRA was limited to these five substances (or groups of substances) after we performed a screening HRA on over 260 substances that were detected in U.S. EPA-sponsored source tests on the emissions from residential waste burning (U.S. EPA, 1997a). Of these 260 substances or groups of substances, the Air Resources Board lists approximately fifty percent as TACs. We refined this HRA to focus on these five substances or groups of substances because they were the main risk drivers in a screening HRA performed by the ARB. These five substances or groups constituted approximately seventy-three percent of the potential cancer risk through breathing and approximately ninety-nine percent of the potential cancer risk through ingestion routes (e.g., crop exposure). Other substances that were measured that have also been identified as TACs included cadmium, chromium, and mercury.

2. Dose-Response Assessment

In this step of risk assessment, we characterized the relationship between a person's exposure to a pollutant and the incidence or occurrence of an adverse health effect.

OEHHA performs this step of the HRA for the ARB. OEHHA supplies these dose-response relationships in the form of cancer potency factors or unit risk factors (URFs) for carcinogenic effects and reference exposure levels (RELs) for non-carcinogenic effects. The URFs and RELs that are used in California for the substances evaluated in this HRA can be found in the following references:

(1) U.S. Environmental Protection Agency Integrated Risk Information System (IRIS), 1996 (OEHHA, 1999c);

(2) The California Air Pollution Control Officer's Association Air Toxics "Hot Spots" Program, Revised 1992, Risk Assessment Guidelines, October 1993;

(3) The Office of Environmental Health and Hazard Assessment Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part I, The Determination of Acute RELs for Airborne Toxicants, March 1999;

(4) The Office of Environmental Health and Hazard Assessment Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors, April 1999;

(5) The Office of Environmental Health and Hazard Assessment Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part III, Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels, April 2000; and

(6) The Office of Environmental Health and Hazard Assessment Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part IV, Technical Support Document for Exposure Assessment and Stochastic Analysis, September 2000.

3. Exposure Assessment

In this step of the risk assessment, we estimated the extent of public exposure by looking at who is likely to be exposed, how exposure will occur (e.g., inhalation and ingestion), and the magnitude of exposure.

Residential waste burning activities emit substances that can impact receptors (residents) both in the near field and on a larger, regional scale. Avoiding the plume of smoke is not necessarily sufficient to eliminate the potential health impacts. Waste burning activities can still impact people who do not burn. Substances that are emitted through incineration can travel long distances, depositing onto crops, soil, and water. Residents can be exposed to these substances when breathing or they can ingest the substances in their diet or daily activities. Ingestion pathways can include soil ingestion, breast milk ingestion, ingestion of crops, meat (e.g., chicken and cows), and cow's milk. Meat and milk products can be impacted because animals ingest the pollutants and then these substances can be passed to people when animal products are ingested.

For this HRA, the receptors are assumed to be residents living near a single waste burning emissions point (burn barrel). We used a multipathway assessment that considers potential exposures through breathing, dermal absorption, and the ingestion of soil, backyard garden crops, meat, eggs, cows milk, and breast milk.

For this HRA, we used emissions from the U.S. EPA source tests which were conducted in 1997 and 2000 (U.S. EPA, 1997a; Lemieux, 2000). Emissions from the 2000 source tests were used for dioxins and PCBs because, according to U.S. EPA, these emissions are more representative than the 1997 emissions. The emissions from the 1997 source tests were used for benzene, 1,3-butadiene, and PAHs because these compounds were not quantified in the 2000 tests. Note however, that the 1997 tests showed higher dioxin and PCB emissions when compared to the 2000 tests.

Computer air dispersion modeling was used to provide downwind ground-level concentrations of the TACs at near-source locations (20 to 1,000 meters). The dispersion modeling used both default meteorological conditions from SCREEN3 and site-specific meteorological data from four locations across California (Alturas, Bishop, San Benito, and Escondido). These locations were selected to represent a range of meteorological conditions throughout the State where the burning of residential waste is allowed.

4. Risk Characterization

This is the final step of risk assessment. In this step, we combined information derived from the previous steps. Modeled concentrations, which are determined through exposure assessment, are combined with the URFs (for cancer risk) and RELs (for non-cancer effects) determined under the dose-response assessment. This step integrates this information to quantify the potential cancer risk and non-cancer health impacts.

B. The Tools Used For This Risk Assessment

The tools and information that are used to estimate the potential health impacts from a source include an air dispersion model and pollutant-specific health risk values. Combining the output from the source tests, air dispersion model, and the pollutant-specific health risk values provides an estimate of the potential cancer and non-cancer health impacts from the emissions of a toxic air contaminant. A description of the air dispersion modeling and pollutant-specific health effect values is provided below.

1. Air Dispersion Modeling

Air dispersion models are used to estimate the downwind, ground-level concentrations of a pollutant after it is emitted from a source. The downwind concentration is a function of the quantity of emissions, release parameters at the source, and appropriate meteorological conditions. We used the ISCST3 model for this assessment. The U.S. EPA recommends the ISCST3 model for refined air dispersion modeling (U.S. EPA, 1995a,b). This model is currently used by the ARB, air districts, and other states. The dispersion modeling used both default meteorological conditions from SCREEN3 and site-specific meteorological data from four locations across California (Alturas, Bishop, San Benito, and Escondido). A detailed discussion of the air dispersion modeling is presented in Appendix C.

2. Pollutant-Specific Health Effects Values

Dose-response or pollutant-specific health effects values are developed to characterize the relationship between a person's exposure to a pollutant and the incidence or occurrence of an adverse health effect. A unit risk factor (URF), also known as a cancer potency factor, with units of (micrograms per cubic meter)$^{-1}$ or ($\mu g/m^3$)$^{-1}$, is used when estimating potential cancer risks. A URF is defined as the estimated upper-confidence limit (usually 95%) probability of a person contracting cancer as a result of constant exposure to a concentration of one $\mu g/m^3$ of a pollutant over a 70-year lifetime.

Reference exposure levels (RELs) are used as an indicator to assess potential non-cancer health impacts. A REL is defined as a concentration level at or below which no adverse health effects are anticipated. RELs are designed to protect most of the sensitive individuals in the population by including safety factors in their development and can be created for both acute and chronic exposures. An acute exposure is defined as one or a series of short-term exposures generally lasting less than 24 hours. Chronic exposure is defined as repeated exposure usually lasting from one year to a lifetime.

Exposure to dioxins, benzene, 1,3-butadiene, PAHs, and PCBs may result in both cancer and non-cancer health effects. Table V-I presents the current health effects values that were used in the HRA and the toxicological endpoints (organs or body systems) that these substances may affect.

Table V-1. Pollutant-Specific Health Effects Values Used For Determining Potential Health Impacts

Compound	Cancer Unit Risk Factors		Non-Cancer Reference Exposure Levels			Non-Cancer Toxicological Endpoints	
	Inhalation[1] $(ug/m^3)^{-1}$	Oral [1,2] $(mg/kg\text{-}d)^{-1}$	Acute [3] (inhalation) (ug/m^3)	Chronic [4] (Inhalation) (ug/m^3)	Chronic [2,4] (Oral) (mg/kg/d)	Acute [3]	Chronic [4]
Benzene	2.9E-05		1.3E+03	6.0E+01		Developmental Hematologic, Immune, Reproductive	Developmental hematologic; nervous
1,3-Butadiene [5]	1.7E-04			2.0E+01			Reproductive
Polychlorinated Dibenzo-*p*-dioxins [6]							Alimentary; developmental; endocrine; hematologic; reproductive; respiratory
2,3,7,8-TCDD	3.8E+01	1.3E+05		4.0E-05	1.0E-08		
1,2,3,7,8-PeCDD	1.9E+01	6.5E+04		8.0E-05	2.0E-08		
1,2,3,4,7,8-HxCDD	3.8E+00	1.3E+04		4.0E-04	1.0E-07		
1,2,3,6,7,8-HxCDD	3.8E+00	1.3E+04		4.0E-04	1.0E-07		
1,2,3,7,8,9-HxCDD	3.8E+00	1.3E+04		4.0E-04	1.0E-07		
1,2,3,4,6,7,8-HpCDD	3.8E-01	1.3E+03		4.0E-03	1.0E-06		
1,2,3,4,6,7,8,9-OCDD	3.8E-02	1.3E+02		4.0E-02	1.0E-05		
Polychlorinated Dibenzofurans [7]							
2,3,7,8-TCDF	3.8E+00	1.3E+04		4.0E-04	1.0E-07		
1,2,3,7,8-PeCDF	1.9E+00	6.5E+03		8.0E-04	2.0E-07		
2,3,4,7,8-PeCDF	1.9E+01	6.5E+04		8.0E-05	2.0E-08		
1,2,3,4,7,8-HxCDF	3.8E+00	1.3E+04		4.0E-04	1.0E-07		
1,2,3,6,7,8-HxCDF	3.8E+00	1.3E+04		4.0E-04	1.0E-07		
1,2,3,7,8,9-HxCDF	3.8E+00	1.3E+04		4.0E-04	1.0E-07		
2,3,4,6,7,8-HxCDF	3.8E+00	1.3E+04		4.0E-04	1.0E-07		
1,2,3,4,6,7,8-HpCDF	3.8E-01	1.3E+03		4.0E-03	1.0E-06		
1,2,3,4,7,8,9-HpCDF	3.8E-01	1.3E+03		4.0E-03	1.0E-06		
1,2,3,4,6,7,8,9-OCDF	3.8E-02	1.3E+02		4.0E-02	1.0E-05		

Table V-1 (continued). Pollutant-Specific Health Effects Values Used For Determining Potential Health Impacts

Compound	Cancer Unit Risk Factors		Non-Cancer Reference Exposure Levels			Non-Cancer Toxicological Endpoints	
	Inhalation[1] $(ug/m^3)^{-1}$	Oral [1,2] $(mg/kg\text{-}d)^{-1}$	Acute [3] (inhalation) (ug/m^3)	Chronic [4] (Inhalation) (ug/m^3)	Chronic [2,4] (Oral) (mg/kg/d)	Acute [3]	Chronic [4]
Polycyclic Aromatic Hydrocarbons [8]							
Benzo[a]pyrene	1.1E-03	1.2E+01					
Benz[a]anthracene	1.1E-04	1.2E+00					
Benzo[b]fluoranthene	1.1E-04	1.2E+00					
Benzo[k]floranthene	1.1E-04	1.2E+00					
Chrysene	1.1E-05	1.2E-01					
Dibenz[a,h]anthracene	1.2E-03	4.1E+00					
Indeno[1,2,3-c,d]pyrene	1.1E-04	1.2E+00					
Naphthalene				9.0E+00			Respiratory
Polychlorinated Biphenyls	5.7E-04	2.0E+00		1.2E+00 [9]	2.5E-05 [10]		Alimentary, developmental, immune, reproductive

1. Office of Environmental Health Hazard Assessment, Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors, April 1999.
2. Office of Environmental Health Hazard Assessment, Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part IV, Technical Support Document for Exposure Assessment and Stochastic Analysis, September 2000.
3. Office of Environmental Health Hazard Assessment, Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part I, The Determination of Acute Reference Exposure Levels for Airborne Toxicants. Benzene has an REL based on a 6-hour averaging period.
4. Office of Environmental Health Hazard Assessment, Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part III, Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels, April 2000.
5. Office of Environmental Health Hazard Assessment, Adoption of Chronic Reference Exposure Levels For Airborne Toxicants, Memorandum, January 2001.
6. Polychlorinated dibenzo-*p*-dioxin is listed here as a group heading. Individual congeners are listed below this heading with their respective health factors.
7. Polychlorinated dibenzofuran is listed here as a group heading. Individual congeners are listed below this heading with their respective health factors.
8. Polycyclic aromatic hydrocarbons (PAHs) are listed here as a group heading. Individual PAHs (and naphthalene) used in the HRA are listed below this heading with their respective health factors.
9. California Air Pollution Control Officer's Association, Air Toxics Hot Spots Program, Revised 1992 Risk Assessment Guidelines, October 1993.
10. United States Environmental Protection Agency, Integrated Risk Information System, 1996 (OEHHA, 1999c).

C. Potential Health Effects of Dioxins, Benzene, 1,3-Butadiene, PAHs, and PCBs

This section summarizes the cancer and non-cancer impacts that can result from exposure to dioxins, benzene, 1,3-butadiene, PAHs, and PCBs. The information comes from ARB's 1997 reference report, *Toxic Air Contaminant Identification List – Summaries* unless otherwise noted (ARB, 1997).

1. Dioxins

Exposure to dioxins may result in both cancer and non-cancer health effects. The probable route of human exposure to dioxins is inhalation, ingestion, and dermal absorption (ARB 1986). In addition, dioxins can be passed down to children through mother's milk. Once dioxin enters the human body, a small amount is metabolized and eliminated, while the rest bioaccumulates in body fat. As fat is metabolized, stored dioxins is released and excreted primarily in feces. The body's concentration is dependent on the rates of ingestion, elimination, and storage capacity of dioxins. The approximate half-life of dioxins in humans was estimated to range from 6 to 10 years (ARB, 1997).

a. Cancer

The OEHHA staff has performed an extensive assessment of the potential health effects of dioxins, reviewing available carcinogenicity data. OEHHA concluded that dioxins are a potential human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified dibenzo-*p*-dioxins and dibenzofurans (chlorinated in the 2,3,7 and 8 positions and containing 4,5,6, or 7 chlorine atoms) as a TAC in July 1986 (ARB, 1986). The State of California under Proposition 65 listed polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans, and 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin as carcinogens in April 1988 and January 1988, respectively (OEHHA, 2001b).

In 1990, the U.S. EPA listed 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin as a Hazardous Air Pollutant (HAP) pursuant to subsection (b) of Section 112 of the Federal Clean Air Act (42. U.S.C. 7412). The U.S. EPA is preparing a final Dioxin and Related Compounds risk assessment document. The International Agency for Research on Cancer (IARC) classified 2,3,7,8-tetrachlorodibenzo-*p*-dioxin as Group 1: Human carcinogen, based on sufficient evidence in humans (ARB, 1997).

Human studies that have reported cancer increases are inconclusive because of inadequate data. There is adequate evidence to support a conclusion that 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin is carcinogenic in rodents and should be considered a potential carcinogen to humans. Ingestion studies in rodents have shown increases in tumors of the liver, lung, squamous cell, nasal turbinates, and hard palate (ARB, 1997).

b. Non-cancer

Short-term (acute) and long-term (chronic) exposure to dioxins may also result in non-cancer health effects. Acute exposure of humans to dioxins has caused chloracne, liver toxicity, skin rashes, nausea, vomiting, and muscular aches and pains. A severe weight loss in animals has been observed following acute exposure to dioxin as have hyperkeratosis, facial alopecia, inflammation of the eyelids, and loss of fingernails and eyelashes. The immune system appears to be very sensitive to dioxin toxicity. Thymic atrophy is a prominent finding in exposed animals and has been observed in all laboratory species examined. Other lymphoid tissues such as the spleen, lymph nodes, and bone marrow are also affected. Symptoms of chronic exposure to dioxins include splenic and testicular atrophy, elevated gamma-glutamyl transpeptidase levels, elevated cholesterol levels, and abnormal neurological findings. Other effects may include risk of enzyme induction, diabetes, and endocrine changes (ARB, 1997).

Human studies on the adverse reproductive and developmental effects of dioxins have proven inconclusive. Animal studies have shown 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin to be both teratogenic and fetotoxic. Reproductive and teratogenic effects observed in animals are cleft palate, kidney abnormalities, decreased fetal weight, and survival, hydrocephalus, open eye, edema, resorptions, petechiae, and infertility (ARB, 1997). The State of California under Proposition 65 listed 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin as a chemical known to the State to cause developmental toxicity in April 1991 (OEHHA, 2001b).

2. Benzene

Exposure to benzene may result in both cancer and non-cancer health effects. The probable routes of human exposure to benzene are inhalation and ingestion of drinking water (ARB, 1997).

a. Cancer

The OEHHA staff has performed an extensive assessment of the potential health effects of benzene, reviewing available carcinogenicity data. The OEHHA staff agrees with U.S. EPA and IARC that benzene is a human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified benzene as a TAC in January 1985 (ARB, 1984). The State of California under Proposition 65 listed benzene as a carcinogen in February 1987 (OEHHA 2001b).

In 1990, the U.S. EPA listed benzene as a HAP pursuant to subsection (b) of Section 112 of the Federal Clean Air Act (42. U.S.C. 7412). The U.S. EPA has classified benzene in Group A: Human carcinogen based on sufficient epidemiological evidence. The IARC classified benzene in Group 1: Human carcinogen based on sufficient evidence in humans (ARB, 1997). Increased incidences of leukemias, especially acute myelogenous leukemia and its variants including erythroleukemia and myelomonocytic leukemia, have been observed in humans occupationally exposed to benzene. A retrospective mortality study in China in 1989 has provided supporting evidence that benzene exposure is associated with cancers in humans. Animal cancer bioassays show benzene causes leukemia and a variety of other cancers including cancers of the lymphoid system, skin, ovary, oral cavity, lip, tongue, lung, mammary gland, and two secretory organs unique to rodents, the Zymbal and preputial glands (ARB, 1997).

b. Non-cancer

Short-term (acute) and long-term (chronic) exposure to benzene may result in non-cancer health effects. Brief inhalation exposure to high concentrations of benzene can cause central nervous system depression. Acute effects include central nervous system symptoms of nausea, tremors, drowsiness, dizziness, headache, intoxication, and unconsciousness. Benzene vapors are mildly irritating to the eyes and respiratory tract. Benzene can sensitize the myocardium to the arrythmogenic effects of epinephrine. Chronic human inhalation exposure can cause hematopoietic system decreases in erythrocytes, leukocytes, or platelets with progression to leukopenia, thrombocytopenia, pancytopenia, and/or aplastic anemia. Occupational exposures to low concentrations have been observed to have an initial stimulant effect on the bone marrow, followed by aplasia and fatty degeneration. Workers chronically exposed to benzene have shown alterations in serum levels of immunoglobulins (ARB, 1997).

Results from several studies conducted in rats and mice have indicated depressed cellular proliferation in the bone marrow from short-term exposures to benzene. In humans, there have been reports of menstrual disorders and possibly reduced fertility associated with benzene exposure, but these reports are limited by factors such as simultaneous exposure to several chemicals, or poor or no controls. In mice and rats, following inhalation of benzene during pregnancy, reduced fetal weight and other indications of growth retardation have been observed. Exposure of pregnant mice resulted in alterations of hematopoiesis in the fetus or offspring, but no effects on red or white blood cell count or hemoglobin analysis. The significance of the hematopoietic alterations is unclear (ARB, 1997). The State of California under Proposition 65 listed benzene as a chemical known to the State to cause developmental toxicity and male toxicity in December 1997 (OEHHA, 2001b).

3. 1,3-Butadiene

Exposure to 1,3-butadiene may result in both cancer and non-cancer health effects. The probable route of human exposure to 1,3-butadiene is through inhalation (ARB, 1997).

a. Cancer

The OEHHA staff has performed an extensive assessment of the potential health effects of 1,3-butadiene, reviewing available carcinogenicity data. The OEHHA staff agrees with U.S. EPA and IARC that 1,3-butadiene is a probable human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified 1,3-butadiene as a TAC in July 1992 (ARB, 1992). The State of California under Proposition 65 listed 1,3-butatiene as a carcinogen in April 1988 (OEHHA, 2001b).

In 1990, the U.S. EPA listed 1,3-butadiene as a HAP pursuant to subsection (b) of Section 112 of the Federal Clean Air Act (42. U.S.C. 7412). The U.S. EPA has classified 1,3-butadiene in Group B2: Probable human carcinogen. The International Agency for Research on Cancer has classified 1,3-butadiene in Group 2A: Probable human carcinogen based on limited evidence in humans and sufficient evidence in animals. The United States Occupational Safety and Health Administration has proposed that exposure to 1,3-butadiene is associated with an increased risk of death from cancer of the lymphohematopoietic system, and has classified 1,3-butadiene as a potential occupational carcinogen (ARB, 1997).

Epidemiological studies of production workers exposed to 1,3-butadiene provide limited evidence of an increased risk of death from hematologic neoplasms, especially leukemia and other lymphomas. Studies of mice exposed to concentrations of 1,3-butadiene indicate that 1,3-butadiene is taken up rapidly by the body and distributed with metabolites to all tissues. This distribution can result in cancer in multiple sites, including the heart, lung, mammary gland, ovaries, forestomach, liver, pancreas, thyroid, testes, and hematopoietic system. Exposure to 1,3-butadiene at higher concentrations is associated with tumors in the rat. It is important to note that 1,3-butadiene is 1 of only 2 chemicals (the other being the fungicide Captafol) known to induce cancer in the heart of laboratory animals (ARB, 1997).

b. Non-cancer

Short-term (acute) and long-term (chronic) exposure to 1,3-butadiene may result in non-cancer health effects. 1,3-butadiene vapors are mildly irritating to the eyes and mucous membranes and cause neurological effects such as blurred vision, fatigue, headache, and vertigo at very high levels. Epidemiological studies of workers in the rubber industry have shown an increase in cardiovascular diseases such as rheumatic and arteriosclerotic heart diseases and blood effects. Animal studies have shown respiratory effects, blood effects and hyperplastic changes to the heart from prolonged inhalation exposure to 1,3-butadiene.

No information is available on adverse reproductive or developmental effects of exposure to 1,3-butadiene in humans. There is evidence of reproductive toxicity in animal studies. Female mice exhibited ovarian atrophy from exposure to 1,3-butadiene at 6.25 parts per million. In developmental toxicity studies, 1,3-butadiene has been shown to be fetotoxic in the absence of producing maternal toxicity. At 40 parts per million in mice, 1,3-butadiene resulted in reduced fetal weight of males, and at 200 parts per million, reduced ossification was reported in fetuses (ARB, 1997).

4. Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) is within the group of chemicals known as particulate polycyclic organic matter (POM). POM was identified by the Board as a TAC in April 1993 when it formally adopted the federal HAPs as TACs as required by AB 2728 legislation (ARB, 1993a). Benzo[a]pyrene is in the PAH class of compounds. In April 1994, an exposure and health assessment for benzo[a]pyrene was prepared by ARB and OEHHA and reviewed by the ARB's Scientific Review Panel on TACs (ARB, 1994).

Exposure to polycyclic aromatic hydrocarbons (PAHs) may result in cancer health effects. The probable routes of human exposure to PAHs occurs through inhalation, ingestion and dermal contact (ARB, 1997).

a. Cancer

The OEHHA staff has performed an extensive assessment of the potential health effects of benzo[a]pyrene, reviewing available carcinogenicity data. The OEHHA staff agrees with U.S. EPA and IARC that benzo[a]pyrene is a probable human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur (ARB, 1994). The State of California under Proposition 65 listed 25 PAH compounds (including benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) as carcinogens between the years 1987 and 1990 (OEHHA, 2001b).

In 1990, the U.S. EPA listed POM as a HAP pursuant to subsection (b) of Section 112 of the Federal Clean Air Act (42. U.S.C. 7412). The U.S. EPA has classified benzo[a]pyrene in Group B2: Probable human carcinogen. The International Agency for Research on Cancer (IARC) has classified benzo[a]pyrene in Group 2A: Probable human carcinogen based on sufficient evidence in animals and limited evidence in humans.

Results from epidemiologic studies have indicated an increase in lung cancer occurs in humans exposed to coke oven emissions, roofing tar emissions, and cigarette smoke. Each of these mixtures contains a number of PAHs. Respiratory tract tumors have been reported in animals exposed via inhalation to benzo[a]pyrene and forestomach tumors, leukemia, esophageal and laryngeal tumors from oral exposure (ARB, 1997).

b. Non-cancer

No information is available on the acute effects of POM in humans. Enzyme alterations in the mucosa of the gastrointestinal tract and increased liver weights have been reported in animals exposed orally to several PAHs. Chronic exposure to benzo[a]pyrene in humans has resulted in dermatitis, photosensitization in sunlight, eye irritation and cataracts. Animal studies have reported effects on the blood and liver from oral exposure to benzo[a]pyrene and effects on the immune system from dermal exposure to benzo[a]pyrene (ARB, 1997)

No information is available on adverse reproductive or developmental effects of POM in humans. Oral exposure to benzo[a]pyrene in animals has been reported to result in adverse reproductive effects, including reduced incidence of pregnancy and decreased fertility, and developmental effects such as reduced viability of litters and reduced mean pup weight, and decreased fertility in offspring. Benzo[a]pyrene has been demonstrated to cause transplacental carcinogenesis in animals (ARB, 1997).

5. Polychlorinated Biphenyls

Exposure to PCBs may result in both cancer and non-cancer health effects. The probable routes of human exposure to PCBs occurs through inhalation, ingestion, and dermal contact (ARB, 1997).

a. Cancer

The OEHHA staff has performed an extensive assessment of the potential health effects of PCBs, reviewing available carcinogenicity data. The OEHHA staff agrees with U.S. EPA and IARC that PCBs are a probable human carcinogen (OEHHA, 1999b). The Board identified polychlorinated biphenyls (PCBs) as a TAC in April 1993 when it formally adopted the federal HAPs as TACs as required by AB 2728 legislation (ARB 1993a). The State of California under Proposition 65 listed polychlorinated biphenyls and polychlorinated biphenyls (containing 60 or more percent chlorine by molecular weight) as carcinogens in October 1989 and January 1988 respectively (OEHHA, 2001b).

In 1990, the U.S. EPA listed PCBs as a HAP pursuant to subsection (b) of Section 112 of the Federal Clean Air Act (42. U.S.C. 7412). The U.S. EPA has classified PCBs as Group B2: Probable human carcinogen. The IARC has classified PCBs as Group 2A: Probable human carcinogen (ARB, 1997).

Human studies were inconclusive but suggest an association between exposure to PCBs and liver cancer. In studies in which rats and mice were orally exposed to some PCB formulations, an increased incidence of liver tumors was observed (ARB, 1997).

b. Non-cancer

Short-term (acute) and long-term (chronic) exposure to PCBs may result in non-cancer health effects. Exposure to PCBs may cause skin, eyes, nose, throat, and respiratory tract irritation. Chronically overexposed workers may suffer from chloracne and mild liver injury. Infrequently reported symptoms include anorexia, gastrointestinal upset, and peripheral neuropathies. In animal studies, oral exposure to PCBs was reported to cause possible liver, kidney, and central nervous system effects (ARB, 1997).

Mothers exposed to PCBs through fish consumption have given birth to infants with adverse developmental effects including motor deficits, impaired psychomotor index, impaired visual recognition memory, and deficits in short-term memory. Decreased birth weights and lower gestational age at birth are reported among women occupationally exposed to high levels of PCBs as compared to lower levels of PCBs. Animal studies have reported learning deficits, impaired immune function, cellular alterations of the thyroid, and reproductive effects such as decreased fertility, decreased conception, and disrupted ovarian cyclicity (ARB, 1997). The State of California under Proposition 65 listed polychlorinated biphenyls as a chemical known to the State to cause developmental toxicity in January 1991 (OEHHA, 2001b).

D. Summary of the Potential Health Impacts from Residential Waste Burning

This section presents the potential health impacts from the analysis that was performed for residential waste burning. Potential health impacts are discussed both in terms of individual risk, as well as community exposure.

1. Individual Health Impacts

Both carcinogenic and non-carcinogenic individual health risk impacts were estimated at a variety of locations ranging from 20 to 1,000 meters downwind from a single burn barrel. Depending upon property size, these distances could reflect impacts on both an individual household, as well as neighboring households.

Table V-2 provides an overview of the potential multipathway health impacts at 20 meters using both default meteorological conditions from SCREEN3 and site-specific meteorological data from four locations across California (Alturas, Bishop, San Benito, and Escondido). The purpose of presenting this data at a near-source location of 20 meters is to illustrate what the potential health impacts may be if a resident is located in close proximity to a burn barrel. ARB staff observed burn barrels well within the 20 meter distance during tours provided by local air district personnel of residential locations with burn barrels.

The table also provides estimates of potential cancer risk for each exposure pathway. Since an individual's potential cancer risk will vary depending upon the routes they are exposed to, the exposure pathways are presented separately to provide a feel for how each pathway contributes to the total potential cancer risk. An individual's total potential cancer risk can be determined by adding together the potential cancer risk for each exposure route. The four basic pathways of inhalation, soil ingestion, skin absorption, and mother's (breast) milk are considered minimum pathways for this assessment of residential waste burning (OEHHA, 2001c). However, the other pathways (homegrown crops, meat, and cow's milk) can be included or not, depending upon individual lifestyles. For example, an individual who does not consume meat from their own animals would not include the potential risk numbers from that exposure route in their estimate of total potential cancer risk. If they have no homegrown crops, then the crop pathway would not be included.

For more detailed information, tables B-1 to B-5 in Appendix B present the potential multipathway health impacts at 20, 50, 100, 200, 500, and 1,000 meter distances for each meteorological condition or site-specific meteorological data set.

Table V-2 shows a range of near-source potential multipathway cancer risk across all meteorological conditions or data sets at approximately 6 to 2,300 chances per million. The lower end of this range includes the potential cancer risk from inhalation, soil ingestion, dermal absorption, and breast milk pathways (OEHHA 2001c). The upper end of the range estimates potential cancer risks across all included exposure pathways (i.e., the four minimum pathways plus crop, meat, and milk ingestion).

The highest non-cancer acute inhalation hazard index is 0.02. The highest non-cancer chronic hazard index for the minimum the exposure pathways (inhalation, soil, dermal) is 0.08 and the highest non-cancer chronic hazard index across all pathways is 2.0. Generally, hazard Indices less than 1.0 are not considered to be a concern to public health. Hazard indices greater than 1.0 could be an indicator for potential non-cancer health impacts. However for this assessment, hazard indices greater than 1.0 are only present when all exposure pathways are included. As discussed above, if an individual's lifestyle does not include all exposure pathways then their potential health risk would be reduced.

Table V-2. Overview of the Potential Health Impacts from Residential Waste Burning at 20 Meters [1,2]

Exposure Pathways [3,4]	Meteorological Data				
	SCREEN3	Alturas	Bishop	San Benito	Escondido
	Cancer Risk (chances per million)				
Inhalation	44	3.3	4.6	6.4	8.2
Soil Ingestion	16	1.2	1.6	2.2	2.9
Skin Exposure	14	1.0	1.4	2.0	2.6
Mothers Milk [5]	8.9	0.7	1.0	1.3	1.7
Backyard Garden	56	4.2	5.8	8	10
Meat and Eggs	1010	75	105	145	187
Milk (cow)	1160	86	120	166	215
Total Cancer Risk	2309	172	239	331	428
	Non-Cancer Hazard Indices				
Acute Inhalation[6]	0.02	0.01	0.02	0.02	0.02
Chronic Multipathway [7]	0.08 – 2.0	0.15	0.2	0.3	0.4

1. All results are rounded. Potential health impacts are calculated from air dispersion modeling results and risk at 20 meters. Emissions for dioxins and PCBs are from the U.S. EPA 2000 source tests. Emissions for benzene, 1,3-butadiene, and PAHs are from the U.S. EPA 1997 source tests.
2. All risk assessment results are based on a 70-year exposure for all pathways except the mother's (breast) milk pathway (44-year). Results are based on the CAPCOA Risk Assessment Guidelines methodology, HRA 2.0e, and the updated OEHHA cancer potencies and reference exposure levels as of January 2001.
3. All pathways of exposure are assumed to occur at the same distance (location) from the source.
4. Emissions are assumed to be uncontrolled (0.05 factor). Multipathway route assumptions include: 15% of produce in the receptor's diet is homegrown; 100% of dietary meat (beef, pork, and chicken), eggs, and cow's milk is impacted; 50% of cattle's diet is from impacted grassland and other feed is not contaminated; Farm animal drinking water is from a 300 gallon trough, measuring one square meter, and is consumed every 3.75 days byr one lactating cow.
5. PCB contribution calculated by ratio of PCB to PCDD body half-life (0.7) multiplied by the PCDD & PCDF mother's milk to inhalation ratio.
6. Benzene impacts were assessed using 6-hour average concentrations. Primary endpoints are cardiovascular or blood, reproductive system, and immune system.
7. Dioxins, PAHs, and PCBs were assessed for chronic impacts. Includes both inhalation and non-inhalation exposure pathways. Primary endpoints are reproductive system, cardiovascular or blood, and nervous system. The lower end of the range includes inhalation, soil, and dermal exposure pathways. The upper end of the range includes all exposure pathways, except mother's milk.

The potential cancer risk for the four minimum pathways at the near-source (20 meters) residential receptor ranges from 6.2 chances per million at Alturas to approximately 83 chances per million under SCREEN3 meteorological conditions. Benzene, 1,3-butadiene, and dioxins are the primary contributors to the potential health impacts through inhalation exposure. Dioxins, PAHs, and PCBs are the primary contributors to the potential cancer risk through ingestion pathways. Depending upon the environmental setting of the emission's source, additional pathways such as consumption of produce from backyard gardens, home-raised meat, and cow's milk could be considered. If these additional pathways are considered, the range of total potential cancer risk increases to approximately 170 chances in a million at Alturas and approximately 2,300 chances per million under SCREEN3 meteorological conditions. These risk estimates assume that burning occurs twice per week for two hours throughout the year. In some years, CDF may impose a ban on burning during the summer fire season. Depending upon meteorological conditions, a reduction in the period of burning would result in no reduction in potential health impacts up to a 20 percent reduction.

2. Community Health Impacts

Dioxins are emitted from the burning of residential waste materials which can have near source impacts on individuals in the household conducting the burning and on nearby neighbors. However, there is also a broader community impact from the dioxins generated from this source. Dioxins are widespread throughout the environment, representing the cumulative emission impacts from many sources, including residential waste burning. Although dioxins are formed from almost all combustion sources, the most toxic forms are generated by burning manmade substances. The most toxic forms existed only in trace amounts in the environment prior to the 1930's.

Dioxins emitted from a source can travel long distances because they exist partially in the vapor form and partially in the particulate form. They have a half-life in the atmosphere of several days. Eventually, the dioxins in the air are deposited onto vegetation, waterways and the soil.

Once deposited, dioxins are highly persistent, with the half-life in the soil surface estimated at 9 to 15 years, and in the soil subsurface at 25 to 100 years. Dioxins can also accumulate in the fat of fish and animals and are concentrated up the food chain. It is estimated that up to 90% of dioxin intake for a typical person comes from dietary intake of animal fats (Gilman & Newhook, 1991). These various environmental sources lead to widespread, low-level exposure of the general population to dioxins. Because dioxins can be passed through mothers milk, young children are especially vulnerable. Children may also be more sensitive to dioxin exposure because of their rapid growth and development (U.S. EPA, 2001a).

Reducing emissions from the sources that emit dioxin into the atmosphere can therefore reduce community exposure to dioxins. The typical person continues to accumulate dioxins over a lifetime. Current average body burdens are close to levels at which effects on the immune system occur. In addition, current average body burdens pose an unacceptable cancer risk. Countries around the world, including the United States have recognized the public health threat posed by dioxin emissions. They have been taking steps to reduce dioxin emissions with measurable success. Further reductions are dependent upon eliminating sources such as residential burning.

VI. THE PROPOSED CONTROL MEASURE AND ALTERNATIVES

In the previous two chapters we assessed emissions and potential risk from residential waste burning. This chapter contains a summary of the proposed control measure and provides the basis for selecting the provisions being proposed and alternatives we considered in developing this proposal. The proposed ATCM is set forth in Appendix A.

A. Summary of the Proposed Control Measure

1. General Provisions

The proposed control measure would minimize emissions of dioxins, as well as other toxic air contaminants such as benzene, 1,3-butadiene, PAHs, and PCBs, and the criteria pollutant, particulate matter, from residential waste burning by addressing both the materials which can be burned, and the method of burning. The proposed ATCM prohibits the burning of residential waste, other than natural vegetation, anywhere in the State except for areas that qualify for a temporary exemption based upon specified criteria. The use of burn barrels would also be prohibited statewide, except in the exempt areas, as a means of ensuring that such barrels are not used for the burning of prohibited residential waste.

The ATCM would require the use of an ignition device approved by the Air Pollution Control Officer. A variety of devices or materials can be used to ignite residential waste fires, ranging from propane to diesel fuel. This provision will require the use of ignition devices that ensure a fire that ignites quickly and that minimizes the production of smoke, as appropriate to the conditions and materials burned in each air district.

It would also prohibit the burning of allowable combustibles, including natural vegetation, as defined in the regulation, unless it is a permissive burn day in the air district where the residential burning takes place. This requirement aligns the burning of residential waste with the requirements for agricultural and prescribed burning. Burning only on permissive burn days will ensure optimal conditions for smoke dispersion and minimize nuisance and health impacts.

2. Applicability

The proposed ATCM applies to persons conducting outdoor burning of combustible or flammable waste generated from inside residences, and from outdoor activities associated with a residence, for the purpose of disposing of the waste. The proposed ATCM also applies to persons lighting fires that burn combustible or flammable waste in enclosed or partially enclosed vessels, such as incinerators or burn barrels, or in an open outdoor fire, such as in pits or in piles on the ground.

3. Exemptions

With the concurrence of the ARB, air districts may specify geographic areas that will be exempt from the prohibitions in the ATCM if they meet criteria including, but not limited to, all of the following:

1) no available waste pickup service, considering reasonable cost and frequency of service; and
2) greater than a reasonable distance from an approved transfer station or disposal facility or a communal or community dumpster, considering road miles or time traveled, road conditions, terrain, weather conditions, reasonable tipping fees, and hours of operation; and
3) low population density per census tract or other appropriate sub-unit of the county area.

Exemptions would only apply to residential waste materials that are allowed under air district or local jurisdiction rules in effect as of the date of hearing notice for the Board meeting to consider the proposed ATCM. The use of burn barrels would also be allowed in these exemption areas.

In order to be considered for exemptions, air districts must submit documentation to the ARB, which has been approved by the air district Board at a public hearing, by March 1, 2003. The air district must provide mapped excluded geographic areas with a detailed, written justification for the mapping based on the criteria listed above. The justification must also include a demonstration that waste disposal alternatives are not likely to become available within the next five years.

ARB would have 60 days to review the documentation and approve or disapprove the request. If the request is disapproved, the air district must resubmit the request within 30 days. However, it is ARB's intention to work with the air districts requesting exemptions in advance of request submittals in order to provide guidance on exemption criteria and to facilitate the approval process. A determination of allowable exemption areas would be revisited every five years. At that time, air districts must demonstrate to the ARB that the criteria for the exemptions are still met, and that waste disposal services for these areas were not expected within the next five-year time frame. Table VI-1 summarizes the requirements of the proposed ATCM. A further discussion of the exemption criteria is provided in section B.3.

4. Schedule

The provisions of the regulation would be effective on July 1, 2003. As discussed above, Requests for Exemptions would need to be submitted by March 1, 2003 to allow time for ARB review and approval prior to the effective date of the regulation.

Table VI-1. Requirements of the Proposed ATCM

Applicability	Exemptions	Requirements
Applies to all areas of the State.	Allowed based upon air district documentation of areas which meet the criteria, and with ARB concurrence: 1) availability and cost of waste service, 2) distance from and accessibility of an approved transfer station or landfilll, and 3) low population density —	**Effective March 1, 2003:** By this date, air districts must submit Requests for Exemption with appropriate documentation and justification. **Effective July 1, 2003:** The provisions of the ATCM become effective. **Effective Every Five Years after July 1, 2003:** Air districts may request continuing exemptions. Air districts must submit documentation that the criteria for the exemptions still exist.

B. Basis For The Proposed Regulation

California Health and Safety Code section 39665(b) requires the Board to address the technological feasibility of proposed ATCMs. Health and Safety Code section 39665(b) also requires the Board to address the "availability, suitability and relative efficacy" of substitute products of a less hazardous nature when proposing an ATCM. In addition to the issues to be addressed under Health and Safety Code section 39665(b), Health and Safety Code section 39666 requires that any control measure for a TAC without a Board-specified threshold level be designed to reduce emissions to the lowest level achievable through the application of best available control technology (BACT) or a more effective control method.

To evaluate these factors, we reviewed existing literature on emissions from residential waste burning, assessed control programs in other states, and held numerous discussions with waste management agencies, waste service providers, the CIWMB, fire protection agencies, and air districts about enforcement and the feasibility, cost, and environmental impacts of alternative methods for disposing of prohibited residential waste materials. We also reviewed existing air district rules governing residential waste burning.

1. Best Available Control Technology

Dioxins are a by-product of the combustion of residential waste materials containing carbon and chlorine during low temperature, poor oxygen conditions. While the burning of natural vegetation does produce some dioxins, the emissions are much lower than the emissions from the burning of manmade materials. In addition, the burning of natural vegetation produce dioxin isomers which are less toxic. Dioxins are optimally formed when combustion temperatures are within a window of 250° C and 700° C. The formation of dioxins can be minimized or eliminated through careful control of combustion conditions, including maintaining combustion temperatures at approximately 1000°C for a minimum of 1 second. For major sources such as municipal and hospital waste incinerators, combustion conditions can be carefully controlled, and the required high temperature and residence time can be achieved. However, this type of controlled combustion is not feasible for small residential burning sources such as backyard burn barrels or piles. No external control technologies, or changes in burning practices, are available or achievable to reduce or eliminate dioxin emissions from residential burning.

Testing performed by the U.S. EPA (U.S. EPA, 1997a; Lemieux, 2000) on a mixture of residential waste materials including household food waste, plastics, glass, metal cans, and paper demonstrated that dioxins are emitted during the burning of these materials. As discussed in Chapter III, the burning of waste in burn barrels provides optimal conditions for the formation of dioxins, including low combustion temperatures and low oxygen availability. Typical combustion temperatures in burn barrels measured during the U.S. EPA tests ranged from 50° C to 600° C, with temperatures within the optimal 250° C to 700° C window for a significant portion of the test duration (U.S. EPA, 1997a).

Individual tests are not available to quantify the dioxin emissions from separate material types such as paper and cardboard. While the burning of plastics produces the greatest amount of dioxins, both carbon and chlorine are present in all residential waste materials, including paper and cardboard. Most paper and cardboard also contains inks and dyes that can also release other toxic air contaminants when burned. Additionally, many modern paper products contain small amounts of plastics or have plastic linings. Therefore, staff determined that best available control technology for residential waste burning would be a prohibition on burning of all types of residential waste materials other than natural vegetation. As noted in previous chapters, seven air districts already prohibit the burning of non-vegetative materials, and six air districts already prohibit the use of burn barrels.

2. Effectiveness

The proposed control measure would prohibit the burning of all residential waste materials with the exception of natural vegetation except in areas with limited exemptions. We estimate that approximately 108,000 households are burning some form of non-vegetative waste and would be affected by the proposed regulation. In the non-exempt areas, the proposed control measure would result in a complete elimination of dioxins and other TACs generated from the burning of the prohibited residential waste materials, although the potential for illegal burning of prohibited materials could still exist. We recognize that in some areas, alternatives to burning residential waste materials are not available at a reasonable cost. Therefore, the proposed ATCM allows for limited exemption areas. However, exempted areas would need to meet stringent criteria, with documentation provided by the air district, and with concurrence from the

ARB. We estimated the number of households that might be exempt under the criteria specified in the proposed regulation by assuming that only those households living outside an incorporated community would be likely to meet the exemption criteria. Based upon the distribution of population in incorporated versus unincorporated areas in the portion of each air district that allows burning of residential waste, we estimate that up to 67,000 households could be exempt. This is approximately 62 percent of the 108,000 households that are estimated to be currently burning some form of residential waste.

3. Criteria for Exemptions

Pursuant to State law, control measures for TACs without a Board-specified threshold exposure level such as dioxins must be based on best available control technology in consideration of cost and risk. We developed a three-tiered exemption criteria approach that is designed to minimize public health risk in consideration of cost and feasibility in implementing best available control technology. These exemption criteria were developed recognizing that there are some areas in the State where feasible and cost-effective alternatives to burning of residential waste are not available. However, exemptions must also address the need to minimize public exposure to dioxins and other TACs generated from residential waste burning.

In order request an exemption, an area must meet all three criteria: 1) no available waste pickup service, considering reasonable cost and frequency of service; 2) greater than a reasonable distance from an approved transfer station or disposal facility or a communal or community dumpster, considering road miles or time traveled, road conditions, terrain, weather conditions, reasonable tipping fees, and hours of operation; and 3) low population density per census tract or other appropriate sub-unit of the county area.

Based upon discussions with air districts and waste management agencies, staff determined that these exemption criteria must be flexible enough to address the unique variability in waste disposal options and topography in each air district, while maintaining an appropriate level of health protection. Thus "one-size-fits all" exemption criteria were not appropriate. The following sections discuss the various factors that influence how these exemption criteria may be met.

a. Availability of Waste Service

A number of different forms of curbside waste service exist throughout the State. Many jurisdictions require mandatory garbage service. Mandatory service is defined as service by a franchised waste provider where the household is required to pay for and use the service. Voluntary service is defined as households that are served by a franchised waste service provider, but where the household may elect to use or not use the service. Finally, discretionary service represents households which are not served by a selected franchise waste service, but which may contract for waste services on their own.

Under the exemption criteria, areas with mandatory or voluntary waste service would be considered to have available waste service. However, areas with discretionary service may meet the first exemption criteria. In these areas, waste providers may not be willing to serve all households due to access problems, or the cost of service may be many times higher than contracted rates for the mandatory and voluntary service areas. For example, in San Benito County, mandatory or voluntary service is provided to all households in the northern portion of the county. However, households in the more remote southern portions of the county have discretionary service only. In areas with discretionary service, the feasibility and cost of the service will be considered in determining whether an area meets this exemption criteria. Cost for service that exceeds twice the median cost for currently served mandatory and voluntary areas in the air district would be considered high.

b. Distance to Approved Disposal Facility

Many households that do not contract for regular curbside pickup elect to self-haul their residential waste to approved landfills, transfer stations, or recycling facilities. The number and location of these facilities in relation to the locations of households varies throughout the State. Many counties have no landfills, and provide only transfer stations. The waste from these transfer stations is then sent to landfills in other counties or out of State. The distance an individual household would have to travel to dispose of their waste therefore varies in each air district. In addition, reasonable travel distances can vary depending upon road conditions, posted speed limits, terrain, and weather conditions. A reasonable travel distance in a county with flat terrain, may be unreasonable in another county with mountainous terrain and poor roads. For example, current rules in the Kern County air district specify that households within 15 miles of an approved landfill or transfer station may not burn their residential waste. However, this criteria may not be appropriate in a more mountainous region. In general, a half-hour travel time, or approximately 15 miles would be considered a reasonable distance.

The operating hours and tipping fees for a disposal facility may also be considered. For example, in Modoc County, many of the transfer stations are only open a few days a week, with limited operating hours. Therefore, the location of landfills and transfer stations, their operating schedule, and reasonable travel distances in relation to the locations of households all need to be considered in determining whether a specific area would meet the second exemption criteria.

c. Population Density

The population density exemption criteria were developed to ensure that any allowable burning would minimize public exposure to dioxins and other TACs. In addition, it is recognized that it is more difficult to establish regular waste pickup service at a reasonable cost in sparsely populated areas than in more densely populated areas. Due to differences in topography and meteorological dispersion conditions that affect exposure levels, staff determined that specifying a single population density value in the proposed regulation was not appropriate. In addition, the distribution of the population in a given area must be considered. For example, a more densely populated area may exist within a broader region of very low population density. In this situation, the average population density could be very low, however, protection of public health would not be achieved by allowing burning in the more densely populated sub-area. Therefore, the criteria specify that population density exemptions must be made on a sub-county basis such as a census tract or other unit of zoning.

4. Enforceability

Primary responsibility for enforcement of the proposed control measure, as with all ATCMs, would be with the air districts. However, the ARB is also authorized to enforce ATCMs (Health and Safety Code section 39669). Prohibitions on the burning of all residential waste materials other than natural vegetation facilitates enforcement efforts by creating a clear distinction between the types of materials which can and cannot be burned. In addition, the enforceability of the proposed control measure is enhanced through the elimination of burn barrels. Air districts report that many households burn prohibited materials in burn barrels.

In July 1997, the Lake County Air Quality Management District conducted a survey of burn barrel contents from burn barrels randomly selected throughout the county. Inspectors found that greater than 90% of the 52 burn barrels evaluated had illegal materials in them. Burn barrel contents included batteries, diapers, flashlights, children's toys, electronic devices, and other illegal materials (Lake County AQMD, 2001a, Lake County AQMD, 2001b).

In September 2001, ARB surveyed the 21 air districts in California which allow residential waste burning, but not garbage burning. The purpose of the survey was to determine how many burn barrels there are in each of those air districts and what percentage are found to contain illegal materials in them. All 21 air districts surveyed responded. The initial survey found that there were about 113,000 burn barrels burning residential waste. Some numbers were subsequently revised based on further conversations with the air districts, resulting in our best estimate of 93,000 households burning residential waste. Fifteen of the 21 air districts that responded to the survey reported that greater than 50% of burn barrels in their air district have illegal materials burned in them (ARB, 2001).

It is often difficult for air district enforcement staff to determine whether prohibited materials have been burned in burn barrels. The use of open piles on the ground for the burning of natural vegetation will therefore facilitate improved air district enforcement efforts. A strong public education and outreach campaign to alert the public to the health impacts of residential waste burning and the availability of alternative waste disposal options will also assist with compliance efforts and minimize the incidence of illegal burning.

5. Cost and Resource Requirements

The proposed control measure would have a limited fiscal impact on the State and air districts, primarily in terms of enhanced public education and outreach, and enforcement. It would also have a limited economic impact on consumers and local waste management agencies where new service is established. These economic impacts are discussed in Chapter VII.

6. Environmental Effects

The proposed control measure was evaluated for potential impacts on waste diversion rates, landfill capacities, illegal dumping, illegal waste storage, increased vehicle traffic due to expanded waste pickup service, and fire safety. Based on available information, the ARB has determined that no significant adverse environmental impacts should occur. Environmental impacts are discussed in Chapter VIII.

7. Alternative Waste Disposal Methods

The proposed control measure will require some households to use waste disposal methods other than burning for some or all of the residential waste. The greatest impact will be seen in the six air districts where there are no restrictions on the materials that can be burned, and where some households therefore may not be using any other alternative disposal mechanisms. Some of these waste materials, such as food waste and other organic materials, can be composted, and probably already are in many rural households. The remaining waste will need to be disposed of at a landfill, transfer station, or recycling center, either through self-hauling or contracting for curbside pickup. In areas where these disposal options are not available, considering cost and feasibility, limited exemptions will allow for the continued burning of residential waste. It should be noted however, that in some years, the CDF invokes a ban on all residential burning during fire season, typically between July and October. During these months, households may already be using some of the alternative disposal methods discussed above.

In the remaining 21 air districts which already prohibit the burning of household garbage, households are already disposing of a portion of their waste through non-burning methods, presumably through curbside pickup or self-hauling. The proposed control measure will require these households to dispose of additional materials, primarily paper and cardboard, through the same non-burning disposal methods.

Other options to dispose of residential waste materials include the purchasing of products that minimize the use of packaging and re-using materials, as well as shredding and compacting of waste to reduce bulk.

8. Health Impacts

The proposed ATCM would result in a substantial reduction of dioxins and other TACs from residential waste burning. As discussed in Chapter V, dioxins from residential waste burning impact not only individuals located near the source of the burning, but also the broader population due to their transport and deposition onto soil, water, and vegetation. Dioxins can accumulate in the fatty tissues of animals that ingest the water and vegetation. Further bioaccumulation occurs when the meat, milk, and eggs from these animals are ingested by humans. Dioxin emissions from residential waste burning contribute to this global accumulation of dioxins in the environment. Emissions of dioxins from other large sources such as municipal and medical waste incinerators have been controlled. The U.S. EPA estimates that emissions from residential waste burning are one of the largest remaining sources of uncontrolled emissions of dioxins (U.S. EPA, 2001b). Therefore, reductions in the emissions from residential waste burning will reduce the environmental loading of dioxins and further reduce public exposure to dioxins and resultant health impacts.

C. Alternatives to the Proposed Control Measure

Staff identified two alternatives to the proposed control measure. This section discusses each of the two alternatives, and provides the reasons they were considered to be less effective than the proposed regulation. The first alternative was to take no action, to allow the continued burning of residential waste, and the use of burn barrels. The second alternative was to prohibit only the burning of household garbage. We determined that these alternatives would not be as effective at reducing emissions of and exposure to dioxins and other TACs from residential waste burning activities as the proposed control measure. Furthermore, the two alternatives did not meet the HSC section 39666 criterion to reduce emissions to the lowest level achievable through the application of best available control technology, or a more effective control method, in consideration of cost, risk, and environmental impacts.

1. Alternative One - No Action

The "no action" alternative would not address the potential risk posed by residential waste burning activities. As evidenced by the potential health impacts discussed in Chapter V, this alternative would not be protective of public health.

2. Alternative Two – Prohibition Only on Burning of Household Garbage

This alternative would prohibit only the burning of household garbage. Under this alternative, households would still be allowed to burn their non-garbage wastes, such as paper, cardboard, wood products, and cloth. This would affect only six air districts, or approximately 15,000 households that are likely to be burning residential waste in these areas. However, this option would be less protective of public health and would not promote the development and expansion of alternatives to burning in as many areas. In addition, the alternative would do little to minimize the illegal burning of garbage in burn barrels, or the burning of materials such as paper in more densely populated areas.

D. Recommendation

As a result of the evaluation, with incorporation of recommended exemptions, we consider the proposed ATCM to be environmentally, technically, and economically feasible, resulting in a safe, effective, and less-hazardous alternative to burning. Based on this evaluation, we believe that it is appropriate prohibit residential burning of all materials with the exception of natural vegetation, as well as to eliminate the use of burn barrels.

VII. ECONOMIC IMPACTS OF THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE

This chapter discusses the impacts that the proposed ATCM may have on consumers as well as costs to businesses and local, State, and federal agencies.

A. Economic Impacts Analysis on California Businesses as Required by the California Administrative Procedure Act (APA) and other State Law

1. Legal Requirements

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with businesses in other states.

Also, State agencies are required to estimate the costs or savings to any State or local agency and school district in accordance with instructions adopted by the Department of Finance. The estimate shall include any nondiscretionary costs or savings to local agencies and the costs or savings in federal funding to the State.

Health and Safety Code section 57005 requires the ARB to perform an economic impact analysis of submitted alternatives to a proposed regulation before adopting any major regulation. A major regulation is defined as a regulation that will have a potential cost to California business enterprises in an amount exceeding ten million dollars in any single year. The proposed ATCM is not a major regulation.

2. Affected Businesses

Waste service providers in the 27 air districts that currently allow some form of residential waste other than natural vegetation to be burned could be affected by the proposed control measure. We estimate that there are more than 100 waste service providers that serve these air districts. Private recycling centers and waste disposal facilities could also be affected.

3. Potential Impact on Consumers

Consumers who are currently burning their residential waste may have to pay more to dispose of these materials. The proposed ATCM would require them to obtain waste disposal services or to self-haul their waste to landfills or transfer stations. In some areas, new waste service routes may need to be developed. In other areas, new customers may be added to existing routes. The increased cost will vary depending upon the costs associated with increasing waste management service in their area.

We surveyed a number of local waste management agencies to determine the costs and availability of service. Based upon surveys conducted by ARB staff, and information from the CIWMB, we identified several forms of service and cost structures for service. Many jurisdictions require mandatory garbage service. Mandatory service is defined as households that are served by a franchised waste provider selected by the jurisdiction where the household is required to pay for and use the service. Voluntary service is defined as households that are served by a franchised waste service provider selected by the jurisdiction, but where the household may elect to use or not use the service. Finally, discretionary service represents households which are not served by a selected franchise waste service, but which may contract for waste services on their own.

Within these forms of service, there are also a number of cost structures. In many jurisdictions, a standard monthly fee covers the cost of pickup of one 32 gallon trash container per week. Incremental fees often apply for additional or larger containers. In other jurisdictions, the monthly fee is fixed regardless of the number or size of container. Not all areas require the separation of natural vegetation (also known as green waste) and recyclable materials in the waste containers. However, where this is done, some include separate green waste and recyclable containers as part of the overall monthly fee, while other jurisdictions may charge a small additional fee.

A number of different fee structures also exist for landfills and transfer stations. In most jurisdictions, consumers pay what is known as a tipping fee. This tipping fee is based upon the amount of material dropped off, and is often assessed by weight or volume. However, there are some jurisdictions, such as eastern Kern County, where all households are assessed a flat annual fee for landfill services. This fee entitles each household to drop off their waste materials at county landfills, and no "per use" tipping fee is assessed. While some landfills and transfer stations do not separate the materials that enter the landfill, many establish separate areas for recyclable materials. Generally recyclable materials can be dropped off for no cost.

Based on surveys, we found that consumer costs for monthly curbside waste pickup generally range from $8 to $25. This is typically 1 pickup per week for one or two 32 gallon containers. In some jurisdictions, additional fees are charged for additional cans, and/or for containers for recyclable materials. These additional fees can range from $3 to $10 per month. We estimate that a consumer who did not previously contract for waste service could therefore incur new yearly costs for waste pickup of $96 to $420. This would apply primarily to consumers in the six air districts where there are no restrictions on the materials that can be burned. In these air districts there may be households where waste disposal options other than burning have not previously been used. In the remaining 21 air districts where the burning of household garbage has already been prohibited, it can be assumed that consumers are already using some form of alternative waste disposal, whether it is curbside pickup or self-hauling. These consumers however may have some additional waste that was previously burned. Assuming that these consumers live in jurisdictions where additional fees would apply for extra cans or recycling containers, they could incur additional yearly costs of $36 to $120.

It is also possible that the expansion of existing routes could result in enhanced economies of scale and some incremental reduction in costs to all consumers already receiving service. Establishing service for a remote area not previously served however, could necessitate service fees which are two to three times higher than the typical fees described above. In this instance, the cost of service could be a consideration in requesting an exemption for the specified area.

Alternatively, some consumers may elect to self-haul their waste to landfills and transfer stations. Typical tipping fees for landfills and transfer stations generally range from $25 to $85 per ton of compacted waste disposed or $3 to $20 per cubic yard of uncompacted waste. Some landfills also charge on a per vehicle basis, regardless of the amount of waste. However, as discussed above, some landfills and transfer stations have established sorting areas for recyclable materials, and consumers are not charged for the portion of their waste which is recyclable.

Assuming that a household would make one trip per week to a landfill or transfer station, with one half a cubic yard of waste in each trip, staff estimates that a consumer who previously burned all of their waste could incur yearly costs of $78 to $520 to self-haul their waste materials. These costs could be reduced in areas where recyclable materials are separated. Consumers who had previously been self-hauling only a portion of their waste, and burning the rest, would incur lower additional yearly costs. Again, these costs could be reduced if the additional waste, which is often paper and cardboard, was brought to a recycling facility. Households that self-haul could also incur additional fuel costs to transport the material to the landfill or transfer station. Assuming a round trip distance to the landfill or transfer station of 20 miles, a fuel cost of $1.50 per gallon, and a fuel efficiency of 20 miles per gallon, a household that previously burned all their waste could incur additional costs of $1.50 per trip. At 52 trips per year, that additional fuel related costs would amount to $78 per year. This cost would be less for households that previously transported some of their waste materials, and only increase the frequency of trips as a result of the proposed regulation.

4. Potential Impact on Employment, Business Creation, Elimination or Expansion

The proposed ATCM is not expected to have a noticeable impact on the status of California businesses. The primary businesses affected would be waste service providers as well as operators of private recycling centers and waste disposal facilities. The proposed ATCM may actually create some business opportunities and employment for California waste service providers in areas where either additional households opt into service where service had been voluntary, or where service areas are expanded. New or expanded opportunities could also be created for recycling facilities.

5. Potential Impact on Business Competitiveness

The proposed ATCM would have no impact on the ability of California waste service providers to compete with similar businesses in other states. Waste service contracts are determined on a local jurisdictional basis. The requirements of the proposed ATCM would affect all waste service providers competing for a contract, regardless of where they originate from.

B. Analysis of Potential Impacts to California State or Local Agencies

1. Costs to Air Districts

Although there are no specific mandates, the proposed ATCM could have some small, but unquantifiable, economic impacts on the air districts. Health and Safety Code section 39666 requires that after the adoption of the proposed ATCM by the Board, the air districts must enforce the ATCM or adopt and enforce an equal or more stringent regulation. Beginning in July 2003, the air districts, during their normal course of business, will be responsible for enforcement activities and responding to complaints. The proposed regulation does not contain any specific requirements for enforcement or inspection. In addition, because most air districts already have rules and regulations in place that necessitate enforcement for currently prohibited materials, the enforcement efforts required for the proposed regulation would build upon these existing efforts. Air districts are also provided with State funding through the subvention process. Air districts have discretion in using this funding for enforcement purposes, and can apportion the funding based upon program needs.

The air districts may also need to carry out a public education and outreach campaign to enhance compliance with the ATCM and to alert the public to available options for waste disposal. However, ARB will develop public education and outreach materials that can be provided to the air districts. Some air districts may also require resources to determine exemption areas. We estimate that 1 to 2 person months would be needed for this effort initially, with one half to one person month needed every five years to renew exemptions. The ARB will provide technical assistance to the air districts in preparing exemption requests. It should be noted that eight air districts already have programs at least as stringent as the proposed ATCM and therefore would incur no additional burden from the requirements of the regulation.

2. Costs to Local Waste Management Agencies

The proposed ATCM could result in non-mandatory costs to local agencies responsible for waste management services to the extent they choose to provide expanded waste disposal services and to address waste diversion impacts. In many jurisdictions, waste service is already available throughout the area, although in many cases it is not mandatory. Additional households who might opt into service due to the proposed ATCM would not have an impact on the local agency. The expansion of waste service to areas which were previously unserved however, could result in increased costs to local agencies to develop new waste hauling contracts and for continued management and oversight. However, the costs of additional waste service could be recovered through waste collection service fees.

Local agencies could experience increased costs if they decide to expand the hours of operation at a landfill or transfer station to meet consumer demand or need. Additional costs could also be incurred if a waste agency needed to go through a permit amendment process to expand the allowable capacity of a landfill. It is also possible that a local jurisdiction could elect to build new transfer stations to address increased demand or better serve outlying residents. Infrastructure costs to establish a small, unattended transfer station are approximately $10,000. Additional costs of approximately $20,000 would be incurred for permitting, and costs would be higher for larger, attended facilities. However, discussions with several waste management agencies indicate that many factors would influence the decision to establish additional transfer stations, therefore the potential for this impact cannot be quantified.

Finally, local waste management agencies could develop new baseline waste disposal levels to better address the addition of materials that were previously burned to the waste stream and more accurately calculate diversion rates. Development of a new baseline could cost approximately $50,000 for surveys at selected waste disposal facilities. However, not all local waste management agencies may choose to develop new baseline years.

3. Costs to State and Federal Land Management Agencies

Although there are no specific mandates, the proposed ATCM could have limited economic impacts on State and federal land management agencies. The main impact would be on public education, issuance or permits, and enforcement of complaints that could arise from burning that occurred on State and federal responsibility area lands. As discussed above, ARB will provided the needed public education and outreach materials. The number of permits is not expected to increase as a result of the proposed regulation, and may decrease due to the decrease in the number of households allowed to bum residential waste materials. In terms of enforcement, while these fire agencies have primary responsibility for fire safety, they often are the first ones to respond to complaints about burning, which often are not about fire safety, but the burning of prohibited materials. Some jurisdictions have addressed this problem through a memorandum of understanding between the local fire protection agencies and the air district to allow the fire protection agency to recoup its costs for enforcement through a pass-through of fines assessed by the air district. This has worked especially well in Placer County. Similar efforts in other jurisdictions could minimize the economic impact of enforcement efforts for these State and federal land management agencies.

VIII. ENVIRONMENTAL IMPACTS OF THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE

The intent of the proposed ATCM is to improve air quality and protect the public health by reducing the public's exposure to potentially harmful emissions of dioxins, other TACs, and particulate matter produced during the burning of residential waste materials. An additional consideration is the impact that the proposed ATCM may have on other areas of the environment. This chapter describes the potential impacts that the proposed ATCM may have on waste diversion rates, landfill capacities, illegal dumping, illegal waste storage, increased vehicle miles traveled due to expanded waste pickup service, and fire safety. In evaluating the potential impacts, we considered the role of exemptions in the proposed regulation. The goal of the exemptions would be to allow burning to continue in those areas where feasible alternatives for waste disposal do not exist, and where population density is low. These exemptions are expected to mitigate the potential for adverse impacts in areas where they would be the most likely to occur. Therefore, based on available information, the ARB has determined that no significant adverse environmental impacts should occur.

A. Legal Requirements Applicable to the Analysis

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential adverse environmental impacts of proposed regulations.[4] Since the ARB's program involving the adoption of regulations has been certified by the Secretary of Resources (see Public Resources Code section 21080.5), the CEQA environmental analysis is included in the Initial Statement of Reasons for a rulemaking in lieu of preparing an environmental impact report or negative declaration. In addition, prior to adopting the regulation, the ARB will respond in writing to all significant environmental issues raised by the public during the public review period or at the Board hearing. These responses will be contained in the Final Statement of Reasons for the ATCM.

B. Waste Diversion Rates

The proposed ATCM will result in some increases in residential waste sent to municipal waste disposal facilities. The increases would be greatest in the six air districts that currently allow all types of materials to be burned. In the remaining 21 air districts, an increase primarily in paper and cardboard could be seen at these facilities. This additional waste would impact the 50 percent waste diversion requirements established in State law by AB 939 (PRC 41780-41786). The goal of AB 939 is to decrease the amount of materials disposed of at landfills through the development of source reduction, recycling, and composting programs. The legislation established a requirement of 25 percent diversion from landfills for all jurisdictions by January 1, 1995, with a 50 percent diversion requirement by January 1, 2000.

4 California Code of Regulations, title 17, sections 60005 through 60007.

Diversion rates are determined by measuring the amount of solid waste disposed of at a permitted disposal and comparing that with the amount of estimated amount of waste generated by that jurisdiction. Disposal is determined for the current year. Generation is estimated for the current year by adjusting estimates for a base year (generally 1990) based on changes in population, employment, and taxable sales corrected for inflation. These base year generation rates however, would not have included waste that was burned.

Each local jurisdiction is responsible for developing local recycling and waste reduction programs to meet the diversion requirements. Jurisdictions which cannot meet the 50 percent diversion requirement may request an extension, upon demonstration that the jurisdiction is making a good faith effort to implement source reduction, recycling, and composting programs, and that these programs represent the greatest diversion amount that may reasonably and feasibly be achieved.

The CIWMB is currently evaluating reports submitted by local jurisdictions to determine whether they met the diversion requirements. Because the waste that is currently burned was not included in the baseline generation values, the addition of this material to landfills will impact waste diversion rates. However, efforts to promote recycling, particularly for paper could help mitigate this impact. Jurisdictions may also elect to develop new baseline levels to account for the waste that had previously been burned. In addition, as discussed above, CIWMB has a process to work with jurisdictions that have not met the diversion requirements providing the jurisdiction is making a good faith effort to meet the diversion goals.

C. Landfill Capacity

The addition of materials that were previously burned to existing landfills could cause some landfills to reach capacity sooner than originally anticipated. Staff estimates that the additional waste will not exceed 100,000 tons per year, which is less than one percent of the existing waste disposed in California. This percentage may vary by air district however, depending upon the amount of waste previously burned. As with the waste diversion issue discussed above, efforts to promote recycling of materials can help alleviate this potential impact.

D. Illegal Dumping

The proposed ATCM could result in some increases in illegal dumping near roadsides and/or in remote wildland areas by households that refuse to either pay for curbside service, or self-haul their waste to a transfer station or landfill. While illegal dumping is a continuing concern for waste management officials, the proposed ATCM is not expected to result in a significant increase in the small percent of the population that contributes to this illegal activity. A strong public education and outreach campaign that emphasizes the options that are available to consumers for disposing of their waste legally can help mitigate this impact. In addition, the proposed regulation provides for exemptions for those households that may not have alternative waste disposal options other than burning. This should therefore minimize the possibility of illegal dumping.

E. Waste Storage

The proposed ATCM could result in some increases in illegal storage of residential waste where inclement weather impacts residents' ability to utilize available disposal services, or where residents choose not to utilize available disposal services. This could cause a public health impact associated with increases in disease transmitted by vermin, as well as odor and nuisance problems. Again, a targeted public education and outreach campaign can provide consumers with information about appropriate means of disposing of their residential waste. In addition, as discussed above, the proposed regulation provides for exemptions for those households that would have the greatest difficulty in routinely disposing of their waste through non-burning alternatives, and would therefore minimize the occurrence of extended waste storage.

F. Potential Air Pollution Impacts

The proposed ATCM is designed to reduce the public health risks associated with exposure to the emissions of dioxins and other toxic air contaminants. In addition, the proposed ATCM will reduce the emissions of particulate matter. The proposed ATCM will also result in reductions in oxides of nitrogen (NOx) and volatile organic compounds (VOC). Oxides of nitrogen and volatile organic compounds contribute to the formation of ozone, a key component of smog, and to particulate matter.

The proposed ATCM could result in some increases in vehicle miles traveled (VMT) associated with increased garbage collection service and increased trips associated with taking garbage to landfills and collection sites. As discussed in previous chapters, as many as 108,000 households could be affected by the proposed ATCM. Many of these households could potentially start receiving new curbside service, or start self hauling their residential waste to a landfill of transfer station who were not previously doing so.

For many of these households where waste service has been voluntary, there are existing waste service routes which already serve their neighborhood. In this situation, the VMT from garbage trucks would not increase. However, in some cases, the proposed ATCM could result in additional VMT for new waste service routes. Additional VMT may also arise from increased trips by garbage trucks transporting additional waste from transfer stations to a central landfill. Assuming that a garbage truck traveled an additional 100 miles per week, or 5,200 miles per year, transporting additional waste, and using ARB emission factors for refuse trucks in 2004, an additional 29 pounds of PM10, 641 pounds of NOx, and 102 pounds of VOC per year would be generated. For comparison purposes, the additional PM10 emissions from the garbage truck hauling waste for this scenario would nearly equal the PM10 emissions from one burn barrel (approximately 25 pounds per year). The ARB also has an active program to reduce particulate emissions from diesel vehicles through the diesel risk reduction program. A comparison of NOx and VOCs cannot be made because these pollutants were not measured in the U.S. EPA burn barrel tests.

Many households may also be self hauling a portion of their waste to the landfill. In some cases, they may only increase the amount of material transported, but not the frequency. However, in other cases, some households may increase the frequency with which they transport their waste materials to the landfill or transfer station. Assuming two extra trips per month, at a distance of 20 miles per round trip, the extra VMT would equal 520 miles per year. For a household that previously burned all of their waste, and would therefore begin self-hauling their residential waste once per week, the extra VMT would equal 1,040 miles per year. Using ARB emission factors for light duty trucks (pick-ups) for 2004 of 0.021, 1.171, and 0.846 grams per mile respectively for PM10, NOx, and VOC, the additional emissions would amount to approximately 0.05 pounds of PM10, 2.7 pounds of NOx, and 2.0 pounds of ROG per household per year. For comparison purposes, the additional PM10 emissions from vehicle travel for one household is approximately 500 times smaller than the PM10 emissions from one burn barrel.

G. Fire Safety Issues

The proposed ATCM was evaluated to determine whether there could be any adverse impacts on fire safety. Burn barrels are sometimes recommended by fire safety officials for the burning of residential materials in order to provide a contained area for the fire. However, burn barrels are not typically used for the burning of vegetative material. Rather this material, because of its bulk, is typically burned in piles on the ground. In areas that are not exempt under the proposed regulation, the burning of natural vegetation will be the only material that can be burned under the proposed ATCM. However, areas that receive an exemption will be allowed to use burn barrels to burn allowable waste materials. Therefore, the ATCM should not substantially impact fire safety.

H. Combustion of Waste Materials Indoors

We received several comments that the proposed ATCM would result in the inappropriate burning of residential waste material indoors, either through wood stoves or fireplaces. We recognize that there is a possibility that some people might try this alternative. As part of the public outreach materials that the ARB will prepare, we will make it clear that this is an inappropriate activity and potentially extremely risky because the pollutants can build up indoors.

I. Environmental Justice

The ARB is committed to evaluating community impacts of proposed regulations, including environmental justice concerns. Because some communities experience higher exposures to toxic air pollutants, it is a priority of the ARB to ensure that full protection is afforded to all Californians. The proposed ATCM is designed to reduce emissions of dioxins and other TACs from residential waste burning, resulting in reduced exposures to these emissions for all communities throughout the State, with associated lower potential health risks.

J. Reasonably Foreseeable Alternatives to the ATCM

We have evaluated two alternatives to the proposed control measure: 1) no action, and 2) prohibition only on the burning of household garbage. Alternatives to the ATCM are discussed in Chapter VI.

IX. REFERENCES

ARB (1984). Report to the Scientific Review Panel on Benzene. Technical Support Document. Air Resources Board, Stationary Source Division. Sacramento, California.

ARB (1986). Staff Report: Initial Statement of Reasons for Proposed Rulemaking. Public Hearing to Consider the Adoption of a Regulatory Amendment Identifying Chlorinated Dioxins and Dibenzofurans as Toxic Air Contaminants. Agenda Item No.: 86. Release Date: June 6, 1986. Scheduled for Consideration: July 24, 1986

ARB (1990). Proposed Dioxins Control Measure for Medical Waste Incinerators. Air Resources Board, Stationary Source Division. Sacramento, California.

ARB (1992). Proposed Identification of 1,3-Butadiene as a Toxic Air Contaminant. Staff Report, Executive Summary. Air Resources Board, Stationary Source Division. Sacramento, California.

ARB (1993a). The Identification of Federal Hazardous Air Pollutants as Toxic Air Contaminants, California Air Resources Board, June 1993.

ARB (1993b). Measurements of Ambient Concentrations of Chlorinated Dioxins and Furans, and Polycyclic Hydrocarbons. Contract No. A932-093. Final Report. Air Resources Board, Research Division. Sacramento, California.

ARB (1994). Benzo[a]pyrene as a Toxic Air Contaminant. Technical Support Document. Air Resources Board, Stationary Source Division. Sacramento, California.

ARB (1997). Toxic Air Contaminant Identification List – Summaries. Staff Report. Air Resources Board, Stationary Source Division. Sacramento, California.

ARB (2001). ARB Burn Barrel Survey. Air Resources Board, Planning and Technical Support Division. Sacramento, California. December 2001.

Balkanski et al. (1993). "Transport and residence times of tropospheric aerosols inferred from a global three-dimensional simulation of ^{210}Pb." J. Geophys. Res. **98**:20573-20586.

Bidleman, T.F. (1988). "Atmospheric Processes. Wet and Dry Deposition of Organic Compounds are Controlled by Their Vapor-Particle Partitioning." Environ. Sci. Technol. **22**(4):361-367.

Bumb, et al. (1980). "Trace Chemistries of Fire: A Source of Chlorinated Dioxins." Science. **210**:385.

CAPCOA, 1993. Air Toxics "Hot Spots" Program: Revised 1992 Risk Assessment Guidelines. Prepared by the California Air Pollution Control Officers Association

(CAPCOA), the Office of Environmental Health Hazard Assessment and the California Air Resources Board. October, 1993.

CIWMB (2000). Residential Waste Disposal Rates. California Integrated Waste Management Board, Sacramento, California. November 2, 2000.
URL: http://www.ciwmb.ca.gov/WasteChar/ResDisp.htm

Commoner, B. et al. (2000). Long-range Transport of Dioxin from North American Sources to Ecologically Vulnerable Receptors in Nunavut, Arctic Canada. Final Report to the North American Commission for Environmental Cooperation. Center for the Biology of Natural Systems, Queens College, CUNY, USA, September 2000.

Denison, M.S. (2000). Organohalogen Compounds, Volume 45, Submitted Papers. 20th International Symposium on Halogenated Environmental Pollutants and Persistent Organic Pollutants (POPs). August 13-17, 2000. Editor and Publisher: Dr. Michael S. Denison, University of California, Davis, California USA.

Finlayson-Pitts, B J., Pitts, J.N., Jr. 1986. Atmospheric Chemistry: Fundamentals and Experimental Techniques. John Wiley and Sons, Publisher. New York, New York.

Federal Register (1994). United States Federal Register. September 20, 1994. 40 CFR Part 60. FR 48198. Standards of Performance for New Stationary Sources: Municipal Waste Combustors (AD-FRL-5068-5). Emission Guidelines: Municipal Waste Combustors (AD-FRL-5068-6). Office of Air Quality Planning and Standards. United States Environmental Protection Agency. Washington, D.C

Gilman, A., and Newhook, R. (1991). "An Updated Assessment of the Exposure of Canadians to Dioxins and Furans." Chemosphere. 23:1661-1667.

Hites, R.A. (1991). Atmospheric Transport and Deposition of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans. Prepared for the U.S. Environmental Protection Agency. Methods Research Branch. Atmospheric Research and Assessment Laboratory. Office of Research and Development. Research Triangle Park, North Carolina. EPA/600/3-91/002.

Hunt, G. et al. (1990). Ambient Concentrations of PCDDs/PCDFs in the South Coast Air Basin. California Air Resources Board. Contract No. A6-100-32. Document No. 1200-005-700.

Lake County AQMD (2001a). Mr. Bob Reynolds Presentation to the Mid-Spring Rural California Air Pollution Control Officers Association Section Meeting: Burn Barrels and Residential Burning. March 29-30, 2001.

Lake County AQMD (2001b). "July 1997 Survey of Burn Barrel Contents in Lake County." Telephone Conversation between Mr. Bob Reynolds, Air Pollution Control Officer, Lake County Air Quality Management District and Bruce Oulrey, ARB, December 7, 2001.

Lemieux et al. (2000). "Emissions of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans from the Open Burning of Household Waste in Barrels" Environmental Science & Technology 34:377-384.

Marple, L., Brunk, R., Berridge, B., Throop, L. (1987). "Experimental and Calculated Physical Constants for 2,3,7,8-tetrachlorodibenzo-p-dioxin." In: Solving Hazardous Waste Problems. Exner, J.H., Editor. ACS Symposium Series 338. Developed from a symposium sponsored by the Division of Environmental Chemistry at the 191st meeting of the American Chemical Society, New York, New York. April 13-18. Page 105-113.

Merck (1989). The Merck Index. Edited by Susan Budavari. 11th edition. Merck & Co., Inc. Rahway, New Jersey.

NTP (1991). Sixth Annual Report on Carcinogens: 1991 Summary: . Pages 323-327. National Toxicology Program, U.S. Department of Health and Human Services, Research Triangle Park, North Carolina.

OEHHA (1999a). Air Toxic Hot Spots Program Risk Assessment Guidelines, Part I, The Determination of Acute Reference Exposure Levels for Airborne Toxicants, Office of Environmental Health Hazard Assessment (OEHHA), March 1999.

OEHHA (1999b). Air Toxic Hot Spots Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors, Office of Environmental Health Hazard Assessment (OEHHA), April 1999.

OEHHA (1999c). Facsimile From Office of Health and Environmental Assessment, U.S. EPA Chronic Reference Concentrations (RFC's) Available on the U.S. EPA IRIS Database (1996) as Referenced In Appendix F of the Emission Inventory Criteria and Guidelines Report. June 14, 1999.

OEHHA (2000a). Air Toxic Hot Spots Program Risk Assessment Guidelines, Part III, Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels, Office of Environmental Health Hazard Assessment (OEHHA), April 2000.

OEHHA (2000b). Air Toxic Hot Spots Program Risk Assessment Guidelines, Part IV, Technical Support Document for Exposure Assessment and Stochastic Analysis, Office of Environmental Health Hazard Assessment (OEHHA), September 2000.

OEHHA (2001a). Memorandum "Adoption of Chronic Reference Exposure Levels For Airborne Toxicants" to Winston H. Hickox, Agency Secretary, California Environmental Protection Agency from Joan E. Denton, Director, OEHHA.

OEHHA (2001b). State of California, Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Safe Drinking Water and Toxic Enforcement Act of 1986, Chemical Known To The State To Cause Cancer And Reproductive Toxicity, Office of Environmental Health Hazard Assessment, November 16, 2001.

OEHHA (2001c). Telephone Conversation with Bob Blaisdell, Manager, Exposure Modeling Unit, Office of Environmental Health Hazard Assessment and Greg Harris. November 26, 2001.

OEHHA (2001d). Prioritization of Toxic Air Contaminants Under the Children's Environmental Health Protection Act. Office of Environmental Health Hazard Assessment, Sacramento, California. Final Report, October 2001.

OEHHA (2001e). Personal communication with Bob Blaisdell, Manager, Exposure Modeling Unit, Office of Environmental Health Hazard Assessment.

Paustenbach et al. (1992). "Recent Developments on the Hazards posed by 2,3,7,8-Tetrachlorodibenzo-p-dioxin in soil: implications for setting risk-based cleanup levels at residential and industrial sites." Journal of Toxicology and Environmental Health. **36**:103-149.

Pope III C.A. and D.W. Dockery (1999). "Epidemiology of Particle Effects." Air Pollution and Health, Academic Press, 675-705.

Samet, J.M., F. Dominici, S.L. Zeger, J. Schwartz, and D.W. Dockery (2000). National Morbidirt, Mortality, and Air Pollution Study, HEI Research Report No. 94, Health Effects Institute, Cambridge, MA.

Tiernan, T.O., Taylor, M.L., Garrett, J.H., VanNess, G.F., Solch, J.G., Deis, D.A., Wagel, D.J. (1983). "Chlorodibenzodioxins, Chlorodibenzofuran and Related Compounds in Effluents from Combustion Processes." Chemosphere. 12(4/5):595-606.

(U.S. EPA). Code of Federal Regulations, Part 60, subparts Eb and Cb-New Source Performance Standards and Guidelines for Large Municipal Waste Combustors; subparts AAAA and BBBB-New Source Performance Standards and Emission Guidelines for Small Municipal Waste Combustion Units; subparts Ec and Cc-new Source Performance Standards and Emission Guidelines for Hospital, Medical, and Infectious Waste Incinerators; subparts CCCC and DDDD-New Source Performance Standards and Emission Guidelines for Commercial and Industrial Solid Waste Incineration Units.

U.S. EPA (1987). Locating and Estimating Air Emissions from Sources of Polycyclic Organic Species. U.S. Environmental Protection Agency, EPA-450/4-84-007.

U.S. EPA (1989a). Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and -dibenzofurans (CDDs and CDFs) and 1989 update. U.S. Environmental Protection Agency. Risk Assessment Forum. Washington, D.C. EPA/625/3-89/016.

U.S. EPA (1989b). Locating and Estimating Air Emissions from Sources of 1,3-Butadiene. United States Environmental Protection Agency, EPA-450/2-89-021. December, 1989.

U.S. EPA (1993a). Ambient Concentration Summaries for Clean Air Act Title III Hazardous Air Pollutants. Kelly, T.J., Ramamurthi, M., Pollack, A.J., Spicer, C.W. and L.T. Cupitt. U.S. Environmental Protection Agency, U.S. EPA Contract No. 68-D80082.

U.S. EPA, (1995a). ISCST3 Model User's Guide, Volume I, EPA-454/B-95-003a, United States Environmental Protection Agency (U.S. EPA), Research Triangle Park, North Carolina, September 1995.

U.S. EPA, (1995b). ISCST3 Model User's Guide, Volume II, EPA-454/B-95-003b, United States Environmental Protection Agency (U.S. EPA), Research Triangle Park, North Carolina, September 1995.

U.S. EPA (1997a). "Evaluation of Emissions from the Open Burning of Household Waste in Barrels, Volume 1. Technical Report. Prepared by: Paul M. Lemieux, U.S. Environmental Protection Agency, National Risk Management Research Laboratory, Air Pollution Prevention and Control Division, Research Triangle Park, NC 27711. EPA-600/R-97-134a, November 1997.

U.S. EPA (1997b). Locating and Estimating Air Emissions from Sources of Dioxins and Furans. U.S. Environmental Protection Agency, Research Triangle Park, NC: Office of Air Quality Planning and Standards. DCN No. 95-298-130-54-01.

U.S. EPA (2001a). "Dioxin: Database of Sources. Database of Sources of Environmental Releases of Dioxin-like Compounds in the United States (Version 3.0 for reference year 1987 and 1995)." URL: http//cfpub.epa.gov/ncea/cfm/dioxindb.cfm. September 19, 2001. U.S. Environmental Protection Agency, Office of Research and Development, Washington D.C., 20460.

U.S. EPA (2001b). "Dioxin: Summary of the Dioxin Reassessment Science -- Information Sheet 1". U.S. Environmental Protection Agency, Office of Research and Development, Washington D.C., 20460. May 25, 2001.

APPENDIX A

Proposed Regulation Order:
Airborne Toxic Control Measure to Reduce Emissions of Toxic Air Contaminants from Outdoor Residential Waste Burning

Proposed Regulation Order

Airborne Toxic Control Measure to Reduce Emissions of Toxic Air Contaminants from Outdoor Residential Waste Burning

Adopt new section 93113, title 17, California Code of Regulations, to read as follows:

93113 Airborne Toxic Control Measure to Reduce Emissions of Toxic Air Contaminants from Outdoor Residential Waste Burning.

(a) Applicability.

(1) Notwithstanding section 41806(a) of the Health and Safety Code, this regulation shall apply to persons conducting outdoor burning of combustible or flammable waste generated from inside residences and from outdoor activities associated with a residence, for the purpose of disposing of the waste.

(2) This regulation shall apply to persons lighting fires that burn combustible or flammable waste, as defined, outdoors in enclosed or partially enclosed vessels, such as incinerators or burn barrels, or in an open outdoor fire, such as in pits or in piles on the ground. This regulation shall not apply to persons lighting fires at the direction of a public officer in an emergency situation for public health or fire safety reasons, in accordance with section 41801 of the Health and Safety Code or other provisions of law.

(3) Except as provided in (a)(1) and (a)(2) above, nothing in this regulation shall affect the applicability of the provisions of article 2 and article 3, respectively, of chapter 3 of part 4 of division 26 of the Health and Safety Code.

(b) Definitions.

Terms used shall have the same definitions as in Health and Safety Code section 39010 et. seq., unless otherwise indicated. For purposes of this regulation, the following additional definitions shall apply:

(1) "Air Pollution Control District" (APCD), "Air Quality Management District" (AQMD), "air district," or "district" means the Governing Board of an air pollution control district or an air quality management district created or continued in existence pursuant to Health and Safety Code section 40000 et seq.

(2) "APCO" means the Air Pollution Control Officer or the chief executive officer of the respective local air pollution control district or local air quality management district where the property is located, or a designated representative.

(3) "ARB" means the State of California Air Resources Board.

(4) "Air Toxic" means toxic air contaminants as defined in section 39655 (a) of the Health and Safety Code.

(5) "Allowable Combustibles" means dry natural vegetation waste originating on the premises and reasonably free of dirt, soil and visible surface moisture.

(6) "Approved transfer station or disposal facility" means a transfer station, landfill, or municipal waste incinerator with a valid operating permit from the solid waste authority with jurisdiction over its operation.

(7) "Approved ignition device" means an instrument or material that will ignite open fires without the production of black smoke by the ignition device, as approved by the APCO.

(8) "Available regular waste pickup service" means the availability of mandatory or voluntary regular waste collection service, through a licensed waste hauler, by virtue of the residence's location within an area franchised by the local jurisdiction with authority to delineate and to franchise geographic service areas, or through regular waste collection service provided directly by the local jurisdiction.

(9) "Burn Barrel" means a metal container used to hold combustible or flammable waste materials so that they can be ignited outdoors for the purpose of disposal.

(10) "Combustible" means any substance capable of burning or any substance that will readily burn.

(11) "Communal or Community Dumpster" means a dumpster or bin at a fixed location and used by more than one household, under contract with a licensed waste hauler, for disposal of residential waste.

(12) "Disallowed Combustibles" means any waste or manufactured material, including but not limited to petroleum products and petroleum wastes; construction and demolition debris; coated wire; putrescible wastes; tires; tar; tarpaper; non-natural wood waste; processed or treated wood and wood products; metals; motor vehicle bodies and parts; rubber; synthetics; plastics, including plastic film, twine and pipe; fiberglass;

styrofoam; garbage; trash; refuse; rubbish; disposable diapers; ashes; glass; industrial wastes; manufactured products; equipment; instruments; utensils; appliances; furniture; cloth; rags; paper or paper products; cardboard; boxes; crates; excelsior; offal; swill; carcass of a dead animal; manure; human or animal parts or wastes, including blood; and fecal- and food-contaminated material. For purposes of this regulation, dry, natural vegetation waste from yard maintenance is not a disallowed combustible, if reasonably free of dirt, soil and surface moisture.

(13) "Flammable" means capable of catching fire easily, or combustible.

(14) "Incinerator" means any device constructed of nonflammable materials, including containers commonly known as burn barrels, for the purpose of burning therein trash, debris, and other flammable materials for volume reduction or destruction.

(15) "Mandatory regular waste pickup service" means regular waste collection provided to residences by a local agency or an approved waste hauler, where the local waste authority has designated a franchise or a permit, and where each household is required to pay for and use the pickup service.

(16) "Natural vegetation" means all plants, including but not limited to grasses, forbs, trees, shrubs, flowers, or vines that grow in the wild or under cultivation. Natural vegetation excludes vegetative materials that have been processed, treated or preserved with chemicals for subsequent human or animal use, including but not limited to chemically-treated lumber, wood products or paper products.

(17) "Open outdoor fire" means the combustion of combustible material of any type outdoors in the open, not in any enclosure, where the products of combustion are not directed through a flue.

(18) "Permissive burn day" or "burn day" means any day on which agricultural burning, including prescribed burning, is not prohibited by the ARB and agricultural and prescribed burning is authorized by the air district consistent with the Smoke Management Guidelines for Agricultural and Prescribed Burning, set forth in sections 80100-80330 of title 17 of the California Code of Regulations.

(19) "Processed or treated wood and wood products" means wood that has been chemically treated to retard rot or decay or wood that has been modified with glues, laminates, stains, finishes, paints or glosses for use in furniture or for construction purposes, including but not limited to plywood, particle board, fencing or railroad ties. For the purposes of this regulation, dimensional lumber that has been air-dried or kiln-dried, with

no preservatives or finishes added, is not considered processed or treated wood.

(20) "Residence" means a single- or two-family dwelling unit and the land and ancillary structures surrounding it.

(21) "Residential waste burning" means the disposal of the combustible or flammable waste from a single- or two-family dwelling unit or residence by burning outdoors. Residential waste burning is not agricultural, including prescribed, burning.

(22) "Voluntary regular waste pickup service" means regular waste collection offered to residences by a local agency or an approved waste hauler, where the local waste authority has designated a franchise or a permit, but where each household has the option of not paying for and receiving the pickup service that is available.

(23) "Waste" means all discarded putrescible and non-putrescible solid, semisolid, and liquid materials, including but not limited to petroleum products and petroleum wastes; construction and demolition debris; coated wire; tires; tar; tarpaper; wood waste; processed or treated wood and wood products; metals; motor vehicle bodies and parts; rubber; synthetics; plastics, including plastic film, twine and pipe; fiberglass; styrofoam; garbage; trash; refuse; rubbish; disposable diapers; ashes; glass; industrial wastes; manufactured products; equipment; instruments; utensils; appliances; furniture; cloth; rags; paper or paper products; cardboard; boxes; crates; excelsior; offal; swill; carcass of a dead animal; manure; human or animal parts or wastes, including blood; fecal- and food-contaminated material; felled trees; tree stumps; brush; plant cuttings and prunings; branches; garden waste; weeds; grass clippings, pine needles, leaves and other natural vegetation waste.

(c) Prohibitions.

(1) No person shall burn disallowed combustibles from any property for the purpose of disposing of waste material outdoors at a residence, except as provided under subsection (e), "Exemptions", below.

(2) No person shall dispose of allowable combustibles from any property by burning them in a burn barrel or incinerator outdoors, except as provided under subsection (e), "Exemptions", below.

(3) No person shall ignite, or allow to become ignited, allowable combustibles unless using an approved ignition device.

(4) No person shall ignite, or allow to become ignited, allowable combustibles unless it is a permissive burn day in the air district where the residential waste burning is to take place.

(d) Compliance Schedule.

(1) For the purposes of Section 39666(d) of the Health and Safety Code, the date of adoption of this regulation shall be ___________ [insert the date of filing with the Secretary of State].

(2) Unless an air district adopts an earlier effective date under section 39666(d) of the Health and Safety Code, or applies for exemptions under subsection (e), below, the prohibitions set forth in subsection (c), above, shall become effective on July 1, 2003.

(e) Exemptions.

(1) The prohibitions described in subsections (c)(1) and (c)(2), above, of this regulation shall not apply to any exempted geographic area described under subsection (e)(5), below.

(2) Any air district seeking an exemption from subsections (c)(1) and (c)(2), above, shall file a Request for Exemption in writing to ARB before March 1, 2003. The requirements for a Request for Exemption are described in subsection (e)(4), below.

(3) No air district shall file a Request for Exemption to allow the burning of any disallowed combustible prohibited by air district rules in effect on January 4, 2002. An air district shall not apply for an exemption for a geographic area with a more stringent local ordinance, in effect on January 4, 2002, prohibiting the burning of a disallowed combustible, otherwise allowed by the air district.

(4) A Request for Exemption shall include:

(A) a resolution from the air district's Governing Board adopted at a public hearing approving the Request for Exemption; and

(B) a map of the exempted geographic areas within their jurisdiction, which meet the criteria listed in subsection (e)(5), below, and

(C) a detailed, written justification for the mapping, including a demonstration that alternatives for waste disposal, other than residential waste burning, are not likely to become available within the five-year exemption period, and

(D) an analysis showing that local ordinances existing on January 4, 2002 do not prohibit the outdoor burning of the materials requested for exemption, in any part of the exempted geographic area.

(5) The exempted geographic areas must meet criteria including, but not limited to, all of the following:
   (A) no mandatory or voluntary regular waste pickup service, considering reasonable cost and frequency of service; and
   (B) greater than a reasonable distance from an approved transfer station or disposal facility or a communal or community dumpster, considering road miles or time travelled, road conditions, terrain, weather conditions, reasonable tipping fees, and hours of operation; and
   (C) low population density per census tract or other appropriate subunit of the county area, including but not limited to zoning designation or parcel size.

(6) ARB shall review the air district's Request for Exemption and approve or disapprove the Request for Exemption, in writing, within 60 days after submittal. The approval shall state the exempted geographic areas in the air district where the prohibitions of subsections (c)(1) and (c)(2), above, apply.

(7) If the initial Request for Exemption is disapproved, the ARB shall return the Request for Exemption to the air district for amendment. The disapproval shall include reasons for the denial and the air district shall be afforded an additional 30 days from the date of denial to submit a revised Request for Exemption.

(8) Within 30 days of receipt of the revised Request for Exemption, the ARB shall approve or reject the revised Request for Exemption, and shall designate the geographic areas where the prohibitions of (c)(1) and (c)(2) do not apply.

(9) Every five years after ARB has approved an air district's Request for Exemption, the air district, with the concurrence of ARB, shall determine whether to renew the exemption for an additional five years and whether the mapped exempted geographic area(s) should be modified. In renewing the exemption or in modifying the exempted geographic area(s), the Governing Board of the air district shall make a finding at a public hearing that the exemption criteria in (e)(5) are still applicable to the renewed or modified exempted geographic area.

(10) Consultation with, and concurrence from, the ARB on the renewal and/or modification of the exempted geographic areas shall continue every five years thereafter until the exemption criteria are no longer met, at which time the exemptions shall terminate.

NOTE: Authority cited: Sections 39600, 39601, 39659 and 39666, Health and Safety Code. Reference: Sections 39020, 39044, 39650 through 39669, 39701, 41700 and 41806, Health and Safety Code.

APPENDIX B

Risk Assessment Results Using SCEEN3 Meteorological Conditions And Site-specific Meteorological Data

This appendix includes five tables that summarize the potential health impacts for residential waste burning using default meteorological conditions from SCREEN3 and site-specific meteorological data from four locations across California (Alturas, Bishop, San Benito, and Escondido). Both carcinogenic and non-carcinogenic individual health impacts are presented at locations ranging from 20 meters to 1,000 meters downwind from a single burn barrel. The tables also provide estimates of potential cancer risk for each exposure pathway.

Table B-1. Overview of the Potential Health Impacts from Residential Waste Burning Using the Meteorological Conditions from SCREEN3. [1,2]

Exposure Pathways [3, 4]	Distance (meters)					
	20	50	100	200	500	1000
	Cancer Risk (chances per million)					
Inhalation	44	17	6.4	2.0	0.4	0.1
Soil Ingestion	16	6.1	2.2	0.7	0.2	0.05
Skin Exposure	14	5.5	2.0	0.6	0.1	0.04
Mothers Milk [5]	8.9	3.5	1.3	0.4	0.09	0.03
Backyard Garden	56	22	8.1	2.6	0.5	0.2
Meat and Eggs	1010	397	146	46	9.7	3.0
Milk (cow)	1160	456	168	53	11	3.4
Total Cancer Risk	2309	907	334	106	22	6.7
	Non-Cancer Hazard Indices					
Acute Inhalation [6]	0.02	0.008	0.003	0.0009	0.0002	0.00006
Chronic Multipathway [7]	0.08 - 2.0	0.03 - 0.78	0.01 - 0.29	0.004 - 0.091	0.0008 - 0.019	0.0002 - 0.0058

1. All results are rounded. Potential health impacts listed at 50, 100, 200, 500, and 1,000 meters are extrapolated from air dispersion modeling results and risk at 20 meters. Emissions for dioxins and PCBs are from the U.S. EPA 2000 source tests. Emissions for benzene, 1,3-butadiene, and PAHs are from the U.S. EPA 1997 source tests.
2. All risk assessment results are based on a 70-year exposure for all pathways except the mother's (breast) milk pathway (44-year). Results are based on the CAPCOA Risk Assessment Guidelines methodology, HRA 2.0e, and the updated OEHHA cancer potencies and reference exposure levels as of January 2001.
3. All pathways of exposure are assumed to occur at the same distance (location) from the source.
4. Emissions are assumed to be uncontrolled (0.05 factor). Multipathway route assumptions include: 15% of produce in the receptor's diet is homegrown; 100% of dietary meat (beef, pork, and chicken), eggs, and cow's milk is impacted; 50% of cattle's diet is from impacted grassland and other feed is not contaminated; Farm animal drinking water is from a 300 gallon trough, measuring one square meter, and is consumed every 3.75 days by one lactating cow.
5. PCB contribution calculated by ratio of PCB to PCDD body half-life (0.7) multiplied by the PCDD & PCDF mother's milk to inhalation ratio.
6. Benzene impacts were assessed using 6-hour average concentrations. Primary endpoints are cardiovascular or blood, reproductive system, and immune system.
7. Dioxins, PAHs, and PCBs were assessed for chronic impacts. Includes both inhalation and non-inhalation exposure pathways. Primary endpoints are reproductive system, cardiovascular or blood, and nervous system. The lower end of the range includes inhalation, soil, and dermal exposure pathways. The upper end of the range includes all exposure pathways, except mother's milk.

Table B-2. Overview of the Potential Health Impacts from Residential Waste Burning Using the Alturas Meteorological Data [1,2]

Exposure Pathways [3, 4]	Distance (meters)					
	20	50	100	200	500	1000
	Cancer Risk (chances per million)					
Inhalation	3.3	0.9	0.3	0.07	0.01	0.003
Soil Ingestion	1.2	0.3	0.1	0.03	0.004	0.001
Skin Exposure	1.0	0.3	0.1	0.02	0.004	0.001
Mothers Milk [5]	0.7	0.2	0.06	0.02	0.003	0.0007
Backyard Garden	4.2	1.1	0.3	0.09	0.02	0.004
Meat and Eggs	75	20	6.1	1.7	0.3	0.08
Milk (cow)	86	23	6.9	1.9	0.3	0.09
Total Cancer Risk	172	46	14	3.9	0.7	0.2
Non-Cancer Hazard Indices						
Acute Inhalation [6]	0.01	0.005	0.002	0.001	0.0002	0.00008
Chronic Multipathway [7]	0.15	0.04	0.01	0.003	0.0006	0.0001

1. All results are rounded. Potential health impacts listed at 50, 100, 200, 500, and 1,000 meters are extrapolated from air dispersion modeling results and risk at 20 meters. Emissions for dioxins and PCBs are from the U.S. EPA 2000 source tests. Emissions for benzene, 1,3-butadiene, and PAHs are from the U.S. EPA 1997 source tests.
2. All risk assessment results are based on a 70-year exposure for all pathways except the mother's (breast) milk pathway (44-year). Results are based on the CAPCOA Risk Assessment Guidelines methodology, HRA 2.0e, and the updated OEHHA cancer potencies and reference exposure levels as of January 2001.
3. All pathways of exposure are assumed to occur at the same distance (location) from the source.
4. Emissions are assumed to be uncontrolled (0.05 factor). Multipathway route assumptions include: 15% of produce in the receptor's diet is homegrown; 100% of dietary meat (beef, pork, and chicken), eggs, and cow's milk is impacted; 50% of cattle's diet is from impacted grassland and other feed is not contaminated; Farm animal drinking water is from a 300 gallon trough, measuring one square meter, and is consumed every 3.75 days by one lactating cow.
5. PCB contribution calculated by ratio of PCB to PCDD body half-life (0.7) multiplied by the PCDD & PCDF mother's milk to inhalation ratio.
6. Benzene impacts were assessed using 6-hour average concentrations. Primary endpoints are cardiovascular or blood, reproductive system, and immune system.
7. Dioxins, PAHs, and PCBs were assessed for chronic impacts. Includes both inhalation and non-inhalation exposure pathways. Primary endpoints are reproductive system, cardiovascular or blood, and nervous system.

Table B-3. Overview of the Potential Health Impacts from Residential Waste Burning Using the Bishop Meteorological Data [1,2]

Exposure Pathways [3,4]	Distance (meters)					
	20	50	100	200	500	1000
	Cancer Risk (chances per million)					
Inhalation	4.6	1.2	0.4	0.1	0.02	0.005
Soil Ingestion	1.6	0.4	0.1	0.04	0.007	0.002
Skin Exposure	1.4	0.4	0.1	0.03	0.006	0.002
Mothers Milk [5]	1.0	0.3	0.08	0.02	0.004	0.001
Backyard Garden	5.8	1.5	0.5	0.1	0.02	0.007
Meat and Eggs	105	28	8.4	2.4	0.4	0.1
Milk (cow)	120	32	9.6	2.8	0.5	0.1
Total Cancer Risk	239	63	19	5.5	1.0	0.3
Non-Cancer Hazard Indices						
Acute Inhalation [6]	0.02	0.008	0.003	0.001	0.0002	0.00007
Chronic Multipathway [7]	0.2	0.05	0.02	0.005	0.0009	0.0002

1. All results are rounded. Potential health impacts listed at 50, 100, 200, 500, and 1,000 meters are extrapolated from air dispersion modeling results and risk at 20 meters. Emissions for dioxins and PCBs are from the U.S. EPA 2000 source tests. Emissions for benzene, 1,3-butadiene, and PAHs are from the U.S. EPA 1997 source tests.
2. All risk assessment results are based on a 70-year exposure for all pathways except the mother's (breast) milk pathway (44-year). Results are based on the CAPCOA Risk Assessment Guidelines methodology, HRA 2.0e, and the updated OEHHA cancer potencies and reference exposure levels as of January 2001.
3. All pathways of exposure are assumed to occur at the same distance (location) from the source.
4. Emissions are assumed to be uncontrolled (0.05 factor). Multipathway route assumptions include: 15% of produce in the receptor's diet is homegrown; 100% of dietary meat (beef, pork, and chicken), eggs, and cow's milk is impacted; 50% of cattle's diet is from impacted grassland and other feed is not contaminated; Farm animal drinking water is from a 300 gallon trough, measuring one square meter, and is consumed every 3.75 days by one lactating cow.
5. PCB contribution calculated by ratio of PCB to PCDD body half-life (0.7) multiplied by the PCDD & PCDF mother's milk to inhalation ratio.
6. Benzene impacts were assessed using 6-hour average concentrations. Primary endpoints are cardiovascular or blood, reproductive system, and immune system.
7. Dioxins, PAHs, and PCBs were assessed for chronic impacts. Includes both inhalation and non-inhalation exposure pathways. Primary endpoints are reproductive system, cardiovascular or blood, and nervous system.

Table B-4. Overview of the Potential Health Impacts from Residential Waste Burning Using the San Benito Meteorological Data [1,2]

Exposure Pathways [3,4]	Distance (meters)					
	20	50	100	200	500	1000
	Cancer Risk (chances per million)					
Inhalation	6.4	1.7	0.5	0.1	0.02	0.006
Soil Ingestion	2.2	0.6	0.2	0.05	0.008	0.002
Skin Exposure	2.0	0.5	0.2	0.04	0.008	0.002
Mothers Milk [5]	1.3	0.3	0.1	0.03	0.005	0.001
Backyard Garden	8	2.1	0.6	0.2	0.03	0.008
Meat and Eggs	145	38	12	3.2	0.6	0.1
Milk (cow)	166	44	13	3.7	0.6	0.2
Total Cancer Risk	331	88	26	7.3	1.3	0.3
Non-Cancer Hazard Indices						
Acute Inhalation [6]	0.02	0.008	0.003	0.001	0.0002	0.00008
Chronic Multipathway [7]	0.3	0.08	0.02	0.006	0.001	0.0003

1. All results are rounded. Potential health impacts listed at 50, 100, 200, 500, and 1,000 meters are extrapolated from air dispersion modeling results and risk at 20 meters. Emissions for dioxins and PCBs are from the U.S. EPA 2000 source tests. Emissions for benzene, 1,3-butadiene, and PAHs are from the U.S. EPA 1997 source tests.
2. All risk assessment results are based on a 70-year exposure for all pathways except the mother's (breast) milk pathway (44-year). Results are based on the CAPCOA Risk Assessment Guidelines methodology, HRA 2.0e, and the updated OEHHA cancer potencies and reference exposure levels as of January 2001.
3. All pathways of exposure are assumed to occur at the same distance (location) from the source.
4. Emissions are assumed to be uncontrolled (0.05 factor). Multipathway route assumptions include: 15% of produce in the receptor's diet is homegrown; 100% of dietary meat (beef, pork, and chicken), eggs, and cow's milk is impacted; 50% of cattle's diet is from impacted grassland and other feed is not contaminated; Farm animal drinking water is from a 300 gallon trough, measuring one square meter, and is consumed every 3.75 days by one lactating cow.
5. PCB contribution calculated by ratio of PCB to PCDD body half-life (0.7) multiplied by the PCDD & PCDF mother's milk to inhalation ratio.
6. Benzene impacts were assessed using 6-hour average concentrations. Primary endpoints are cardiovascular or blood, reproductive system, and immune system.
7. Dioxins, PAHs, and PCBs were assessed for chronic impacts. Includes both inhalation and non-inhalation exposure pathways. Primary endpoints are reproductive system, cardiovascular or blood, and nervous system.

Table B-5. Overview of the Potential Health Impacts from Residential Waste Burning Using the Escondido Meteorological Data [1,2]

Exposure Pathways [3,4]	Distance (meters)					
	20	50	100	200	500	1000
	Cancer Risk (chances per million)					
Inhalation	8.2	2.2	0.7	0.2	0.03	0.009
Soil Ingestion	2.9	0.8	0.2	0.07	0.01	0.003
Skin Exposure	2.6	0.7	0.2	0.06	0.01	0.003
Mothers Milk [5]	1.7	0.5	0.1	0.04	0.007	0.002
Backyard Garden	10	2.8	0.9	0.2	0.04	0.01
Meat and Eggs	187	51	15	4.3	0.8	0.2
Milk (cow)	215	58	18	4.9	0.9	0.2
Total Cancer Risk	428	116	35	9.8	1.7	0.5
Non-Cancer Hazard Indices						
Acute Inhalation [6]	0.02	0.008	0.003	0.0009	0.0002	0.00005
Chronic Multipathway [7]	0.4	0.1	0.03	0.008	0.001	0.0004

1. All results are rounded. Potential health impacts listed at 50, 100, 200, 500, and 1,000 meters are extrapolated from air dispersion modeling results and risk at 20 meters. Emissions for dioxins and PCBs are from the U.S. EPA 2000 source tests. Emissions for benzene, 1,3-butadiene, and PAHs are from the U.S. EPA 1997 source tests.
2. All risk assessment results are based on a 70-year exposure for all pathways except the mother's (breast) milk pathway (44-year). Results are based on the CAPCOA Risk Assessment Guidelines methodology, HRA 2.0e, and the updated OEHHA cancer potencies and reference exposure levels as of January 2001.
3. All pathways of exposure are assumed to occur at the same distance (location) from the source.
4. Emissions are assumed to be uncontrolled (0.05 factor). Multipathway route assumptions include: 15% of produce in the receptor's diet is homegrown; 100% of dietary meat (beef, pork, and chicken), eggs, and cow's milk is impacted; 50% of cattle's diet is from impacted grassland and other feed is not contaminated; Farm animal drinking water is from a 300 gallon trough, measuring one square meter, and is consumed every 3.75 days by one lactating cow.
5. PCB contribution calculated by ratio of PCB to PCDD body half-life (0.7) multiplied by the PCDD & PCDF mother's milk to inhalation ratio.
6. Benzene impacts were assessed using 6-hour average concentrations. Primary endpoints are cardiovascular or blood, reproductive system, and immune system.
7. Dioxins, PAHs, and PCBs were assessed for chronic impacts. Includes both inhalation and non-inhalation exposure pathways. Primary endpoints are reproductive system, cardiovascular or blood, and nervous system.

APPENDIX C

Air Dispersion Modeling of Emissions from Burn Barrels

Air Dispersion Modeling of Emissions from Burning Barrels

Summary

The air dispersion of emissions from burning trash in domestic burning barrels is evaluated to estimate downwind impacts. This analysis is based on an emission rate of 1 g/s input into the U.S. EPA air dispersion models, Industrial Source Complex – Short Term 3 (ISCST3) and SCREEN3. As a result, the estimated short-term and long-term average air concentrations may be directly scaled by the actual emission rate to estimate downwind concentrations of actual pollutants. A summary of the results is shown in Table C-1 below. A detailed description of the analysis with sensitivity studies follow.

As an example, shown in Table C-1 below, the maximum annual average χ/q for emissions from a burning barrel, based on meteorological data collected in Escondido, is 1920 ($\mu g/m^3$)/(g/s) at the nearest receptor, 20 meters from the source. This is based

Table C-1
Maximum Annual Average Concentration (χ/q)
Above Ambient Conditions - Burning Barrel Emissions

Met. County	Modoc	Inyo	San Benito	San Diego	
Met. City	**Alturas**	**Bishop**	**San Benito**	**Escondido**	***SCREENING***
Notes	(a)	(a)	(a)	(a)	*(b)*
D (m)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	*($\mu g/m^3$)/(g/s)*
20	773.	1070.	1490.	1920.	*590.*
50	206.	284.	395.	521.	*232.*
100	62.1	85.6	119.	158.	*85.4*
200	17.3	24.6	33.0	43.9	*27.1*
500	3.01	4.48	5.66	7.71	*5.65*
1000	0.78	1.22	1.47	2.03	*1.73*

Notes: (a) Annual χ/q for site specific meteorological data is based on 3,654 hours of emissions at 1 g/s.

(b) Annual χ/q for Screening analysis is based on 208 hours of emissions at 1 g/s.

(c) χ/q is the concentration in $\mu g/m^3$ based on an hourly emission rate of 1 g/s.

(d) Results are valid for two significant digits. Three significant digits are reported to reduce round off error in subsequent calculations.

(e) Burning is permitted 12 months per year.

on uniformly distributing the emissions from burning over an assumed 3,654 daylight hours in a year. Further description on how these values are derived is provided below.

Analysis

This analysis estimates the downwind concentration of emissions from burn barrels for annual averages and six-hour averages. The following parameters are established for the operating conditions of a domestic burning barrel based on discussions with various air districts and at the committee meetings.

Burn Barrel Parameters

- Burning will occur during daylight hours.
- One family may burn twice per week.
- Each burn may last for two hours.
- Each burn can be at any time during a day.
- The final plume height is from 2 meters close to the barrel to a maximum of 4 meters further away from the barrel. Since maximum concentrations are located close to the barrel, the final plume rise will be fixed at 2 meters.
- Perform a sensitivity study for periods for when burn bans are in effect (i.e., June 15 to October 15 burn restrictions).
- Evaluate meteorological conditions for the following meteorological climates.
  - Screening (Worst-Case Maximum)
  - Modoc County
  - Great Basin Air District Counties
  - Monterey / San Benito Counties
  - Eastern San Diego County

Based on the above parameters, we decided to simulate the release of emissions from a burning barrel as a volume source in the ISCST3 and SCREEN3 air dispersion models. The initial dispersion of the plume and the final plume rise of the plume will be static regardless of atmospheric conditions. In this way, the calculations are consistent with air district and committee recommendations on burn barrel plume conditions. The following initial conditions are calculated for the above list of parameters.

Initial Conditions for Model Input

- $\sigma_{yo} = \sigma_{zo} = L/4.3 = 1m / 4.3 = 0.23$ meters
- **$H_{final\text{-}plume\text{-}rise}$ = 2 meters**
- $H_{flagpole\text{-}receptor\text{-}height}$ = 1 meter
- Minimum receptor distance to source = 20 meters
- Daylight hours defined as the following.

Winter	9am to 5pm (8 hours)
Spring	8am to 6pm (10 hours)
Summer	7am to 7pm (12 hours)
Fall	8am to 6pm (10 hours)

- Rural Dispersion Coefficients

Meteorological data are obtained from various California Irrigation Management Information System (CIMIS) stations to represent the locations indicated above. CIMIS stations are managed by the California Department of Water Resources. CIMIS data are collected on two meter towers which is consistent with the plume height estimates for the burn barrels. The atmospheric stability classes are based on the heat flux method as described in U.S. EPA 8/95 and Pasquill 1983.

The nearby city for the CIMIS stations to represent the various county regions are Alturas (Modoc County), Bishop (Great Basin District Counties), San Benito (San Benito County), and Escondido (San Diego County). In all cases, we attempted to obtain the latest consecutive five years of meteorological data as recommended by U.S. EPA Guidelines. The data collected at Alturas, Bishop, and San Benito meets these requirements for data from 1996 through 2000. The station located at Escondido began collecting data in 1999. Therefore only the latest complete year, 2000, was available for processing. Attachment B shows CIMIS information for the location of each station in our analysis.

<u>Annual Average Concentration</u>

The annual average concentration is assessed in a screening mode to estimate an upper bound calculation as well as a refined mode to estimate a site specific calculation. The refined modeling assessment is based on inputting meteorological data from the four CIMIS stations, separately, into the ISCST3 air dispersion model. In addition, the refined modeling assessment for estimating annual average concentrations is based on uniformly distributing the emissions over all possible operating hours on a daily basis. That is 8 hours, 10 hours, 12 hours, and 10 hours for each of the fours seasons, respectively. As a result, the emissions are distributed over 3,654 hours in a year. This is critical for the health risk assessment which is based on the annual average concentration. The emission rate on a gram per second basis for estimating annual average concentrations from the refined χ/q the emissions should be prorated over 3,654 hours.

The SCREEN3 air dispersion model is used to estimate the upper bound annual average concentration. Initially, the SCREEN3 air dispersion model is used to estimate the maximum one-hour concentration. The results from the SCREEN3 model show that the maximum 1-hour concentration (χ/q) is 81,560 $\mu g/m^3$ at 20 meters for F stability and 1 m/s wind speed. F stability is a stable condition that only occurs at night.

Since one of the assumptions for the burn barrels is that emissions are for daylight hours, the SCREEN3 model is used again for the next incremental stability class which is a daytime neutral condition, D stability. The results from the SCREEN3 model show the maximum 1-hour concentration (χ/q) is 49,550 $\mu g/m^3$ at 20 meters for D stability.

The standard procedure for estimating long-term (annual) averages from maximum 1-hour averages is to apply the U.S. EPA scaling factor of 0.08. The screening factor of 0.08 is ideally used when the emissions are continuous over all hours of the year (8760 hours/year). However, in the case for the burning barrels, it is assumed emissions are for two hours per burn and two burns per week (208 hours/year).

Although not explicitly indicated in the U.S. EPA Guidance, the U.S. EPA screening factor of 0.08 to estimate the annual average concentration from maximum 1-hour concentration inevitably includes the effects of varying conditions of wind speed, wind direction, and atmospheric stability over a year period.

Intermittent emissions, such as those from the burning barrels, could have the effect of eliminating some of the annual variability of meteorological conditions. For example, emissions only during the daytime could eliminate the variability of a drainage flow pattern in mountainous terrain. Guidance for estimating long term averages for a screening approach and intermittent emissions is not available. In the interim, we recommend the following approach to estimate long term averages from a source with a burning barrel schedule. Equation Box 1 shows an example that is described below.

Estimate the maximum one-hour concentration based on the SCREEN3 model approach for possible meteorological conditions consistent with operating conditions. In this case, the conditions are restricted to daytime neutral or unstable atmospheric conditions. Estimate the concentration for the averaging period consistent with the

Equation Box 1

$$\chi_{8\text{-}hr} = (\chi_{1\text{-}hr})(0.5)\left(\frac{2hrs_{burning}}{8hrs_{period}}\right) = \left(49{,}550\frac{\mu g}{m^3}\right)(0.5)(0.25) = 6{,}194\frac{\mu g}{m^3}$$

$$\chi_{annual} = \frac{(\chi_{8\text{-}hr})\left(8\frac{hrs}{period}\right)\left(2\frac{periods}{week}\right)\left(52\frac{weeks}{year}\right) + (0)\left(7928\frac{non\text{-}burn\text{-}period\text{-}hours}{year}\right)}{8760hrs/yr}$$

$$\chi_{annual} = \left(6{,}194\frac{\mu g}{m^3}\right)\left(\frac{(8)(2)(52)}{8760}\right) = 590\frac{\mu g}{m^3}$$

$$q_{annual}\left(\frac{g}{s}\right) = Q\left(\frac{lbs}{yr}\right)\left(\frac{453.6g}{lb}\right)\left(\frac{day}{2hrs}\right)\left(\frac{wk}{2days}\right)\left(\frac{yr}{52wk}\right)\left(\frac{hr}{3600s}\right) = Q\left(\frac{lbs}{yr}\right)\frac{453.6}{748{,}800}\left(\frac{g-yr}{lb-s}\right)$$

$$Concentration = (\chi_{annual})(q_{annual})$$

operating conditions. In this case, emissions could occur during the daylight, an 8-hour window during the winter and a 12-hour window during the summer. Therefore, estimate the 8-hour concentration. Use the U.S. EPA screening factor of 0.7 ± 0.2 to estimate the maximum 8-hour concentration. In addition, the emissions are prorated over the 8 hours (i.e., 2hrs/8hrs).

The U.S. EPA Screening Guidance allows for deviation from the suggested conversion factor on a case-by-case basis. We recommend the lower end of the conversion factor (i.e., 0.5) because variability associated with seasonal differences in wind speed, wind direction, and atmospheric stability would not be accounted for otherwise.

The worst-case annual average screening concentration can be estimated by assuming the worst-case 8-hour concentration occurs during each burn and no emissions occur during all other hours in a year. Estimating the worst-case annual average concentration is a matter of prorating the 8-hour concentration over an annual average, as shown in the Equation Box 1.

The emission rate on a gram per second basis for estimating annual average concentrations from the above χ/q now needs to be calculated based on the prorated year (208 hours) instead of the full year (8760 hours). An example is shown in Equation Box 1. This step is necessary for estimating risk with the Health Risk Assessment Program.

Other Results

Table 1, above, shows the maximum annual average concentration (χ/q) for the burning barrel emissions. Table 2, below, shows the maximum 6-hour average concentration (χ/q) for the burning barrel emissions.

The six-hour average is based on the maximum two-hour average concentration because of the assumption that the burns last for only two hours. The example calculation in Equation Box 2 shows the method used to estimate the maximum six-hour concentration for Alturas. A similar method is used to estimate the six-hour average in a screening mode from the maximum 1-hr concentration.

Equation Box 2
Example calculation for Alturas maximum 6-hour average at 20 meters from the source.

$$(\chi)_{2-HR} = 48{,}871\left(\frac{\mu g}{m^3}\right), (from\_ISCST3\_output)$$

$$(\chi)_{6-HR} = \frac{(\chi)_{2-HR}(2hrs)+(0)(4hrs)}{(6hrs)} = \frac{(48{,}871)(2)}{6}\left(\frac{\mu g}{m^3}\right) = 16{,}290\left(\frac{\mu g}{m^3}\right)$$

Table C-2 Maximum 6-hour Average Concentration (χ/q) Above Ambient Conditions – Burning Barrel Emissions					
Met. County	Modoc	Inyo	San Benito	San Diego	
Met. City	**Alturas**	**Bishop**	**San Benito**	**Escondido**	**SCREENING**
Notes	(a)	(a),(b)	(a),(b)	(a)	*(a)*
D (m)	(μg/m³)/(g/s)	(μg/m³)/(g/s)	(μg/m³)/(g/s)	(μg/m³)/(g/s)	*(μg/m³)/(g/s)*
20	16,300	17,800	18,800	15,400	*16,500*
50	7,170	7,370	7,880	5,940	*6,490*
100	3,570	2,860	3,120	2,160	*2,390*
200	1,400	945	1,040	678	*758*
500	334	202	227	139	*158*
1,000	110	63	71	42	*48*

Notes: (a) Six-hour maximum χ/q is based on 2 hours of emissions at 1 g/s and 4 hours of zero emissions.

(b) χ/q for Inyo and San Benito is higher than for screening analysis. This is a result of slightly stable conditions (E Stability) used for one of the two hours of emissions. This is a direct result of the method used to distribute emissions over the seasons. The screening analysis assumes emissions are for daytime (neutral or unstable) conditions.

(c) χ/q is the concentration in μg/m^3 based on an hourly emission rate of 1 g/s.

(d) Results are valid for two significant digits. Three significant digits are reported to reduce round off error in subsequent calculations.

Attachment A shows sensitivity study results for evaluating the differences when estimating concentrations in the non-predominant wind direction, as well as evaluating the scenario of a burn ban for four months per year.

References for Appendix C

Marks' Standard Handbook for Mechanical Engineers, 1987, McGraw-Hill, Inc.

Pasquill, Atmospheric Diffusion, 3rd Ed., 1983, Figure 6.10.

U.S. EPA, Evaluation of Emissions From the Open Burning of Household Waste in Barrels, Volume 1. Technical Report, November 1997, EPA-600/R-97-134a

U.S. EPA, Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised, October 1992, EPA-454/R-92-019

U.S. EPA, User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, September 1995, EPA-454/B-95-003a

U.S. EPA, Appendix W to Part 51 - Guideline on Air Quality Models, 2001

U.S. EPA, On-Site Meteorological Program Guidance For Regulatory Modeling Applications, 8/95.

Attachment A

Sensitivity Study

Tables A-1 through A-6 show the results from sensitivity studies of various aspects of the burning barrel evaluation. The primary focus of the sensitivity study are the effects of burning restrictions during fire hazard seasons on downwind impacts. We note that under certain years of high fire hazard, restrictions on burning may restrict the use of burning barrels. In this sensitivity analysis, we assumed that a burning restriction is in place from June 15 to October 15. Table CA-2 (w/burn restrictions) can be compared to Table C-1 of the main text (w/o burn restrictions) to evaluate the differences caused by the burn restrictions on the annual average concentration.

Another sensitivity study evaluates the maximum and minimum concentrations through the evaluation of the predominant and non-predominant wind direction. Tables C-1 and CA-1, C-2 and CA-4, and CA-2 & CA-3 show the minimum concentration in the non-predominant wind direction for various averaging periods.

The final sensitivity study is to report the maximum two hour average concentration in Tables A-5 and A-6 for both the predominant and non-predominant wind directions. The two hour concentrations are used to construct the six hour average concentrations shown in Tables C-2 and CA-4.

The following list gives a brief description of each table.

<u>Annual Average Concentrations Above Ambient Conditions</u>

Table CA-1
Annual Average Concentration (χ/q)
Non-Predominant Wind Direction

Table CA-2
Maximum Annual Average Concentration (χ/q)
Predominant Wind Direction
(Burning is Restricted from 6/15 – 10/15)

Table CA-3
Annual Average Concentration (χ/q)
Non-Predominant Wind Direction
(Burning is Restricted from 6/15 – 10/15)

Six Hour Average Concentrations Above Ambient Conditions

Table CA-4
Six-Hour Average Concentration (χ/q)
Non-Predominant Wind Direction

Two Hour Average Concentration Above Ambient Conditions

Table CA-5
Two-Hour Maximum Average Concentration (χ/q)
Predominant Wind Direction

Table CA-6
Two-Hour Average Concentration (χ/q)
Non-Predominant Wind Direction

Table CA-1
Annual Average Concentration (χ/q)
Non-Predominant Wind Direction
Above Ambient Conditions - Burning Barrel Emissions

Met. City	**Alturas**	**Bishop**	**San Benito**	**Escondido**
D (m)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)
20	145.	162.	70.9	41.0
50	42.5	39.2	21.6	11.0
100	13.5	11.2	6.96	3.28
200	3.85	2.99	2.00	0.88
500	0.69	0.47	0.36	0.15
1,000	0.19	0.11	0.10	0.04

Notes: (a) χ/q for site specific meteorological data is based on 3,654 hours of emissions at 1 g/s.
(b) Results are valid for two significant digits. Three significant digits are reported to reduce round off error in subsequent calculations.
(c) Burning is permitted 12 months per year.

Table CA-2
Maximum Annual Average Concentration (χ/q)
Above Ambient Conditions - Burning Barrel Emissions
(Burning is Restricted from 6/15 – 10/15)

Met. City	**Alturas**	**Bishop**	**San Benito**	**Escondido**	***SCREENING***
Notes	(a)	(a)	(a)	(a)	*(b)*
D (m)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)
20	571.	812.	1330.	1860.	*393.*
50	162.	277.	353.	514.	*154.*
100	50.3	88.3	106.	157.	*56.9*
200	14.5	25.4	29.4	44.4	*18.1*
500	2.72	4.61	5.05	7.83	*3.76*
1,000	0.77	1.26	1.30	2.06	*1.15*

Notes: (a) χ/q for site specific meteorological data is based on 2,280 hours of emissions at 1 g/s.
(b) χ/q for Screening analysis is based on 139 hours of emissions at 1 g/s.
(c) χ/q is the concentration in $\mu g/m^3$ based on an hourly emission rate of 1 g/s.
(d) Results are valid for two significant digits. Three significant digits are reported to reduce round off error in subsequent calculations.

Table CA-3
Annual Average Concentration (χ/q)
Non-Predominant Wind Direction
Above Ambient Conditions – Burning Barrel Emissions
(Burning is Restricted from 6/15 – 10/15)

Met. City	**Alturas**	**Bishop**	**San Benito**	**Escondido**
D (m)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)
20	157.	246.	87.1	40.8
50	45.4	35.4	27.5	10.6
100	14.4	10.2	8.79	3.16
200	4.12	2.72	2.51	0.86
500	0.74	0.44	0.46	0.14
1,000	0.20	0.10	0.12	0.04

Notes:(a) χ/q for site specific meteorological data is based on 2,280 hours of emissions at 1 g/s.
(b) χ/q is the concentration in $\mu g/m^3$ based on an hourly emission rate of 1 g/s.
(c) Results are valid for two significant digits. Three significant digits are reported to reduce round off error in subsequent calculations.

Table CA-4
Six-Hour Average Concentration (χ/q)
Non-Predominant Wind Direction
Above Ambient Conditions – Burning Barrel Emissions

Met. City	**Alturas**	**Bishop**	**San Benito**	**Escondido**
D (m)	(μg/m^3)/(g/s)	(μg/m^3)/(g/s)	(μg/m^3)/(g/s)	(μg/m^3)/(g/s)
20	10,244	7,940	8,224	5,674
50	3,629	2,982	3,228	1,753
100	1,283	1,086	1,190	591
200	393	340	377	171
500	79	70	78	31
1,000	24	21	24	8

Notes: (a) χ/q for site specific meteorological data is based on 2 hours of burning and 4 hours of no burning with emissions at 1 g/s.

(b) χ/q is the concentration in μg/m^3 based on an hourly emission rate of 1 g/s.

(c) Results are valid for two significant digits. Three significant digits are reported to reduce round off error in subsequent calculations.

Table CA-5
Two Hour Maximum Acute Average Concentration (χ/q)
Above Ambient Conditions – Burning Barrel Emissions

Met. City	**Alturas**	**Bishop**	**San Benito**	**Escondido**	***SCREENING***
Avg.	Two HR	Two HR	Two HR	Two HR	One HR
D (m)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)
20	43,200	53,300	56,500	46,200	49,600
50	21,500	22,000	23,600	17,800	19,500
100	10,700	8,590	9,370	6,490	7,170
200	4,210	2,840	3,130	2,030	2,280
500	1,000	607	681	416	474
1,000	330	188	214	125	145

Notes: (a) χ/q is the concentration in $\mu g/m^3$ based on an hourly emission rate of 1 g/s.
(b) Results are valid for two significant digits. Three significant digits are reported to reduce round off error in subsequent calculations.

Table CA-6
Two-Hour Average Concentration (χ/q)
Non-Predominant Wind Direction
Above Ambient Conditions – Burning Barrel Emissions

Met. City	**Alturas**	**Bishop**	**San Benito**	**Escondido**
D (m)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)	($\mu g/m^3$)/(g/s)
20	30,700	23,800	24,700	17,000
50	10,900	8,940	9,690	5,260
100	3,850	3,260	3,570	1,770
200	1,180	1,020	1,130	512
500	236	209	235	93
1,000	72	63	72	25

Notes: (a) χ/q is the concentration in $\mu g/m^3$ based on an hourly emission rate of 1 g/s for two hours.
(b) Results are valid for two significant digits. Three significant digits are reported to reduce round off error in subsequent calculations.

Attachment B

CIMIS Details for Meteorological Stations

STATION NO.	**= 90**	**MAINT. BY**	**= M-DWR**
STATION NAME	= Alturas	ELEVATION	= 4405 ft.
COUNTY	= Modoc	LATITUDE	= 41D26'18"N (41.4383)
REGION	= Northeast Plateau	LONGITUDE	= 120D28'45"W (120.4792)
NEARBY CITY	= Alturas	START DATE	= 4/23/89
OWNER	= University of California	END DATE	= ACTIVE
MAINT. PERSON	= Northern District		

STATION NO.	= 126	MAINT. BY	= M-OWN
STATION NAME	= San Benito	ELEVATION	= 340 ft.
COUNTY	= San Benito	LATITUDE	= 36D51'15"N
REGION	= Monterey Bay	LONGITUDE	= 121D21'42"W
NEARBY CITY	= Hollister	START DATE	= 6/ 9/94
OWNER	= San Benito County Water Dist	END DATE	= ACTIVE
MAINT. PERSON	= San Joaquin District		

STATION NO.	= 143	MAINT. BY	=
STATION NAME	= San Juan Valley	ELEVATION	= 245 ft.
COUNTY	= San Benito	LATITUDE	= 36D49'23"
REGION	= Monterey Bay	LONGITUDE	= 121D28'03"
NEARBY CITY	= Hollister	START DATE	= 1/ 1/98
OWNER	= Lisa Kemmer/San Benito WD	END DATE	= ACTIVE
MAINT. PERSON	=		

STATION NO.	= 35	MAINT. BY	= M-DWR
STATION NAME	= Bishop	ELEVATION	= 4170 ft.
COUNTY	= Inyo	LATITUDE	= 37D21'29"N
REGION	= Bishop	LONGITUDE	= 118D24'14"W
NEARBY CITY	= Bishop	START DATE	= 2/ 4/83
OWNER	= DWR	END DATE	= ACTIVE
MAINT. PERSON	= Southern District		

STATION NO.	= 153	MAINT. BY	=
STATION NAME	= Escondido SPV	ELEVATION	= 390 ft.
COUNTY	= San Diego	LATITUDE	= 33D04'52"
REGION	= South Coast/Valley	LONGITUDE	= 116D58'33"
NEARBY CITY	= Escondido	START DATE	= 2/ 1/99
OWNER	=	END DATE	= ACTIVE
MAINT. PERSON	=		

Attachment C

SCREEN3 Model Results

11/13/01

15:11:28

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***
Burn Barrel
SIMPLE TERRAIN INPUTS:
   SOURCE TYPE              =        VOLUME
   EMISSION RATE (G/S)      =       1.00000
   SOURCE HEIGHT (M)        =        2.0000
   INIT. LATERAL DIMEN (M)  =         .2300
   INIT. VERTICAL DIMEN (M) =         .2300
   RECEPTOR HEIGHT (M)      =        1.0000
   URBAN/RURAL OPTION       =         RURAL

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


BUOY. FLUX =     .000 M**4/S**3;  MOM. FLUX =     .000 M**4/S**2.

*** STABILITY CLASS  4 ONLY ***

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST      CONC              U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
   (M)    (UG/M**3)   STAB   (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
-------  ----------   ----   -----  -----  ------  ------  ------  ------  -----
    20.   .4955E+05     4     1.0    1.0   320.0    2.00    2.01    1.30    NO
    50.   .1946E+05     4     1.0    1.0   320.0    2.00    4.47    2.68    NO
   100.   7173.         4     1.0    1.0   320.0    2.00    8.36    4.78    NO
   200.   2275.         4     1.0    1.0   320.0    2.00   15.71    8.62    NO
   500.   474.2         4     1.0    1.0   320.0    2.00   36.28   18.36    NO
  1000.   144.9         4     1.0    1.0   320.0    2.00   68.25   32.10    NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION          MAX CONC     DIST TO    TERRAIN
  PROCEDURE          (UG/M**3)     MAX (M)     HT (M)
 --------------     -----------    -------    -------
 SIMPLE TERRAIN      .4955E+05       20.          0.
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Attachment D

Example ISCST3 Input File / Output File

(Note: In the interest of brevity, only those pages deemed most prevalent from the ISCST3 output have been reproduced here. The entire input/output files are available on request.)

```
CO STARTING
   TITLEONE  Burning Barrel Analysis
   TITLETWO  Modoc County, Alturas Met. Data
   MODELOPT  DFAULT RURAL CONC
   AVERTIME  1 2 6 PERIOD
   POLLUTID  OTHER
   FLAGPOLE  1.0
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
** LOCATION  Srcid    Srctyp   Xs    Ys     (Zs)
   LOCATION  VOL1     VOLUME   0.    0.     0.

** Volume Source     QS      HS   Syo   Szo
** Parameters:       ----    ----  ---   ---
   SRCPARAM  VOL1    1.      2.   0.233 0.233

**                        Winter             Spring
   EMISFACT VOL1 SEASHR  8*0. 8*1. 8*0.    7*0. 10*1. 7*0.
**                        Summer             Fall
   EMISFACT VOL1 SEASHR  6*0. 12*1. 6*0.   7*0. 10*1. 7*0.

   SRCGROUP  ALL

SO FINISHED

RE STARTING
   GRIDPOLR POLAR STA
            POLAR ORIG  0.  0.
            POLAR DIST 20. 50. 100. 200. 500. 1000.
            POLAR GDIR 36 10. 10.
   GRIDPOLR POLAR END
RE FINISHED

ME STARTING
   INPUTFIL  alt96_00.txt
   ANEMHGHT  2 METERS
   SURFDATA  99090  1996  Alturas
   UAIRDATA  99090  1996  Holzworth
**   DAYRANGE  1/1-6/15 10/16-12/31
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE 20
   PLOTFILE  PERIOD ALL plotann_alt_12m.dat
   PLOTFILE  6      ALL FIRST plotsix_alt_12m.dat
   PLOTFILE  2      ALL FIRST plottwo_alt_12m.dat
OU FINISHED1
```

```
**MODELOPTs:
CONC                    RURAL FLAT  FLGPOL DFAULT

                             ***     MODEL SETUP OPTIONS SUMMARY       ***
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

**Intermediate Terrain Processing is Selected

**Model Is Setup For Calculation of Average CONCentration Values.

  --  SCAVENGING/DEPOSITION LOGIC --
**Model Uses NO DRY DEPLETION.  DDPLETE =  F
**Model Uses NO WET DEPLETION.  WDPLETE =  F
**NO WET SCAVENGING Data Provided.
**NO GAS DRY DEPOSITION Data Provided.
**Model Does NOT Use GRIDDED TERRAIN Data for Depletion Calculations

**Model Uses RURAL Dispersion.

**Model Uses Regulatory DEFAULT Options:
           1. Final Plume Rise.
           2. Stack-tip Downwash.
           3. Buoyancy-induced Dispersion.
           4. Use Calms Processing Routine.
           5. Not Use Missing Data Processing Routine.
           6. Default Wind Profile Exponents.
           7. Default Vertical Potential Temperature Gradients.
           8. "Upper Bound" Values for Supersquat Buildings.
           9. No Exponential Decay for RURAL Mode

**Model Assumes Receptors on FLAT Terrain.

**Model Accepts FLAGPOLE Receptor Heights.

**Model Calculates  3 Short Term Average(s) of:   1-HR   2-HR   6-HR
    and Calculates PERIOD Averages

**This Run Includes:     1 Source(s);      1 Source Group(s); and     216 Receptor(s)

**The Model Assumes A Pollutant Type of:  OTHER

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:
         Model Outputs Tables of PERIOD Averages by Receptor
         Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)
         Model Outputs Tables of Overall Maximum Short Term Values (MAXTABLE Keyword)
         Model Outputs External File(s) of High Values for Plotting (PLOTFILE Keyword)

**NOTE:  The Following Flags May Appear Following CONC Values:  c for Calm Hours
                                                                m for Missing Hours
                                                                b for Both Calm and Missing Hours
```

130

```
**Misc. Inputs:  Anem. Hgt. (m) =      2.00 ;    Decay Coef. =    0.000       ;    Rot. Angle =      0.0
                 Emission Units = GRAMS/SEC                                     ;  Emission Rate Unit Factor =   0.10000E+07
                 Output Units   = MICROGRAMS/M**3

**Approximate Storage Requirements of Model =     1.2 MB of RAM.

**Input Runstream File:          quick_alt.in
**Output Print File:             quick_alt_12m.out
**Detailed Error/Message File:   ERRORS.OUT


1 *** ISCST3 - VERSION 00259 ***     ***  Burning Barrel Analysis                                    ***        11/07/01
                                     ***  Modoc County, Alturas Met. Data                            ***        14:33:20
**MODELOPTs:                                                                                                    PAGE   2
CONC                        RURAL FLAT  FLGPOL DFAULT
```

*** VOLUME SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	INIT. SY (METERS)	INIT. SZ (METERS)	EMISSION RATE SCALAR VARY BY
VOL1	0	0.10000E+01	0.0	0.0	0.0	2.00	0.23	0.23	SEASHR

**MODELOPTs:
CONC   RURAL FLAT FLGPOL DFAULT

* SOURCE EMISSION RATE SCALARS WHICH VARY SEASONALLY AND DIURNALLY (SEASHR) *

SOURCE ID = VOL1 ; SOURCE TYPE = VOLUME :

SEASON = WINTER

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
1	.00000E+00	2	.00000E+00	3	.00000E+00	4	.00000E+00	5	.00000E+00	6	.00000E+00
7	.00000E+00	8	.00000E+00	9	.10000E+01	10	.10000E+01	11	.10000E+01	12	.10000E+01
13	.10000E+01	14	.10000E+01	15	.10000E+01	16	.10000E+01	17	.00000E+00	18	.00000E+00
19	.00000E+00	20	.00000E+00	21	.00000E+00	22	.00000E+00	23	.00000E+00	24	.00000E+00

SEASON = SPRING

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
1	.00000E+00	2	.00000E+00	3	.00000E+00	4	.00000E+00	5	.00000E+00	6	.00000E+00
7	.00000E+00	8	.10000E+01	9	.10000E+01	10	.10000E+01	11	.10000E+01	12	.10000E+01
13	.10000E+01	14	.10000E+01	15	.10000E+01	16	.10000E+01	17	.10000E+01	18	.00000E+00
19	.00000E+00	20	.00000E+00	21	.00000E+00	22	.00000E+00	23	.00000E+00	24	.00000E+00

SEASON = SUMMER

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
1	.00000E+00	2	.00000E+00	3	.00000E+00	4	.00000E+00	5	.00000E+00	6	.00000E+00
7	.10000E+01	8	.10000E+01	9	.10000E+01	10	.10000E+01	11	.10000E+01	12	.10000E+01
13	.10000E+01	14	.10000E+01	15	.10000E+01	16	.10000E+01	17	.10000E+01	18	.10000E+01
19	.00000E+00	20	.00000E+00	21	.00000E+00	22	.00000E+00	23	.00000E+00	24	.00000E+00

SEASON = FALL

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
1	.00000E+00	2	.00000E+00	3	.00000E+00	4	.00000E+00	5	.00000E+00	6	.00000E+00
7	.00000E+00	8	.10000E+01	9	.10000E+01	10	.10000E+01	11	.10000E+01	12	.10000E+01
13	.10000E+01	14	.10000E+01	15	.10000E+01	16	.10000E+01	17	.10000E+01	18	.00000E+00
19	.00000E+00	20	.00000E+00	21	.00000E+00	22	.00000E+00	23	.00000E+00	24	.00000E+00

```
**MODELOPTs:
CONC                     RURAL FLAT  FLGPOL DFAULT

                    *** GRIDDED RECEPTOR NETWORK SUMMARY ***

             *** NETWORK ID: POLAR    ;  NETWORK TYPE: GRIDPOLR ***

                       *** ORIGIN FOR POLAR NETWORK ***
             X-ORIG =      0.00 ;   Y-ORIG =       0.00   (METERS)

                       *** DISTANCE RANGES OF NETWORK ***
                                 (METERS)

     20.0,      50.0,     100.0,     200.0,     500.0,    1000.0,

                       *** DIRECTION RADIALS OF NETWORK ***
                                 (DEGREES)

     10.0,      20.0,      30.0,      40.0,      50.0,      60.0,      70.0,      80.0,      90.0,     100.0,
    110.0,     120.0,     130.0,     140.0,     150.0,     160.0,     170.0,     180.0,     190.0,     200.0,
    210.0,     220.0,     230.0,     240.0,     250.0,     260.0,     270.0,     280.0,     290.0,     300.0,
    310.0,     320.0,     330.0,     340.0,     350.0,     360.0,
```

**MODELOPTs:
CONC   RURAL FLAT FLGPOL DFAULT

*** THE FIRST 24 HOURS OF METEOROLOGICAL DATA ***

FILE: alt96_00.txt
FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1,f9.4,f10.1,f8.4,i4,f7.2)
SURFACE STATION NO.: 99090   UPPER AIR STATION NO.: 99090
NAME: ALTURAS   NAME: HOLZWORTH
YEAR: 1996   YEAR: 1996

YR	MN	DY	HR	FLOW VECTOR	SPEED (M/S)	TEMP (K)	STAB CLASS	MIXING HEIGHT (M) RURAL	MIXING HEIGHT (M) URBAN	USTAR (M/S)	M-O LENGTH (M)	Z-0 (M)	IPCODE	PRATE (mm/HR)
96	01	01	01	299.5	1.03	269.2	6	350.0	350.0	0.0000	0.0	0.0000	0	0.00
96	01	01	02	222.2	1.00	268.8	6	350.0	350.0	0.0000	0.0	0.0000	0	0.00
96	01	01	03	306.2	1.02	268.1	6	350.0	350.0	0.0000	0.0	0.0000	0	0.00
96	01	01	04	214.1	1.00	268.1	6	350.0	350.0	0.0000	0.0	0.0000	0	0.00
96	01	01	05	250.6	1.16	268.4	6	350.0	350.0	0.0000	0.0	0.0000	0	0.00
96	01	01	06	16.5	1.00	267.8	6	350.0	350.0	0.0000	0.0	0.0000	0	0.00
96	01	01	07	310.4	1.00	268.2	6	350.0	350.0	0.0000	0.0	0.0000	0	0.00
96	01	01	08	340.6	1.00	269.6	5	350.0	350.0	0.0000	0.0	0.0000	0	0.00
96	01	01	09	91.9	1.00	271.0	4	175.0	466.7	0.0000	0.0	0.0000	0	0.00
96	01	01	10	96.0	1.02	272.1	4	350.0	583.3	0.0000	0.0	0.0000	0	0.00
96	01	01	11	154.0	1.05	274.2	3	525.0	700.0	0.0000	0.0	0.0000	0	0.00
96	01	01	12	148.4	1.18	276.4	2	700.0	816.7	0.0000	0.0	0.0000	0	0.00
96	01	01	13	352.5	1.11	278.3	2	875.0	933.3	0.0000	0.0	0.0000	0	0.00
96	01	01	14	97.1	1.46	279.3	2	1050.0	1050.0	0.0000	0.0	0.0000	0	0.00
96	01	01	15	195.1	1.00	280.4	2	1050.0	1050.0	0.0000	0.0	0.0000	0	0.00
96	01	01	16	78.9	1.00	280.9	3	1050.0	1050.0	0.0000	0.0	0.0000	0	0.00
96	01	01	17	297.6	1.13	277.2	4	1050.0	1050.0	0.0000	0.0	0.0000	0	0.00
96	01	01	18	286.6	1.05	273.2	5	950.0	950.0	0.0000	0.0	0.0000	0	0.00
96	01	01	19	280.8	1.00	273.1	6	850.0	850.0	0.0000	0.0	0.0000	0	0.00
96	01	01	20	330.1	1.44	273.2	6	750.0	750.0	0.0000	0.0	0.0000	0	0.00
96	01	01	21	183.1	1.19	272.9	6	650.0	650.0	0.0000	0.0	0.0000	0	0.00
96	01	01	22	160.5	1.29	271.9	6	550.0	550.0	0.0000	0.0	0.0000	0	0.00
96	01	01	23	14.1	1.15	270.8	6	450.0	450.0	0.0000	0.0	0.0000	0	0.00
96	01	01	24	298.4	1.36	270.7	6	350.0	350.0	0.0000	0.0	0.0000	0	0.00

*** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

133

**MODELOPTs:
CONC   RURAL FLAT FLGPOL DFAULT

*** THE PERIOD (43848 HRS) AVERAGE CONCENTRATION   VALUES FOR SOURCE GROUP: ALL   ***
INCLUDING SOURCE(S):   VOL1   ,

*** NETWORK ID: POLAR   ; NETWORK TYPE: GRIDPOLR ***

** CONC OF OTHER   IN MICROGRAMS/M**3   **

DIRECTION (DEGREES)	DISTANCE (METERS) 20.00	50.00	100.00	200.00	500.00	1000.00
10.00	359.28723	109.09495	35.23533	10.17595	1.86986	0.51552
20.00	322.79550	94.75423	30.04909	8.58382	1.55289	0.42200
30.00	303.82068	87.01556	27.26755	7.73402	1.38359	0.37210
40.00	310.64249	88.56834	27.80078	7.90533	1.41740	0.38177
50.00	343.76212	97.06303	30.28417	8.56304	1.52019	0.40539
60.00	415.36121	118.75463	37.26259	10.58086	1.89030	0.50684
70.00	483.38943	137.87877	43.25087	12.28842	2.19577	0.58894
80.00	551.75903	156.56862	48.91713	13.85778	2.47025	0.66145
90.00	625.56580	175.35014	54.31086	15.28538	2.69682	0.71475
100.00	701.34460	195.15503	60.22597	16.92513	2.97425	0.78414
110.00	743.75629	203.13817	62.05415	17.31683	3.00745	0.78362
120.00	764.23553	204.78236	61.90730	17.15272	2.93798	0.75377
130.00	772.67841	205.59232	62.08289	17.20626	2.93811	0.74987
140.00	745.85541	194.59494	58.10659	15.93469	2.66552	0.66503
150.00	723.08447	188.13655	56.23870	15.42978	2.57930	0.64322
160.00	697.60840	181.07933	54.17500	14.88348	2.49010	0.62121
170.00	675.42920	175.23468	52.36225	14.37422	2.39870	0.59566
180.00	658.65680	174.99783	52.97433	14.69991	2.50293	0.63527
190.00	579.61694	155.84921	47.50737	13.25050	2.28134	0.58686
200.00	437.30966	115.82762	34.90974	9.62612	1.63262	0.41498
210.00	317.55426	84.92886	25.80663	7.16093	1.23060	0.31777
220.00	232.50551	62.56200	19.06682	5.29708	0.91314	0.23672
230.00	186.68686	51.73637	16.08179	4.53995	0.80231	0.21303
240.00	159.59248	45.10520	14.17402	4.02594	0.71774	0.19218
250.00	148.55293	43.20642	13.82930	3.98011	0.72292	0.19682
260.00	151.88326	44.79121	14.40066	4.14873	0.75450	0.20557
270.00	175.13824	55.05038	18.46500	5.49965	1.04397	0.29501
280.00	157.86005	48.11384	15.69142	4.54722	0.83457	0.22946
290.00	154.47588	47.91508	15.80337	4.62305	0.86071	0.23978
300.00	155.87004	48.62551	16.12665	4.74183	0.88769	0.24817
310.00	146.41270	44.58778	14.54168	4.22844	0.78086	0.21581
320.00	144.94771	42.50871	13.51841	3.84975	0.69014	0.18579
330.00	179.44879	54.08427	17.46337	5.04325	0.92535	0.25465
340.00	233.74501	70.48315	22.71098	6.53114	1.19126	0.32634
350.00	324.58835	101.20020	33.15681	9.66215	1.79817	0.50140
360.00	379.02032	118.68980	38.97332	11.38465	2.12648	0.59483

**MODELOPTs:
CONC   RURAL FLAT FLGPOL DFAULT

*** THE MAXIMUM 20 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): VOL1 ,

** CONC OF OTHER IN MICROGRAMS/M**3 **

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR, YR)		OF TYPE	RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR, YR)		OF TYPE
1.	81534.78125	(98111108)	AT (	-20.00,	0.00)	GP	11.	62762.19531	(96111717)	AT (	3.47,	19.70)	GP
2.	77099.78125	(97112708)	AT (	18.79,	6.84)	GP	12.	62494.07812	(98110208)	AT (	-20.00,	0.00)	GP
3.	63778.89062	(96111108)	AT (	-17.32,	-10.00)	GP	13.	62494.07422	(98111109)	AT (	-6.84,	18.79)	GP
4.	63717.26953	(97110408)	AT (	-19.70,	3.47)	GP	14.	62407.88281	(96013009)	AT (	0.00,	-20.00)	GP
5.	63717.26172	(00112308)	AT (	-20.00,	0.00)	GP	15.	62295.17188	(97120909)	AT (	-18.79,	-6.84)	GP
6.	63617.28125	(97112808)	AT (	-15.32,	-12.86)	GP	16.	62195.92578	(99011109)	AT (	18.79,	-6.84)	GP
7.	63525.13281	(98012209)	AT (	17.32,	-10.00)	GP	17.	62195.85938	(00111408)	AT (	-19.70,	-3.47)	GP
8.	63206.09766	(00111208)	AT (	0.00,	20.00)	GP	18.	61867.87500	(97120809)	AT (	-3.47,	19.70)	GP
9.	62999.52344	(00012309)	AT (	-20.00,	0.00)	GP	19.	61510.69922	(97122309)	AT (	17.32,	10.00)	GP
10.	62999.52344	(00112608)	AT (	-6.84,	18.79)	GP	20.	61216.41016	(97030608)	AT (	15.32,	12.86)	GP

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

135

136

**MODELOPTs:
CONC   RURAL FLAT FLGPOL DFAULT

*** THE MAXIMUM 20 2-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): VOL1 ,

** CONC OF OTHER IN MICROGRAMS/M**3 **

RANK	CONC	(YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE			RANK	CONC	(YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE		
1.	48871.01172	(98120312) AT (	20.00,	0.00)	GP	11.	40026.98438	(99012910) AT (	-20.00,	0.00)	GP
2.	47849.55469	(98011014) AT (	-6.84,	-18.79)	GP	12.	39146.01562	(97121716) AT (	17.32,	10.00)	GP
3.	43185.06250	(98111112) AT (	3.47,	-19.70)	GP	13.	38723.82031	(97012414) AT (	15.32,	-12.86)	GP
4.	41447.76172	(97122110) AT (	-17.32,	10.00)	GP	14.	38549.89062	(97112708) AT (	18.79,	6.84)	GP
5.	41197.90625	(98011510) AT (	-3.47,	-19.70)	GP	15.	38313.87500	(00021810) AT (	20.00,	0.00)	GP
6.	40964.49219	(97062708) AT (	15.32,	-12.86)	GP	16.	38282.94141	(00080108) AT (	10.00,	-17.32)	GP
7.	40842.83594	(99011810) AT (	-15.32,	-12.86)	GP	17.	38258.22656	(96080108) AT (	-3.47,	-19.70)	GP
8.	40767.39062	(98111108) AT (	-20.00,	0.00)	GP	18.	38173.92188	(00072508) AT (	12.86,	-15.32)	GP
9.	40444.94141	(96122110) AT (	3.47,	19.70)	GP	19.	38112.43359	(96080708) AT (	20.00,	0.00)	GP
10.	40256.50000	(97011510) AT (	-20.00,	0.00)	GP	20.	37763.02344	(97110210) AT (	12.86,	-15.32)	GP

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

**MODELOPTs:
CONC   RURAL FLAT FLGPOL DFAULT

*** THE MAXIMUM 20 6-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): VOL1 ,

** CONC OF OTHER IN MICROGRAMS/M**3 **

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR)	OF TYPE	RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR)	OF TYPE
1.	23044.16211	(98011012)	AT (	0.00, -20.00)	GP	11.	16884.92969	(00072512)	AT (	12.86, -15.32)	GP
2.	19217.70312	(97112712)	AT (	18.79, 6.84)	GP	12.	16869.17578	(97062712)	AT (	15.32, -12.86)	GP
3.	18968.23242	(98011018)	AT (	-6.84, -18.79)	GP	13.	16400.34961	(97120512)	AT (	6.84, -18.79)	GP
4.	18637.32422	(97122112)	AT (	-18.79, 6.84)	GP	14.	16290.33789	(98120312)	AT (	20.00, 0.00)	GP
5.	18598.71094	(98111112)	AT (	3.47, -19.70)	GP	15.	16217.56641	(00021612)	AT (	19.70, 3.47)	GP
6.	18119.53906	(98012218)	AT (	-6.84, -18.79)	GP	16.	16210.42773	(97080512)	AT (	12.86, -15.32)	GP
7.	17679.75000	(00073012)	AT (	10.00, -17.32)	GP	17.	15785.03711	(97110212)	AT (	12.86, -15.32)	GP
8.	17354.37891	(00101112)	AT (	-6.84, 18.79)	GP	18.	15478.49512	(97122112)	AT (	-17.32, 10.00)	GP
9.	17291.69336	(98112712)	AT (	-20.00, 0.00)	GP	19.	15428.75195	(98071212)	AT (	19.70, -3.47)	GP
10.	16999.28516	(96080112)	AT (	-3.47, -19.70)	GP	20.	15314.57812	(98011512)	AT (	-3.47, -19.70)	GP

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

```
1 *** ISCST3 - VERSION 00259 ***     ***  Burning Barrel Analysis                                              ***          11/07/01
                                     ***  Modoc County, Alturas Met. Data                                      ***          14:33:20
 **MODELOPTs:                                                                                                               PAGE  19
 CONC                    RURAL FLAT  FLGPOL DFAULT

                                         *** THE SUMMARY OF MAXIMUM PERIOD ( 43848 HRS) RESULTS ***

                                     ** CONC OF OTHER     IN MICROGRAMS/M**3                                 **

                                                                                                       NETWORK
 GROUP ID                        AVERAGE CONC                RECEPTOR  (XR, YR, ZELEV, ZFLAG)  OF TYPE  GRID-ID
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 ALL       1ST HIGHEST VALUE IS      772.67841 AT (      15.32,      -12.86,       0.00,      1.00)  GP    POLAR
           2ND HIGHEST VALUE IS      764.23553 AT (      17.32,      -10.00,       0.00,      1.00)  GP    POLAR
           3RD HIGHEST VALUE IS      745.85541 AT (      12.86,      -15.32,       0.00,      1.00)  GP    POLAR
           4TH HIGHEST VALUE IS      743.75629 AT (      18.79,       -6.84,       0.00,      1.00)  GP    POLAR
           5TH HIGHEST VALUE IS      723.08447 AT (      10.00,      -17.32,       0.00,      1.00)  GP    POLAR
           6TH HIGHEST VALUE IS      701.34460 AT (      19.70,       -3.47,       0.00,      1.00)  GP    POLAR
           7TH HIGHEST VALUE IS      697.60840 AT (       6.84,      -18.79,       0.00,      1.00)  GP    POLAR
           8TH HIGHEST VALUE IS      675.42920 AT (       3.47,      -19.70,       0.00,      1.00)  GP    POLAR
           9TH HIGHEST VALUE IS      658.65680 AT (       0.00,      -20.00,       0.00,      1.00)  GP    POLAR
          10TH HIGHEST VALUE IS      625.56580 AT (      20.00,        0.00,       0.00,      1.00)  GP    POLAR

  *** RECEPTOR TYPES:  GC = GRIDCART
                       GP = GRIDPOLR
                       DC = DISCCART
                       DP = DISCPOLR
                       BD = BOUNDARY
```

APPENDIX D

Glossary and Acronyms

Glossary and Acronymns

Glossary

Acute Exposure:	One or a series of short-term exposures generally lasting less than 24 hours.
Air Dispersion Model:	A mathematical model or computer simulation used to estimate the concentration of toxic air pollutants at specific locations as a result of mixing in the atmosphere.
Airborne Toxic Control Measure:	Section 39655 of the Health and Safety Code, defines an "Airborne Toxic Control Measure" means either of the following: 1) Recommended methods, and, where appropriate, a range of methods, that reduce, avoid, or eliminate the emissions of a toxic air contaminant. Airborne toxic control measures include, but are not limited to, emission limitations, control technologies, the use of operational and maintenance conditions, closed system engineering, design equipment, or work practice standards; and the reduction, avoidance, or elimination of emissions through process changes, substitution of materials, or other modifications. 2) Emission standards adopted by the U.S. Environmental Protection Agency pursuant to Section 112 of the federal act (42 U.S.C. Sec. 7412).
Cancer Risk:	The theoretical probability of contracting cancer when exposed for a lifetime to a given concentration of a substance usually calculated as an upper confidence limit. The maximum estimated risk may be presented as the number of chances in a million of contracting cancer.
Chronic Exposure:	Long-term exposure usually lasting from one year to a lifetime.
Hazardous Air Pollutant or HAP:	Means a substance that the U.S. Environmental Protection Agency has listed in, or pursuant to, Section 112 subsection (b) of the federal Clean Air Act Amendments of 1990 (42 U.S. Code, Section 7412(b)).
Hazard Index:	The ratio of the concentration of a toxic pollutant with non-cancer health effects and the reference exposure level for that pollutant.
Health Risk Assessment (HRA):	A comprehensive analysis of the dispersion of hazardous substances in the environment, the potential for human exposure, and a quantitative assessment of both individual and population-wide health impacts associated with the level of exposure.

Near Source Location:	The location closest to an emission's source where concentrations could be estimated through air dispersion modeling.
Non-cancer Risk:	Refers to non-cancer health effects due to acute and/or chronic exposure. This may be illustrated as an estimate of the hazard index or total hazard index (by endpoint) resulting from exposure to toxic air pollutants.
Reference Exposure Level (REL):	These are used as indicators of potential non-cancer adverse health effects. An REL is a concentration level at or below which no adverse health effects are anticipated. RELs are designed to protect most sensitive individuals in the population by including safety factors in their development.
Risk:	The possibility of injury or disease, which may result from exposure to toxic air pollutants.
Scientific Review Panel on Toxic Air Contaminants (SRP):	A nine-member panel appointed to advise the Air Resources Board and the Department of Pesticide Regulation in their evaluation of the adverse health effects toxicity of substances being evaluated as Toxic Air Contaminants.
Toxic Air Contaminant (TAC):	Section 39655 of the Health and Safety Code, defines a TAC as an air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health. A substance that is listed as a hazardous air pollutant pursuant to subsection (b) of Section 112 of the federal act (42 U.S.C. Sec. 7412(b)) is a TAC. TACs that are pesticides are regulated in their pesticidal use by the Department of Pesticide Regulation.
Total Hazard Index:	The sum of hazard indices for pollutants with non-cancer health effects that have the same or similar adverse health effects (endpoints).
Unit Risk Factor: (URF):	The estimated upper-confidence limit (usually 95%) probability of a person contracting cancer as a result of a constant exposure to 1 $\mu g/m^3$ of a substance over a 70-year lifetime.

Acronyms

ARB	Air Resources Board
APCD	Air Pollution Control District
AQMD	Air Quality Management District
ATCM	Airborne Toxic Control Measure
Districts	Local Air Pollution Control and Air Quality Management Districts
HAP	Hazardous Air Pollutant
HSC	Health and Safety Code
IARC	International Agency for Research on Cancer
OEHHA	Office of Environmental Health Hazard Assessment
RfD	Reference Dose
REL	Reference Exposure Level
SB	Senate Bill
SRP	Scientific Review Panel on Toxic Air Contaminants
TAC	Toxic Air Contaminant
URF	Unit Risk Factor
U.S. EPA	United States Environmental Protection Agency

SUMMARY OF BOARD ITEM

ITEM # 02-1-4: **PUBLIC HEARING TO CONSIDER AMENDMENTS TO THE ALTERNATIVE FUEL REGULATIONS REGARDING COMPRESSED NATURAL GAS AND LIQUEFIED PETROLEUM GAS**

STAFF RECOMMENDATION: The staff recommends that the Board approve the proposed amendments to the Alternative Fuel Regulations regarding compressed natural gas (CNG) and liquefied petroleum gas (LPG). These amendments will add an alternative specification for CNG based on methane number (MN), and will provide an exemption from the LPG motor vehicle specifications for small local LPG delivery trucks which deliver and operate on the same LPG cargo fuel.

DISCUSSION: In 1992, the Board adopted the alternative fuel regulations in anticipation that the specifications would be used by engine manufacturers to design vehicles to meet the increasingly stringent low emission vehicle (LEV) standards. The regulations include specifications for certification fuels for certifying new vehicles and specifications for commercial fuels for in-use vehicles. The certification specifications provide engine manufacturers with fuel quality specifications to design and certify engines. The commercial specifications (which are the sole subject of the proposed amendments) define the fuel that is used by motor vehicles operated in California. The commercial specifications ensure that in-use fuels are similar to the fuels used to certify new vehicles and engines, and to ensure the fuel quality in the market place to protect engines and maintain the emissions benefits of alternative fuels.

In the natural gas market, there are two specifications: one is the specification for motor vehicle fuel and the other is for residential/commercial use. However, there is only one infrastructure to deliver the fuels. In addition, there are areas in the State where the availability of natural gas meeting the motor vehicle fuel specifications is limited. Therefore, staff is proposing amendments to the alternative fuels regulations for CNG to increase compliance flexibility.

For CNG, the proposed amendments include an alternative statewide CNG methane number (MN) specification of at least 80. There is also proposed a limited alternative CNG specification of MN 73 for fleet operations in the Southern San Joaquin Valley (SSJV) and the South Central Coast (SCC) that meet the following criteria: 1) The fueling station cannot economically provide CNG meeting a MN of 80; 2) The fleet vehicles are capable to operate on CNG with a MN of 73 as recommended by the engine manufacturer; and 3) The fueling station has controls in place to prevent misfueling. Other amendments include definitions of the SSJV and the SCC.

Similar to CNG, there is also a commercial and motor vehicle fuel specification for LPG and only one infrastructure to deliver these fuels. Because certain delivery trucks operate on the fuel that is delivered, these trucks may be in violation of the regulation when the fuel does not meet the LPG motor vehicle specifications.

For LPG, the proposed amendments include an exemption for LPG delivery vehicles that deliver and operate on the same LPG cargo fuel. These vehicles would be allowed to operate on commercial grade or motor vehicle grade LPG.

In developing the proposed amendments, ARB staff conducted five CNG and three LPG public meetings from June 2000 to June 2001, and held numerous meetings with industry associations, environmental groups and other government agencies.

SUMMARY AND IMPACTS: In summary, the proposed amendments for CNG provide an alternative set of specifications in addition to the existing CNG specifications to add flexibility in the availability of complying motor vehicle CNG in California. The proposed amendments for LPG do not change the current LPG fuel specifications but provide an exemption from the fuel specifications for specific delivery vehicles thus making it more practical for LPG suppliers and distributors to market and sell their fuel. The proposed amendments are not expected to result in any adverse impact to either the public health or the environment.

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER AMENDMENTS TO THE CALIFORNIA ALTERNATIVE FUELS FOR MOTOR VEHICLE REGULATIONS

The Air Resources Board (the "Board" or "ARB") will conduct a public hearing at the time and place noted below to consider adoption of amendments to the compressed natural gas and liquefied petroleum gas specifications within the alternative fuels regulations. This proposal includes amendments to the definition and prohibition sections of the regulations.

DATE: February 21, 2002

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Coastal Valley Hearing Room, 2nd Floor
1001 "I" Street
Sacramento, CA 95814

This item will be considered at a two-day meeting of the ARB, which will commence at 9:00 a.m., February 21, 2002, and may continue at 8:30 a.m., February 22, 2002. This item may not be considered until February 22, 2002. Please consult the agenda for the meeting, which will be available at least 10 days before February 21, 2002, to determine the day on which this item will be considered.

This facility is accessible to persons with disabilities. If accommodation is needed, please contact the ARB's Clerk of the Board by February 7, 2002, at (916) 322-5594, or Telephone Device for the Deaf (TDD) (916) 324-9531 or (800) 700-8326 for TDD calls from outside the Sacramento area, to ensure accommodation.

INFORMATIVE DIGEST OF PROPOSED ACTION AND POLICY STATEMENT OVERVIEW

Sections Affected: California Code of Regulations (CCR), Title 13, Division 3, Air Resources Board, Chapter 5. Standards for Motor Vehicle Fuels, article 3. Specifications for Alternative Motor Vehicle Fuels, sections 2290, 2291, 2292.5, and 2292.6.

A. Background

The ARB alternative fuels regulations, adopted in 1992, include specifications for seven alternative fuels that are shown below:

- M-100 (100 volume percent methanol)
- M-85 (Nominally 85 volume percent methanol and 15 volume percent unleaded gasoline)
- E-100 (100 volume percent ethanol)
- E-85 (Nominally 85 volume percent ethanol and 15 volume percent unleaded gasoline)
- CNG (Compressed Natural Gas)
- LPG (Liquefied Petroleum Gas)
- Hydrogen

The regulations include specifications for certification fuels for certifying new vehicles and specifications for commercial fuels for in-use vehicles. The specifications were developed in anticipation that alternative fuels would be used by engine manufacturers to design vehicles to meet the increasingly stringent low emission vehicle (LEV) standards. The certification specifications provide engine manufacturers with fuel quality specifications to design and certify engines. The commercial specifications (which are the sole subject of the proposed amendments) define the fuel that is used by motor vehicles operated in California. The commercial specifications ensure that in-use fuels are similar to the fuels used to certify new vehicles and engines, and to ensure the fuel quality in the marketplace to protect engines and maintain the emissions benefit of alternative fuels. The following discusses the commercial CNG and LPG motor vehicle specifications.

Compressed Natural Gas

The motor vehicle specifications for CNG were developed in consultation with the natural gas industry, the automobile industry, the engine manufacturers, and other interested parties. The specifications developed were based on a consensus of the quality of natural gas that was imported and produced in California. The motor vehicle CNG specifications are contained in the California Code of Regulations (CCR), title 13, section 2292.5. The CNG specifications have not been amended since the original adoption.

Liquefied Petroleum Gas

The motor vehicle specifications for LPG were adopted in consultation with the LPG industry, automobile industry, the engine manufacturers, and other interested parties. The specifications were originally developed to be consistent with the Gas Producers Association (GPA) Standard 2140 and the American Society of Testing and Materials (ASTM) Designation D1835-89. However, the

Board later revised the specifications to be more representative of the quality of LPG that is produced and used in California. The LPG motor vehicle specifications are contained in CCR, title 13, section 2292.6.

Other CNG and LPG Motor Vehicle Fuel Specifications

There are no other legally enforceable specifications for CNG and LPG motor vehicle fuels in the United States. The Board's specifications for CNG and LPG for use in motor vehicles are the only required specifications for motor vehicle CNG and LPG, respectively. The United States Environmental Protection Agency does not have any specifications for motor vehicle CNG and LPG.

B. Proposed Amendments

The ARB staff is proposing the adoption of alternative CNG motor vehicle fuel specifications and an exemption for LPG bobtail trucks.

CNG

Staff is proposing to establish new CNG specifications based on methane number (MN) to provide more flexibility for producers and suppliers of CNG to comply with the specifications. These specifications will be an additional compliance option to the existing specifications. Specifically, staff proposes two additional specifications: a statewide specification of MN 80, and an alternative specification of MN 73 available in the Southern San Joaquin Valley (SSJV) and South Central Coast (SCC) to fleet operations that meet the following criteria:

- The fueling station cannot economically provide CNG meeting a MN of 80;
- The fleet vehicles can operate on CNG with a MN of 73 as recommended by the engine manufacturer;
- The fueling station has controls in place that will prevent misfueling.

Staff also proposes two definitions that are necessary to define the SSJV and SCC. For the purpose of these specifications, SSJV will be defined as inclusion of the following counties within the jurisdiction of the San Joaquin Valley Air Pollution Control District: Fresno, Kings, Tulare, and Kern counties. The SCC includes San Luis Obispo and Santa Barbara counties.

LPG

Staff is proposing to add a provision allowing small local delivery trucks, which deliver LPG fuel to non-motor vehicle accounts an exemption from the LPG motor vehicle specifications. Small local delivery trucks or "bobtails" are defined as a truck capable of being fueled off of the cargo tank with a maximum capacity of 3000 gallons. These vehicles would be allowed to operate on LPG that does not meet the motor vehicle fuel specifications.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSONS

The Board staff has prepared a Staff Report: Initial Statement of Reasons (ISOR) for the Proposed Regulatory Action, which includes a summary of the environmental impacts of the proposal. The Report is entitled, "Proposed Amendments to the California Alternative Fuels for Motor Vehicle Regulations."

Copies of the Staff Report and the full text of the proposed regulatory language, in underline and strikeout format to allow for comparison with the existing regulations, may be accessed on the ARB's web site listed below, or may be obtained from the Public Information Office, Air Resources Board, 1001 I Street, Environmental Resources Center, 1st Floor, Sacramento, CA 95814, (916) 322-2990 at least 45 days prior to the scheduled hearing (February 21, 2002). Upon its completion, the Final Statement of Reasons (FSOR) will be available and copies may be requested from the agency contact persons in this notice, or may be accessed on the ARB's web site listed below.

Further inquiries concerning the substance of the proposed regulation may be directed to the designated agency contact persons, Ms. Lesley E. Crowell, Air Resources Engineer, Industrial Section, (916) 323-7227, or Mr. Gary M. Yee, Manager, Industrial Section, at (916) 327-5986.

Further, the agency representative and designated back-up contact persons to whom nonsubstantive inquiries concerning the proposed administrative action may be directed are Artavia Edwards, Manager, Board Administration & Regulatory Coordination Unit, (916) 322-6070, or Marie Kavan, Regulations Coordinator, (916) 322-6533. The Board has compiled a record for this rulemaking action, which includes all the information upon which the proposal is based. This material is available for inspection upon request to the contact persons.

If you are a person with a disability and desire to obtain this document in an alternative format, please contact the Air Resources Board ADA Coordinator at (916) 323-4916, or TDD (916) 324-9531, or (800) 700-8326 for TDD calls outside the Sacramento area.

This notice, the ISOR and all subsequent regulatory documents, including the FSOR, when completed, are available on the ARB Internet site for this rulemaking at www.arb.ca.gov/regact/cng-lpg/cng-lpg.htm

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred in reasonable compliance with the proposed regulations are presented below.

The Executive Officer has determined that the proposed regulatory action will not create costs or savings, as defined in Government Code section 11346.5(a)(6), to any state agency or in federal funding to the state, costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code, or other non-discretionary savings to local agencies.

In developing this regulatory proposal, the ARB staff evaluated the potential economic impacts on representative private persons or businesses. The ARB is not aware of any cost impacts that a representative private person or business would necessarily incur in reasonable compliance with the proposed action. Representative private persons will not be affected by cost impacts for this proposed regulation.

The Executive Officer has made an initial determination that the proposed regulatory action will not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states, or on representative private persons.

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action will not affect the creation or elimination of jobs within the State of California, the creation of new businesses or elimination of existing businesses within the State of California, or the expansion of businesses currently doing business within the State of California. A detailed assessment of the economic impacts of the proposed regulatory action can be found in the Staff Report (ISOR).

The Executive Officer has also determined, pursuant to Government Code section 11346.5(a)(3)(B), that the proposed regulatory action will not affect small businesses because this is a change to a regulation that is voluntary with respect to small businesses and there are no mandated requirements and no associated impacts.

Before taking final action on the proposed regulatory action, the Board must determine that no alternative considered by the agency or that has otherwise been identified and brought to the attention of the agency would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

SUBMITTAL OF COMMENTS

The public may present comments relating to this matter orally or in writing at the hearing, and in writing or by e-mail before the hearing. To be considered by the Board, written submissions not physically submitted at the hearing must be received **no later than 12:00 noon, February 20, 2001**, and addressed to the following:

Postal mail is to be sent to:

Clerk of the Board
Air Resources Board
1001 "I" Street, 23rd Floor
Sacramento, California 95814

Electronic mail is to be sent to: cng-lpg@listserve.arb.ca.gov and received at the ARB **no later than 12:00 noon, February 20, 2001**.

The Board requests but does not require that 30 copies of any written statement be submitted and that all written statements be filed at least 10 days prior to the hearing so that ARB staff and Board Members have time to fully consider each comment. The ARB encourages members of the public to bring to the attention of staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

STATUTORY AUTHORITY AND REFERENCES

This regulatory action is proposed under that authority granted in Health and Safety Code, sections 39600, 39601, 43013, 43018, 43101, and 43806. This action is proposed to implement, interpret and make specific sections California Health and Safety Code sections 39000, 39001, 39002, 39003, 39010, 39500, 40000, 43000, 43013, 43016, 43018, 43100, 43101, and 43806.

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, Title 2, Division3, Part 1, Chapter 3.5 (commencing with section 11340) of the Government Code.

Following the public hearing, the Board may adopt the regulatory language as originally proposed or with non substantial or grammatical modifications. The Board may also adopt the proposed regulatory language with other modifications if the text as modified is sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action; in such event the full regulatory text with the modifications clearly indicated, will be made available to the public, for written comment at least 15 days before it is adopted.

The public may request a copy of the modified regulatory text from the ARB's Public Information Office, Air Resources Board, 1001 "I" Street, Environmental Services Center, 1st Floor, Public Information Office, Sacramento, CA 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

Michael P. Kenny
Executive Officer

Date: December 11, 2001

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs see our Web –site at www.arb.ca.gov.

California Environmental Protection Agency

Air Resources Board

Proposed Amendments to the California Alternative Fuels for Motor Vehicle Regulations

Proposed Amendments to the Compressed Natural Gas and Liquefied Petroleum Gas Specifications in the Alternative Fuels for Motor Vehicle Regulations

STAFF REPORT: INITIAL STATEMENT OF REASONS

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER AMENDMENTS TO THE CALIFORNIA ALTERNATIVE FUELS FOR MOTOR VEHICLE REGULATIONS

The Air Resources Board (the "Board" or "ARB") will conduct a public hearing at the time and place noted below to consider adoption of amendments to the compressed natural gas and liquefied petroleum gas specifications within the alternative fuels regulations. This proposal includes amendments to the definition and prohibition sections of the regulations.

DATE: February 21, 2002

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Coastal Valley Hearing Room, 2nd Floor
1001 "I" Street
Sacramento, CA 95814

This item will be considered at a two-day meeting of the ARB, which will commence at 9:00 a.m., February 21, 2002, and may continue at 8:30 a.m., February 22, 2002. This item may not be considered until February 22, 2002. Please consult the agenda for the meeting, which will be available at least 10 days before February 21, 2002, to determine the day on which this item will be considered.

This facility is accessible to persons with disabilities. If accommodation is needed, please contact the ARB's Clerk of the Board by February 7, 2002, at (916) 322-5594, or Telephone Device for the Deaf (TDD) (916) 324-9531 or (800) 700-8326 for TDD calls from outside the Sacramento area, to ensure accommodation.

INFORMATIVE DIGEST OF PROPOSED ACTION AND POLICY STATEMENT OVERVIEW

Sections Affected: California Code of Regulations (CCR), Title 13, Division 3, Air Resources Board, Chapter 5. Standards for Motor Vehicle Fuels, article 3. Specifications for Alternative Motor Vehicle Fuels, sections 2290, 2291, 2292.5, and 2292.6.

A. Background

The ARB alternative fuels regulations, adopted in 1992, include specifications for seven alternative fuels that are shown below:

- M-100 (100 volume percent methanol)
- M-85 (Nominally 85 volume percent methanol and 15 volume percent unleaded gasoline)
- E-100 (100 volume percent ethanol)
- E-85 (Nominally 85 volume percent ethanol and 15 volume percent unleaded gasoline)
- CNG (Compressed Natural Gas)
- LPG (Liquefied Petroleum Gas)
- Hydrogen

The regulations include specifications for certification fuels for certifying new vehicles and specifications for commercial fuels for in-use vehicles. The specifications were developed in anticipation that alternative fuels would be used by engine manufacturers to design vehicles to meet the increasingly stringent low emission vehicle (LEV) standards. The certification specifications provide engine manufacturers with fuel quality specifications to design and certify engines. The commercial specifications (which are the sole subject of the proposed amendments) define the fuel that is used by motor vehicles operated in California. The commercial specifications ensure that in-use fuels are similar to the fuels used to certify new vehicles and engines, and to ensure the fuel quality in the marketplace to protect engines and maintain the emissions benefit of alternative fuels. The following discusses the commercial CNG and LPG motor vehicle specifications.

Compressed Natural Gas

The motor vehicle specifications for CNG were developed in consultation with the natural gas industry, the automobile industry, the engine manufacturers, and other interested parties. The specifications developed were based on a consensus of the quality of natural gas that was imported and produced in California. The motor vehicle CNG specifications are contained in the California Code of Regulations (CCR), title 13, section 2292.5. The CNG specifications have not been amended since the original adoption.

Liquefied Petroleum Gas

The motor vehicle specifications for LPG were adopted in consultation with the LPG industry, automobile industry, the engine manufacturers, and other interested parties. The specifications were originally developed to be consistent with the Gas Producers Association (GPA) Standard 2140 and the American Society of Testing and Materials (ASTM) Designation D1835-89. However, the

Board later revised the specifications to be more representative of the quality of LPG that is produced and used in California. The LPG motor vehicle specifications are contained in CCR, title 13, section 2292.6.

Other CNG and LPG Motor Vehicle Fuel Specifications

There are no other legally enforceable specifications for CNG and LPG motor vehicle fuels in the United States. The Board's specifications for CNG and LPG for use in motor vehicles are the only required specifications for motor vehicle CNG and LPG, respectively. The United States Environmental Protection Agency does not have any specifications for motor vehicle CNG and LPG.

B. Proposed Amendments

The ARB staff is proposing the adoption of alternative CNG motor vehicle fuel specifications and an exemption for LPG bobtail trucks.

CNG

Staff is proposing to establish new CNG specifications based on methane number (MN) to provide more flexibility for producers and suppliers of CNG to comply with the specifications. These specifications will be an additional compliance option to the existing specifications. Specifically, staff proposes two additional specifications: a statewide specification of MN 80, and an alternative specification of MN 73 available in the Southern San Joaquin Valley (SSJV) and South Central Coast (SCC) to fleet operations that meet the following criteria:

- The fueling station cannot economically provide CNG meeting a MN of 80;
- The fleet vehicles can operate on CNG with a MN of 73 as recommended by the engine manufacturer;
- The fueling station has controls in place that will prevent misfueling.

Staff also proposes two definitions that are necessary to define the SSJV and SCC. For the purpose of these specifications, SSJV will be defined as inclusion of the following counties within the jurisdiction of the San Joaquin Valley Air Pollution Control District: Fresno, Kings, Tulare, and Kern counties. The SCC includes San Luis Obispo and Santa Barbara counties.

LPG

Staff is proposing to add a provision allowing small local delivery trucks, which deliver LPG fuel to non-motor vehicle accounts an exemption from the LPG motor vehicle specifications. Small local delivery trucks or "bobtails" are defined as a truck capable of being fueled off of the cargo tank with a maximum capacity of 3000 gallons. These vehicles would be allowed to operate on LPG that does not meet the motor vehicle fuel specifications.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSONS

The Board staff has prepared a Staff Report: Initial Statement of Reasons (ISOR) for the Proposed Regulatory Action, which includes a summary of the environmental impacts of the proposal. The Report is entitled, "Proposed Amendments to the California Alternative Fuels for Motor Vehicle Regulations."

Copies of the Staff Report and the full text of the proposed regulatory language, in underline and strikeout format to allow for comparison with the existing regulations, may be accessed on the ARB's web site listed below, or may be obtained from the Public Information Office, Air Resources Board, 1001 I Street, Environmental Resources Center, 1st Floor, Sacramento, CA 95814, (916) 322-2990 at least 45 days prior to the scheduled hearing (February 21, 2002). Upon its completion, the Final Statement of Reasons (FSOR) will be available and copies may be requested from the agency contact persons in this notice, or may be accessed on the ARB's web site listed below.

Further inquiries concerning the substance of the proposed regulation may be directed to the designated agency contact persons, Ms. Lesley E. Crowell, Air Resources Engineer, Industrial Section, (916) 323-7227, or Mr. Gary M. Yee, Manager, Industrial Section, at (916) 327-5986.

Further, the agency representative and designated back-up contact persons to whom nonsubstantive inquiries concerning the proposed administrative action may be directed are Artavia Edwards, Manager, Board Administration & Regulatory Coordination Unit, (916) 322-6070, or Marie Kavan, Regulations Coordinator, (916) 322-6533. The Board has compiled a record for this rulemaking action, which includes all the information upon which the proposal is based. This material is available for inspection upon request to the contact persons.

If you are a person with a disability and desire to obtain this document in an alternative format, please contact the Air Resources Board ADA Coordinator at (916) 323-4916, or TDD (916) 324-9531, or (800) 700-8326 for TDD calls outside the Sacramento area.

This notice, the ISOR and all subsequent regulatory documents, including the FSOR, when completed, are available on the ARB Internet site for this rulemaking at www.arb.ca.gov/regact/cng-lpg/cng-lpg.htm

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred in reasonable compliance with the proposed regulations are presented below.

The Executive Officer has determined that the proposed regulatory action will not create costs or savings, as defined in Government Code section 11346.5(a)(6), to any state agency or in federal funding to the state, costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code, or other non-discretionary savings to local agencies.

In developing this regulatory proposal, the ARB staff evaluated the potential economic impacts on representative private persons or businesses. The ARB is not aware of any cost impacts that a representative private person or business would necessarily incur in reasonable compliance with the proposed action. Representative private persons will not be affected by cost impacts for this proposed regulation.

The Executive Officer has made an initial determination that the proposed regulatory action will not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states, or on representative private persons.

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action will not affect the creation or elimination of jobs within the State of California, the creation of new businesses or elimination of existing businesses within the State of California, or the expansion of businesses currently doing business within the State of California. A detailed assessment of the economic impacts of the proposed regulatory action can be found in the Staff Report (ISOR).

The Executive Officer has also determined, pursuant to Government Code section 11346.5(a)(3)(B), that the proposed regulatory action will not affect small businesses because this is a change to a regulation that is voluntary with respect to small businesses and there are no mandated requirements and no associated impacts.

Before taking final action on the proposed regulatory action, the Board must determine that no alternative considered by the agency or that has otherwise been identified and brought to the attention of the agency would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

SUBMITTAL OF COMMENTS

The public may present comments relating to this matter orally or in writing at the hearing, and in writing or by e-mail before the hearing. To be considered by the Board, written submissions not physically submitted at the hearing must be received **no later than 12:00 noon, February 20, 2001**, and addressed to the following:

Postal mail is to be sent to:

Clerk of the Board
Air Resources Board
1001 "I" Street, 23rd Floor
Sacramento, California 95814

Electronic mail is to be sent to: cng-lpg@listserve.arb.ca.gov and received at the ARB **no later than 12:00 noon, February 20, 2001**.

The Board requests but does not require that 30 copies of any written statement be submitted and that all written statements be filed at least 10 days prior to the hearing so that ARB staff and Board Members have time to fully consider each comment. The ARB encourages members of the public to bring to the attention of staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

STATUTORY AUTHORITY AND REFERENCES

This regulatory action is proposed under that authority granted in Health and Safety Code, sections 39600, 39601, 43013, 43018, 43101, and 43806. This action is proposed to implement, interpret and make specific sections California Health and Safety Code sections 39000, 39001, 39002, 39003, 39010, 39500, 40000, 43000, 43013, 43016, 43018, 43100, 43101, and 43806.

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, Title 2, Division3, Part 1, Chapter 3.5 (commencing with section 11340) of the Government Code.

Following the public hearing, the Board may adopt the regulatory language as originally proposed or with non substantial or grammatical modifications. The Board may also adopt the proposed regulatory language with other modifications if the text as modified is sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action; in such event the full regulatory text with the modifications clearly indicated, will be made available to the public, for written comment at least 15 days before it is adopted.

The public may request a copy of the modified regulatory text from the ARB's Public Information Office, Air Resources Board, 1001 "I" Street, Environmental Services Center, 1st Floor, Public Information Office, Sacramento, CA 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

Michael P. Kenny
Executive Officer

Date: December 11, 2001

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs see our Web –site at www.arb.ca.gov.

State of California
California Environmental Protection Agency
AIR RESOURCES BOARD
Stationary Source Division

STAFF REPORT: INITIAL STATEMENT OF REASONS PROPOSED AMENDMENTS TO THE ALTERNATIVE FUELS FOR MOTOR VEHICLE REGULATIONS

Public Hearing to Consider Amendments to the California Alternative Fuel Regulations

Date of Release: December 21, 2001
Scheduled for Consideration: February 21, 2002

Location:

California Air Resources Board
Central Valley Auditorium, 2nd Floor
1001 I Street
Sacramento, California 95814

Acknowledgments

This report was prepared with the assistance and support from the other divisions and offices of the Air Resources Board. In addition, we would like to acknowledge the assistance and cooperation that we have received from many individuals and organizations. In particular, we would like to thank members of the California Energy Commission, Southern California Gas Company, Clean Air Vehicle Technology Center, Engine Manufacturers Association, California Independent Petroleum Association, Independent Oil Producers' Agency, and the Western States Petroleum Association.

Authors

Lesley E. Crowell, Industrial Section
Cherie M. Cotter, Industrial Section
Kim K. Nguyen, Industrial Section
Victoria E. Davis, Office of Legal Affairs

Reviewed by:

Michael H. Scheible, Deputy Executive Officer
Peter D. Venturini, Chief, Stationary Source Division
Robert D. Barham, Ph.D., Assistant Division Chief, Stationary Source Division
Dean C. Simeroth, Chief, Criteria Pollutants Branch
Gary M. Yee, Manager, Industrial Section

Table of Contents

Appendices

Figures

Tables

I. Executive Summary

A. Introduction

This report is the Initial Statement of Reasons for the proposed amendments to sections 2292.5 – 2292.6, Title 13, California Code of Regulations. Section 2292.5 contains specifications for compressed natural gas (CNG) sold for motor vehicle use, while section 2292.6 contains the motor vehicle liquefied petroleum gas (LPG) specifications. Section 2291 prohibits the sale or supply of motor vehicle CNG and LPG in California that does not meet the specifications contained in sections 2292.5 and 2292.6. This summary first discusses the proposed amendments for CNG and the second part discusses the proposed amendments for LPG.

A previous report regarding the CNG and LPG specifications was published in 1991[1]. Additional reports regarding LPG were published in 1994[2], 1997[3], and 1998[4].

B. Compressed Natural Gas

1. Summary of Proposed CNG Amendments

a. Why is staff proposing amendments to the alternative fuels regulations for CNG?

Staff is proposing amendments to the alternative fuels regulations for CNG to increase compliance flexibility and the availability of complying motor vehicle CNG in California.

The current CNG fuel specifications consist of a set of prescriptive limits that restrict flexibility in complying with the CNG fuel specifications. Due to these narrow limits, much of the CNG produced in the Southern San Joaquin Valley and the South Central Coast does not comply with the CNG fuel specifications. The reason for this is because natural gas produced in these regions is produced in association with oil production where oil constituents can contaminate the natural gas, thus making the natural gas out of specification. In other parts of the State, natural gas is either imported or produced from gas wells (not associated with oil) where the natural gas is relatively clean and meets the CNG fuel specifications.

b. How do the proposed amendments provide more compliance flexibility?

In the past, engine manufacturers and the natural gas industry have used the specific composition of CNG to evaluate CNG fuel quality and its effect on engine performance and emissions. However more recently, engine manufacturers have developed indices such as methane number and Wobbe Index to assess CNG fuel quality. These indices do not specifically limit the compositional make-up of CNG but establishes performance thresholds for which engines can properly operate. Therefore, proposing a CNG fuel specification by one of these indices (e.g. methane number) would provide additional compliance flexibility and increase the availability of compliant CNG.

Engine manufacturers have also developed new technology engines that can operate on wider variations in CNG fuel quality. These new technology engines are equipped with advanced feedback control systems that compensate for varying fuel quality; thus allowing the engine to operate on a wide range of CNG composition. In comparison to the existing CNG fuel specifications, these engines can expand the CNG compositional range that would be acceptable for proper engine operation. Therefore, proposing an alternative CNG specification in recognition of new advance technology engines would also allow additional compliance flexibility and increase the availability of compliant CNG.

c. What is Methane Number and why is it necessary?

Methane number (MN) for CNG is similar to the octane number used in gasoline. Like octane number, MN provides an indication of the knock tendency of the fuel. MN can be calculated from the fuel composition as demonstrated in Appendix D. The primary benefit from using MN is the flexibility it provides in allowing the CNG composition to vary. A producer can improve gas quality by choosing which fuel components to remove. The heavier or higher carbon chain components are easier to remove and have more of an adverse influence on the MN than the lighter components. Thereby a reduction of the heavier components will have a larger positive impact on the MN (resulting in an improvement in gas quality) than the lighter components.

d. What amendments to the alternative fuels regulations are being proposed?

Staff is proposing that a statewide CNG methane number (MN) specification of at least 80 be added as an alternative to the existing CNG specifications. This provision would allow the CNG producers and providers more flexibility to comply with the regulations while ensuring that engine performance and emissions will not be affected.

In addition, staff is proposing an alternative CNG specification of MN 73 for CNG fueling facilities in the Southern San Joaquin Valley (SSJV) and the South Central Coast (SCC) that meet the following criteria:

1) The natural gas service provider does not provide natural gas that meets an MN of 80 at the service connection;

2) The vehicles fueled at the facility are recommended by the engine manufacturer as being able of operating on CNG with a MN of 73; and

3) The fueling station has controls in place to prevent misfueling.

2. Effects of the Proposed CNG Amendments

a. Who will be affected by the amendments?

Producers, gas companies, fuel station owners, fleet owners, and vehicle owners will all benefit from the proposed CNG amendments. The proposed amendments will provide flexibility and increase the supply of motor vehicle CNG.

b. How will the proposed amendments affect fuel quality?

The existing CNG specifications equate to a MN of about 81 and are almost equivalent to the proposed MN 80 specification. The MN 80 specification represents a minimum fuel quality specification recommended by engine manufacturers that is protective of existing and future technology engines.

The proposed MN 73 specification is significantly different than the existing CNG fuel specifications and represents a broader range of fuel quality. Engine manufacturers recognize that advanced and future technology engines can and would be able to properly operate on a MN 73 specification without significantly affecting emissions and with no impact on engine performance and durability. The proposed MN 73 specification will be limited to advanced and future technology engines in the SSJV and SCC. The MN 73 specification is not recommended for the SCAQMD as the extensive CNG fleet has too many of the older technology vehicles to allow for the dual approach. The additional flexibility is not needed in the remainder of the State as the CNG is from imported natural gas, which is very high quality.

c. How will the proposed amendments affect the availability of fuel?

The proposed amendments for CNG will provide more flexibility for the natural gas suppliers including producers to comply with the motor vehicle CNG fuel specifications. By providing additional compliance options, the proposed amendments allow gas suppliers to tailor modifications to their facilities, which will enable easier compliance with the specifications; thereby increasing the availability of motor vehicle grade CNG fuel.

d. How will these proposed amendments affect engine performance?

Engine manufacturers recommend that open loop and first generation closed loop technology CNG engines utilize fuel that meets a minimum MN of 80. This specification allows these engines to properly operate and maintain performance. Advanced technology closed loop engines are equipped with improved feedback controls which allow these engines to operate on a broader range of fuel quality. Engine manufacturers believe that advanced technology engines can properly operate on CNG with a MN of 73.

3. Regulatory Development Process and Evaluation of Alternatives

a. What process did the ARB staff use to develop the proposed amendments?

The staff developed the proposed CNG amendments with the participation of stakeholders that included the Southern California Gas Company (SoCalGas), natural gas producers, vehicle fleet owners, CNG fueling station owners, and engine manufacturers. The Engine Manufacturers Association (EMA), Western States Petroleum Association (WSPA), California Independent Producers Association (CIPA) and the Independent Oil Producers Association (IOPA) were instrumental in coordinating the participation of their respective members.

Several joint industry meetings were conducted in addition to individual meetings and teleconferences with the SoCalGas, the producer associations and the engine manufacturers. The staff worked with SoCalGas to discuss existing and potential compliance options to meet the current CNG specifications. Staff also held conference calls with individual engine manufacturers to discuss engine technologies and fueling requirements for the vehicles. Staff met and discussed with the producer associations and individual natural gas producers to evaluate the processing capabilities of production sites.

Staff plans to conduct a public workshop after the release of the staff report to discuss the proposed amendments to the CNG motor vehicle fuel specifications.

b. What other alternatives were evaluated?

The CNG amendments are being proposed to add more flexibility and increase the supply of these fuels for motor vehicles. The alternative would be to not amend the existing regulations.

4. Compliance with the Proposed CNG Amendments

a. How is the industry complying with the current CNG standards?

Less than one percent of the natural gas used in the State is compressed and used as CNG motor vehicle fuel. Most of the pipeline gas used to produce CNG in the State complies with the motor vehicle fuel specifications. However, about ten percent of the pipeline gas used to produce CNG does not comply with these fuel specifications. This non-complying fuel is primarily found in areas that have natural gas production associated with oil production. These areas are in the SSJV, SCC, and parts of the Los Angeles Basin.

In the SSJV and the SCC, SoCalGas is blending the pipeline natural gas with trucked in high quality methane at about seven CNG fueling stations to ensure that the CNG supplied to motor vehicles meets the fuel specifications. A blend gas transport vehicle delivers high quality methane to the fueling stations on a weekly basis. This blend gas is mixed with the pipeline gas at the time of fueling. As discussed in Chapter IV, SoCalGas's ability to manage the fueling stations is limited by the blending gas transport vehicle and the local restrictions at the blend gas production site.

In the Los Angeles Basin, local produced associated gas is diluted with high quality gas in the pipeline and has not required blending at the fueling stations. However, due to changes in the State's natural gas demand, more gas from the SSJV is being shipped south into the Los Angeles Basin. Industry is currently evaluating several mitigation measures to ensure that natural gas used for motor vehicles in the Los Angeles Basin complies with the specifications. These include additional processing by producers and blending in the gas company distribution system.

b. Can the industry continue to comply by blending CNG at fueling facilities?

The current practice of blending has several drawbacks, and is not the most desirable option for an extended period.

SoCalGas is operating a unique blend truck, which can take uncompressed natural gas and compress it as it loads. This enables them to transport a larger quantity of gas per load. In addition, this truck can maintain the compression as it off loads the gas into storage tanks. The current process can only service seven fueling stations.

In addition, county restrictions at the gas site that produces the blend gas limit the number of loads per day. Therefore, no additional fueling stations can be serviced with high quality gas from this site. SoCalGas has over twenty applications for additional fueling stations that are currently on hold. The proposed amendments would provide the needed supply of motor vehicle

CNG fuel for these additional fueling sites to operate, thus allowing the CNG vehicle fleet to expand.

c. Are the proposed specifications technologically and commercially feasible?

Yes, the proposed amendments are technologically and commercially feasible. The proposed CNG amendments add compliance flexibility to the regulations and are not mandatory. The existing fuel specifications are not affected and may be still used in place of the alternative specifications. Measures to comply with the existing fuel specifications can be used to meet the proposed amendments.

d. Do the proposed amendments affect the motor vehicle certification fuel?

The proposed amendments do not affect the certification fuel specifications, nor how engine manufacturers comply with engine certification standards.

e. How will CNG fueling stations comply with the proposed standards?

The proposed amendments are optional and do not impose additional requirements beyond those in the current regulation; in fact the proposed amendments provide additional compliance flexibility. Currently, fueling station owners need to ensure that their stations provide CNG that meets the CNG fuel specifications. The current fuel specifications are approximately equivalent to the proposed CNG MN 80 specification. However, due to the non-complying status of some of the CNG produced in the SSJV and SCC, industry will need to continue to take affirmative efforts to provide a source of complying CNG.

The industry is considering several measures to provide complying CNG. As mentioned, gas blending at fueling stations has been used, but may have logistic issues that would limit its wide application and long term feasibility. SoCal Gas has also used in-pipeline blending to improve the quality of natural gas, but this is limited by the pipeline infrastructure and availability of high quality pipeline gas for blending.

Recently, some producers are now evaluating gas treatment options that would improve gas quality at the producers level. Some producers are considering moderate to major gas treatment improvements depending on their current facility configurations and volume of gas production. Also being considered is the repowering of older CNG vehicles in the SSJV and SCC. This would lessen the need to treat all of the gas produced in the SSJV and SCC. Staff estimates that if most of the major gas producers met the proposed MN 80 specifications, gas quality in the SSJV, SCC, and the Los Angeles Basin would be maintained at a level to be protective of existing and new CNG vehicles, without significant effort on the part of small producers.

f. What should be considered when siting future CNG fueling stations to avoid gas quality issues?

The proposed amendments would establish a CNG specification of MN 80 statewide and a MN 73 option in a limited region in California. Generally, while the vast majority of potential sites will not have any fuel quality issues, potential fleet operators should coordinate with their gas provider to determine the quality of fuel that is available. Staff has identified small pockets of gas production in the Los Angeles Basin that do not meet the MN 80 specification. This gas production does not currently affect existing CNG fueling stations, but can potentially impact future fueling stations if located in the close proximity of these pockets. Thus, potential fleet operators in coordination with the gas provider should consider the quality of gas available in selecting future fueling sites.

For the region where the MN 73 option is allowed, potential fleet operators should coordinate with their gas service provider to determine the quality of fuel that is available and the appropriate technology vehicles that can be fueled with the fuel.

g. How will the ARB enforce the Alternative Fuels Regulations?

The proposed amendments will not change the ARB's enforcement practice. ARB enforcement staff will test the fuel at the fueling stations, to determine compliance. If the fuel is being used to fuel motor vehicles and does not comply with the motor vehicle specifications, ARB staff will attempt to determine which of the parties that are responsible for supplying the fuel that is in violation of the alternative fuels regulations.

5. Impacts of the Proposed CNG Amendments

a. Emission Impacts

1) How will the proposed amendments affect exhaust emissions?

Test results show that for dedicated light-duty NGVs, large variations in fuel composition produced only slight variations, both increases and decreases, in emissions and driveability. Also, bi-fuel vehicles had only modest changes in emissions and performance with changes in CNG quality.[5, 6] Heavy-duty vehicle test data shows that fueling advanced generation engine technologies with MN73 fuel produces no discernible impact on the particulate matter (PM) and oxides of nitrogen (NOx) emissions when compared to emissions from higher quality fuels with MN greater than 80. There were very small increases in carbon dioxide (CO_2) and non-methane hydrocarbon (NMHC) emissions.

2) How do CNG exhaust emissions compare to diesel exhaust emissions?

Typical in-use diesel PM emissions from buses without after-treatment represent a three- to five-fold increase over typical PM emissions from CNG buses using compliant motor vehicle fuel. On average, NOx emissions from diesel buses are greater than NOx emissions from CNG buses.[7]

3) What potential emissions impacts may result if the proposed amendments are not adopted?

The limited availability of motor vehicle grade CNG in the SSJV and SCC has resulted in the potential conversion of several diesel fleets to CNG fleets and fueling sites being postponed. In some cases, proponents have elected to remain with diesel vehicles since there is no certainty in the availability of motor vehicle grade CNG in these regions. In cases where diesel is elected over CNG vehicles, exhaust emissions of NOx and PM will be likely higher.

The amendments should help make CNG more widely available for vehicles, thus enabling greater use of CNG vehicles. Such greater use would reduce emissions because, overall, CNG fueled vehicles emit less than the diesel vehicles they replace.

b. Economic Impacts

1) What economic impact do the proposed amendments create?

There will be no new mandated costs associated with the proposed amendments to the CNG motor vehicle specifications. These amendments provide additional flexibility to the specifications and allow more cost effective options to comply with the regulations. The proposed amendments for CNG will facilitate further expansion of CNG fueling sites and CNG vehicles.

Although the proposed amendments do not directly impose new costs to industry, there will likely be costs associated with industry ensuring that the quality of fuel that is shipped to the Los Angeles Basin meets an MN 80 specification. As discussed earlier, some gas producers are considering gas treatment options to improve the quality of the gas. These options will have cost associated with their implementation.

c. Environmental Impacts

1) What impact do the proposed amendments have on public health and the environment?

The proposed amendments to the CNG motor vehicle fuel specifications would cause no significant adverse impact to either the public health or the environment.

As discussed earlier, the proposed CNG amendments will not significantly impact motor vehicle exhaust emissions from vehicles now using CNG. The proposed amendments would allow more variability in the motor vehicle CNG fuel formulations, but the fuel constituents and fuel processing methods already in use would remain the same. The proposed amendments would allow gas producers to shift the ratio of fuel constituents while still maintaining a minimum methane number. More of some constituents would be allowed to remain in the motor vehicle fuel rather than be extracted and added to another fuel (e.g., LPG). Therefore, there is no increase or decrease in fuel constituents that are released to the environment (e.g., air, water, or land).

2) Do the proposed amendments affect the commitments in the SIP?

The proposed CNG amendments will not have any impact on the State Implementation Plan measures because these fuel specifications are not a SIP strategy.

3) How will the proposed amendments affect greenhouse gases?

The CNG amendments are not expected to significantly increase emissions of greenhouse gases (GHG). Although there is a small increase in carbon dioxide emissions from using MN 73 versus MN 80, the use of MN 73 CNG is expected to be minimal since most of the CNG produced in the SSJV and the SCC is anticipated to comply with MN 80 CNG specification. Therefore, no significant impact on GHG is expected from the proposed amendments.

6. Future CNG Activities

The proposed CNG amendments provide increased compliance flexibility that will increase the availability of motor vehicle grade CNG. This will facilitate the continued use and expansion of the existing CNG fleets, maintain the emissions benefits of CNG vehicles, and improve the expansion of the CNG market. However, to address the need for future emission control strategies to meet the federal and State ambient air quality standards, it may be necessary in the future to re-evaluate the CNG motor vehicle fuel specifications. Specifically, future motor vehicle exhaust emissions standards may require the cleanest fuels available. Therefore, CNG as well as other alternative fuels may need to be further refined to accommodate future engine technologies and vehicle exhaust emission standards.

C. Liquefied Petroleum Gas

1. Summary of Proposed LPG Amendments

a. Why is staff proposing amendments to the alternative fuels regulations for LPG?

Staff is proposing amendments to the alternative fuels regulations for LPG to increase compliance flexibility. In Northern California, the quality of LPG varies significantly and ranges from LPG meeting the commercial specifications (residential and commercial use) to LPG meeting the more stringent motor vehicle fuel specifications. Because both fuels are handled in a single distribution system, issues arise regarding the delivery of these fuels in small transport trucks ("bobtails") that operate on the same fuel as they deliver. In the case where the delivery fuel does not meet the motor vehicle fuel specifications, the use of this fuel to operate the truck may be in violation of the LPG motor vehicle specifications in the alternative fuels regulations.

Discussions with LPG distributors regarding the historical use of non-motor vehicle LPG in bobtails indicates that bobtails experience satisfactory engine performance although some higher engine maintenance may exist with using off-specification LPG fuel. LPG distributors have long accepted possible increased service frequencies and recognize the potential invalidation of engine warranties may result with the use of off-specification LPG fuel.

b. What amendments to the alternative fuels regulations are being proposed?

Staff is proposing to add an exemption for LPG delivery vehicles that deliver and operate on the same LPG cargo fuel. These vehicles would be allowed to operate on commercial grade or motor vehicle grade LPG. -

2. Effects of the Proposed LPG Amendments

a. Who will be affected by the amendments?

The proposed LPG amendments will aid the marketers, suppliers, retailers, and end-users by allowing bobtails to operate without violating the motor vehicle LPG specifications.

b. How will the proposed amendments affect fuel quality?

The proposed exemption from the LPG motor vehicle specifications applies only to bobtail trucks used to transport LPG to distribution and marketing facilities. Bobtails are small transport trucks that operate on the cargo fuel. This exemption will only affect the fuel quality that bobtail vehicles use. All other vehicles are required to operate on LPG that meets the motor vehicle fuel specifications. Bobtail vehicles would therefore be allowed to run on either commercial or motor vehicle grade LPG.

c. How will the proposed amendments affect the availability of fuel?

The proposed LPG amendments will facilitate the delivery of commercial LPG fuel to non-motor vehicle accounts. However, the proposed amendments will have no effect on the supply of motor vehicle LPG fuel.

d. How will these proposed amendments affect engine performance?

Bobtails in Northern California have been satisfactorily operating on commercial grade LPG fuel for the last ten years. The proposed amendments would not change the current operational practices of bobtail owners. Although engine manufacturers believe that additional maintenance may be necessary for vehicles operating on commercial grade fuel due to potential injector and vaporizer deposits, only a few fleet owners indicate that increased maintenance is necessary. Many fleet owners operate bobtails in both Northern and Southern California. Fleet owners claim that when comparing their Northern California and Southern California bobtail truck engines (Southern California vehicles typically operate on motor vehicle grade LPG), the Northern California bobtail engines have not experienced any increased performance or durability problems.[8]

3. Regulatory Development Process and Evaluation of Alternatives

a. What process did the ARB staff use to develop the proposed amendments?

The staff developed the proposed LPG amendments with the participation of several stakeholders that included vehicle fleet owners, LPG fueling station owners, engine manufacturers, refineries, LPG brokers, and LPG suppliers.

Staff held numerous teleconferences and meetings with refiners to discuss their ability to comply with the motor vehicle LPG specifications and how future refinery modifications may impact compliance. The staff held several conference calls and meetings with the associations, LPG suppliers, and brokers to understand the limitations of the current LPG distribution system.

Staff held a public workshop at the start of the process to solicit comments and identify stakeholders. Staff plans to conduct a second public workshop after the release of the staff report to discuss the proposed amendments to the LPG motor vehicle fuel specifications.

b. What other alternatives were evaluated?

The LPG amendments are being proposed to add more flexibility and increase the supply of these fuels for motor vehicles. The alternative would be to not amend the existing regulations.

4. Compliance with the Proposed LPG Amendments

a. How is the industry complying with the current LPG standards?

Southern California refineries generally comply with the LPG motor vehicle fuel specifications, but in Northern California, only one refinery consistently complies. Of the four remaining Northern California refineries, only two are currently selling LPG (with quality ranging from commercial to motor vehicle grade LPG), one refiner is using its LPG onsite, and the other is not producing LPG at all. Also, LPG produced from gas plants and imported LPG generally meet the motor vehicle fuel specifications.

While most large transport trucks have cargo tanks and separate fuel tanks from which they operate, many of the some smaller transport trucks, "bobtails", operate on the same cargo fuel they carry. Bobtails typically transport LPG from intermediate storage facilities to the end-users (e.g. residential users, industrial/commercial users, and agricultural users). Many of the end users are in rural areas that are not accessible by the larger transport trucks and can only be supplied by bobtails. Since Northern California refineries produce both commercial and motor vehicle LPG and the industry's infrastructure is not designed with dual fuel storage capability, bobtails may intermittently operate on commercial grade LPG when delivering fuel to non-motor vehicle accounts.

Staff has been working with the industry to evaluate several options available to facilitate compliance. However, based on the limited availability of complying motor vehicle grade LPG in Northern California, equipping bobtails with separate fuel tanks would not ensure compliance. Thus, staff is proposing an exemption for these delivery trucks. If the proposed amendments are not adopted, bobtails would likely be converted to operate on diesel fuel. As discussed in section 5.a, conversion to diesel would increase PM emissions beyond that experienced from bobtails operating on commercial grade LPG fuel.

5. Impacts of the Proposed LPG Amendments

a. Emission Impacts

1) How will the proposed amendments affect exhaust emissions?

Test results with LPG heavy-duty vehicles show that off-specification LPG (20 percent propene as compared to the LPG specification of 10 percent propene) will increase NOx emissions by about 14 percent when compared to motor vehicle grade LPG. This increase, however, is still within original vehicle emission certification standards since these vehicles were originally certified on diesel. There is no significant impact on other emissions.

2) How do LPG exhaust emissions compare to diesel exhaust emissions?

Most LPG bobtails were originally certified to diesel engine certification emissions standards. Although potentially cleaner, the overall ozone forming potential of the emissions from LPG bobtail conversions are comparable to their diesel counterparts. However, PM emissions from LPG bobtails are significantly lower than from diesel vehicles.

3) What potential emissions impacts may result if the proposed amendments are not adopted?

If LPG bobtail delivery trucks are not allowed to operate on commercial LPG, these trucks will need to be equipped with separate fuel tanks to run on a legal motor vehicle fuel. Although motor vehicle grade LPG would be the preferable fuel, gasoline or diesel fuel would likely be chosen due to the limited availability of complying LPG. In this case, running on gasoline or diesel fuel would likely increase emissions.

b. Economic Impacts

1) What economic impact do the proposed amendments create?

There will be no new costs associated with the proposed amendments to the LPG motor vehicle specifications. These amendments provide additional flexibility to the specifications and allow a more cost effective option to comply with the regulations.

c. Environmental Impacts

1) What impact do the proposed amendments have on public health and the environment?

The proposed amendments to the LPG motor vehicle fuel specifications would cause no significant adverse impact to either the public health or the environment.

The proposed amendments to the LPG motor vehicle fuel specifications would not change either fuel constituents or fuel processing methods. It would allow bobtail delivery vehicles to use commercial and motor vehicle grade LPG. As discussed, the use of commercial LPG in these vehicles could result in a moderate increase in NOx emissions. However considering there are only about 500 bobtail delivery trucks in Northern California that are likely to use commercial LPG intermittently, staff believes there would be little impact on public health or the environment.[8] As discussed earlier, if these vehicles are not allowed to run on commercial LPG, they would likely convert back to gasoline or diesel fuel and would increase emissions above existing levels.

2) Do the proposed amendments affect the commitments in the SIP?

The proposed LPG amendments will not have any impact on the State Implementation Plan measures because these fuel specifications are not a SIP strategy.

3) How will the proposed amendments affect greenhouse gases?

The LPG amendments are not expected to significantly increase emissions of greenhouse gases (GHG). Therefore no significant impact on GHG is expected from the proposed amendments.

II. Recommendation

The staff recommends that the Board adopt the proposed amendments to the Board's alternative fuel regulations as contained in Appendix A with the recognition that staff may propose some modifications to the proposal based on information and comments obtained subsequent to the release of the Staff Report and prior to the Board hearing in February 2002.

III. Background

This section provides background on the alternative fuels regulations.

A. Alternative Fuels Regulations

The ARB alternative fuels regulations, adopted in 1992, include specifications for seven alternative fuels that are shown below:

- M-100 (100 volume percent methanol)
- M-85 (Nominally 85 volume percent methanol and 15 volume percent unleaded gasoline)
- E-100 (100 volume percent ethanol)
- E-85 (Nominally 85 volume percent ethanol and 15 volume percent unleaded gasoline)
- CNG (Compressed Natural Gas)
- LPG (Liquefied Petroleum Gas)
- Hydrogen

The regulations include specifications for certification fuels for certifying new vehicles and specifications for commercial fuels for in-use vehicles. The specifications were developed in anticipation that alternative fuels would be used by engine manufacturers to design vehicles to meet the increasingly stringent low emission vehicle (LEV) standards. The certification specifications provide engine manufacturers with fuel quality specifications to design and certify engines. The commercial specifications (which are the sole subject of the proposed amendments) define the fuel that is used by motor vehicles operated in California. The commercial specifications ensure that in-use fuels are similar to the fuels used to certify new vehicles and engines, and to ensure the fuel quality in the market place to protect engines and maintain the emissions benefit of alternative fuels. The following sections discuss the commercial CNG and LPG motor vehicle specifications.

B. Compressed Natural Gas

The motor vehicle specifications for CNG were developed in consultation with the natural gas industry, the automobile industry, the engine manufacturers, and other interested parties. The specifications developed were based on a consensus of the quality of natural gas that was imported and produced in California. The motor vehicle CNG specifications are contained in the California Code of Regulations (CCR), title 13, section 2292.5 and are shown in Table III-1. The CNG specifications have not been amended since their original adoption.

Table III-1: Motor Vehicle CNG Specifications

Specifications		Value
Hydrocarbons (expressed as mole percent)	Methane	88.0% (min.)
	Ethane	6.0% (max.)
	C3 and higher HC	3.0% (max.)
	C6 and higher HC	0.2% (max.)
Other Species (expressed as mole percent unless otherwise indicated)	Hydrogen	0.1% (max.)
	Carbon Monoxide	0.1% (max.)
	Oxygen	1.0% (max.)
	Inert Gases (Sum of CO_2 and N2)	1.5-4.5% (range)
	Sulfur	16 ppmv (max.)
	Water	a
	Particulate Mater	b
	Odorant	c

[a]The dewpoint at vehicle fuel storage container pressure shall be at least 10°F below the 99.0% winter design temperature listed in Chapter 24, Table 1, Climatic Conditions for the United States, in the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook, 1989 fundamentals volume. Testing for water vapor shall be in accordance with ASTM D 1142-90, utilizing the Bureau of Mines apparatus.

[b]The compressed natural gas shall not contain dust, sand, dirt, gums, oils, or other substances in an amount sufficient to be injurious to the fueling station equipment or the vehicle being fueled.

[c]The natural gas at ambient conditions must have a distinctive odor potent enough for its presence to be detected down to a concentration in air or not over 1/5 (one-fifth) of the lower limit of flammability.

C. Liquefied Petroleum Gas

Like other alternative fuel specifications, the motor vehicle specifications for LPG were adopted in consultation with the LPG industry, automobile industry, the engine manufacturers, and other interested parties. The specifications were developed using two established references as guides. The first is the Gas Producers Association (GPA) Standard 2140, which contains recommended specifications for motor vehicle LPG fuel (referred to as "heavy-duty-5" or HD-5). These specifications require a fuel composition of "not less than 90 liquid volume percent propane...[and] not more than 5.0 liquid volume percent propene." The second reference is the American Society of Testing and Materials (ASTM) Designation D1835-89, which has set specifications for "special-duty LPG" to be consistent with the HD-5 specifications set by the GPA.

When the regulations were adopted, the Board set an interim limit of 10.0 volume percent propene and a minimum 80.0 volume percent propane content requirement, applicable from

January 1, 1993 through December 31, 1994. Starting on January 1, 1995, the propene content is limited to a maximum value of 5.0 volume percent and the minimum propane content is increased to 85.0 volume percent. Thus, the Board's specifications for LPG for use in vehicles is very similar to HD-5, differing only in the minimum propane content. The Board adopted the 5.0 volume percent propene requirement to limit the reactivity of exhaust emissions because propene is more reactive in the atmosphere than propane. However, the Board provided a two-year delay because LPG fuel proponents expressed concerns that LPG fuel meeting the 5.0 volume percent propene requirement would not immediately be available.

In 1994, the Western Propane Gas Association (WPGA) petitioned the Board to continue the interim 10 volume percent propene requirement because of concern that there was no reliable supply of 5 volume percent propene fuel. In response, the Board continued the interim 10 volume percent propene requirement until January 1, 1997. Then again in 1996, the WPGA petitioned the Board a second time to further continue the interim propene requirement because of similar supply issues. In response, the Board in 1997 extended the interim requirement until January 1, 1999. In making the second delay of the 5 volume percent propene requirement, the Board stated its intent to grant no further delays. It instructed the staff to seek an alternative to the specifications in section 2292.6 to take effect in 1999 that would provide satisfactory emission control, provide good performance in LPG engines, and be more likely to be met by the LPG produced in the market.

In 1998, the Board adopted the 10 volume percent propene limit as a permanent alternative to the LPG specifications in CCR, title 13, section 2292.6, effective January 1, 1999 after engine test results show minimal emissions increased between a 5 volume percent propene fuel and a 10 volume percent propene fuel. The current motor vehicle LPG specifications are shown in Table III-2. The Board acted to preserve and enhance the current supply of complying fuel to owners of LPG vehicles and to assure adequate emissions performance.

Table III-2: Motor Vehicle LPG Specifications

Specifications	*Value*	*Test Method*
Propane	85.0 vol. % (min.) a/	ASTM D 2163-87
Vapor Press. at 100° F	208 psig (max.)	ASTM D 1267-89 ASTM D 2598-88 b/
Volatility residue: Evaporated temp., 95% or butanes	 -37° F (max.) 5.0 vol. % (max.)	 ASTM D 1837-86 ASTM D 2163-87
Butenes	2.0 vol. % (max.)	ASTM D 2163-87
Pentenes, and heavier	0.5 vol. % (max.)	ASTM D 2163-87
Propene	10.0 vol. % (max.)	ASTM D 2163-87
Residual matter: Residue on evap. of 100 ml Oil stain observed.	 0.05 ml (max.) pass c/	 ASTM D 2158-89 ASTM D 2158-89
Corrosion, copper strip	No. 1 (max.)	ASTM D 1838-89
Sulfur	80 ppmw (max.)	ASTM D 2784-89
Moisture content	pass	ASTM D 2713-86
Odorant	d/	

a/ Propane shall be required to be a minimum of 80.0 volume percent starting on January 1, 1993. Starting on January 1, 1997, the minimum propane content shall be 85.0 volume percent.

b/ In case of dispute about the vapor pressure of a product, the value actually determined by Test Method ASTM D 1267-89 shall prevail over the value calculated by Practice ASTM D 2598-88.

c/ An acceptable product shall not yield a persistent oil ring when 0.3 ml of solvent residue mixture is added to a filter paper, in 0.1 ml increments and examined in daylight after 2 min. as described in Test Method ASTM 2158-89.

d/ The liquefied petroleum gas upon vaporization at ambient conditions must have a distinctive odor potent enough for its presence to be detected down to a concentration in air of not over 1/5 (one-fifth) of the lower limit of flammability.

D. Comparable Federal Regulations

There are no other legally enforceable specifications for CNG and LPG motor vehicle fuels in the United States. The United States Environmental Protection Agency does not have any specifications for motor vehicle CNG and LPG. The Board's specifications for CNG and LPG for use in motor vehicles, as presented in the previous discussion, are the only required specifications for motor vehicle CNG and LPG, respectively.

E. Commercial Standards

In addition to use as motor vehicle fuels, natural gas and LPG are used in industrial, commercial and residential applications. The gas quality for these applications is referred to as commercial grade. The industry has developed fuel standards for commercial grade natural gas and LPG.

There are four general standards that apply to commercial natural gas. These standards were developed mainly for safety reasons. Two of the four are recommended practices and include:

- Society of Automotive Engineers (SAE) J1616, "Recommended Practice for Compressed Natural Gas Vehicle Fuel," issued in February 1994

- National Fire Protection Association (NFPA) 52, "Compressed Natural Gas (CNG) Vehicular Fuel Systems 1992 Edition," issued August 1992.

SAE J1616 and NFPA 52, apply to the design and installation of CNG vehicle fuel systems and fueling dispensing systems.

The other two standards include:

- California Public Utilities Commission (PUC) General Order 58-A, "Standards for Gas Service in the State of California," last revised April 1989

- Individual public utility's contract agreement.

The PUC General Order 58-A and the utilities' contract agreements apply to the safe transport of gas through the pipeline systems. The commercial gas quality standards specified include general limits on such parameters as flammability, water content and other corrosion precursors, energy content, and gas delivery pressure. No restrictions on compositional elements such as methane, ethane, propane and other heavier hydrocarbons are specified.

The commercial LPG standard is the voluntary industry standard for "commercial propane", which allows up to 50 percent propene content. Table III-3 shows the compositional elements of the commercial propane standard.

Table III-3: Commercial Standard for LPG

Constituent	*Commercial Propane*
Propane	"predominantly propane"
C_4+ (butane & heavier)	< 2.5%
Olefins (e.g., propene)	(no limit)

F. Alternative Fuels Enforcement

Enforcement of the alternative fuels regulations is similar to enforcement of the gasoline and diesel regulations within California. The proposed amendments will not change the enforcement procedure. ARB staff will test the fuel at fueling stations, to determine compliance. If the fuel is being used to fuel motor vehicles and does not comply with the motor vehicle specifications, ARB staff will consider all of the parties that are responsible for supplying the fuel to be in violation of the alternative fuels regulations. However, chemical analysis speciation data for the fuel at locations in the distribution system upstream of the fueling facility will be considered in assessing liability.

IV. Description and Rationale of the Proposed CNG Amendments

A. Proposed Amendments

Staff is proposing to establish new CNG specifications based on methane number (MN) to provide more flexibility for producers and suppliers of CNG to comply with the specifications. These specifications will be an additional compliance option to the existing specifications. Specifically, staff proposes two additional specifications: a statewide specification of MN 80, and an alternative specification of MN 73 available in the SSJV and SCC to fleet operations that meet the following criteria:

- The natural gas service provider does not provide natural gas that meets an MN of 80 at the service connection;
- The vehicles fueled at the facility are recommended by the engine manufacturer as being able of operating on CNG with a MN of 73; and
- The fueling station has controls in place that will prevent misfueling.

Staff also proposes two definitions that are necessary to define the SSJV and SCC. For the purpose of these specifications, SSJV will be defined as inclusion of the following counties within the jurisdiction of the San Joaquin Valley Air Pollution Control District: Fresno, Kings, Tulare, and Kern counties. The SCC includes San Luis Obispo and Santa Barbara counties.

B. Rationale

1. Feasibility of Meeting the Proposed Alternative Specifications

Staff is proposing amendments to the alternative fuels regulations for CNG to increase compliance flexibility and the availability of complying CNG in California. There are areas in California where the availability of CNG meeting the motor vehicle fuel specifications is very limited. These areas include the SSJV and the SCC where natural gas is produced in association with oil production. This gas or "associated gas" typically does not meet the motor vehicle fuel specifications for CNG. But because this gas meets the commercial quality specifications for natural gas, it is allowed to enter the common pipeline that supplies natural gas to residential, commercial, industrial, and motor vehicle end-users. Therefore, SSJV and SCC gas that is drawn off the pipeline in these areas for motor vehicle CNG use may exceed the CNG motor vehicle specifications and would be considered a non-compliant fuel.

Methane number (MN) for CNG is similar to the octane number used in gasoline. Like octane number, MN provides an indication of the knock tendency of the fuel. MN can be calculated from the fuel composition as demonstrated in Appendix D. The primary benefit from using MN is the flexibility it provides in allowing the CNG composition to vary. A producer can improve gas quality by choosing which fuel components to reduce or remove. The heavier or higher carbon chain components are easier to remove and have a greater adverse influence on the MN than the lighter components. Thereby a reduction of the heavier components will have a larger positive impact on the MN (improvement in gas quality) than the lighter components.

Based on this, staff has determined that alternative CNG specifications using the methane number index would provide more compliance flexibility with the regulations. By providing additional compliance options, the proposed amendments allow gas suppliers to tailor modifications to their facilities, which will enable them to comply with the specifications easier; thereby, increasing the availability of motor vehicle grade fuel.

2. Performance

The proposed MN 80 will not cause performance or durability concerns with existing and new technology engines. Existing engines (open-loop and first generation closed-loop technology) were designed to handle the existing CNG motor vehicle fuel specifications (about MN 80 to 82). Engine manufacturers agree that these existing engine technologies can properly operate on CNG with a methane number of at least 80. Also, major engine manufacturers agree that the newer advanced technology engines can operate on a broader range of fuel quality. These engines can properly operate on CNG with a methane number as low as 73.

3. Supply

The proposed amendments would increase the amount of fuel available for use as motor vehicle fuel by providing more flexibility to comply with the regulations. Currently, 89 percent of the statewide supply of CNG is in compliance with the existing motor vehicle fuel specifications. The proposed MN 80 specification would increase this amount to about 91 percent by increasing the amount of CNG that would comply in the SSJV and SCC.[9]

In the SSJV and the SCC where most associated gas production occurs, almost all of the CNG supply in these regions does not comply with the existing motor vehicle fuel specification. The proposed MN 73 specification would increase the local supply of complying CNG to about 88 percent in the SCC and 99 percent in SSJV.[9] In this area, only a relatively small number of current technology vehicles exist using about seven fueling facilities. Since future growth in CNG vehicles will be new technology vehicles, it is feasible for these regions to accommodate an MN 73 CNG specification.

In the Los Angeles Basin, no impact on CNG supply is expected to occur since essentially all of the gas used for motor vehicles use comes from clean imported sources. Also, since this region has a significant amount of existing technology vehicles that require a MN 80 fuel, staff is not recommending the allowance of a MN 73 fuel.

4. Emissions

The proposed amendments would have no significant adverse impact on mass emissions from CNG vehicles. The proposed MN 80 specification is very similar to the existing CNG motor vehicle fuel specifications. Test data on light and heavy-duty engines using MN 80 CNG shows no impact on emissions from fuel meeting the current CNG motor vehicle fuel specifications. Regarding the proposed MN 73 specification, test data on light-duty vehicles shows only minimal effects on emissions, both increases and decreases, as summarized in Table IV-1[5]. For advanced technology closed loop heavy-duty vehicles, test data shows no discernable impact on PM and NOx emissions and only a slight impact on CO_2 and NMHC emissions (as summarized in

Table IV-2[10]). A complete discussion on the fuel effects on emissions is discussed in Chapter VII and Appendix B.

Table IV-1: Range of emissions by pollutant for MN 89 and MN 63 CNG for Light-Duty Dedicated NGVs

Pollutant	MN 89 CNG (g/mi)	MN 63 CNG (g/mi)
CO	0.46 – 1.26	0.29 – 1.48
NOx	0.09 – 0.17	0.05 – 0.20
NMOG	0.016 – 0.027	0.012 – 0.030

Table IV-2: Range of emissions by pollutant for MN 80 and MN 73 CNG for Advanced Technology Heavy-Duty NGVs

Pollutant	MN 80 CNG (g/mi)	MN 73 CNG (g/mi)
CO	0.2 – 4.2	0.2 – 4.2
PM	0.009 – 0.029	0.008 – 0.031
THC	7.5 – 7.9	7.5 – 8.2
NOx	6.9 – 12.8	6.1 – 11.0
NMHC	1.3 – 2.7	1.5 – 3.0
CO_2	944 – 1020	978 – 1077

The proposed amendments will help to ensure the continued emission benefits of CNG fueled vehicles. As discussed in Chapter VII, typical in-use diesel PM emissions from buses without after-treatment represent a three- to five-fold increase over typical PM emissions from CNG buses using compliant motor vehicle fuel. On average, NOx emissions from diesel buses are greater than NOx emissions from CNG buses.[7]

C. Future CNG motor vehicles fuel specifications

The proposed amendments provide increased compliance flexibility that will increase the availability of motor vehicle grade CNG. This will facilitate the continued use of the existing CNG fleets, maintain the emissions benefits of CNG vehicles, and improve the expansion of the

CNG market. However, to address the need for future emission control strategies to meet the federal and State ambient air quality standards, it may be necessary in the future to re-evaluate the CNG motor vehicle fuel specifications. Specifically, future motor vehicle exhaust emissions standards may require the cleanest fuels available. Therefore, CNG as well as other alternative fuels may need to be further refined to accommodate future engine technologies and vehicle exhaust emission standards. The MN 73 specification may be temporary.

V. Description and Rationale of the Proposed LPG Amendments

A. Proposed Amendments

Staff is proposing to add a provision allowing small local delivery trucks, which deliver LPG fuel to non-motor vehicle accounts an exemption from the LPG motor vehicle specifications. Small local delivery trucks or "bobtails" are defined as a truck capable of being fueled off of the cargo tank with a maximum capacity of 3000 gallons. These vehicles would be allowed to operate on commercial grade LPG.

B. Rationale

1. Performance

Bobtail trucks transport fuel to non-motor vehicle and motor vehicle accounts. Although some bobtail trucks have a side-saddle fueling tank, many do not, and they fuel on the same cargo fuel that they are delivering. These trucks have operated intermittently on off-specification fuel for the last ten years. Although engine manufacturers believe that additional maintenance is necessary to maintain engine performance and fuel economy, only a few fleet owners have indicated that additional maintenance is necessary. According to the suppliers, marketers and fleet owners of bobtail trucks, the trucks have not had any durability or engine performance problems over the last ten years. In addition, vehicle testing demonstrates that engine performance was unaffected by fuel blends, and no abnormal wear to the engine was detected. Additional detail on the testing programs is discussed in Chapter VIII and Appendix C.

2. Supply

These proposed amendments will not affect the supply of motor vehicle grade LPG.

3. Emissions

When comparing emissions from heavy-duty vehicles operating on the current motor vehicle specification LPG to commercial grade LPG fuel, NMHC emissions decrease by 11 percent, CO emissions decrease by 20 percent, and NOx increase by 14 percent. However, the NOx emissions increase is still within the original vehicle emission certification standards, since these vehicles were originally certified on diesel.

When compared to diesel, vehicles operating on commercial LPG have significantly less PM emissions. If bobtails were to convert back to diesel, PM emissions could potentially increase above existing levels. To prevent this from occurring, we believe it is necessary to include this exemption. Additional information can be found in Chapter IX and Appendix C.

VI. Discussion of Compressed Natural Gas as a Motor Vehicle Fuel

A. Overview of CNG as a Motor Vehicle Fuel

Compressed natural gas (CNG) is a highly compressed form of the natural gas. Natural gas is a combustible, gaseous mixture primarily composed of methane (CH_4), with small amounts of ethane (CH_6), propane (C_3H_8), butane (C_4H_{10}) and pentane (C_5H_{12}). Natural gas is produced either from gas wells which do not produce any crude oil (non-associated gas) or in conjunction with crude oil production (associated gas). In California, associated gas is produced within the southern half of the state.

In California, natural gas is distributed in an extensive pipeline system that extends from the well-head to the end user. The pipeline system consists of long-distance transmission lines, operating at 250 to 1,000 pounds per square inch gauge (psig) pressure, which transfer natural gas from a gathering line (production facility) or storage facility to a distribution center or another storage facility. From there, natural gas is distributed by local distribution lines to customers through either a 60-psig high-pressure distribution system or a low-pressure system that delivers natural gas to a residential gas meter at 1/4 psig.

The natural gas pipeline also serves as the source for CNG. At strategically located CNG fueling outlets, natural gas is pulled off the pipeline and is compressed to 3,000 to 3,600 psig for motor vehicle use.

CNG fueling outlets are provided by natural gas utilities and through a limited number of major gasoline retailers and independent CNG retailers. In California, the utilities include the City of Long Beach Gas Department, Pacific Gas and Electric (PG&E), San Diego Gas & Electric, and SoCalGas. These companies do not produce or own the gas but are the service providers that own and maintain the pipeline infrastructure that delivers the gas.

As of July 2001, there are 212 CNG fueling sites in existence throughout California. More than half of these compressor stations have full or limited access to the public, providing both "time-fill" (slow-fill requiring two to three hours to refuel) and "fast-fill" (quick-fill requiring two to five minutes) systems. In addition, individual home compressors are also available which use a time-fill system for overnight refueling. A small compressor is usually located in a home's garage area and connected directly to the natural gas supply to the house.[11]

B. Current Gas Quality Issues

In 1999, about 16 percent of the natural gas used in California was produced in the State and 84 percent was imported from the Rockies and the southwestern United States, and Canada. The natural gas imported into California generally meets the existing specifications for CNG motor vehicle fuel. Of the 16 percent of the natural gas produced in California, about 72 percent is associated gas (gas produced in association with oil production) which can vary widely in properties.[12] Generally, the ethane content and the propane and heavier hydrocarbons content (referred to as C3+) of associated gas can often exceed the levels in the CNG motor vehicle fuel specifications but meet the pipeline specifications for commercial natural gas. The remaining 28 percent of total California production of natural gas is non-associated gas (gas produced from gas wells which do not produce any crude oil) which is high in methane content and normally meets the existing motor vehicle CNG specifications.

As discussed previously, natural gas produced in Northern California is non-associated gas. In addition, natural gas supplied to Northern California is imported gas from out-of-state. Thus, fuel quality is not an issue in Northern California.

Production of associated gas is concentrated in the SSJV and SCC region. Generally, the associated gas in the SSJV tends to have a greater ethane content than the specifications for CNG motor vehicle fuel. The associated gas in the SCC almost meets the ethane content, but it exceeds the C3+ content. Table VI-1 compares the CNG motor vehicle fuel specifications to the pipeline gas in the SSJV and SCC.

Table VI-1: Comparison of Existing CNG Motor Vehicle Fuel Specifications to Pipeline Gas in Southern San Joaquin Valley (SSJV) and South Central Coast (SCC)

Component	*SSJV Pipeline Gas*		*SCC Pipeline Gas*		*Motor Vehicle Specifications*
	Average	*Range*	*Average*	*Range*	
Methane (mole%)	86.0	79-97	88.5	86-97	88.0 min.
Ethane (mole%)	8.9	0-12	5.2	0-8	6.0 max.
C3+ (mole%)	2.7	0-9	3.8	0-6	3.0 max.
Inerts (mole%)	2.4		2.5		4.5 max.
CO_2	1.9	2-3	2.0	2-3	
N2	0.5	0-1	0.5	0-1	
BTU	1100	990-1181	1095	990-1141	N/A

As can be seen in Table VI-1, there is a significant variation in natural gas quality in both regions. The volume-weighted average for the SJV region is about 9 mole percent ethane with the ethane content varying significantly from almost none to as high as 12 mole percent. The volume-weighted average for the SCC region is 3.8 mole percent C3+ with the C3+ varying from almost none to as high as 6 mole percent.[13]

Historically, producers have not processed or treated their natural gas to meet the CNG motor vehicle specifications. In California a market does not exist for ethane. As a result, most gas plants are not equipped for or designed to extract ethane. In other parts of the country, ethane is extracted from natural gas because it is marketed for use in the petrochemical industry. In

California, the only likely use for ethane is as an onsite fuel but many facilities may not have enough demand to absorb all of the ethane that would be extracted.

In contrast, a market does exist for propane in California. However, the demand for propane is seasonal (i.e., high in the winter for home heating - see LPG section for further discussion). As discussed in the previous section, heavier hydrocarbons that naturally accompany associated gas as it leaves the ground include ethane, propane (LPG), butane, and pentane. Because propane boils at -44 degrees Fahrenheit and ethane boils at -127 degrees Fahrenheit, less processing is needed to separate propane than ethane. Generally, the heavy gases are removed from the raw natural gas stream, leaving mostly methane before entering the natural gas pipeline distribution system. The removal of the heavy gases is refers to as liquid extraction or liquid recovery. Producers in SSJV and SCC do have limited capacity to extract propane and heavier hydrocarbons from the natural gas. However, additional propane extraction or recovery has economic tradeoffs. Producers will run their systems to maximize propane recovery if the liquid sale can make up the operational cost.[14]

As noted above, the ethane content in the SJV region and the C3+ content in SCC region exceed the levels allowed by the CNG motor vehicle fuel specifications. Because associated gas is regionally produced, most of this gas is consumed locally with no opportunity to be diluted with higher quality gas in the pipeline. Thus, gas that is drawn off the pipeline in these areas for motor vehicle CNG use typically does not meet the CNG specifications. Currently, SoCalGas, the main service provider for Southern California, is blending the pipeline gas with high quality gas that is trucked to various NGV fueling stations in the affected regions to ensure that the CNG supplied to motor vehicles meets the motor vehicle CNG specifications. However, SoCalGas's ability to manage the fueling stations is limited by the blending gas transport vehicle and the local restrictions on pick-up and delivery at the blend gas production site.

The current gas quality issues in these regions have prevented the expansion of additional CNG re-fueling stations. Presently, there are about twenty (20) businesses that have applied to the utilities for the installation of CNG re-fueling stations. These requests have been put on hold because the utilities are not certain that they will be able to provide the stations with motor vehicle grade CNG.

During the recent energy crisis in California, there has been an increase in natural gas production in the San Joaquin Valley. Also, changes in supplier contracts have resulted in decreased demand in the region. These events have resulted in an increase in migration of SJV produced associated gas to the Los Angeles basin. As discussed, this gas meets the pipeline quality standards, but does not comply with the motor vehicle specifications for CNG. The increased migration of this gas could potentially affect CNG fueling sites in the Los Angeles basin.

C. Engine Performance Issues

If allowed to be used in vehicles without treatment or blending to meet minimum specifications, the variation in CNG composition seen throughout the SCC and SSJV can adversely affect engine performance. These effects can include misfire, stumble and underrated operation[15] as well as engine knock and overheating that can lead to possible catastrophic failure. Light-duty engines are less susceptible to these fuel-related performance problems because of the engine operation controls that have been developed for emissions control. Recent advances in engine controls for heavy-duty engines have resulted in newer heavy-duty engines that are more tolerant of variable fuel quality. However, there is a wide range of heavy-duty CNG engine technologies currently in use in California. The older or less sophisticated heavy duty CNG engine technologies are susceptible to fuel-related performance problems. This vehicle population must be either safeguarded against these problems by ensuring that the engines operate on a minimum quality fuel or replacing the engines with more advanced engine technology.

D. Gas Quality Indices

Two measures of CNG gas quality are the Wobbe Index and the methane number. The Wobbe Index is a measure of the fuel interchangeability with respect to its energy content and metered air/fuel ratio.[16, 17] Thus, changes in Wobbe Index can affect the engine's metered air/fuel ratio and power output.[18] The Wobbe Index is calculated from the energy content of gas (using the higher heating value of the energy content range), and the relative density of the gas.. The relative density of the gas is the ratio of the gas density to the density of air.

Wobbe Index = Higher Heating value / (relative density)

The methane number is a measure of the knock resistance of the fuel. Knock, or detonation, can be extremely damaging to an engine. Knock occurs when there is uncontrolled combustion with multiple flame fronts rather than smooth combustion proceeding along a flame front initiated at the spark plug.[19, 20] Knock can result from the heat produced by compression of the air/fuel gas mixture in the piston. The knock resistance of the fuel is a function of the fuel composition. Methane has a very high knock resistance. The heavier hydrocarbons in CNG, such as ethane, propane, and butane, have lower knock resistance and thus reduce the overall knock resistance of the fuel. Methane number and how it is determined in explained in Appendix D. The current CNG motor vehicle fuel specifications equate to a methane number of approximately 80 to 82, depending on the speciation of the C3+ content, as shown in Appendix D.

VII. CNG Engine Types and Fuel Quality Requirements

A. Light-Duty Engines

Light-duty engines are stoichiometric burn engines with three-way catalyst exhaust after-treatment and exhaust feedback control developed to meet light-duty vehicle exhaust emissions standards.[21] Stoichiometric burn engines are designed for an air/fuel ratio that can completely burn the fuel without excess air. Light-duty engines have feedback controls that process information from the exhaust to aid in engine operation. Engines with feedback controls are called closed loop systems. Both the feedback controls used for light-duty engines and their stoichiometric operation make them very tolerant of the natural gas fuel variations seen in California. A survey of light duty vehicle manufacturers indicated that fuel quality requirements for light duty engines are more frequently cited in terms of Wobbe Index. Manufacturer recommended gas quality requirements range approximately from a minimum of 1300 BTU/ft3 to a maximum of 1400 to 1500 BTU/ft3.[18,22] These equate to a minimum methane number of approximately 65 to 70, as discussed in Appendix E.

A test program to determine the effect of fuel quality on emissions and driveability for light-duty vehicles was sponsored by the Gas Research Institute (GRI), Pacific Gas & Electric (PG&E), SoCalGas, Atlanta Gas Light Company (AGL), automakers, and regulatory agencies. This test program is discussed in Appendix B. The test program used eight light-duty natural gas vehicles (NGV) with five different fuel qualities. The tested fuel qualities ranged from a methane number of approximately 65 to 100. Test results showed that for original equipment manufacturer (OEM) dedicated NGVs, even large variations in fuel composition produced only slight variations in the emissions and driveability, both increases and decreases, while bifuel vehicles had only modest changes in emissions and performance.[5,6] This is shown by a comparison of the measured emissions ranges obtained with the MN 89 gas and a MN 63 minimum quality gas given in Table VII-1 below for the OEM dedicated NGVs.

Table VII-1: Range of emissions for MN 89 and MN 63 CNG for OEM Dedicated NGVs

Pollutant	MN 89 CNG (g/mi)	MN 63 CNG (g/mi)
CO	0.46 – 1.26	0.29 – 1.48
NOx	0.09 – 0.17	0.05 – 0.20
NMOG	0.016 – 0.027	0.012 – 0.030

B. Medium-Duty and Heavy-Duty Engines

Medium-duty and heavy-duty engines are usually designed as lean-burn engines because these engines are more fuel-efficient and produce lower combustion temperatures than stoichiometric burn combustion. Lean-burn engines are designed to operate at an air/fuel ratio with more air than required to completely burn the fuel. This engine technology has been used to meet applicable exhaust emission standards without the use of after-treatment technology. However, as explained in Appendix E, lean-burn engines are more susceptible to problems associated with variable gas quality.

Early CNG lean-burn engines operated without feedback controls. Theses are called open loop systems. Open loop lean-burn engine technology is the least tolerant of variable gas quality. Most CNG lean-burn engines currently being manufactured include closed loop engine technology. Recent advances in lean-burn engine feedback control have made some closed loop heavy-duty engines more tolerant of variable fuel quality than others. The less tolerant closed loop engines will be referred to as first generation closed loop engine technology. Open loop and first generation closed loop engine technologies require fuel with a methane number of 80 or higher. The more advanced engine technology will be referred to as "advanced generation closed loop" engine technology. Advanced generation closed loop engine technologies can tolerate a fuel quality with a methane number as low as 73. Advanced generation engine technology is being successfully used in a number of SSJV and SCC fleets operating on fuel that does not meet the current CNG motor vehicle fuel specifications where a test program exemption has been granted by the ARB. Additionally, there are closed loop engines recently certified by ARB as low emissions engines that can tolerate methane numbers as low as 65.[23] The different engine technologies, i.e. stoichiometric versus lean-burn and open versus closed loop, are explained in more detail in Appendix E.

A test program was sponsored by the Gas Research Institute (GRI), Pacific Gas & Electric (PG&E), SoCalGas, Atlanta Gas Light Company (AGL), automakers, and regulatory agencies to determine the effect of fuel quality on emissions and performance for seven different heavy-duty open and closed loop engine technologies.[10] The results of this testing are summarized in Appendix B. The tested CNG qualities ranged from MN 73 to MN 99. These data showed that fueling advanced generation engine technologies with MN 73 fuel produced no discernible impact on the PM and NOx emissions when compared to measured emissions of the other cleaner fuels, as shown below in Figure VII-1 and Figure VII-2, respectively.

Figure VII-1: Measured PM Emissions versus Methane Number for Advanced Generation Closed Loop Engines

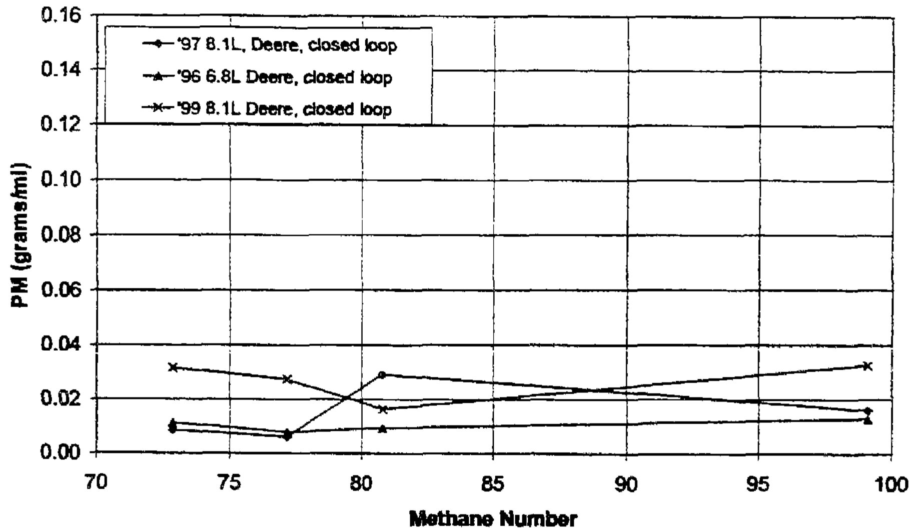
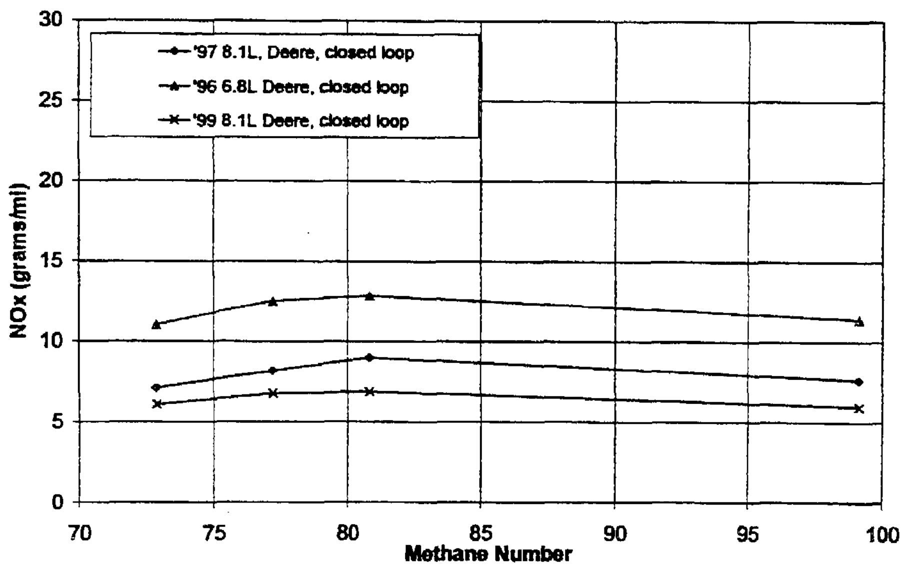


Figure VII-2: Measured NOx Emissions versus Methane Number for Advanced Generation Closed Loop Engines



The measured emissions ranges for the advanced generation closed loop vehicles are summarized in Table VII-2 below for a fuel equivalent in methane number to the current specifications, MN 81, and for a MN 73 fuel. As shown, there were increases in carbon dioxide (CO_2) and nonmethane hydrocarbon (NMHC) emissions of about six percent and approximately 10 percent respectively. There were no discernible impacts on the other emissions.

Table VII-2: Range of emissions for MN 81 and MN 73 CNG for the Tested Advanced Generation Closed Loop Vehicles

Pollutant	MN 81 CNG (g/mi)	MN 73 CNG (g/mi)
CO	0.2 – 4.2	0.2 – 4.2
PM	0.009 – 0.029	0.008 – 0.031
THC	7.5 – 7.9	7.5 – 8.2
NOx	6.9 – 12.8	6.1 – 11.0
NMHC	1.3 – 2.7	1.5 – 3.0
CO_2	944 – 1020	978 – 1077

C. Industry's Efforts to Address CNG Issues

Currently, industry is considering a combination of market options to address the issues related to off-specification CNG. Options include increased gas processing, continued pipeline blending, and engine re-powering.

Improvements in gas processing at major production sites in the SSJV and the SCC are being considered by the industry. Improvements range from moderate gas plant modifications to installing new gas plant capacity. These improvements would allow major gas producers to meet or exceed a gas quality of MN 80. By significantly improving the gas quality for most of the gas produced in these regions, it may be possible to maintain the average pipeline quality above MN 80.

Pipeline blending is another option that has been used in the past and can be used to provide added assurance that pipeline gas quality is maintained. Specifically, the gas that is sent down to the Los Angeles basin must meet a MN 80 to protect the existing CNG motor vehicle fleet. SoCalGas has indicated that it can monitor the quality of gas at a strategic location on the pipeline and, if necessary, blend in high quality gas to improve the quality of the gas that is sent to the LA Basin. However, blending will displace an equivalent amount of gas and would likely involve some curtailment in the amount of gas that is allowed to enter the pipeline from the producers in the SSJV and the SCC. SoCalGas is presently discussing the possibility of gas curtailments with gas producers if significant pipeline blending occurs.

Re-powering existing engines in SSJV and the SCC is an option that would facilitate the use of MN 73 CNG in these regions. As discussed, light-duty vehicles and advanced closed-looped technology heavy-duty vehicles can properly operate on MN 73 CNG. However, existing open-looped and first generation closed-looped technology heavy-duty vehicles require MN 80 CNG. Therefore, re-powering these vehicles with advanced closed-looped technology would allow the use of MN 73 CNG in these regions.

To facilitate these industry options, the proposed amendments to the CNG motor vehicle fuel specifications would allow the use of a flexible fuel specification based on methane number. The proposed amendments would also allow the option of an alternative MN 73 specification for vehicles that operate in the SSJV and the SCC.

For future CNG fueling sites, industry will need to consider the quality of the fuel that is available. Generally, while the vast majority of potential sites will not have any fuel quality issues, potential fleet operators should coordinate with their gas provider to determine the quality of fuel that is available. Staff has identified small pockets of gas production in the Los Angeles Basin that do not meet the MN 80 specification. This gas production does not currently affect existing CNG fueling stations, but can potentially impact future fueling stations if located in the close proximity of these pockets. Thus, potential fleet operators in coordination with the gas provider should consider the quality of gas available in selecting future fueling sites.

For the region where the MN 73 option is allowed, potential fleet operators should coordinate with their gas service provider to determine the quality of fuel that is available and the appropriate technology vehicles that can be fueled with the fuel.

VIII. Discussion of Liquefied Petroleum Gas as a Motor Vehicle Fuel

A. Overview of LPG as a Motor Vehicle Fuel

LPG refers to a mixture of light hydrocarbons, predominantly propane, that is pressurized into a liquid for use as a fuel. LPG has uses similar to those of natural gas. In addition to its application as a motor vehicle fuel, LPG is used in space heating (e.g., in rural buildings and recreational vehicles) and portable appliances (e.g., barbecues), as well as heating and cooking in areas where natural gas is not available.

LPG is produced and supplied from oil refineries and by gas plants in oil and gas fields. In refineries, it is a by-product of processes that produce gasoline. At gas plants, LPG is separated from crude oil and from natural gas.

LPG from refineries can contain substantial amounts of propene. The propene content in LPG is partly dependent on a refiner's use of fluidized catalytic cracking units (FCC), or coking units. These processing units create olefin compounds (such as propene) in its by-product gas that largely makes up LPG. However, the actual propene content in LPG will depend on whether or not a refinery separates the olefins from the by-product gas for use in processes that make high-octane gasoline blending materials such as alkylates. Without such processes, a refiner has no in-house use for propene. Thus, it is generally more economical for a refiner to blend the propene-rich by-product gas into its LPG product stream.

LPG from gas plants has almost no propene if the LPG comes only from production fields. However, some gas plants also receive by-product gas from refineries. LPG from such gas plants can contain substantial propene.

In California, about 90 percent of the total LPG production comes from oil refineries and 10 percent comes from gas plants in oil and gas fields. California imports roughly 25 percent from other states and Canada during the winter months (generally November through March) when demand is high and exports about the same amount to other states and other countries during the summer (generally April through October) when demand is slow. The LPG imported into California generally is of motor vehicle LPG quality (10 or less volume percent propene content).[24] California produces two grades of LPG, motor vehicle and commercial (greater than 10 volume percent propene content).

In Central California and Southern California mainly motor vehicle grade LPG is produced, while in Northern California two grades of LPG are produced. Most gas plants are concentrated in Central California, near oil producing sites. Thus, this LPG contains little or no propene and meets the motor vehicle specifications for LPG. Southern California refineries are configured such that the LPG produced is typically less than 10 volume percent propene content. In Northern California, the refineries, with one major exception, were not configured to maximize capture of light olefins for processing in alkylation units. As a result, one refiner produces motor vehicle grade LPG and two do not. Two other refineries are not selling LPG.

LPG storage is generally separated into three categories. The first is primary storage at refineries, gas plants, and pipeline tanks. Also used are large bulk storage facilities built from depleted underground mines and salt domes, which are clustered mostly around Conway, Kansas; Hattiesburg, Mississippi; and Mont Belvieu, Texas. In California, primary storage exists at one bulk terminal with above ground tanks, and at refineries and gas plants. Secondary storage consists of above-ground tanks located at distribution centers, retail outlets, and satellite locations. The third type of storage is tertiary storage, consisting of tanks at point of end-use which are primarily at residences, businesses, and farms. During the summer months (generally April through October) when demand is slow, LPG marketers make a concerted effort to ensure that their tanks, secondary storage, are full and that their customers' tanks, tertiary storage, are also full to meet wintertime demand.[25]

In California, LPG is transported by trucks and railroad tank cars. Typically, LPG is transported by bulk transport trucks (maximum capacity of 10,000 gallons) and railroad tank cars (maximum capacity of 30,000 gallons per tank car) from the refineries and gas plants to the distribution centers and retail outlets. Smaller local delivery trucks (maximum capacity of 3000 gallons), commonly referred to as "bobtails," transport the LPG from these locations to the final customers. Most of these bobtails have the capability to fuel on the LPG that is contained in the cargo tank.

LPG is typically distributed in one of three ways:

1) A distributor/marketer picks up the LPG by bulk transport truck or railroad tank cars from a producer's loading rack and delivers it in bulk to its own regional storage facility, or directly to a customer's storage tank.

2) A distributor/marketer picks up the fuel from a bulk terminal (e.g. Suburban Elk Grove Terminal) or a regional storage facility and delivers it directly to its customers' sites, or stores it in its own storage tank, from which bobtails are used for subsequent deliveries.

3) End use customers bring their LPG portable containers or vehicles for filling at retail or wholesale facilities.

Most LPG is delivered to end users from the marketers' own storage tanks. Most marketers have only one tank and one dispensing system for LPG.

B. LPG Bobtail Delivery Truck Issues

A bobtail delivery truck is a LPG transport truck capable of transporting up to 3000 gallons of LPG. A bobtail is used to make local deliveries from the LPG distribution centers and retail outlets directly to the final customers of both non-motor vehicle and motor vehicle accounts.

Most bobtails fuel on the LPG that is contained in the cargo tank. Therefore, if the cargo fuel is for a commercial account, bobtails operating in Northern California could be running on off-specifications LPG. Although some bobtails are equipped with a side-saddle fueling tank which is independent of the cargo tank, it is neither practical nor economical for the operator to secure motor vehicle LPG, especially in areas where non-motor vehicle accounts exist.

The WPGA reported less than 1000 bobtails operating in the State with about 500 operating in Northern California. According to the suppliers and marketers of commercial propane, bobtail trucks have routinely fueled on commercial LPG for the last ten years. Some increased maintenance and services are typical of these trucks; however, there have been no reports of any durability or engine performance problems in bobtail trucks over this time frame.[8]

C. Summary of Emissions, Performance, and Durability Testing

Studies have been conducted to evaluate emissions, engine performance, and engine durability associated with different formulations of LPG. Three emissions studies include the LPG Task Group test program, the WPGA test program, and the ARCO tests. The LPG Task Group test program is the 1998 test program coordinated by staff with a LPG Task Group established by the ARB to oversee the project. The task group consisted of representatives from refiners, engine makers, automakers, LPG marketers, and government agencies. The LPG Task Group test program also evaluated engine performance and engine durability. Detroit Diesel Company also conducted engine performance testing. Appendix C provides a detail discussion of the emissions, performance, and durability studies.

To estimate the emissions effects of bobtails operating on commercial grade LPG, staff used the LPG Task Group emissions data, which evaluated heavy-duty engine on varying propene content as high as 21 percent. Table VIII-1 summarizes the potential effects of two LPG blends with propene content greater than 10 volume percent in relation to a 10 volume percent propene LPG fuel on a Cummins B5.9 medium heavy-duty LPG engine.

Table VIII-1: Estimates of Emission Effects in LPG Heavy Duty Vehicles[a]

Greater than 10% Propene vs. 10% Propene[b]

Fuel	*NMHC or THC*	*NOx*	*CO*
	(percent change)		
1 (14.6% propene,5.0% butane)	-5%	3%	20%
2 (21.3% propene,1.6% butane)	-11%	14%	-20%

[a]Cummins B5.9 medium heavy-duty LPG engine.

[b]LPG fuel at 9.8 volume percent propene, 5.0 volume percent butane.

As shown from the table, increasing the propene content (fuel 1) appeared to decrease hydrocarbon emissions (NMHC or THC), but increase oxides of nitrogen (NOx); and carbon monoxide (CO) emission. However, increasing the propene content and reducing the butane content to less than 2.5 percent (fuel 2), as specified in the commercial LPG standard, appeared to only increase NOx emissions. As seen from the table, the NOx emission increases could be as high as 14 percent more than a 10 volume percent propene LPG fuel.

The LPG Task Group test program also evaluated engine performance and engine durability associated with different formulations of LPG on a Cummins B5.9-195 LPG engine. Detroit Diesel Company reported results on engine performance testing of a Detroit Diesel Series 50 engine. Both the Task Group and the Detroit Diesel studies reported testing only different LPG formulations up to 10 volume percent propene. The Task Group results show that for up to 10 volume percent propene content engine performance was unaffected by LPG blends, and no abnormal wear to the engine was detected. The Detroit Diesel results show that performance is well within the design of the vehicle.

IX. Environmental Impacts of the Proposed Amendments

This section discusses the environmental impact of the proposed amendments to the CNG motor vehicle fuel specifications and the LPG motor vehicle fuel specifications.

A. Overview of Environmental Impact Analysis

The staff evaluated the environmental impacts of the proposed amendments and determined that the amendments would have no significant adverse impact on public health or the environment. As discussed in Chapter IV, the proposed amendments for CNG provide an alternative set of specifications in addition to the existing CNG specifications. The proposed amendments for LPG do not change the current LPG fuel specifications but provide an exemption for specific delivery vehicles from the fuel specifications.

The staff evaluated the environmental impacts of the proposed amendments following the requirements of the California Environmental Quality Act and the Public Resources Code section 21159. The staff also followed the requirements of Health and Safety Code 43830.8, which requires the state board to conduct a multi-media evaluation before adopting any regulation that establishes a specification for motor vehicle fuels. The following discusses the specific requirements of these statutes and staff's environmental impact analysis.

B. Environmental Requirements

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential adverse environmental impacts of the proposed standards. Because the ARB's program involving the adoption of regulations has been approved by the Secretary of Resources (see Public Resources Code, section 21080.5), the CEQA environmental analysis requirements are to be included in the ARB's Staff Report in lieu of preparing an environmental impact report or negative declaration. In addition, the ARB responds in writing to all significant environmental issues raised by the public during the public review period or the public Board hearing. These responses are to be contained within the Final Statement of Reasons for the proposed amendments.

Public Resources Code section 21159 requires that the environmental impact analysis conducted by the ARB include the following: 1) an analysis of the reasonably forseeable environmental impacts of the methods of compliance, 2) an analysis of reasonably forseeable mitigation measures, and 3) an analysis of reasonably foreseeable alternative means of compliance with the standard. Our analyses of the reasonably foreseeable environmental impacts of the methods of compliance are contained in the environmental impact analysis. Because the proposed amendments do not result in any significant environmental impact, mitigation measures are not necessary. In regards to reasonably foreseeable alternative means of compliance, the proposed amendments add alternative fuel specifications; therefore, the existing fuel specifications can still be used for compliance.

Health and Safety Code section 43830.8 requires the state board to conduct a multimedia evaluation before adopting any regulation that establishes a specification for motor vehicle fuel. Section 43830.8 defines "multimedia evaluation" as "the identification and evaluation of any significant adverse impact on public health or the environment, including air, water, or soil, that may result from the production, use, or disposal of the motor vehicle fuel that may be used to meet the state board's motor vehicle fuel specifications." Section 43830.8 also requires the California Environmental Policy Council (CEPC) to review the multimedia evaluation and determine if any significant adverse impact on public health or the environment may result from a proposed regulation. Section 43830.8 also allows the CEPC to determine, through an initial evaluation, that no multimedia evaluation is required based on its finding that a proposed regulation has no significant adverse impact on public health and the environment.

Because staff has determined that the proposed amendments will not have any significant adverse impact on public health or the environment, staff has made a formal request to the CEPC to exempt this regulatory proposal from CEPC review and the need for a multimedia evaluation. The exemption request is currently under review by the CEPC.

Below presents staff's impact analysis of the potential environmental impacts of the proposed amendments.

C. Environmental Impact Analysis

1. Effects on Water Quality and Waste Disposal

The proposed amendments to the CNG and LPG specifications do not change the existing specifications but add alternative specifications and provisions that allow increased compliance flexibility with the regulations. For CNG, to comply with the proposed specifications, producers would use the same production processes and the same waste treatment processes as are presently used to comply with the existing regulation. As discussed below, changes in fuel constituents are shifted between CNG and other fuel products already being produced. Thus, additional waste products are not expected to be generated. For LPG, the production, use, and disposal activities have not changed because staff is not proposing any amendment to the LPG specifications. Thus, the proposed amendments are not expected to result in any adverse impact to water quality or waste disposal.

2. Effects on Air Quality

Stationary Sources: For CNG, the MN index will increase the flexibility for gas producers and marketers to comply with the regulations by allowing more variability in the motor vehicle fuel formulations. This could be accomplished through operational changes of existing gas processing methods. These operational changes (e.g., additional extraction) would result in a potential increase in emissions due to additional gas processing. However, these emissions would occur regardless of the proposed amendments since industry must take action to comply with the existing regulations.

One benefit from additional gas processing would be a reduction in the reactivity of the treated natural gas. This would result in lowering the reactivity of gas transmission fugitive emissions and from downstream combustion source emissions by about 20 percent. Staff estimates that about 0.22 tons per day of gas transmission fugitive emissions in the SJV and the SCC would see a reduction in reactivity.[26] The extracted products (e.g. butanes and propanes) would be diverted to supplement LPG production. Thus, the proposed amendments are not expected to increase emissions from the production of the fuel.

Mobile Sources: For CNG, test results show that for dedicated light-duty NGVs, even large variations in fuel composition produced only slight variations, both increases and decreases, in all emissions while bifueled vehicles had only modest changes. Heavy-duty vehicle test data showed that fueling advanced generation technologies with MN 73 fuel produced no discernible impact on PM and NOx emissions when compared to measured emissions with higher CNG fuel quality (greater than MN 80). There were small increases of NMHC emissions of about 10 percent and a six percent increase in CO_2 emissions.

Although there are small increases in NMHC and CO_2 emissions, these increases are expected to be further reduced because, as discussed in Chapter VII, industry's efforts to resolve the CNG quality issue in the SSJV and the SCC will require major gas producers to produce MN 80 CNG. This would effectively make most of the natural gas produced in these regions MN 80; thus, very little MN 73 would likely be available for motor vehicle use. Therefore, no significant impact on air quality is expected.

A concern would exist if the proposed amendments to the CNG fuel specifications were not adopted. In this case, there is a potential for existing CNG fleets and planned CNG fleet proposals to revert back to diesel vehicles. As discussed, conventional diesel vehicles are much more polluting than CNG vehicles even when operating on MN 73 CNG. Thus, not adopting the proposed CNG amendments could adversely impact air quality.

For LPG, emission tests on heavy duty vehicles operating on commercial LPG shows a 14 percent increase in NOx emissions in comparison to motor vehicle grade LPG. There were no discernible changes in other emissions. The WPGA reported that there are less than 500 bobtails operating in Northern California, consuming about two million gallons per year (MM gal/yr) of LPG. Assuming that bobtails fuel on commercial LPG about 70 percent of the time, staff estimates that the potential increase in NOx emissions results in about 0.02 tons per day.[8, 27]

If the proposed amendments are not adopted, existing LPG bobtail delivery vehicles would likely revert back to diesel. Data indicate that PM emissions are significantly greater from diesel vehicles than from LPG vehicles.[28] Therefore, PM emissions may increase above current levels if the proposal amendments are not adopted.

3. Effects of the Staff's Proposal on Greenhouse Gas (GHG) Emissions

The staff's proposal is not expected to significantly increase emissions of greenhouse gases that may contribute to global warming. Global warming is based on the premise that greenhouse gases (carbon dioxide, methane, nitrous oxide, ozone, and others) absorb infrared radiation in the atmosphere, thereby increasing the overall average global temperature. Although there is a small increase in CO_2 exhaust tail-pipe emissions from CNG vehicles running on MN 73, the use of MN 73 CNG is expected to be minimal since most of the CNG produced in the SSJV and the SCC is anticipated to comply with the MN 80 CNG. Also, if the proposed amendments are not adopted, compliance with the existing CNG specifications would require more extensive gas extraction that could generate much more greenhouse gas emissions than if a small amount of vehicles were allowed to use CNG with an MN of 73. Therefore no significant impact on greenhouse gases is expected from the proposed amendments.

4. Public Health

The proposed amendments to the CNG and LPG motor vehicle fuel specifications would cause no significant adverse impact to public health.

5. Potential Effects of Proposed Alternative Fuel Regulations on Allowable Emissions

The proposed amendments to the CNG and LPG regulations will ensure the quality of the fuel for proper engine performance and durability, thus maintaining the emissions benefits of alternative fuels and alternative fuel vehicles.

The minimal increases in emissions of about 10 percent NMHC and six percent CO_2 from a CNG vehicle running on a MN 73 fuel versus a MN 81 fuel must be considered in light of the cleanliness of CNG vehicle emissions compared to gasoline or diesel vehicle emissions. The limited availability of motor vehicle grade CNG in the SSJV and the SCC has resulted in several potential CNG fleets and fueling sites being postponed. In some cases, proponents have elected to revert back to diesel vehicles since there is no certainty in the availability of motor vehicle grade CNG in these regions. If the continued availability of complying CNG due to the proposal prompts the development and sale of new CNG vehicles in lieu of new gasoline or diesel vehicles, the net effect of the proposal could be a decrease in future emissions. If existing CNG use in vehicles were displaced by gasoline (in re-conversions to gasoline prompted by an inadequate CNG supply), current exhaust, evaporative, and gasoline marketing emissions would increase. If re-conversions consisted of diesel vehicles, exhaust emissions of particulate matter and NOx would increase.

For LPG, if the bobtails are allowed to continue operating due to the proposal this will prevent the disruption in the marketplace. In addition, the net effect of the proposal could be a decrease in future emissions from these trucks not reverting back to diesel vehicles. If existing LPG use in bobtails would be displaced by diesel (in re-conversions to diesel prompted by an inadequate LPG supply), exhaust emissions of particulate matter would increase.

X. Economic Impacts of the Proposed Amendments to the Alternative Fuels Regulation

This chapter discusses the economic impacts that would be expected from the implementation of the proposed amendments to the CNG and LPG motor vehicle fuel specifications.

A. Overview of Economic Impact Analysis

As discussed in Chapter IV, the proposed amendments for CNG provide an alternative set of specifications in addition to the existing CNG specifications which adds flexibility and provide more cost-effective compliance options. The proposed amendments for LPG do not change the current LPG fuel specifications but provide an exemption from the fuel specifications for specific delivery vehicles thus making it more economical for LPG suppliers and distributors to market and sell their fuel.

The staff evaluated the economic impacts of the proposed amendments following the requirements of Section 11346.3 of the Government Code. Staff assessed the potential for adverse economic impacts on California business enterprises and individuals, including a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with businesses in other states. The following sections discuss the specific requirements of these statutes and staff's economic impact analysis.

B. Summary of Findings

The staff does not believe that adoption of the proposed amendments would result in significant adverse economic impacts. Consumers, producers, and marketers of vehicular CNG fuel would benefit from the proposed amendments to the CNG motor vehicle fuel specifications. Marketers of LPG fuel would benefit from the proposed amendments to the LPG motor vehicle fuel specifications. The proposed amendments would not significantly alter the profitability of most businesses though it could allow new fueling stations to be brought on-line, thus creating additional jobs. Staff also found no significant adverse fiscal impacts on any local or State agencies.

1. CNG Specifications

The proposed amendments to the CNG motor vehicle fuel specifications would not increase the cost of producing or delivering the fuel and would greatly increase the amount and availability of fuel in the SSJV and SCC that would comply with the specifications. Establishing a methane number of 80 for all natural gas vehicles in general allows compliance of approximately 20 percent of the fuel produced in the SSJV, compared to less than 1 percent compliance with the current specifications. Approximately 20 percent of the fuel produced in the SCC will comply with the methane number 80 specification compared to 11 percent compliance with the current specifications. Establishing an alternative 73 methane number for advanced generation heavy-duty engines and light duty vehicles increases the percentage complying fuel to 99 percent in the SSJV and 88 percent in the SCC and significantly increases the opportunity for siting new light-duty and heavy-duty fleets.[9] In the Los Angeles Basin, all CNG fueling facilities are supplied by imported natural gas that meets the current CNG motor vehicle fuel specifications. Non-complying local gas production in the Los Angeles Basin is used for commercial applications and does not supply CNG fueling facilities.

The proposed amendments would allow producers, distributors and marketers to supply and sell locally produced gas that meets a minimum MN 73 in the SSJV and the SCC without further treatment or blending to CNG fleets with engine technology that can properly operate on this fuel. Engine technology that can properly operate on MN 73 CNG is based solely on the recommendation of the engine manufacturer. Costs related to verifying compliance with the amended specifications are the same as costs to verify compliance with the current specifications.

2. LPG Bobtail Exemption

The proposed amendments to the LPG motor vehicle fuel specifications would not increase the cost of producing or delivering the fuel. These proposed amendments would provide an exemption to allow LPG suppliers and distributors to deliver commercial and motor vehicle grade LPG in the same delivery trucks thus making it more economical to supply fuel to their customers. There are no costs associated with verifying compliance to the proposed exemption.

C. Economic Impacts Analysis on California Businesses as Required by the California Administrative Procedure Act (APA)

1. Legal Requirements

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with businesses in other states.

2. Findings

Staff's findings show that adoption of the proposed regulatory action would not result in significant adverse impacts on small businesses. The proposed amendments provide more flexibility to the motor vehicle fuel specifications and allow more cost effective options to comply with the regulations. The increased flexibility of the fuel specifications could allow new fueling stations to be sited, thus creating additional jobs.

D. Analysis of Potential Impacts to California State or Local State Agencies

1. Legal Requirements

Section 11346.3 of the Government Code requires State agencies to estimate the costs or savings to any State or local agency and school district in accordance with instructions adopted by the

Department of Finance. The estimate shall include any nondiscretionary costs or savings to local agencies and the costs or savings in federal funding to the State.

2. Findings

Staff has determined that the proposed amendments would not create costs or savings, as defined in Government Code section 11346.5 (a)(6), to any State agency or in federal funding to the State, costs or mandate to any local agency or school district whether or not reimbursable by the State pursuant to Part 7 (commencing with section 17500. Division 4, Title 2 of the Government Code), or other nondiscretionary savings to local agencies. Costs related to verifying compliance with the amended specifications are the same as costs to verify compliance with the current specifications.

E. Analysis of the Cost-Effectiveness and the Impacts on a Cost per Gallon

The proposed amendments provide flexibility and provide more cost-effective compliance options. Consequently, staff believes that there will be no adverse impact on fuel cost. The alternative considered was to leave the current regulations unchanged. The compliance costs associated with the current regulations are higher than those projected with the proposed amendments.

XI. References

1 Air Resources Board; Proposed Specifications for Alternative Fuels for Motor Vehicles, October 28, 1991.

2 Air Resources Board; Proposed New Specifications for Diesel Fuel ... and Proposed Amendments to the Commercial Motor Vehicle Liquefied Petroleum Gas Regulation, August 5, 1994.

3 Air Resources Board; Proposed Amendment to the Limit on the Propene Content of Liquefied Petroleum Gas Intended for Use in Motor Vehicles, January 1997.

4 Air Resources Board; Proposed Amendment to the Specifications for LPG Used in Motor Vehicles, October 23, 1998.

5 Bevilacqua, Oreste M., Ph.D., "Natural Gas Vehicle Technology and Fuel Performance Evaluation Program", File No. Z-19-2-13-96, Clean Air Vehicle Technology Center, April 1, 1997.

6 Bevilacqua, Oreste M., Ph.D., "Impact of Natural Gas Composition on Light Duty Vehicle Emissions, Fuel Economy and Driveability, Project Overview", Clean Air Vehicle Technology Center.

7 Ayala, Alberto, " Comparative Emissions Testing of Natural Gas and Heavy-Duty Transit Buses", California Air Resources Board.

8 Reynolds, Mary, WPGA LPG Fleet Questionnaire, December 7, 2001.

9 Compiled Southern California Gas Data provided to ARB Staff on July 18, 2001, August 1, 2001, and August 2, 2001.

10 Bevilacqua, Oreste M., Ph.D., "Impacts of Natural Gas Fuel Composition on Tailpipe Emissions and Fuel Economy", ARB Public Workshop on the Alternative Fuels Regulations, Sacramento, CA, June 21, 2000.

11 Alternative Fuels Data Center,"Natural Gas (CNG/LNG)," http://www.afdc.nrel.gov/alyfuel/propane.html, http://www.afdc.nrel.gov/alyfuel/natural_gas.html.

12 California Energy Commission, "California's Major Sources of Energy," http://www.energy.ca.gov/html/energysources.html.

13 Air Resources Board staff presentation, "Public Meeting to Discuss Motor Vehicle CNG Fuel Specifications," ARB Public Meeting on CNG, Sacramento, CA, March 7, 2001.

14 Tom McGuire of Chevron, Telephone Conversation with ARB Staff, 8/24/01.

15 Clark, Nigel N., Mott, Gregory E., Atkinson, deJong, Remco J., Atkinson, Richard J., Latvakosky, Tim, Traver, Michael L., "Effect of Fuel Composition on the Operation of a Lean-Burn Natural Gas Engine", *Society of Automotive Engineers, Inc.*, SAE 952560, 1995.

16 King, Steven R., "The Impact of Natural Gas Composition on Fuel Metering and Engine Operational Characteristics", *Society of Automotive Engineers, Inc.*, SAE 920593, 1992.

17 North American Combustion Handbook, Vol. I, Third Edition, North American Mfg. Co., Cleveland, OH, 1986, p. 39.

18 SAE Standard J1616, Surface Vehicle Recommended Practice, Recommended Practice for Compressed Natural Gas Vehicle Fuel, *Society of Automotive Engineers, Inc.*, Feb 1994.

19 "Octane Determination in Piston Engines," http://www.prime-mover.org/Engines/GArticles/octane.html.

20 Bohacz, R.T., "The Causes of Engine Knock, and How to Eliminate it," http://www.zhome.com/ZCMnL/PICS/detonation/detonation.html.

21 Clark, Nigel N., Rapp, Bryon L., Gautam, Mridul, Wang, Wenguang, and Lyons, Donald W., "A Long Term Field Emissions Study of Natural Gas Fueled Refuse Haulers in New York City", Reprinted from: Alternative Fuels 1998 (SP-1391), *Society of Automotive Engineers, Inc.*, SAE 982456, 1998.

22 Ben Knight of Honda R&D Americas, Email message to ARB Staff, 18 June 2001.

23 Cummins Press release, "Cummins Westport Inc. C8.3G Plus natural gas engine certified by California," http://www.cummins.com/na/pages/en/mediaresources/pressreleases/pressrelease.cfm?uuid=D51BA786-073E-11D4-985C0004AC33EA57, Vancouver, B.C., 32 July 2001.

24 Telephone contacts with individual out-of-state LPG producers, 4th quarter 2000 and 1st quarter 2001.

25 Dan Lippe, "Storage gaps threaten US winter" *Oil & Gas Journal*, December 4, 2000, pp. 82-87.

26 ARB, Calculation of Natural Gas Transmission Emissions, December 11, 2001.

27 ARB, Calculation of NOx increase for LPG bobtails, December 10, 2001.

28 ARB, MSD heavy-duty database, years 2000 and 2001

Appendices

APPENDIX A

PROPOSED REGULATION ORDER

AMENDMENTS TO SECTIONS 2290, 2291, 2292.5 AND 2292.6, TITLE 13, CALIFORNIA CODE OF REGULATIONS, REGARDING THE COMPRESSED NATURAL GAS AND LIQUEFIED PETROLEUM GAS SPECIFICATIONS IN THE ALTERNATIVE FUELS FOR MOTOR VEHICLE REGULATIONS

The text of the proposed amendments is shown in underline to indicate additions and ~~strikeout~~ to indicate deletions, compared to the preexisting regulatory language.

Amend section 2290, title 13, California Code of Regulations, to read as follows:

§ 2290. Definitions.

(a) For the purposes of this article, the following definitions apply:
(1) "Alternative fuel" means any fuel which is commonly or commercially known or sold as one of the following: M-100 fuel methanol, M-85 fuel methanol, E-100 fuel ethanol, E-85 fuel ethanol, compressed natural gas, liquefied petroleum gas, or hydrogen.
(2) "ASTM" means the American Society for Testing Materials.
(3) "Bobtail truck" means any liquefied petroleum gas transportation truck capable of being run off the fuel from the cargo tank with a maximum cargo capacity of 3000 gallons.
~~(3)~~(4) "Motor vehicle" has the same meaning as defined in section 415 of the Vehicle Code.
(5) "South Central Coast" for the purpose of the CNG specifications is defined as San Luis Obispo and Santa Barbara County.
(6) "Southern San Joaquin Valley" for the purpose of the CNG specifications means the following areas within the San Joaquin Valley Air Pollution Control District: Fresno, Kings, and Tulare Counties and the western portion of Kern County.
~~(4)~~(7) "Supply" means to provide or transfer a product to a physically separate facility, vehicle, or transportation system.

NOTE

Authority cited: Sections 39600, 39601, 43013, 43018, ~~and~~ 43101, and 43806, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). **Reference:** Sections 39000, 39001, 39002, 39003, 39010, 39500, 40000, 43000, 43016, 43018 ~~and~~ 43101, and 43806, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Amend section 2291, title 13, California Code of Regulations, to read as follows:

§ 2291. Basic Prohibitions.

(a) Starting January 1, 1993, no person shall sell, offer for sale or supply an alternative fuel intended for use in motor vehicles, excluding LPG bobtail trucks, in California unless it conforms with the applicable specifications set forth in this article 3.

(b) An alternative fuel shall be deemed to be intended for use in motor vehicles in California if it is:

(1) stored at a facility which is equipped and used to dispense that type of alternative fuel to motor vehicles, or

(2) delivered or intended for delivery to a facility which is equipped and used to dispense that type of alternative fuel to motor vehicles, or

(3) sold, offered for sale or supplied to a person engaged in the distribution of motor vehicle fuels to motor vehicle fueling facilities, unless the person selling, offering or supplying the fuel demonstrates that he or she has taken reasonably prudent precautions to assure that the fuel will not be used as a motor vehicle fuel in California.

(c) For the purposes of this section, each retail sale of alternative fuel for use in a motor vehicle, and each supply of alternative fuel into a motor vehicle fuel tank, shall also be deemed a sale or supply by any person who previously sold or supplied such alternative fuel in violation of this section.

NOTE

Authority cited: Sections 39600, 39601, 43013, 43018, ~~and~~ 43101, and 43806, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 40000, 43000, 43016, 43018 ~~and 43101~~, 43101, and 43806, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

SPECIFICATIONS FOR COMPRESSED NATURAL GAS

Amend section 2292.5, title 13, California Code of Regulations, to read as follows:

§ 2292.5 Specifications for Compressed Natural Gas.

The following Standards apply to compressed natural gas
(The identified test methods are incorporated herein by reference):

~~Specifications for Compressed Natural Gas~~

Motor Vehicle Compressed Natural Gas Fuel must meet one of the following specifications:

A. Statewide Specifications

Specification	**Value**	**Test Method**
Hydrocarbons (expressed as mole percent)		
Methane	88.0% (min.)	ASTM D 1945-96~~81~~
Ethane	6.0% (max.)	ASTM D 1945-96~~81~~
C_3 and higher HC	3.0% (max.)	ASTM D 1945-96~~81~~
C_6 and higher HC	0.2% (max.)	ASTM D 1945-96~~81~~
Other Species (expressed as mole percent unless otherwise indicated)		
Hydrogen	0.1% (max.)	ASTM D 2650-88
Carbon Monoxide	0.1% (max.)	ASTM D 2650-88
Oxygen	1.0% (max.)	ASTM D 1945-96~~81~~
Inert Gases		
Sum of CO_2 and N_2	1.5-4.5% (range)	ASTM D 1945-96~~81~~
Water	[a]	
Particulate Matter	[b]	
Odorant	[c]	
Sulfur	16 ppmv by vol. (max.)	Title 17 CCR Section 94112

[a] The dewpoint at vehicle fuel storage container pressure shall be at least 10 ° F below the 99.0% winter design temperature listed in Chapter 24, Table 1, Climatic Conditions for the United States, in the American Society of Heating, Refrigerating and Air Conditioning Engineers ~~Engineer's~~ (ASHRAE) Handbook, 1989 fundamentals volume. Testing for water vapor shall be in accordance with ASTM D 1142-90, utilizing the Bureau of Mines apparatus.
[b] The compressed natural gas shall not contain dust, sand, dirt, gums, oils, or other substances in an amount sufficient to be injurious to the fueling station equipment or the vehicle being fueled.
[c] The natural gas at ambient conditions must have a distinctive odor potent enough for its presence to be detected down to a concentration in air or not over 1/5 (one-fifth) of the lower limit of flammability.

B. Statewide Alternative Specifications

Specification[a]	Value	Test Method
Methane Number[b]	80	ASTM 1945-96

[a] This specification may be used as an alternative to the "Hydrocarbons" portion of the Statewide Specification in part A. All of the specifications under the title "Other Species" must be met to comply with the regulation.

[b] Methane Number is determined by the following calculation:

MN = 1.624* (-406.14+508.04*RHCR-173.55*RHCR^2 +20.17*RHCR^3) -119.1

Where RHCR= (% methane*4 + % ethane*6 + % propane*8+(% isobutane + % n-butane)*10 + (% isopentane + n-pentane)*12+ (% hexane and longer hydrocarbon chains) *14) /(% methane*1+% ethane*2+ % propane*3+(% isobutane + % n-butane)*4+(% isopentane + % n-pentane)*5+% (hexane and longer hydrocarbon chains)*6).

C. Limited Area Alternative Specifications

This specification is limited to fueling facilities that meet the following conditions:

1) The fueling station is located in one of the following counties: San Luis Obispo, Santa Barbara, Ventura, Kings, Fresno, Tulare, and the portion of Kern that is in the San Joaquin Valley Air Pollution Control District;
2) The natural gas service provider does not provide natural gas that meets an MN of 80 at the service connection;
3) The fleet vehicles can operate on CNG with a MN of 73 as recommended and documented by the engine manufacturer; and
4) The fueling station has controls in place that will prevent misfueling.

Specification [a]	**Value**	**Test Method**
Methane Number [b]	73 (min.)	ASTM D 1945-96

[a] This specification may be used as an alternative to the "Hydrocarbons" portion of the Statewide Specification in part A. All of the specifications under the title "Other Species" must be met to comply with the regulation.

[b] Methane Number is determined by the following calculation:

MN = 1.624* (-406.14+508.04*RHCR-173.55* RHCR^2 +20.17*RHCR^3) -119.1

Where RHCR= (% methane*4 + % ethane*6 + % propane*8+(% isobutane + % n-butane)*10 + (% isopentane + n-pentane)*12+ (% hexane and longer hydrocarbon chains) *14) /(% methane*1+% ethane*2+ % propane*3+(% isobutane + % n-butane)*4+(% isopentane + % n-pentane)*5+% (hexane and longer hydrocarbon chains)*6).

NOTE

Authority cited: Sections 39600, 39601, 43013, 43018, ~~and~~ 43101, and 43806, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 40000, 43000, 43016, 43018~~ and 43101~~, 43101, and 43806, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

SPECIFICATIONS FOR LIQUEFIED PETROLEUM GAS

Amend section 2292.6 title 13, California Code of Regulations, to read as follows:

§ 2292.6. Specifications for Liquefied Petroleum Gas

The following Standards apply to liquefied petroleum gas
(The identified test methods are incorporated herein by reference):

Specification	Value	Test Method
Propane	85.0 vol. % (min.) [a]	ASTM D 2163-87
Vapor Press. at 100° F	208 psig (max.)	ASTM D 1267-89 ASTM D 2598-88 [b]
Volatility residue:		
Evaporated temp., 95%	-37 ° F (max.)	ASTM D 1837-86
or		
butanes	5.0 vol. % (max.)	ASTM D 2163-87
Butenes	2.0 vol. % (max.)	ASTM D 2163-87
Pentenes and heavier	0.5 vol. % (max.)	ASTM D 2163-87
Propene	10.0 vol. % (max.)	ASTM D 2163-87
Residual matter:		
Residue on evap. of 100 ml	0.05 ml (max.)	ASTM D 2158-89
Oil stain observed.	Pass [c]	ASTM D 2158-89
Corrosion, copper strip	No. 1 (max.)	ASTM D 1838-89
Sulfur	80 ppmw (max.)	ASTM D 2784-89
Moisture content	Pass	ASTM D 2713-86
Odorant	[d]	

[a] Propane shall be required to be a minimum of 80.0 volume percent starting on January 1, 1993. Starting on January 1, 1999, the minimum propane content shall be 85.0 volume percent.

[b] In case of dispute about the vapor pressure of a product, the value actually determined by Test Method ASTM D 1267-89 shall prevail over the value calculated by Practice ASTM D 2598-88.

[c] An acceptable product shall not yield a persistent oil ring when 0.3 ml of solvent residue mixture is added to a filter paper, in 0.1 ml increments and examined in daylight after 2 min. as described in Test Method ASTM 2158-89.

The liquefied petroleum gas upon vaporization at ambient conditions must have a distinctive odor potent enough for its presence to be detected down to a concentration in air of not over 1/5 (one-fifth) of the lower limit of flammability.

Within five years from the effective date of adoption or implementation, whichever comes later, of the amendments approved December 11, 1998, the Air Resources Board, in consultation with the Secretary for Environmental Protection, shall review the provisions of this chapter to determine whether it should be retained, revised or repealed.

NOTE

Authority cited: sections 39600, 39601, 43013, 43018, ~~and~~ 43101, and 43806, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 40000, 43000, 43016, 43018, ~~and~~ 43101, and 43806, Health and Safety Code; and Western Oil and Gas Ass'n v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Appendix B - Overview and Results of CNG Emission Testing Programs

A. Background

Two studies have been conducted to evaluate CNG fuel quality effects on light-duty and heavy-duty vehicle driveability, emissions, and fuel economy. These studies are referred to as the Natural Gas Vehicle Technology and Fuel Performance Evaluation Program (PEP).

The PEP studies were supported by a collaborative group that included the Gas Research Institute (GRI), Pacific Gas & Electric (PG&E), Southern California Gas Company (SoCalGas), Atlanta Gas Light Company (AGL), U.S. Environmental Protection Agency (EPA), Air Resources Board (ARB), and auto manufacturers. The Clean Air Vehicle Technology Center (CAVTC) was contracted to conduct the testing and data evaluation. The results from these studies are documented in a light-duty vehicle test report,[1] completed in 1997, and a heavy-duty data presentation,[2] presented in 2000.

B. Light Duty Test Program

1. Test Protocol

The light-duty testing included emissions tests, fuel economy tests, including highway and acceleration, and driveability tests.[1] The emissions tests used the standard 3-phase Federal Test Procedure (FTP) test cycle and the additional acceleration phase (US06) from the proposed supplemental FTP cycle presented by the United States Environmental Protection Agency (U.S. EPA) in 1994. Each test was run twice for each vehicle/fuel combination to determine test repeatability. The measured emissions included total hydrocarbons (THC), methane (CH4), non-methane organic gases (NMOG), nitrogen oxides (NOx), carbon monoxide (CO), and carbon dioxide (CO_2). The vehicles tested included both dedicated NGVs (designed to use only CNG fuel) and bi-fuel vehicles. Some of these NGVs were designed and built by OEMs and others were after-market conversions, as shown in Table B-1 below. The Dodge Dakota vehicle was unique in that it was a bi-fuel prototype designed and built by an OEM. The emissions data for the individual vehicles are provided in Attachment B-1 at the end of this appendix.

Table B-1: Light-Duty Vehicle Testing - Vehicles

Year	Make & Model	Type	OEM	Conversion
1994	Dodge Caravan	Dedicated	X	
1994	Dodge Ram Van	Dedicated	X	
1992	Ford Crown Victoria	Dedicated	X	
1993	Honda Accord	Dedicated	X	
1994	GMC Sierra (Cardinal)	Dedicated		X
1992	GMC Sierra (PAS)	Dedicated		X
1995	Ford F250 (QVM)	Bi-fuel		X
1994	Dodge Dakota	Bi-fuel	X	

The fuels tested, shown in Table B-2, covered Wobbe numbers and methane numbers inclusive of the variation of the gas produced in the South Central Coast and Southern San Joaquin Valley. The current CNG motor vehicle fuel specifications are included in the last column of this table for comparison. Methane numbers of the tested fuels ranged from approximately 63 to 100 and Wobbe numbers from 1425 to 1182. The gas compositions were speciated out to C4+. The C4+ was assumed to be butane for the calculation of the methane number. Only TF-5 had a significant C4+ content. If the C4+ actually included heavier hydrocarbons than butane, the MN of the test fuel would be lower than reported. Methane content for the fuels ranged from 82 percent to 94 percent, ethane content from two percent to eight percent and C3+ from zero percent to 10 percent.

Table B-2: Light-Duty Vehicle Testing - Fuels

Mole %	TF-1	TF-2	TF-3	TF-4	TF-5	Current Spec
Methane	91.44	90.04	84.89	94.97	82.38	88.0 min
Ethane	1.75	4.0	8.44	3.02	4.65	6.0 max
Propane	0.00	C3+ = 2.0	0.00	0.14	6.00	C3+ = 3.0 max
C4+	0.02		0.00	0.06	4.07	
Inerts	6.78	3.5	6.40	1.79	2.89	1.5-4.5
Oxygen	0.01	0.5	0.27	0.02	0.02	1.0 max
MN*	103	89	88	99	63	NA
Wobbe	1245	1182	1284	1341	1425	NA

*ARB staff calculation

2. Test Results

Figure B-1, Figure B-2, and Figure B-3 below show the variation of NOx, CO and NMOG emissions as measured with the FTP cycle for the OEM dedicated light-duty vehicles as a function of fuel methane number. Applicable ARB 50,000 mile ultra low-emissions vehicle (ULEV) standards for the vans and for the passenger cars are shown in these figures for reference. The higher ULEV standards correspond to the two vans, the Caravan and the Ram, while the lower ULEV standards correspond to the two passenger cars, the Accord and Crown Victoria. These standards are only applicable to the FTP test cycle emissions. The emissions from all the OEM dedicated vehicles were below the applicable ULEV standard with each of the tested fuels. Additionally, the NMOG values in Figure B-3 have not been adjusted by the natural gas reactivity adjustment factor of 0.41. Applying this adjustment factor drops these values an additional 60 percent.[1]

Figure B-1: Measured NOx Emissions from Dedicated Light-Duty Vehicles with the FTP Test Cycle

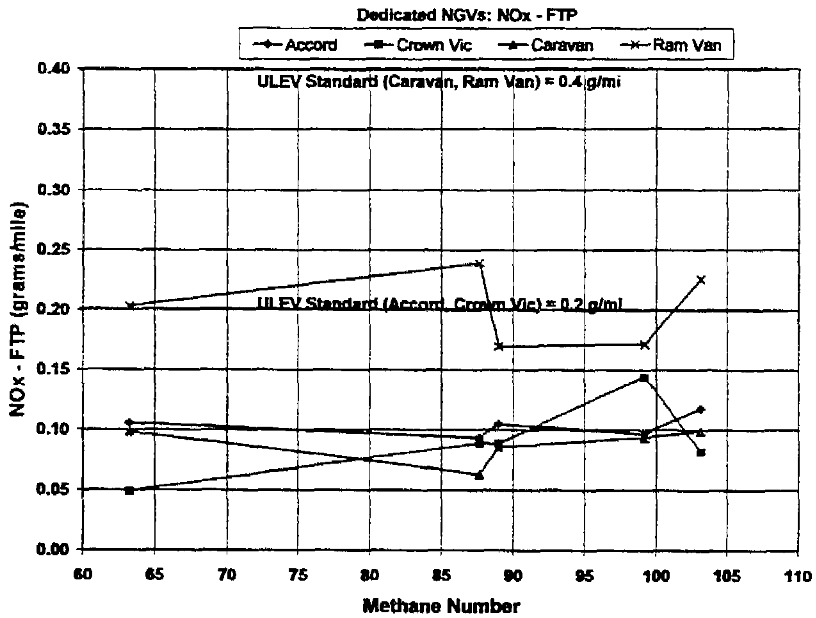


Figure B-2: Measured CO Emissions from Dedicated Light-Duty Vehicles with the FTP Test Cycle

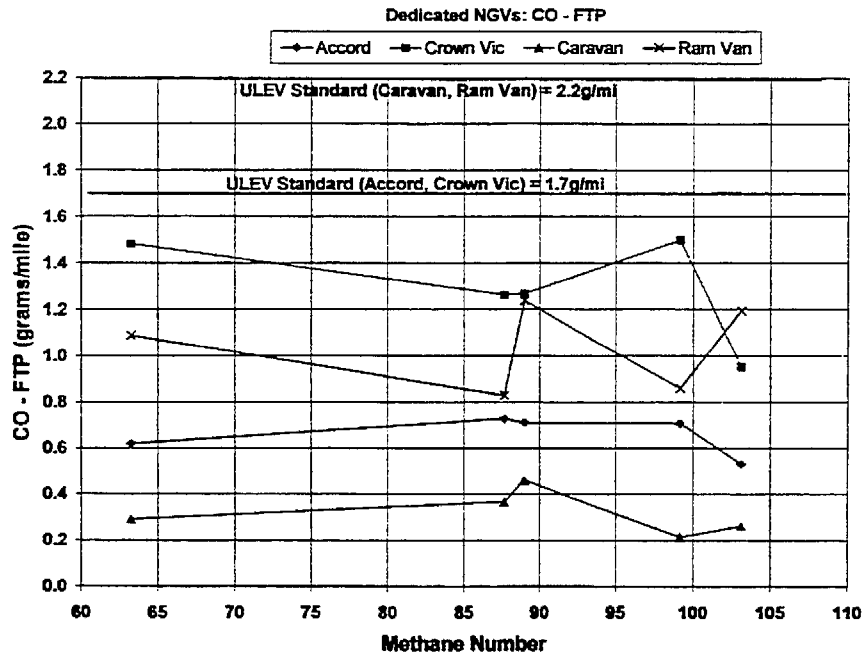


Figure B-3: Measured NMOG Emissions from Dedicated Light-Duty Vehicles with the FTP Test Cycle

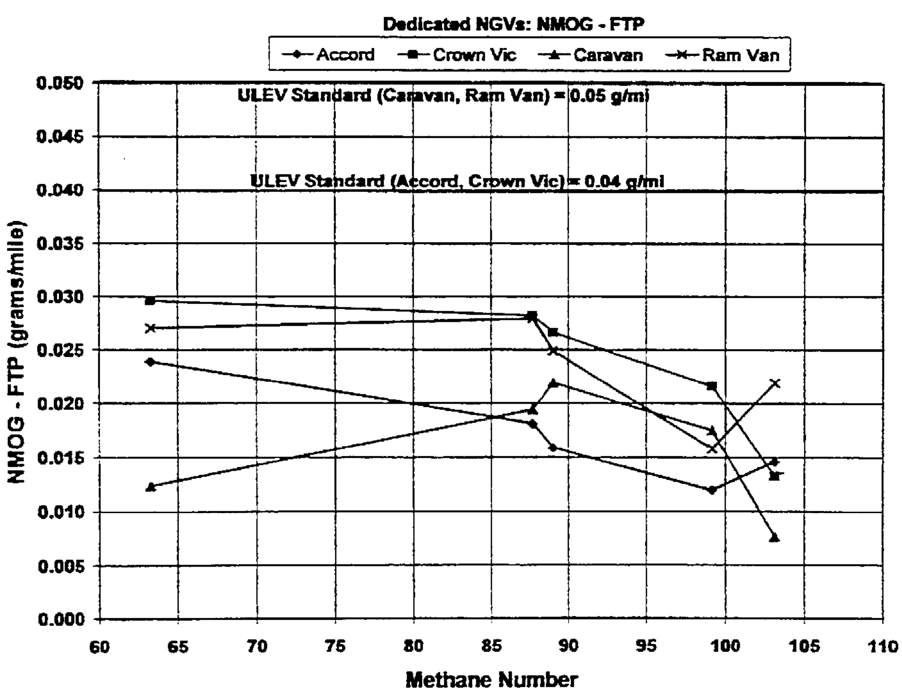


Figure B-4, Figure B-5, and Figure B-6 below show the variation of NOx, CO and NMOG emissions for the after-market conversion dedicated and bi-fuel light-duty vehicles as a function of fuel methane number as measured with the FTP cycle. The OEM prototype bi-fuel Dodge Dakota is included in these figures. The ARB 50,000 mile ultra low-emissions vehicle (ULEV) standard, low emissions vehicle (LEV) standard, and transitional low emission vehicle (TLEV) standard for the this vehicle type (light-duty trucks, 3751-5750 lbs.) are shown in these figures for comparison. Again, these standards are only applicable to the FTP test cycle emissions.

As shown in the figures below, the after-market conversion vehicles and the OEM prototype bi-fuel vehicle had higher emissions and more variation in emissions with fuel quality than the OEM dedicated fuel vehicles. However, all of these vehicles had NMOG emission levels within the LEV standard and NOx levels that were at or near the TLEV standard. Three of the four vehicles also met the TLEV/LEV CO emissions standard. The GMC (PAS), an after-market conversion dedicated vehicle, had CO emissions that were consistently higher than the standard for all tested fuels.

Figure B-4: Measured NOx Emissions from After-market Conversion and OEM Prototype Light-Duty Vehicles with the FTP Test Cycle

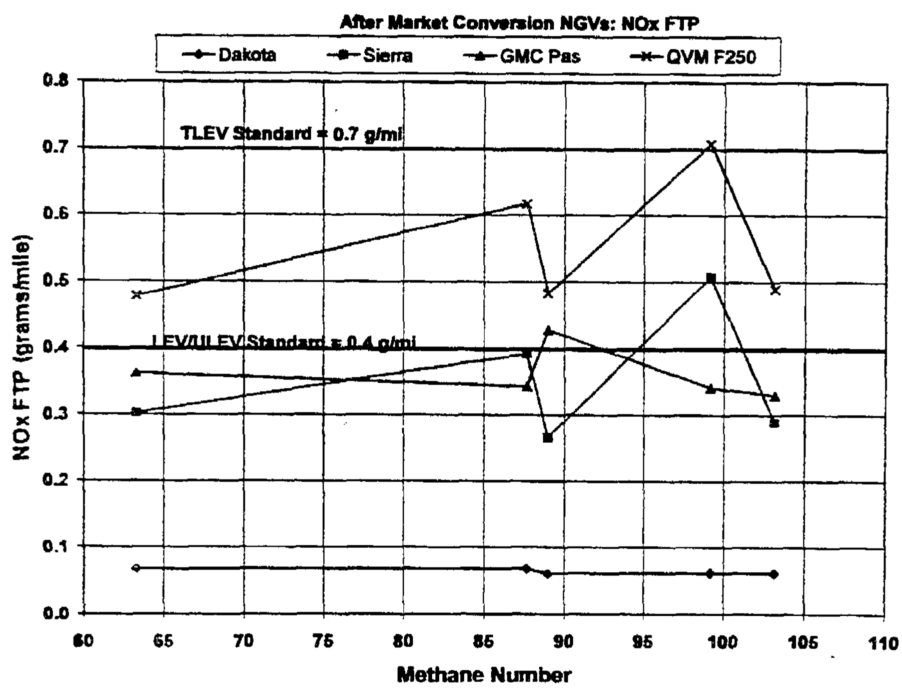


Figure B-5: Measured CO Emissions from After-market Conversion and OEM Prototype Light-Duty Vehicles with the FTP Test Cycle

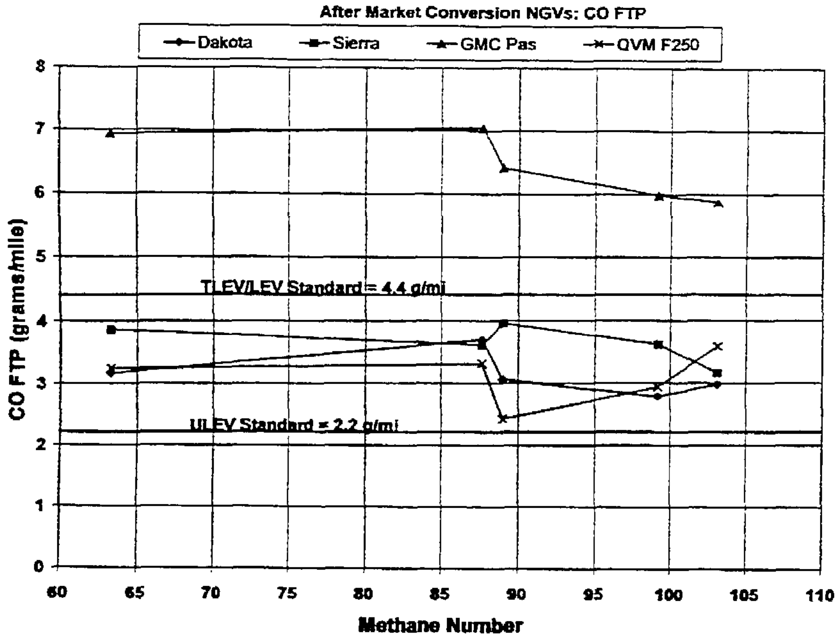


Figure B-6: Measured NMOG Emissions from After-market Conversion and OEM Prototype Light-Duty Vehicles with the FTP Test Cycle

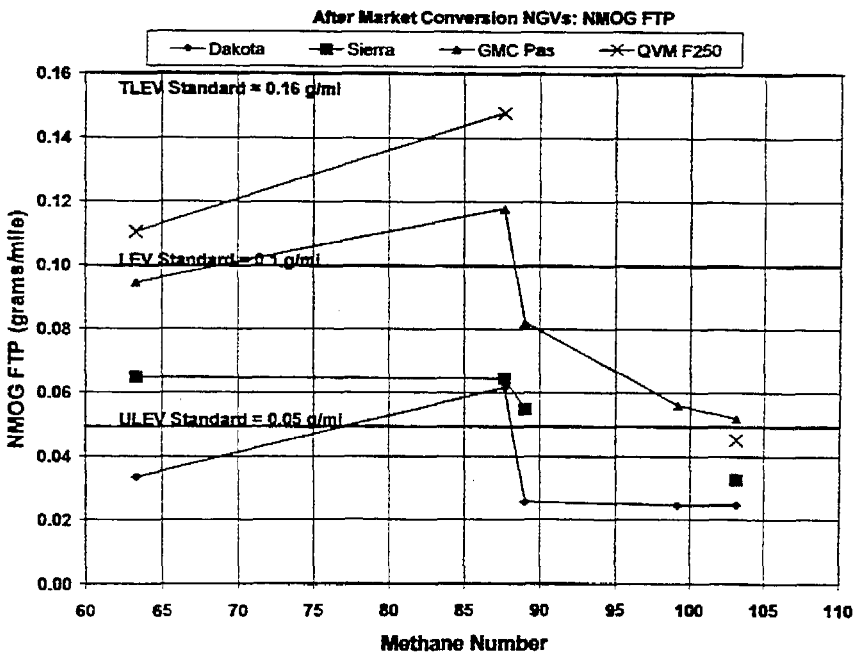
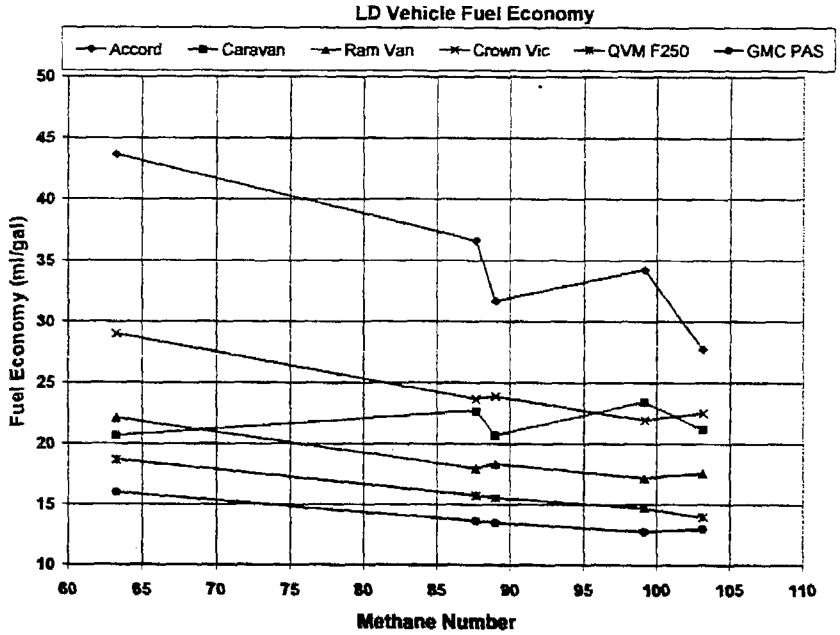


Figure B-7 below shows that fuel economy was either insensitive to fuel quality or increased with the reduced methane number.

Figure B-7: Measured Fuel Economy with Light Duty Vehicles with the FTP Test Cycle



C. Heavy Duty Test Program

1. Test Protocol

The heavy-duty vehicle testing evaluated emissions, fuel economy, and performance of seven different HD vehicles with four different fuels.[2] Testing included three different drive cycles with three tests run for each cycle/fuel/vehicle combination. The three drive cycles used were the EPA Heavy-Duty Urban Dynomometer Driving Schedule (UDDS), the Commuter cycle, and the Modified Central Business District (Mod-CBD) cycle. The measured emissions included total hydrocarbons (THC), methane (CH4), non-methane hydrocarbons (NMHC), nitrogen oxides (NOx), carbon monoxide (CO), and carbon dioxide (CO_2). The seven vehicles tested included both open loop and closed loop technology engines, as shown in Table B-3 below. The closed loop technology engines are designated as either advanced or first generation in Table B-3. The Cummins closed loop technology engine is considered first generation closed loop technology and is not as adaptable to variable fuel quality as the advanced generation closed loop technology engines such as the John Deere.

Table B-3: Heavy-Duty Vehicle Testing - Vehicles

Year	Make & Model	Duty	Control
1997	John Deer 8.1L	School Bus	Closed Loop, Advanced
1999	Cummins 8.3L	School Bus	Closed Loop, First Generation
1996	John Deere 6.8L	School Bus	Closed Loop, Advanced
1999	John Deere 8.1L	Crew Truck	Closed Loop, Advanced
1996	Detroit Diesel 8.5L Series 50	Transit Bus	Open Loop
1996	Cummins 10.0L	Transit Bus	Open Loop
1999/2000	Detroit Diesel 12.7L Series60G(LNG)*	Tractor	Closed Loop, First Generation

* Omitted from the data due to inconsistent data trends

The fuel qualities tested, shown in Table B-4, had methane contents ranging from 82 percent to 95 percent, ethane content from 3 percent to 8 percent and C3+ from 0 percent to 5 percent. The Wobbe numbers for the tested fuels ranged from 1310 to 1360 and methane numbers from 73 to 99. The methane number range included the lowest recommended fuel quality for advanced generation closed loop technology heavy-duty engines, methane number 73. The highest methane number fuel, labeled High Quality, meets the current CNG motor vehicle fuel specifications and exceeds the proposed specification of MN 80. The methane number calculated for the high ethane fuel, MN 81, is in the range of the calculated methane number for gas that meets the current specifications, MN ~ 80 – 82, as shown in Table D-1 in Appendix D. Although this high ethane fuel does not meet the current specifications, due to the slightly low methane content and the high ethane content, the emissions data using this fuel can be equated to a fuel that would meet the proposed MN 80 specification.

Table B-4: Heavy-Duty Vehicle Testing - Fuels

Mole %	High C3+	High Inerts/C3+	High Ethane	High Quality*	Current Spec
Methane	87.25	82.06	87.11	94.97	88.0 min
Ethane	5.84	7.11	8.25	3.02	6.0 max
Propane	3.06	3.83	1.81	0.14	C3+ = 3.0 max
Iso-butane	0.28	0.35	0.09	0.02	
N-butane	0.55	0.17	0.17	0.02	
Iso-pentane	0.08	0.06	0.02	0.01	
N-pentane	0.07	0.04	0.02	0.01	
C6+	0.05	0.0	0.01	0.0	
Inerts	2.82	5.92	2.52	1.81	1.5-4.5
Oxygen	0.0	0.0	0.0	0.03	1.0 max
MN**	77	73	81	99	~80-82***
Wobbe**	1363	1310	1359	1338	

* Meets current specification
** ARB staff calculation
***No current requirement for MN

Three tests were run for each cycle/fuel/vehicle combination for test repeatability. One exception to this was the 1996 8.5L Detroit Diesel Series 50 open loop technology transit bus tested with the UDDS cycle, where only two tests per fuel were completed. The other exception was the absence of particulate emissions data for 1997 8.1L John Deere closed loop technology school bus with the high ethane fuel. Only one measurement was available for this fuel/vehicle combination for the UDDS cycle. No data was available for this fuel/vehicle combination for the other two test cycles.

2. Test Results

The emissions and fuel economy results shown in the following tables and figures are for the UDDS driving schedule. The UDDS driving schedule generally resulted in the highest emissions levels as well as the highest fuel consumption.[3] Figure B-5 through Table B-7 below summarize the emissions data for each technology group. These tables give the range observed for each pollutant with each fuel quality. Table B-6 does not give a range since the first generation closed loop technology group was represented by a single vehicle. The emissions data for the individual vehicles are provided in Attachment B-1 at the end of this appendix. An average value for each cycle/fuel/vehicle combination is given in the attachment.

Table B-5: Advanced Generation Closed Loop Technology Engine Emissions and Fuel Economy Comparison of MN99, MN81, and MN73 CNG

Advanced Generation Closed Loop Technology, Vehicles # 1,3,4 only						
Test Fuel MN	**99**		**81**		**73**	
Tailpipe emissions (grams/mile)	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
THC	8.0	8.6	7.5	7.9	7.5	8.2
CO	0.3	3.8	0.2	4.2	0.2	4.2
NOx	6.0	11.4	6.9	12.8	6.1	11.0
CO_2	910	980	944	1020	978	1077
NMHC	0.4	2.0	1.3	2.7	1.5	3.0
PM	0.013	0.032	0.009	0.029	0.008	0.031
(Mi/Gal.)	6.1	7.3	7.6	7.7	8.0	8.3

Table B-6: First Generation Closed Loop Technology Engine Emissions and Fuel Economy Comparison of MN99, MN81, and MN73 CNG

First Generation Closed Loop Technology, Vehicle # 2 only			
Test Fuel MN	**99**	**81**	**73**
Tailpipe emissions (grams/mile)			
THC	9.6	7.2	7.3
CO	0.7	0.7	0.8
NOx	10.3	12.4	12.4
CO_2	1070	1098	1144
NMHC	1.9	1.8	1.9
PM	0.066	0.043	0.039
(Mi/Gal.)	6.1	6.7	7.0

Table B-7: Open Loop Technology Engine Emissions and Fuel Economy Comparison of MN99, MN81, and MN73 CNG

Open Loop Technology, Vehicles # 5 and 6 only						
Test Fuel MN	**99**		**81**		**73**	
Tailpipe emissions (grams/mile)	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
THC	5.2	11.0	5.3	9.1	5.2	12.8
CO	0.04	4.6	0.1	5.0	0.1	5.0
NOx	6.4	14.2	16.7	20.8	7.5	18.0
CO_2	1167	1259	1290	1469	1336	1478
NMHC	1.0	2.4	1.3	3.0	1.3	4.7
PM	0.025	0.035	0.033	0.051	0.021	0.055
(Mi/Gal.)	5.1	5.7	5.1	5.7	5.2	6.1

The closed loop technology 12.7L Detroit Diesel LNG tractor was omitted from the data presented because its CO and PM data trends were inconsistent with the other closed loop technology engine data. The LNG tractor PM emissions were over 10 times higher than those for the other engines, independent of fuel quality. Additionally, the LNG tractor CO emissions varied much more significantly with fuel quality than those from the other closed loop technology engines. However, this data can be found in Attachment B-1.

The PM emissions for the open and closed loop technology engines are shown in Figure B-8 and Figure B-9 versus methane number. Both the closed loop and the open loop technology engine PM emissions were 0.07 grams/mile or less with the majority of the data in the 0.02 to 0.04 gram/mile range. The typical PM variation with fuel quality seen in this data, 0.02 grams/mile, was not significantly different from the test to test variations seen within the data sets.

Figure B-8: PM Emissions for Open Loop Technology Engines

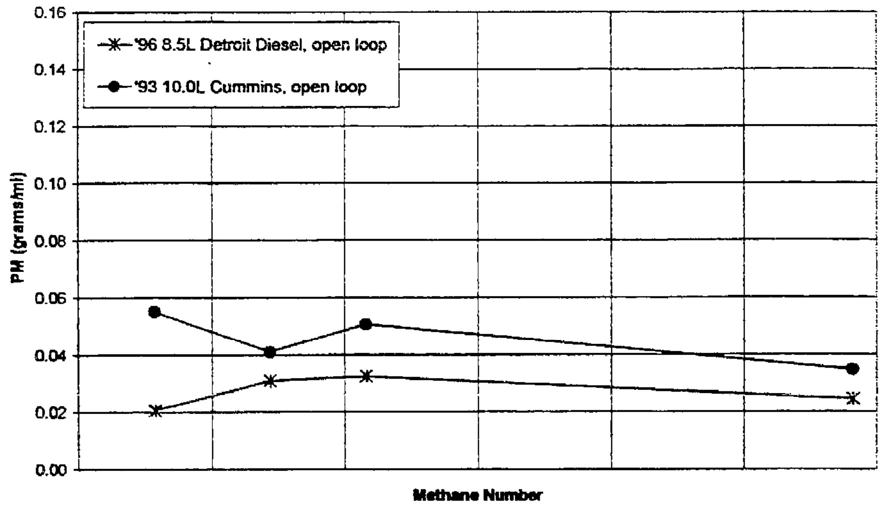
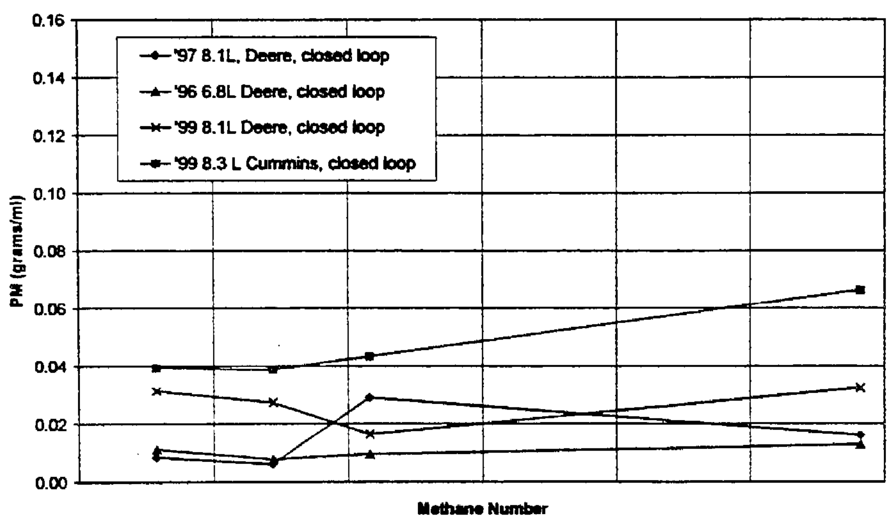


Figure B-9: PM Emissions for Closed Loop Technology Engines



NOx emissions for the open loop technology engines, shown in Figure B-10, were higher and had significantly more variation with fuel quality than those measured with the closed loop technology engines, shown in Figure B-11. The NOx emissions with the high quality MN99 fuel were similar in value between the open loop and closed loop technology engines. However, the open loop technology engines indicated an increase in

NOx emissions with reduced methane number that was not evident with the either the first generation or the advanced generation closed loop technology engines.

Figure B-10: NOx Emissions for Open Loop Technology Engines

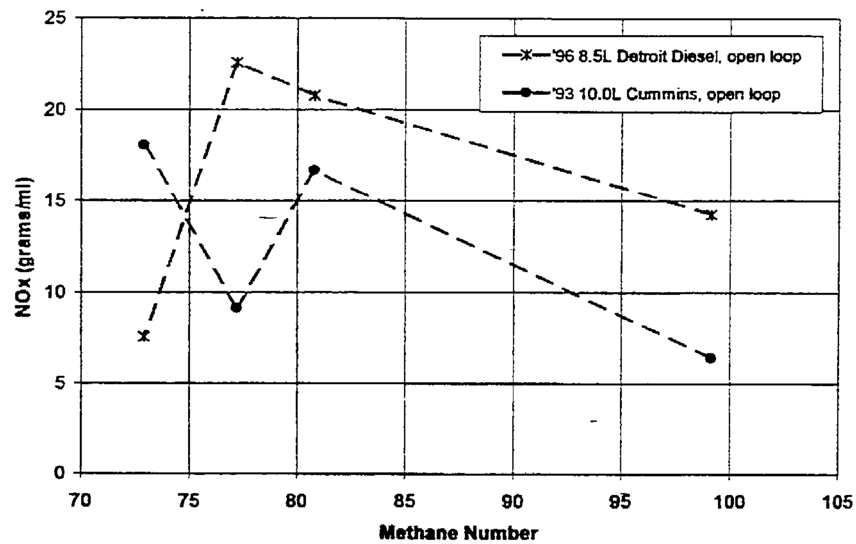
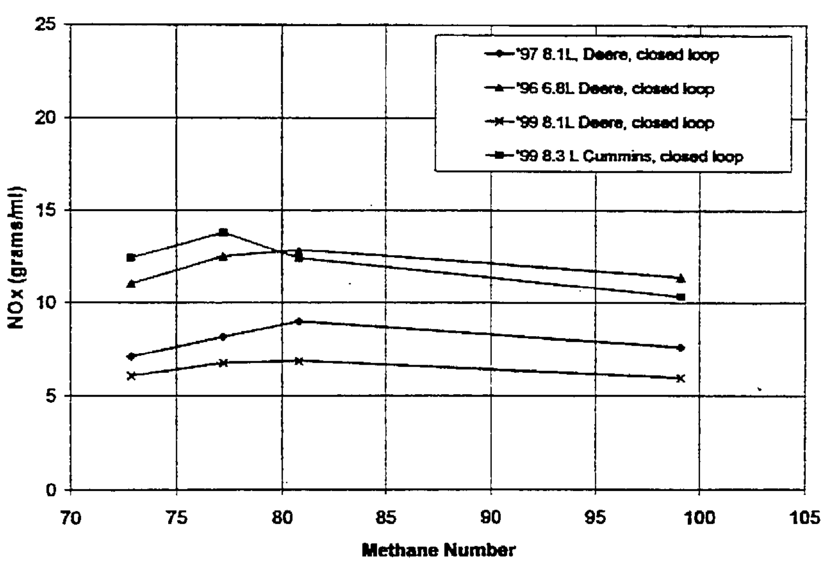


Figure B-11: NOx Emissions for Closed Loop Technology Engines



Non-methane hydrocarbon emissions trends with fuel quality, see Figure B-12 and Figure B-13, were similar for the open loop and closed loop technology engines. Both technologies indicated some increases in emissions with decreasing fuel quality. The Detroit Diesel open loop technology engine exhibited a larger increase in NMHC emissions with the MN73 fuel than any of the other engines. The advanced generation technology engines showed the most consistent trends from vehicle to vehicle with approximately a 10 percent increase from MN81 fuel quality to MN73 fuel quality.

Figure B-12: NMHC Emissions for Open Loop Technology Engines

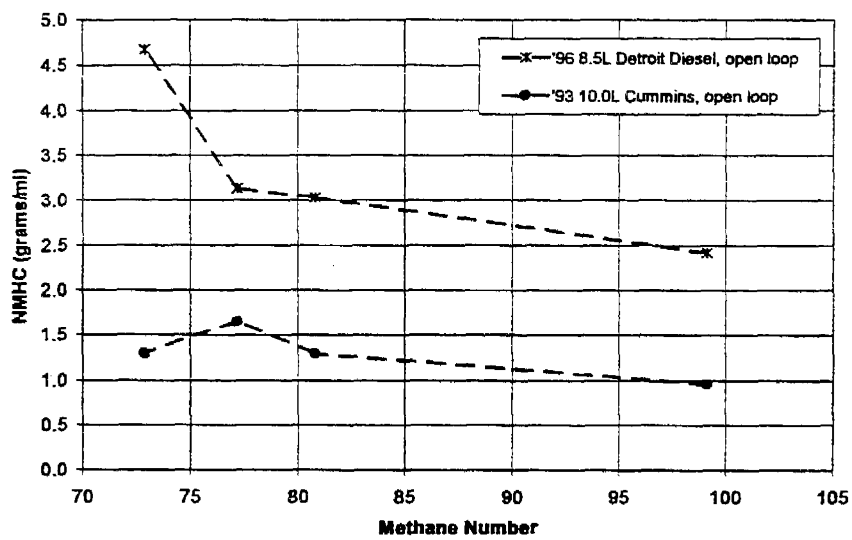
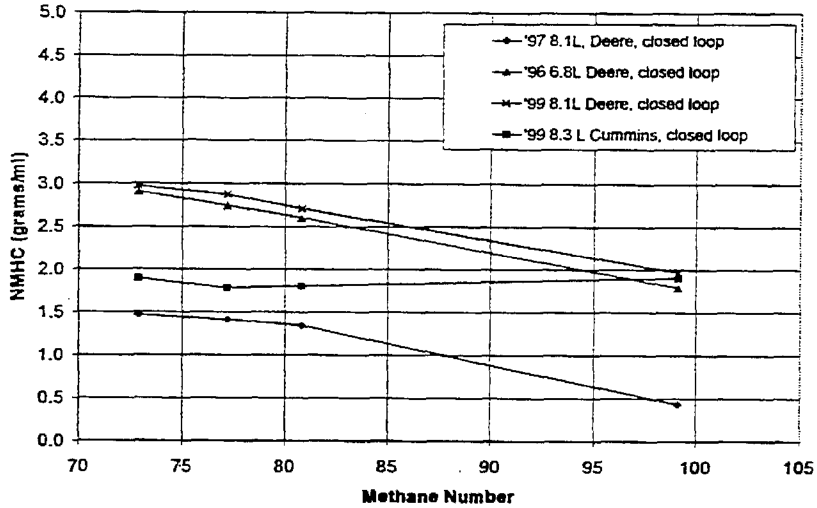


Figure B-13: NMHC Emissions for Closed Loop Technology Engines



THC emissions for both open and closed loop technology engines are shown in Figure B-14 and Figure B-15 below. With the exception of the Detroit Diesel open loop technology vehicle, there was minimal THC emissions variation with fuel quality. The Cummins open loop technology engine actually produced lower THC emissions, 5 to 6 grams/mile, than any of the closed loop technology engines. The THC emissions from all four of the closed loop technology engines were tightly grouped together at approximately 8 grams/mile.

Figure B-14: THC Emissions for Open Loop Technology Engines

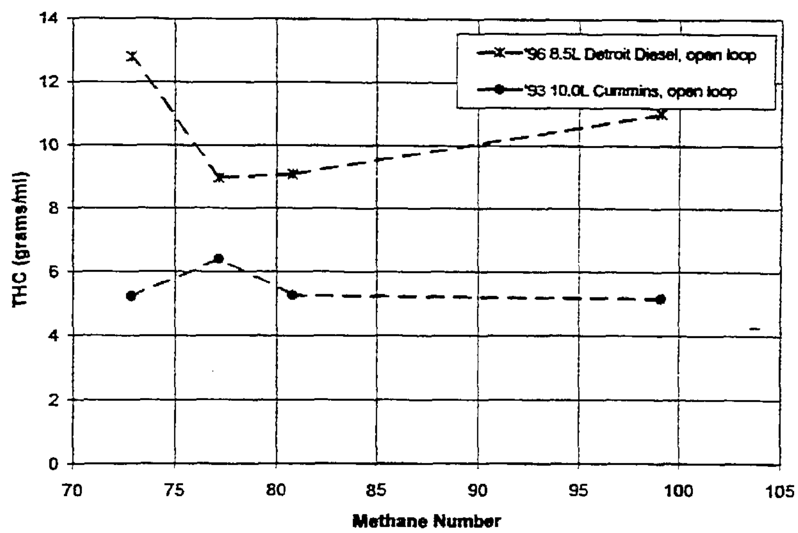
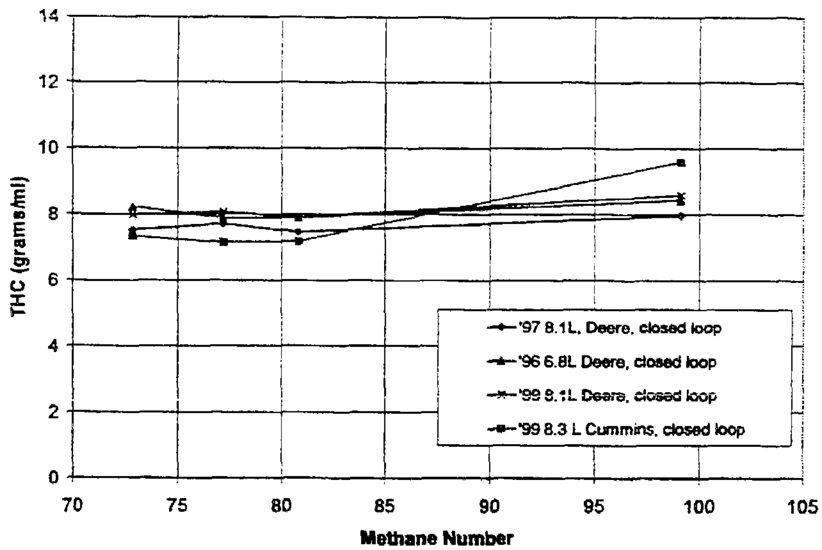


Figure B-15: THC Emissions for Open Loop Technology Engines



CO emissions for both open and closed loop technology engines, shown in Figure B-16 and Figure B-17, did not vary significantly with the variation of fuel quality. However, there was a significant difference between the CO emissions for the different engines. Both the first generation closed loop technology Cummins vehicle and the open loop technology Cummins engine as well as one of the advanced technology closed loop technology engines, the 1997 8.1L John Deere school bus, all had measured CO emissions of less than 1 gram/mile. The other two advanced technology closed loop technology engines had CO emissions of approximately 3 to 4 grams/mile. The Detroit Diesel open loop technology engine produced CO emissions of 4 to 5 grams/mile.

Figure B-16: CO Emissions for Open Loop Technology Engines

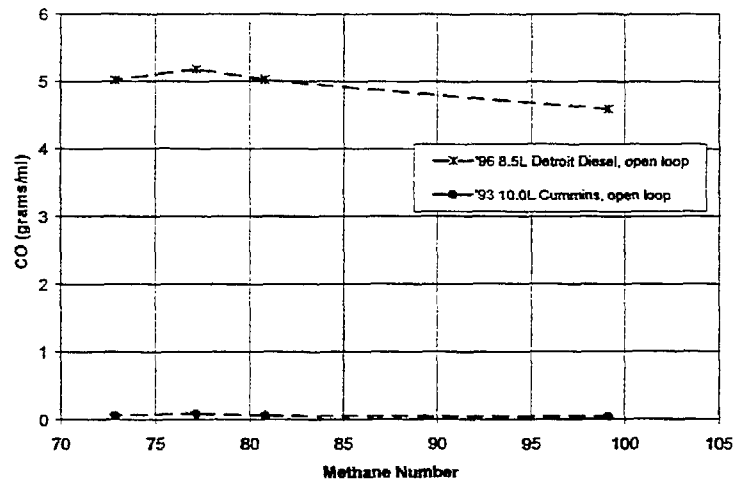
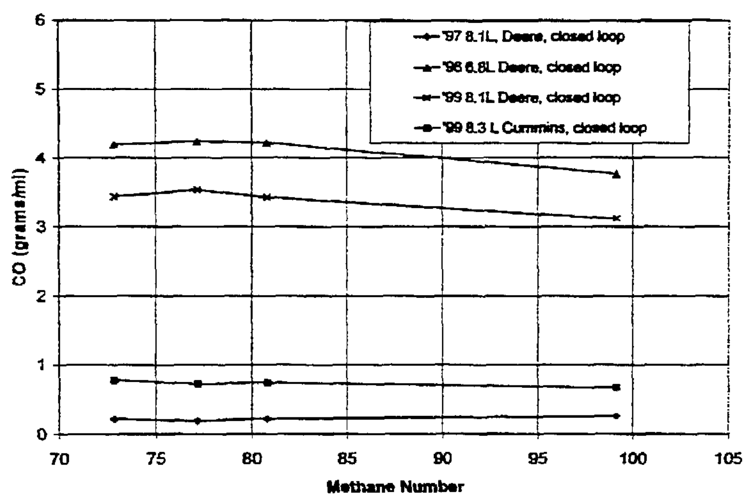


Figure B-17: CO Emissions for Closed Loop Technology Engines



CO_2 emissions for both open and closed loop technology engines are shown in Figure B-18 and Figure B-19 below. The CO_2 emissions for the open loop engines were higher than for the closed loop engines for all fuel qualities. The 1993 Cummins open loop vehicle had significant emissions variation with fuel quality. However the 1996 Detroit Diesel open loop vehicle and all the closed loop vehicles experienced only a six percent increase in emissions from the MN81 to the MN73 fuel quality.

Figure B-18: CO_2 Emissions for Open Loop Technology Engines

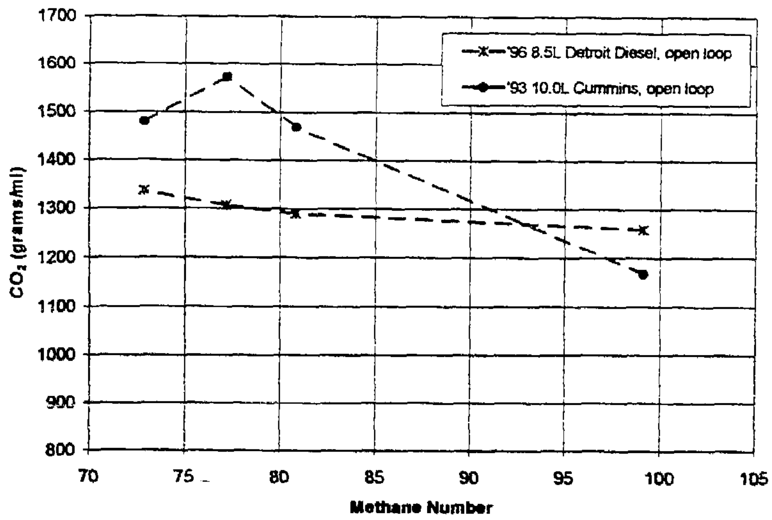


Figure B-19: CO_2 Emissions for Closed Loop Technology Engines

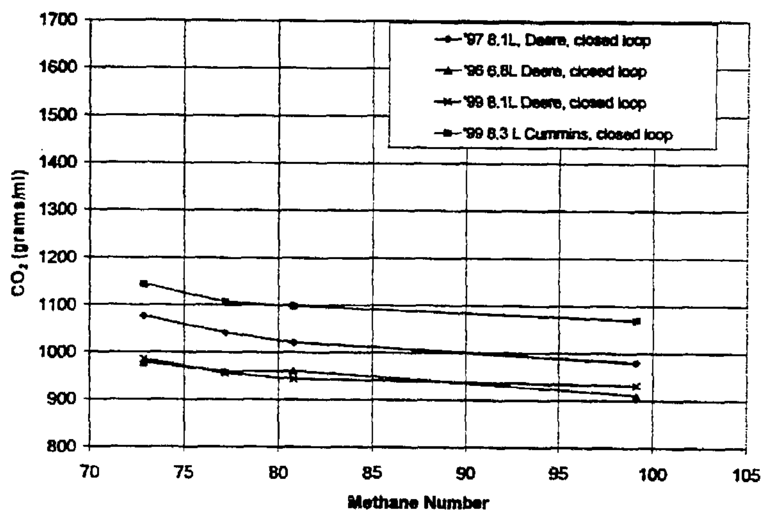


Figure B-20 and Figure B-21, below, show measured fuel economy as a function of fuel grade for the open and closed loop technology engines. The closed loop technology engines produced better fuel economy than the open loop technology engines. All of the closed loop technology engines and one of the open loop technology engines obtained better fuel economy with the lower MN fuels than with the higher MN fuel. The lower MN fuels contain larger fractions of higher molecular weight hydrocarbons, resulting in a higher energy content. The closed loop technology engines were better able to utilize the higher energy content fuels by adjusting the air/fuel ratio accordingly. Consequently, the closed loop technology engines showed a more consistent increase in fuel economy with fuel variations, an average 20 percent increase from MN99 to MN73 fuel quality, than the open loop technology engines. The open loop technology Detroit Diesel engine also showed a 20 percent increase with decreasing fuel MN. However in contrast, the open loop technology Cummins engine showed a 9 percent decrease in fuel economy with decreasing fuel MN.

Figure B-20: Fuel Economy for Open Loop Technology Engines

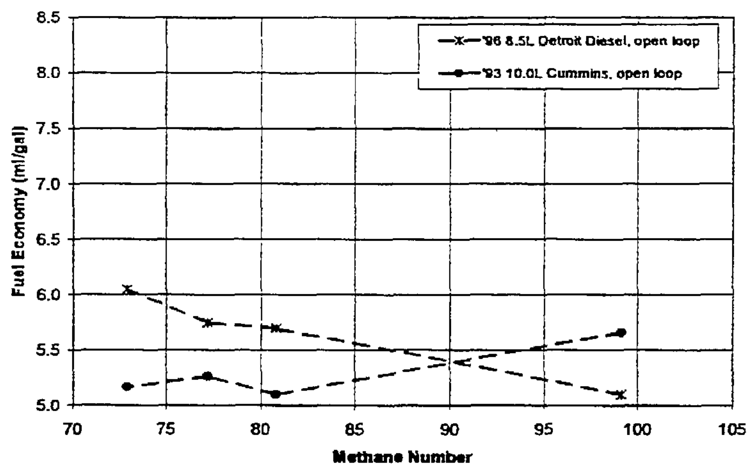
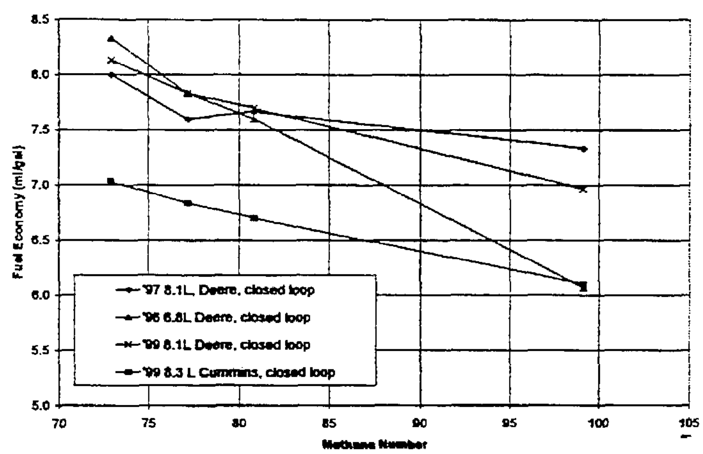


Figure B-21: Fuel Economy for Closed Loop Technology Engines



3. Data Analysis

a) Coefficient of Variance

The coefficient of variance (COV) for the data was maintained at less than 10 percent for the majority of the data, as summarized in Table B-8 for the three technology types.

Table B-8: Coefficient of Variance for Different Technology Groups

Technology Group	Average Coefficient of Variance (%)						
	THC	CO	NOx	CO_2	NMHC	Partic	Fuel Econ
Advanced Generation Closed Loop	2.8%	5.5%	3.5%	1.1%	3.3%	26.2%	3.7%
First Generation Closed Loop	2.6%	4.0%	2.7%	0.5%	3.0%	16.9%	0.6%
Open Loop	1.6%	15.2%	4.5%	0.9%	2.5%	43.1%	1.0%

The COV for the CO emissions exceeded 10 percent for three of the seven vehicles, the 1997 8.1L John Deere advanced generation closed loop technology school bus, the 1993 10.0L Cummins open loop technology transit bus, and the 1999/2000 12.7L Detroit Diesel Series 60G (LNG) closed loop technology tractor. The Detroit Diesel Series 60G (LNG) tractor was excluded from the summary due to inconsistent data trends. The high COVs for the John Deere and the Cummins vehicles were due to the low absolute value of the emissions. The standard deviations of the data were similar to that for the other test vehicles, but the measured CO emissions for these two vehicles were significantly lower, so the standard deviations were a higher percentage of the measured values.

The COVs for the PM emissions were also high due to low emission level. The COV for the PM emissions significantly exceeded 10 percent for at least two of the four fuels for every single vehicle, as evidenced in Table B-8. However, these high COVs were primarily due to the low measured PM emissions values. The PM test to test variations were small relative to more typical diesel PM measurements. However, again, these variations were a large percentage of the measured values for these vehicles. Consequently, while there appears to be a large degree of scatter in the PM emissions measurements, this variation is primarily due to the difficulty of measuring theses low values.

b) Statistical Analysis

A statistical analysis of the NOx and PM emissions data showed minimal statistically significant differences between the different vehicle technology groups and fuels for the UDDS cycle data shown in the preceding figures. The PM emissions data analysis indicated that only the first generation vehicle with the high quality fuel, which appears anomalously high, was statistically different, at a 95 percent confidence level, than any of the other vehicle/fuel combinations. The NOx emissions data analysis indicated that within individual vehicle technology groups, there were no statistically differences from fuel to fuel. However, the NOx emission response of the advanced generation closed loop technology engines showed less variation than either the first generation closed loop technology engine or the open loop technology engines, as shown in Figure B-22. The results of the statistical analysis are summarized in Table B-9 and Table B-10 for PM and NOx respectively.

Figure B-22: NOx Emission Response of the Different Engine Technologies

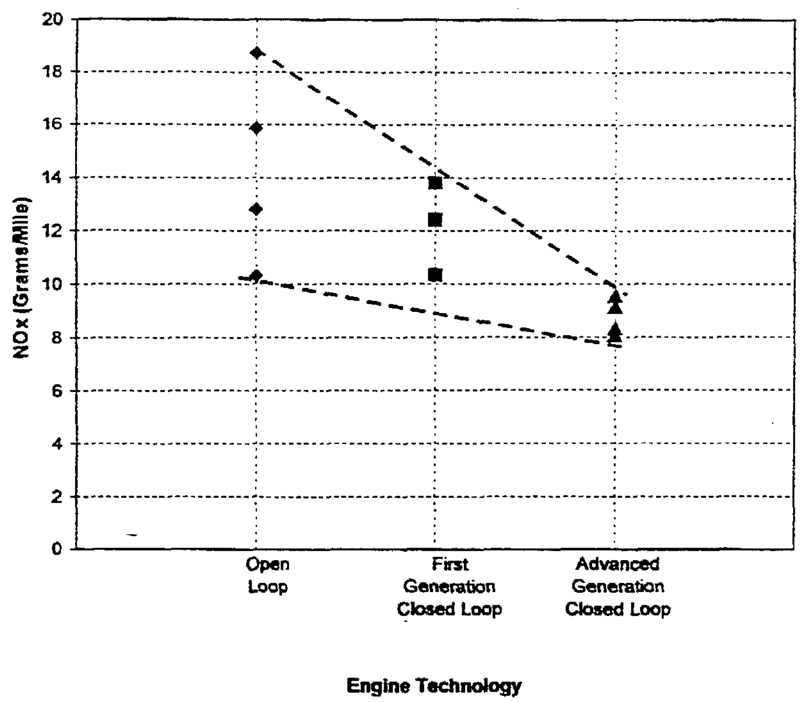


Table B-9: Statistical Mean and Standard Error of the PM Emissions for the Three Technology Groups and Four Fuel Qualities

UDDS Cycle					
Technology Group	Pollutant	Fuel MN	Mean	Standard Error	Group*
Closed Loop Advanced	PM	73	0.017	0.007	A
Closed Loop Advanced	PM	77	0.014	0.007	A
Closed Loop Advanced	PM	81	0.014	0.007	A
Closed Loop Advanced	PM	99	0.020	0.007	A
First Generation Closed Loop	PM	73	0.039	0.012	A
First Generation Closed Loop	PM	77	0.039	0.012	A
First Generation Closed Loop	PM	81	0.043	0.012	A
First Generation Closed Loop	PM	99	0.066	0.012	B
Open Loop	PM	73	0.039	0.009	A B
Open Loop	PM	77	0.035	0.009	A B
Open Loop	PM	81	0.042	0.009	A B
Open Loop	PM	99	0.029	0.009	A

* Means that share the same letter are not statistically different

Table B-10: Statistical Mean and Standard Error of the NOx Emissions for the Three Technology Groups and Four Fuel Qualities

UDDS Cycle Technology Group	Pollutant	Fuel MN	Mean	Standard Error	Group*
Closed Loop Advanced	NOx	73	8.1	2.6	C
Closed Loop Advanced	NOx	77	9.1	2.6	C
Closed Loop Advanced	NOx	81	9.6	2.6	C
Closed Loop Advanced	NOx	99	8.3	2.6	C
First Generation Closed Loop	NOx	73	12.4	4.6	C D
First Generation Closed Loop	NOx	77	13.8	4.6	C D
First Generation Closed Loop	NOx	81	12.4	4.6	C D
First Generation Closed Loop	NOx	99	10.3	4.6	C D
Open Loop	NOx	73	12.8	3.2	C D
Open Loop	NOx	77	15.9	3.2	C D
Open Loop	NOx	81	18.7	3.2	D
Open Loop	NOx	99	10.3	3.2	C D

*** Means that share the same letter are not statistically different**

D. Estimated Effect on Individual Vehicle Emissions

From the test data presented in the preceding sections, staff concluded that for the advanced generation closed loop technology engines the data show no discernable emissions impact for NOx, PM, THC and CO. However, the data indicate increases of approximately six and 10 percent in CO_2 and NMHC respectively from MN81 to MN73 CNG. For first generation closed loop technology the data show similar emissions trends. However, for open loop technology the data indicate significant increases in NMHC of up to approximately 50 percent.

Attachment B-1: Data Tables

Table A: Measured Emissions From Light-Duty Dedicated Fuel OEM Vehicles[1]

Vehicle Emissions (grams/mile) - Dedicated OEMs

NOx - FTP

Fuel	Wobbe	Accord	Crown Vic	Caravan	Ram Van	MN*
TF-1	1245	0.1175	0.0815	0.0988	0.2255	103
TF-2	1182	0.1045	0.0880	0.0850	0.1695	89
TF-3	1284	0.0930	0.0885	0.0630	0.2387	88
TF-4	1341	0.0963	0.1442	0.0930	0.1715	99
TF-5	1425	0.1050	0.0490	0.0980	0.2030	63

NOx - US06

Fuel	Wobbe	Accord	Crown Vic	Caravan	Ram Van	MN*
TF-1	1245	0.3840	0.3625	0.1645	0.2987	103
TF-2	1182	0.1570	0.2705	0.1340	0.2345	89
TF-3	1284	0.1865	0.1970	0.1040	0.2700	88
TF-4	1341	0.1203	0.3534	0.1680	0.2210	99
TF-5	1425	0.1360	0.0935	0.1503	0.2700	63

NMOG - FTP

Fuel	Wobbe	Accord	Crown Vic	Caravan	Ram Van	MN*
TF-1	1245	0.0146	0.0132	0.0076	0.0219	103
TF-2	1182	0.0159	0.0266	0.0219	0.0249	89
TF-3	1284	0.0181	0.0282	0.0194	0.0279	88
TF-4	1341	0.0119	0.0216	0.0175	0.0158	99
TF-5	1425	0.0239	0.0296	0.0123	0.0270	63

NMOG - US06

Fuel	Wobbe	Accord	Crown Vic	Caravan	Ram Van	MN*
TF-1	1245	0.0040	0.0038	0.0037	0.0040	103
TF-2	1182	0.0056	0.0049	0.0045	0.0021	89
TF-3	1284	0.0037	0.0042	0.0049	0.0044	88
TF-4	1341	0.0017	0.0055	0.0029	0.0035	99
TF-5	1425	0.0040	0.0041	0.0023	0.0046	63

CO - FTP

Fuel	Wobbe	Accord	Crown Vic	Caravan	Ram Van	MN*
TF-1	1245	0.5315	0.9525	0.2623	1.1925	103
TF-2	1182	0.7080	1.2640	0.4605	1.2365	89
TF-3	1284	0.7260	1.2615	0.3665	0.8283	88
TF-4	1341	0.7063	1.4974	0.2145	0.8590	99
TF-5	1425	0.6187	1.4815	0.2907	1.0870	63

CO - US06

Fuel	Wobbe	Accord	Crown Vic	Caravan	Ram Van	MN*
TF-1	1245	0.5970	1.1550	0.4813	1.6343	103
TF-2	1182	0.7545	1.4770	0.6545	1.2610	89
TF-3	1284	0.7010	1.3395	0.6110	0.9615	88
TF-4	1341	0.7527	1.8116	0.2435	1.0160	99
TF-5	1425.00	0.6760	1.6680	0.3423	1.1090	63

* ARB Staff Calculation

Table B: Measured Emissions From Light-Duty Bi-fuel and After-Market Conversion Vehicles[1]

Vehicie Emissions (grams/mile) - Bi-Fuel After Market Conversions and Prototype

NOx - FTP

Fuel	Wobbe	Dakota	Sierra	GMC Pas	QVM F250	MN*
TF-1	1245	0.0613	0.2893	0.3295	0.4890	103
TF-2	1182	0.0600	0.2650	0.4275	0.4820	89
TF-3	1284	0.0673	0.3910	0.3420	0.6170	88
TF-4	1341	0.0615	0.5070	0.3405	0.7075	99
TF-5	1425	0.0670	0.3015	0.3610	0.4765	63

NOx - US06

Fuel	Wobbe	Dakota	Sierra	GMC Pas	QVM F250	MN*
TF-1	1245	0.2280	0.4877	0.7375	0.6285	103
TF-2	1182	0.2940	0.4235	0.8120	0.6740	89
TF-3	1284	0.2935	0.5805	0.7325	0.7315	88
TF-4	1341	0.2370	0.7130	0.7700	0.7300	99
TF-5	1425	0.3170	0.5175	0.8080	0.5745	63

NMOG - FTP

Fuel	Wobbe	Dakota	Sierra	GMC Pas	QVM F250	MN*
TF-1	1245	0.0246	0.0327	0.0520	0.0452	103
TF-2	1182	0.0256	0.0550	0.0820	n/a	89
TF-3	1284	0.0616	0.0645	0.1179	0.1479	88
TF-4	1341	0.0245	n/a	0.0562	n/a	99
TF-5	1425	0.0334	0.0648	0.0946	0.1105	63

NMOG - US06

Fuel	Wobbe	Dakota	Sierra	GMC Pas	QVM F250	MN*
TF-1	1245	0.0023	0.0068	0.0262	0.0213	103
TF-2	1182	0.0033	0.0184	0.0717	n/a	89
TF-3	1284	0.0044	0.0135	0.0764	0.0488	88
TF-4	1341	0.0034	n/a	0.0427	n/a	99
TF-5	1425	0.0041	0.0154	0.0771	0.0418	63

CO - FTP

Fuel	Wobbe	Dakota	Sierra	GMC Pas	QVM F250	MN*
TF-1	1245	2.9727	3.1593	5.8705	3.5800	103
TF-2	1182	3.0585	3.9595	6.4060	2.4220	89
TF-3	1284	3.6863	3.6100	7.0400	3.3060	88
TF-4	1341	2.7850	3.6160	5.9830	2.9340	99
TF-5	1425	3.1605	3.8565	6.9345	3.2380	63

CO - US06

Fuel	Wobbe	Dakota	Sierra	GMC Pas	QVM F250	MN*
TF-1	1245	3.6005	3.4223	7.3355	4.7420	103
TF-2	1182	3.9195	4.6905	7.8355	3.6990	89
TF-3	1284	4.3705	4.1320	8.2180	4.4495	88
TF-4	1341	3.9160	3.9233	7.5235	4.3950	99
TF-5	1425	4.1515	4.2080	8.2880	4.5340	63

* ARB Staff Calculation

Table C: Light-Duty Dedicated OEM Vehicle Fuel Economy Data[1]

Dedicated NGVs (OEMs)
Average Fuel Economy (mpg)

Fuel	Wobbe	CH4/THC Vol. %	Lower Heating Value (LHV)	Specific Gravity X LHV	Accord	Caravan	MN*
TF-1	1245	0.981	864	512	27.69	21.15	103
TF-2	1182	0.938	839	519	31.66	20.67	89
TF-3	1284	0.910	913	566	36.62	22.68	88
TF-4	1341	0.967	922	536	34.22	23.38	99
TF-5	1425	0.848	1101	799	43.65	20.64	63

Fuel	Wobbe	CH4/THC Vol. %	Lower Heating Value (LHV)	Specific Gravity X LHV	Ram Van	Crown Vic	MN*
TF-1	1245	0.981	864	512	17.54	22.47	103
TF-2	1182	0.938	839	519	18.31	23.82	89
TF-3	1284	0.910	913	566	17.93	23.62	88
TF-4	1341	0.967	922	536	17.16	21.88	99
TF-5	1425	0.848	1101	799	22.08	28.97	63

* ARB Staff Calculation

Table D: Light-Duty Bifuel and After-Market Conversion Vehicles Fuel Economy Data[1]

Bi-Fuel After Market Conversion and Prototype
Average Fuel Economy (mpg)

Fuel I	Wobbe	CH4/THC Vol. %	Lower Heating Value (LHV)	Specific Gravity X LHV	QVM F250	GMC PAS	MN*
TF-1	1245	0.981	864	512	13.94	12.95	103
TF-2	1182	0.938	839	519	15.52	13.47	89
TF-3	1284	0.910	913	566	15.74	13.62	88
TF-4	1341	0.967	922	536	14.70	12.74	99
TF-5	1425	0.848	1101	799	18.65	15.97	63

* ARB Staff Calculation

Table E: Summarized HD Data for UDDS Cycle[2]

TEST CYCLE: UDDS

'97 8.1L, Deere, closed loop

#1	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	7.97	0.26	7.62	980.1	0.43	0.016	7.33
80.8	7.47	0.22	8.98	1020.3	1.34	0.029	7.67
77.2	7.71	0.19	8.16	1040.7	1.41	0.006	7.60
72.9	7.52	0.22	7.10	1077.1	1.466	0.008	8.00

'99 8.3 L Cummins, closed loop

#2	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	9.59	0.68	10.34	1069.9	1.90	0.07	6.10
80.8	7.18	0.75	12.40	1097.7	1.80	0.043	6.70
77.2	7.16	0.72	13.79	1106.2	1.78	0.039	6.83
72.9	7.33	0.78	12.42	1143.7	1.89	0.039	7.03

'96 6.8L Deere, closed loop

#3	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	8.43	3.77	11.39	910.3	1.79	0.013	6.07
80.8	7.90	4.22	12.84	961.2	2.60	0.009	7.60
77.2	7.90	4.24	12.51	959.2	2.74	0.008	7.83
72.9	8.22	4.20	11.03	978.1	2.91	0.011	8.33

'99 8.1L Deere, closed loop

#4	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	8.59	3.12	5.96	931.6	1.97	0.032	6.97
80.8	7.91	3.43	6.86	944.1	2.71	0.016	7.70
77.2	8.06	3.64	6.76	956.2	2.87	0.027	7.83
72.9	7.99	3.44	6.07	985.3	2.97	0.031	8.13

'96 8.5L Detroit Diesel, open loop

#5	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	11.01	4.59	14.24	1258.9	2.42	0.02	5.10
80.8	9.07	5.01	20.76	1290.1	3.03	0.033	5.70
77.2	8.96	5.18	22.57	1306.7	3.14	0.031	5.75
72.9	12.79	5.02	7.52	1336.3	4.67	0.021	6.05

'93 10.0L Cummins, open loop

#6	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	5.16	0.04	6.39	1167.1	0.96	0.03	5.66
80.8	5.25	0.06	16.66	1468.7	1.30	0.051	5.10
77.2	6.40	0.08	9.15	1573.2	1.65	0.041	5.27
72.9	5.22	0.06	18.04	1478.5	1.30	0.055	5.17

'99/'00 12.7L DD (LNG), closed loop

#7	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	15.00	6.45	4.53	1101.1	0.85	0.52	8.80
80.8	13.53	10.88	6.10	1084.3	2.71	0.482	8.90
77.2	14.64	13.48	6.46	1083.8	3.24	0.512	8.83
72.9	14.19	7.53	4.47	1139.8	3.34	0.500	8.50

*ARB staff calculation

Table F: Summarized HD Data for Mod-CBD Cycle[2]

TESTCYCLE: MCBD

'97 8.1L, Deere, closed loop								
#1	Tailpipe Emissions (GRAMS/MI.)							Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic		(MI/Gal.)
99.1	5.06	0.16	3.88	767.1	0.329	0.008		9.43
80.8	4.64	0.14	4.56	788.2	0.78	n.a.		9.97
77.2	4.90	0.18	4.60	811.1	0.86	0.004		9.80
72.9	4.53	0.14	4.09	825.2	0.82	0.008		10.47

'99 8.3 L Cummins, closed loop								
#2	Tailpipe Emissions (GRAMS/MI.)							Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic		(MI/Gal.)
99.1	5.01	0.53	7.28	831.9	1.01	0.028		7.87
80.8	3.87	0.57	9.28	853.0	0.95	0.03		8.67
77.2	3.82	0.59	9.04	845.7	0.93	0.026		9.00
72.9	3.91	0.59	8.59	872.6	0.99	0.028		9.30

'96 6.8L Deere, closed loop								
#3	Tailpipe Emissions (GRAMS/MI.)							Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic		(MI/Gal.)
99.1	6.29	3.38	8.38	766.4	1.40	0.006		8.43
80.8	5.81	3.89	9.12	805.1	1.97	0.004		9.10
77.2	5.87	4.01	10.70	822.0	2.06	0.006		9.17
72.9	6.36	3.90	7.02	838.4	2.24	0.006		9.73

'99 8.1L Deere, closed loop								
#4	Tailpipe Emissions (GRAMS/MI.)							Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic		(MI/Gal.)
99.1	6.50	2.68	3.82	759.6	1.29	0.033		8.57
80.8	4.78	2.94	4.32	755.1	1.65	0.019		9.67
77.2	5.14	2.99	4.15	781.2	1.87	0.019		9.60
72.9	5.31	2.97	3.79	813.4	2.00	0.025		9.87

'96 8.5L Detroit Diesel, open loop								
#5	Tailpipe Emissions (GRAMS/MI.)							Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic		(MI/Gal.)
99.1	7.69	3.49	8.04	1013.5	1.68	0.025		6.40
80.8	6.70	3.78	11.15	1039.8	2.25	0.04		7.07
77.2	6.48	3.97	12.32	1039.1	2.25	0.022		7.23
72.9	8.43	3.91	4.44	1099.8	2.98	0.021		7.43

'93 10.0L Cummins, open loop								
#6	Tailpipe Emissions (GRAMS/MI.)							Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic		(MI/Gal.)
99.1	6.90	0.07	9.96	1454.0	1.26	0.090		4.50
80.8	4.14	0.04	9.70	1193.1	1.02	0.03		6.23
77.2	4.96	0.05	4.36	1242.0	1.30	0.030		6.67
72.9	3.87	0.06	11.24	1180.2	0.94	0.037		6.47

'99/'00 12.7L DD (LNG), closed loop								
#7	Tailpipe Emissions (GRAMS/MI.)							Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic		(MI/Gal.)
99.1	10.08	6.33	2.26	1051.7	0.82	0.175		9.33
80.8	8.50	7.43	2.95	1034.9	1.97	0.18		9.47
77.2	8.43	7.70	3.13	1050.6	2.14	0.177		9.33
72.9	10.35	6.19	2.20	1126.4	2.70	0.196		8.70

*ARB staff calculation

Table G: Summarized HD Data for Commuter Cycle[2]

TEST CYCLE: Commuter

'97 8.1L, Deere, closed loop							
#1	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	4.69	0.08	3.58	674.9	0.208	0.005	10.67
80.8	4.17	0.03	4.59	718.5	0.60	n.a.	10.97
77.2	3.97	0.08	4.33	690.1	0.62	0.007	11.57
72.9	3.77	0.04	4.47	711.3	0.57	0.009	12.13

'99 8.3 L Cummins, closed loop							
#2	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	4.69	0.30	3.99	723.8	0.96	0.075	9.07
80.8	3.47	0.34	5.46	712.4	0.81	0.02	10.33
77.2	3.58	0.35	5.05	715.7	0.83	0.035	10.63
72.9	3.53	0.34	4.92	737.4	0.85	0.031	10.97

'96 6.8L Deere, closed loop							
#3	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	4.66	2.64	10.22	627.1	0.99	0.009	10.30
80.8	4.35	2.90	11.63	662.0	1.46	0.006	11.10
77.2	4.52	3.01	11.49	676.9	1.58	0.021	11.13
72.9	4.47	2.93	9.80	681.7	1.55	0.004	12.00

'99 8.1L Deere, closed loop							
#4	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	4.55	1.95	4.40	614.2	0.99	0.033	10.60
80.8	5.08	2.40	4.56	714.3	1.74	0.030	10.20
77.2	5.14	2.45	4.32	717.4	1.83	0.027	10.47
72.9	5.17	2.45	4.20	740.8	1.92	0.013	10.83

'96 8.5L Detroit Diesel, open loop							
#5	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	5.27	3.05	7.81	894.7	1.24	0.020	7.27
80.8	4.32	3.43	10.65	926.4	1.43	0.03	8.00
77.2	4.02	3.53	11.91	914.5	1.39	0.018	8.27
72.9	5.95	3.45	4.20	983.9	2.19	0.024	8.37

'93 10.0L Cummins, open loop							
#6	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	4.08	0.04	8.32	1070.5	0.70	0.029	6.13
80.8	2.80	0.02	12.91	1075.0	0.61	0.02	6.97
77.2	2.44	0.02	16.34	1068.2	0.53	0.044	7.17
72.9	3.54	0.03	6.36	1137.5	0.82	0.020	7.30

'99/'00 12.7L DD (LNG), closed loop							
#7	Tailpipe Emissions (GRAMS/MI.)						Fuel Econ
MN*	THC	CO	NOx	CO2	NMHC	Partic	(MI/Gal.)
99.1	5.02	2.54	3.02	660.8	0.31	0.116	14.93
80.8	4.15	3.22	5.39	657.4	0.89	0.10	15.07
77.2	4.33	3.83	4.33	667.2	1.00	0.113	14.80
72.9	4.77	3.13	3.26	706.8	1.15	0.117	14.03

*ARB staff calculation

1 Bevilacqua, Oreste M., Ph.D. "Natural Gas Vehicle Technology and Fuel Performance Evaluation Program", Clean Air Vehicle Technology Center, File No. Z-19-2-013-96, April 1, 1997.

2 Bevilacqua, Oreste M., Ph.D., "Impacts of Natural Gas Fuel Composition on Tailpipe Emissions and Fuel Economy", ARB Public Workshop on the Alternative Fuels Regulations, Sacramento, CA, June 21, 2000.

3 Bevilacqua, Oreste M., "Natural Gas Vehicle Technology and Fuel Performance Evaluation Program (PEP), Phase II: Medium- and Heavy-Duty Vehicle Testing, Technical Proposal", Clean Air Vehicle Technology Center, December 18, 1998.

Appendix C - Overview and Results of LPG Testing Programs

A. LPG Emission Tests

Studies have been conducted to evaluate the impact of varying LPG quality on motor vehicle exhaust emissions. Three studies include the LPG Task Group test program, the WPGA test program, and the ARCO emission tests.

The LPG Task Group test program is the 1998 test program coordinated by staff with a LPG Task Group established by the ARB to oversee the project. The task group consists of representatives from refiners, engine makers, automakers, LPG marketers, and government agencies. The test program was initiated during the 1998 rulemaking to amend the motor vehicle LPG specifications. Emission tests were performed for both heavy duty and light duty vehicles on six different LPG fuel quality.

The WPGA study was sponsored by the WPGA in support of its 1996 petition to delay the 5 volume percent propene limit. Emission tests were performed on light duty duel fuel (LPG and gasoline) vehicles on indolene (Federal certification gasoline) and seven LPGs blends.

ARCO, with several co-investigators, conducted three emission tests on various propane/butane mixtures. Two of the tests, published in 1995, were laboratory studies on a light duty vehicle converted to LPG. The third study, published in 1998, was an in-use vehicle study (during the course of operation) on three medium-duty, LPG-converted transit vehicles.

1. Summary of Estimated Emission Effects of LPG Containing 10 Volume Percent Propene on Individual Vehicle

Table C-1 summarizes information from the three studies about the potential effects of propene and butane content on emissions. The LPG Task Group and the WPGA studies show that the 10 volume percent propene fuel resulted in a small increased (less than 10 percent) in NOx emissions in relation to the 5 volume percent propene fuel. The ARCO data indicate that for some LPG vehicles, emissions of hydrocarbons, CO, and OFP may increase slightly and NOx may decrease slightly at butane content of about 5 volume percent which is the current limit for butane. Detail discussion of the three studies are presented in the 1998 report, entitled, *Proposed Amendment to the Specifications for LPG used in Motor Vehicles*[1,2].

Table C-1: Estimates of Emission Effects in LPG Vehicles --

10% Propene and 5% Butane Fuel vs. 4% Propene and 2.0% Butane Fuel

(percent change)

Data Source	*NMHC or THC*	*NOx*	*CO*	*Ozone-Forming Potential*
Task Group HDV tests (Cummins Engine)	-18%	9%	6%	6%
Task Group LDV tests (Ford F-150)	-9%	-6%	1%	3%
WPGA LDV tests*	0	9%	2%	15%
ARCO LDV tests (butane effect, only)	small increase	small decrease	small increase	small increase
ARCO MDV tests (butane effect, only)	0	0	0	very small increase

* per ARB staff's regression analysis

2. Analysis of Emission Data from LPG containing Greater than 10 Volume Percent Propene on Heavy Duty Engine

Bobtails are LPG delivery trucks capable of fueling on the cargo fuel. Bobtails have been operating on commercial LPG. Commercial LPG fuel could contain from 15 to 30 volume percent propene in the summer months and could be as high as 60 volume percent propene during the winter months[3]. Of the three studies discussed above, only the Task Group study evaluated heavy duty engine on varying propene content as high as 21 percent. Thus, test data were re-evaluated to determine the emission effects of heavy-duty vehicle operating on LPG containing greater than 10 volume percent propene content.

Of the fuels selected by the Task Group, only two test fuels contain greater than 10 percent propene content. Table C-2 describes the two fuels and the base fuel which meets the current specifications of 10 volume percent propene or less and 5 volume percent butane or less. The fuels were tested in a Cummins B5.9 medium heavy-duty LPG engine

Table C-2: ARB/Task Group Test Fuels

Fuel	Propene, vol%	Butane, vol%*	Octane # **
Base	9.8	5.0	101.2
1	14.6	5.0	100.2
2	21.3	1.6	---

* Mean of all measurements
** (R+M)/2

The top half of Table C-3 shows, for the Cummins engine tests, the average emissions from the base fuel and from test fuels 1 and 2. The bottom half of the table shows the same results as percent changes relative to the base fuel average. Linear drift was seen for NOx emissions, therefore the adjusted NOx emissions are shown in the table. Emissions increased slightly for NOx from the beginning to the end of the test program. The emissions drift effect (as fit by a linear model) was statistically significant above a 90 percent confidence level but did not change the results significantly. The analysis and a graphical representation of the data for NOx is presented in the 1998 report.

Table C-3: Average Results for Cummins Engine

Fuel	Propene	Butane	NMHC	THC	CO	NOx*		NMOG	OFP
			Actual Emissions, grams/bhp-hr						
Base	9.8	5.0	.670	.702	.407	3.18	(3.19)	.689	1.14
1	14.6	5.0	.636	.670	.489	3.26	(3.24)	.849	1.34
2	21.3	1.6	.594	.623	.324	3.63	(3.56)	.518	1.07
			Changes Relative to 10% Propene Fuel						
1	14.6	5.0	-5%	-5%	**20%**	**3%**	**(2%)**	**23%**	**18%**
2	21.3	1.6	-11%	-11%	-20%	**14%**	**(12%)**	-25%	-6%

* Numbers in ( ) are adjusted for emissions drift effects.

As shown from the table, increasing the propene and butane contents of the LPG blends (fuel 1) appeared to decrease hydrocarbon emissions but increased oxides of nitrogen (NOx); non-methane organic gas (NMOG); and carbon monoxide (CO) emission, and the ozone-forming potential (OFP) of emissions. However, reducing the butane content to less than 2.5% (fuel 2), as specified in the commercial LPG standard, appeared to only increase NOx emissions. As seen from the table, the NOx emission increases could be as high as 14 percent more than a 10 volume percent propene fuel.

B. Performance and Durability Testing

The LPG Task Group test program also collects data regarding engine performance and engine durability associated with different formulations of LPG. Both tests were completed in 1999.

The LPG Task Group engine performance and combustion compared how a Cummins B5.9-195 LPG engine operates on a 10 volume percent propene fuel and on a 5 volume percent propene fuel for various internal temperatures, pressures, voltages, knock, and power. The objective of the tests was to determine if the engine continues to operate within the manufacturer's design limits while using the 10 volume percent propene fuel. The results reported was that in general, engine performance was unaffected by fuel blend. The engine was able to produce full power at each engine speed with both blends of fuel. No detonation was encountered (audibly or visually with an oscilloscope) with either fuel blend.

For the durability portion of the test program, 500-hour full-load dynamometer test was performed on the prototype Cummins B5.9L spark ignition propane engine on 10 volume percent propene fuel. Results show no abnormal wear to the engine.

Other reported performance testing was by Detroit Diesel. Detroit Diesel has reported testing LPG with 9.8 volume percent propene and 2.3 volume percent butane in a Detroit Diesel Series 50 engine for cold-start cranking and idle stability, peak torque and horsepower, and knock sensitivity. The test fuel was compared to a 5 volume percent propene fuel. Operation on the 9.8 volume percent propene fuel was indistinguishable from operation on the 5 volume percent propene fuel, except for greater knock sensitivity at 1500 revolution per minute (rpm) (but not other rpms). The knock sensitivity, measured as the maximum air-charge temperature that did not produce knock, was well within the design value and not expected to be encountered in normal use[1,2].

1 Air Resources Board, Proposed Amendment to the Specifications for LPG Used in Motor Vehicles, October 23, 1998.

2 Air Resources Board; "Motor Vehicle LPG Test Program (1997/1998)," http://www.arb.ca.gov/fuels/altfuels/lpg/mvlpge/mvlpge.htm.

3 Meetings and telephone contacts with individual California refiners, fall and winter 2000

Appendix D - Methane Number and Fuel Composition

Providing an optional methane number specification for the CNG motor vehicle fuel specifications satisfies both the need to control fuel variability according to the engine manufacturers requirements and to allow more flexibility in fuel composition. Several manufacturers of heavy-duty natural gas engines use either the methane number (MN) or motor octane number (MON) for specification of gas quality requirements.[1, 2] Both the MON and the MN are measures of the knock resistance of the fuel with the difference being the reference fuels used.

A. Methane Number Correlation

The knock resistance of a fuel is determined by comparing the compression ratio at which the fuel knocks to a reference fuel blend that knocks at the same compression ratio. Different scales have been used to rate the knock resistance of CNG including the motor octane number (MON) and the methane number (MN). The differences in these ratings are the reference fuel blends used for comparison to the natural gas. The reference fuel blend used for comparison to the natural gas for the MON is composed of iso-octane, with an octane number of 100, and n-heptane with an octane number of 0. However, since natural gas has a higher knock resistance than iso-octane, tetraethyl lead (TEL) must be blended with the reference fuel to increase the reference MON.[3, 4] The MON for CNG fuels range from approximately 115 to over 130. Methane number uses a reference fuel blend of methane, with a methane number of 100, and hydrogen, with a methane number of 0. The work documented in references 10 and 11 generated correlations between the reactive hydrogen/carbon ratio (H/C) and the MON and between MON and MN. The reactive hydrogen/carbon ratio, which excludes the carbon in the inerts, specifically the CO2, is the number of hydrogen atoms divided by the number of carbon atoms in the hydrocarbon components of the fuel. The correlations used by the engine manufacturers for MON as a function of H/C and MN as a function of MON are: [1, 3, 4]

$$MON = -406.14 + 508.04*(H/C) - 173.55*(H/C)^2 + 20.17*(H/C)^3$$
$$MN = 1.624*MON - 119.1$$

The correlation of MON with H/C ratio is shown in Figure D-1 below. The MON correlation is not valid for H/C ratios below 2.5 or for inert concentrations greater than 5%.

Figure D–1 Motor Octane Number as a Function of Reactive Hydrogen / Carbon Ratio

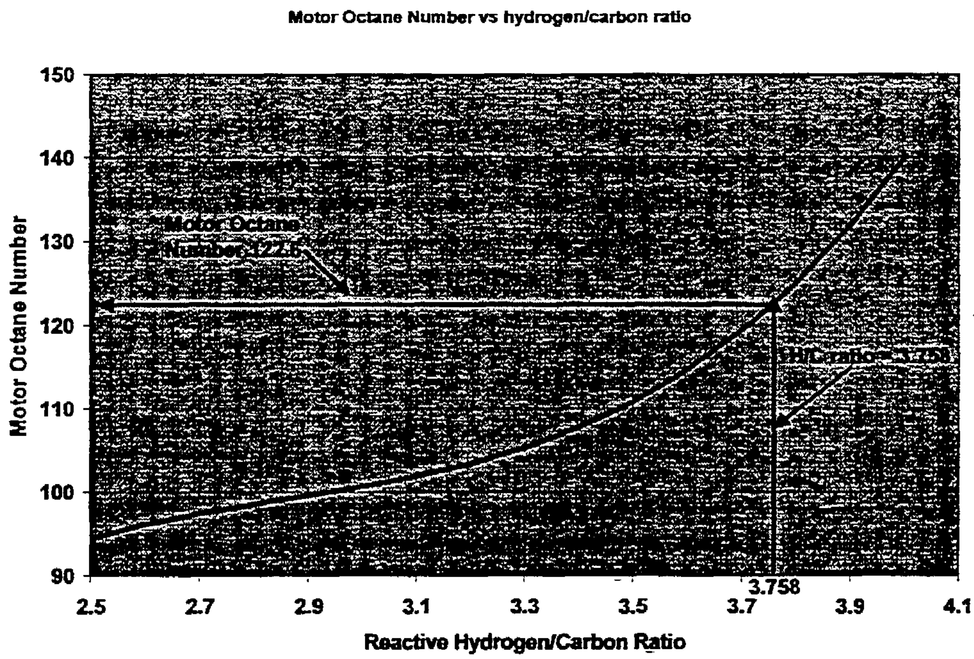
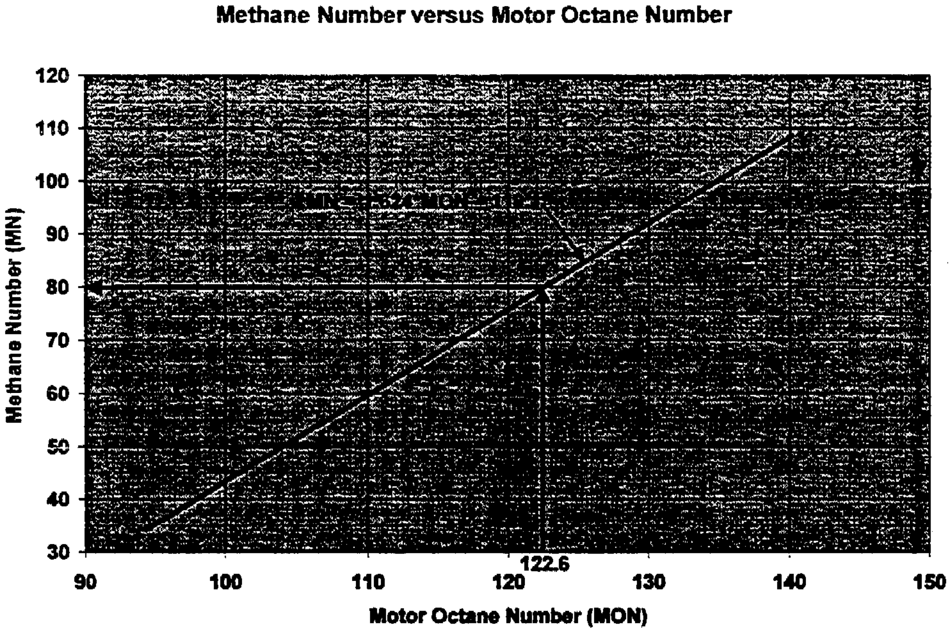


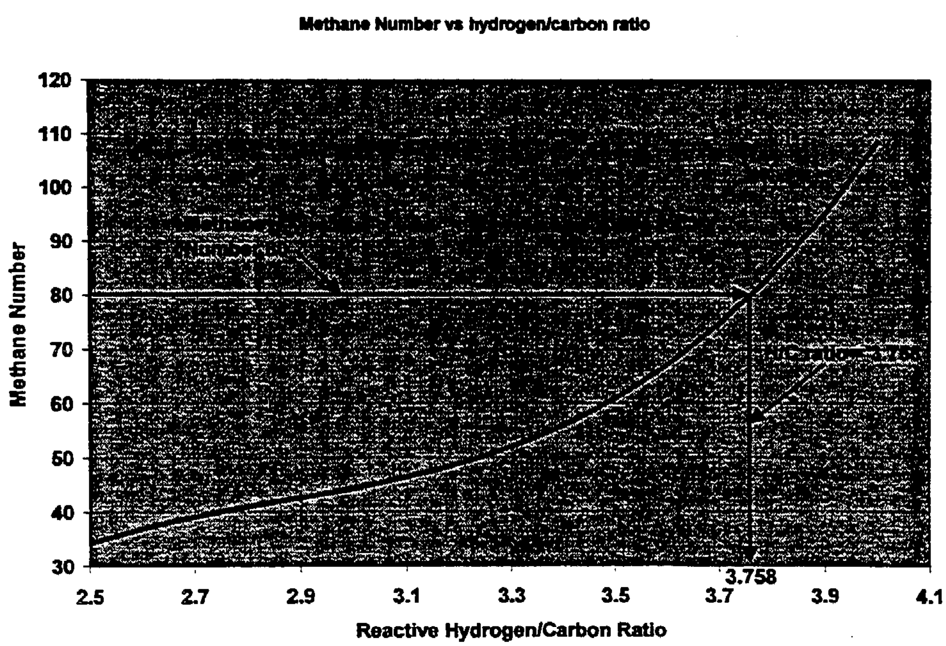
Figure D-2 below shows the relationship between MON and MN. From this figure it can be seen that a MON of approximately 122.6 is equivalent to a MN of 80. From Figure D–1 above, it is apparent that a reactive hydrogen/carbon ratio of 3.758 results in a MON of 122.6. Consequently, a reactive hydrogen/carbon ratio of 3.758 is necessary to obtain a MN of 80. This is shown in Figure D–3 below.

Figure D-2 Methane Number as a Function of Motor Octane Number



The MN can be shown as a function of reactive hydrogen/carbon ratio as shown in Figure D-3 below.

Figure D-3 Calculated Methane Number as a Function of Reactive Hydrogen/Carbon Ratio



B. Fuel Composition Flexibility

The proposed optional MN fuel quality specification being considered would allow gas compositions that do not meet the current compositional specification requirement to be compliant if the calculated methane number was at 80 or above. Thus, a gas specie could be higher than allowed by the current compositional specification if the overall reactive H/C ratio for the entire gas composition was a value of 3.758 or greater. For example, a gas with high ethane content could be compliant if the C3+ content was sufficiently low to compensate for it in the overall reactive H/C ratio.

Table D-1 gives an array of hypothetical gas compositions and the calculated methane number for each composition. The first two compositions do not meet the compositional CNG motor vehicle fuel specifications; however they would meet the proposed optional methane number 80 specification. The first gas, labeled low ethane, high C3+, has a C3+ content of 4.65%, which is over 50% higher than the current allowable level of 3%. However, the ethane content of 2.2% is much lower than the 6% allowable. The overall reactive H/C ratio is greater than 3.758, which gives a methane number of 80.4 for the composition. The second gas in the table, labeled high ethane, low C3+, has an ethane content of 8.66%, nearly 50% over the allowable 6%. However, the C3+ content of 1.86% is well below the allowable 3%, resulting in a reactive H/C ratio of just over 3.758 and a methane number of 80.

The last three hypothetical gases in Table D-1 meet the current compositional specification but have different C3+ compositions to illustrate the effect of heavier hydrocarbon components on methane number. All three gas compositions have 3% C3+. However the first of the three gases has C3+ that contains only propane whereas the other two gases have increasingly more of the heavy hydrocarbons in the C3+. The C3+ of the second of the three gases averages to a carbon atom number of 3.5 (C3.5) and that of the last gas averages to a carbon atom number of 4 (C4). The heavier hydrocarbons in the gas, which are those components with lower H/C ratios, lower the overall reactive H/C ratio of the gas and reduce the methane number, as shown in Figure D - 3 above. Consequently, the methane number for the three gases range from MN 82, for the gas with C3+ that is all propane (C3), down to MN 77, for the gas with the C3+ that averages to a C4.

The proposed methane number optional specification gives gas producers with non-compliant CNG motor vehicle fuel gas more flexibility in cleaning up their gas. Since heavier hydrocarbons condense at higher temperatures than the lighter hydrocarbons, they are easier to remove from the gas. This is evident from typical natural gas liquids (NGL) recovery efficiencies for different processes. Actual recovery efficiencies will vary with plant design and feed gas quality, however, a lean oil absorption plant can typically recover 99 percent of the butane and heavier hydrocarbons, 65 to 75 percent of the propane and 15 to 25 percent of the ethane from a natural gas. A typical refrigeration process can recover 100 percent of the butane and heavier hydrocarbons, 98 percent of the propane and 50 percent of the ethane. A typical cryogenic process can recover all of the propane and heavier hydrocarbons and 50 percent to over 90 percent of the ethane.[5]

Consequently, a gas producer with a high ethane content gas could chose to remove a portion of the heavier hydrocarbons to meet the proposed methane number 80 specification rather than reducing the ethane, which is more difficult to remove. Additionally, these heavier hydrocarbons are more marketable in California than ethane. One possible option is re-injection of these heavier components into the crude oil.

Table D-1 Example Gas Compositions Meeting Either the Proposed Methane Number 80 Specification or the Current Specifications

					C3+ constituents:								
Mole Fraction:	Inerts	methane	ethane	C3+ total	propane	Iso-butane	n-butane	Iso-pentane	n-pentane	C6+	Reactive H/C	MON	MN
CNG meeting MN80:													
Low ethane, high C3+	0.0179	0.9137	0.022	0.0465	0.032	0.0031	0.0092	0.0008	0.0009	0.0005	3.763	122.9	80.4
High ethane, low C3+	0.046	0.8488	0.0866	0.0186	0.0142	0.0006	0.0014	0.0008	0.0012	0.0004	3.759	122.6	80.0
CNG meeting current specifications:													
Spec gas, C3+ all propane	0.03	0.88	0.06	0.03	0.03	0	0	0	0	0	3.780	123.9	82.1
Spec gas, C3+ averages to C 3.5	0.03	0.88	0.06	0.03	0.02	0.003	0.003	0.002	0.001	0.001	3.756	122.4	79.7
Spec gas, C3+ averages to C 4	0.03	0.88	0.06	0.03	0.01	0.0055	0.0055	0.0035	0.0035	0.002	3.731	121.0	77.4

---

1 Facsimile from Vinod Duggal, Cummins Engine Co, to Lesley Crowell, ARB, dated February 26, 2001.

2 Paul Delong of John Deere, Telephone conversation with ARB Staff, 3/6/01.

3 Kubesh, John, King, Steven R., Liss, William E., "Effect of Gas Composition on Octane Number of Natural Gas Fuels", *Society of Automotive Engineers, Inc.*, SAE 922359, 1992.

4 Kubesh, John T., "Effect of Gas Composition on Octane Number of Natural Gas Fuels", SwRI-3178-4.4, GETA 92-01, GRI-92/0150, May 1992.

5 Spletter, Kathy, Adair, Lesa, "Processing", *Oil and Gas Journal*, May 21, 2001.

Appendix E – CNG Engine Performance

The variation in CNG composition seen throughout the South Central Coast and southern San Joaquin Valley can adversely affect engine performance. These effects can include misfire, stumble and underrated operation[1] as well as engine knock and overheating. These effects are dependent on the engine's ability to tolerate or compensate for the variation in fuel composition.

A. Stoichiometric Burn Engines

Engines designed for an air/fuel ratio that can completely burn the fuel without excess air remaining are called stoichiometric burn engines. Light-duty engines are stoichiometric burn engines. Stoichiometric burn engines have been used for light-duty application because they can be equipped with three-way catalyst exhaust after-treatment technology to meet light-duty vehicle exhaust emissions standards.[2] Additionally, the stoichiometric exhaust properties allow the use of a standard stoichiometric exhaust gas oxygen sensor for feedback control of the air/fuel ratio.[3] This feedback control improves engine performance with variable gas properties. However, these advantages come at a price of reduced fuel economy and higher combustion temperatures.

Stoichiometric light-duty engines are also more tolerant of variations in fuel composition. Stoichiometric conditions contain neither excess air nor excess fuel that would serve to dilute the combustion products and reduce combustion temperatures. Consequently, stoichiometric conditions are hotter or more severe than off-stoichiometric conditions and are more likely to cause knock, or detonation, than either richer (more fuel) or leaner (less fuel) conditions. Detonation occurs when there is uncontrolled combustion with multiple flame fronts rather than the combustion proceeding smoothly along a flame front from a single source of ignition, the spark plug.[4, 5] Detonation can be extremely damaging to hardware. Consequently, stoichiometric engines are designed to tolerate the most severe conditions, thus, changes in air/fuel ratio due to variable fuel quality moves the engine operation off stoichiometric to more benign conditions.[6]

B. Lean-Burn Engines

Engines designed to operate at an air/fuel ratio with more air than required to completely burn the fuel, referred to as excess air or lean fuel conditions, are called lean-burn engines. Medium and heavy-duty engines are usually designed as lean-burn engines because these engines are more fuel-efficient and produce lower combustion temperatures than stoichiometric burn combustion. This engine technology has been used to meet applicable exhaust emission standards without the use of after-treatment technology. Excess air both ensures that all the fuel is burned and dilutes the combustion products to reduce the combustion gas temperature. The lower combustion temperatures minimize NOx emissions without after-treatment as well as increase hardware life.

Lean-burn engines are more susceptible to problems arising from variable fuel quality. Most lean-burn heavy-duty engines are designed to operate close to the lean mis-fire zone to minimize

NOx emissions.[1] The lean mis-fire zone is the operating zone where there is too little fuel for the air provided to sustain the burning process. Changes in fuel quality for a lean burn engine can result in mis-fire if the change results in leaner conditions, or detonation and/or overheating if the change results in richer conditions.

C. Open Loop and Closed Loop Systems

All light duty stoichiometric burn engines include feedback controls that process information from the exhaust to aid in engine operation. This is called a closed loop system. Lean-burn engines can be designed either with or without feedback controls. Engines without feedback controls are called open loop systems. Open loop systems use a predetermined "map" of load and speed to determine the engine fuel injection requirements.[1] A certain fuel composition must be assumed to generate this "map". Consequently open loop systems are less tolerant of changes in fuel composition. Engines with closed loop systems have computers that use measurements of the oxygen content of the exhaust stream combined with information about the mode of operation (i.e. throttle level and fuel flow) to adjust engine operation for fuel quality.[1] The exhaust stream oxygen concentration allows the computer to determine how much excess air the engine is running. Light duty stoichiometric burn engines can use a standard stoichiometric exhaust gas oxygen sensor for the necessary feedback controls. However, lean burn heavy-duty engines require a special sensor, (such as a universal exhaust gas oxygen (UEGO) sensor) and/or a special computerized program for engine control.[3] Consequently, not all lean-burn closed loop systems provide the same degree of engine control. First generation systems are more susceptible to fuel quality related operational problems than more recent advanced generation systems. In general however, closed loop systems are more tolerant of changes in fuel composition.

Some higher compression ratio heavy-duty lean burn engines include an additional feedback for knock detection. Higher compression ratio makes an engine more susceptible to knock or detonation. If knock is detected via an accelerometer, the spark plug timing can be retarded, or caused to spark later in the cycle, to reduce knock.[5, 7] Retarding the timing, however, can reduce fuel economy.

D. Gas Quality Requirements

Two measures of CNG gas quality are the Wobbe Index and the methane number. The Wobbe Index is a measure of the fuel interchangeability with respect to its energy content and metered air/fuel ratio.[6, 8] Thus, changes in Wobbe Index can affect the engine's metered air/fuel ratio and power output.[9] The Wobbe Index is calculated from the energy content, or higher heating value of the gas, and the relative density of the gas. The relative density of the gas is the ratio of the gas density to the density of air.

Wobbe Index = Higher Heating value / (relative density)

The methane number is a measure of the knock resistance of the fuel. Knock, or detonation, can be extremely damaging to an engine. Knock occurs when there is uncontrolled combustion with multiple flame fronts rather than smooth combustion proceeding along a flame front initiated at the spark plug.[4,5]Knock can result from the heat produced by compression of the air/fuel gas mixture in the piston. The knock resistance of the fuel is a function of the fuel composition. Methane has a very high knock resistance. The heavier hydrocarbons in CNG, such as ethane, propane, and butane, have lower knock resistance and thus reduce the overall knock resistance of the fuel. Methane number and how it is determined in explained in Appendix D.

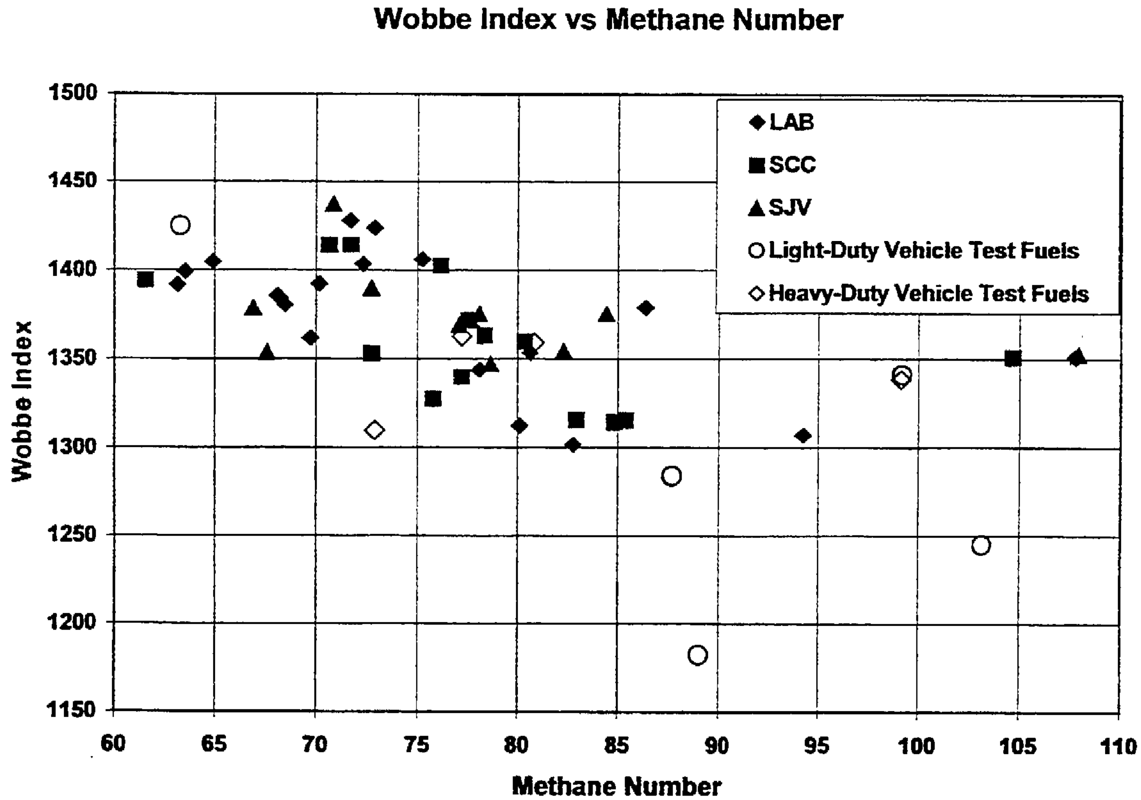
1. Light Duty Engines

Light duty natural gas engines run at stoichiometric burn conditions (sufficient air to completely burn the fuel without excess air remaining) and use closed loop control, making them extremely tolerant of the natural gas fuel variations seen in California. A survey of light duty vehicle manufacturers indicated that fuel quality requirements for light duty engines are more frequently cited in terms of Wobbe Index.

Wobbe Index values given as vehicle requirements range from approximately a minimum of 1300 BTU/ft3 to a maximum of 1400 to 1500 BTU/ft3.[10, 9] This requirement range encompasses the entire fuel quality range reported for the California South Central Coast (SCC), southern San Joaquin Valley (SJV), and the Los Angeles Basin (LAB) regions of approximately 1300 BTU/cu.ft. to 1450 BTU/cu.ft., as shown in Figure 1 below.[11] From this figure it can also be seen that this range encompasses methane numbers down to 65 to70.

Testing to determine the effect of fuel quality on emissions and driveability, discussed in Appendix B, was conducted using eight light-duty natural gas vehicles (NGV) with five different fuel qualities, ranging from a Wobbe Index of 1182 BTU/cu.ft. to 1425 BTU/cu.ft.[12] Staff calculated the methane number range for these fuels to be MN 65 to MN 100. The Wobbe Index and methane number for these test fuels are shown plotted in Figure E-1. Test results showed that for dedicated NGVs, even large variations in fuel composition produced only small variations in the emissions and driveabliltiy, while bifuel vehicles had only modest changes in emissions and performance.[12, 13]

Figure E-1: Wobbe Index and Methane Number Variations of California CNG Fuel [11, 12, 15]



2. Heavy Duty Engines

A survey of heavy duty vehicle manufacturers indicated that fuel quality requirements for heavy duty engines are more frequently cited in terms of methane number or motor octane number. Motor octane number and methane number are linearly related, as shown in Appendix D. A methane number of 80 is required for both open loop and first generation closed loop lean-burn heavy duty engines. However, more recent advanced generation closed loop lean-burn heavy-duty engines can tolerate a fuel quality down to a methane number of 73. Additionally, there are closed loop engines recently certified by ARB as a low emissions engine that can tolerate methane numbers as low as 65.[14]

Testing to determine the effect of fuel quality on emissions was conducted on seven heavy-duty vehicles using four fuels.[15] The results of this testing is summarized in Appendix B. The seven vehicles included five closed loop systems and two open loop systems. Three of the closed loop systems were recent advanced generation systems and the others were first generation systems. The results from one of the closed loop systems, an LNG vehicle, were excluded from the final data presentation due to problems with the vehicle operation. The four fuels tested included a high quality commercial grade fuel with a methane number of 99, a high ethane fuel with a methane number of 81, a high C3+ fuel with a methane number of 79, and a high inerts, ethane and C3+ fuel with at methane number of 73. Only the high quality commercial grade fuel complied with the current CNG motor vehicle fuel specifications. Based on staff calculations, the CNG certification fuel equates to a methane number of approximately 86 to 87 and the CNG in use fuel equates to a methane number of approximately 80 to 82. The high ethane fuel with a methane number of 81 is comparable in terms of methane number to the current minimum fuel quality specifications. Consequently, the emissions effects of allowing advanced generation closed loop systems to use fuel with a methane number of 73 can be evaluated based on a comparison to the methane number 81 fuel. There were increases in carbon dioxide (CO2) and nonmethane hydrocarbon (NMHC) emissions of six percent and approximately 10 percent respectively. There were no discernable impacts on the other emissions.

---

[1] Clark, Nigel N., Mott, Gregory E., Atkinson, deJong, Remco J., Atkinson, Richard J., Latvakosky. Tim, Traver, Michael L., "Effect of Fuel Composition on the Operation of a Lean-Burn Natural Gas Engine", *Society of Automotive Engineers, Inc.*, SAE 952560, 1995.

[2] Clark, Nigel N., Rapp, Bryon L., Gautam, Mridul, Wang, Wenguang, and Lyons, Donald W., "A Long Term Field Emissions Study of Natural Gas Fueled Refuse Haulers in New York City", Reprinted from: Alternative Fuels 1998 (SP-1391), *Society of Automotive Engineers, Inc.*, SAE 982456, 1998.

[3] Clark, Nigel n., Atkinson, Christopher M., Lyons, Donald W., Mott, Gregory E., and deJong, Remco J., "Development of a Closed Loop Fuel Management System for a Lean Burn Natural Gas Engine", Proceedings of the 1994 Automotive Technology Development Contractors' Coordination Meeting, *Society of Automotive Engineers, Inc.*, SAE P-289, 1994

[4] "Octane Determination in Piston Engines," http://www.prime-mover.org/Engines/GArticles/octane.html.

[5] Bohacz, R.T., "The Causes of Engine Knock, and How to Eliminate it," http://www.zhome.com/ZCMnL/PICS/detonation/detonation.html.

[6] King, Steven R., "The Impact of Natural Gas Composition on Fuel Metering and Engine Operational Characteristics", Southwest Research Institute, *Society of Automotive Engineers, Inc.*, SAE 920593, 1992.

[7] Paul Delong of John Deere, Telephone conversation with ARB Staff, 3/6/01.

[8] North American Combustion Handbook, Vol. I, Third Edition, North American Mfg. Co., Cleveland, OH 44105, 1986.

[9] SAE Standard J1616, Surface Vehicle Recommended Practice, Recommended Practice for Compressed Natural Gas Vehicle Fuel, *Society of Automotive Engineers, Inc.*, Feb 1994.

[10] Ben Knight of Honda R&D Americas, Email message to ARB Staff, 18 June 2001.

[11] Compiled Southern California Gas Data provided to ARB Staff on July 18, 2001, August 1, 2001, and August 2, 2001.

[12] Bevilacqua, Oreste M., Ph.D., "Natureal Gas Vehicle Technology and Fuel Performance Evaluation Program", File No. Z-19-2-13-96, Clean Air Vehicle Technology Center, April 1, 1997.

[13] Bevilacqua, Oreste M., Ph.D., "Impact of Natural Gas Composition on Light-Duty Vehicle Emissions, Fuel Econogy and Driveability, Project Overview", Clean Air Vehicle Technology Center.

[14] Cummins Press release, "Cummins Westport Inc. C8.3G Plus natural gas engine certified by California," http://www.cummins.com/na/pages/en/mediaresources/pressreleases/pressrelease.cfm?uuid=D51BA786-073E-11D4-985C0004AC33EA57, Vancouver, B.C., 32 July 2001.

[15] Bevilacqua, Oreste M., Ph.D., "Impacts of Natural Gas Fuel Composition on Tailpipe Emissions and Fuel Economy", ARB Public Workshop on the Alternative Fuels Regulations, Sacramento, CA, June 21, 2000.

SUMMARY OF BOARD ITEM

ITEM # 02-1-5: **PUBLIC HEARING TO CONSIDER PROPOSED AMENDMENTS TO THE ARB VOLUNTARY ACCELERATED VEHICLE RETIREMENT REGULATIONS**

STAFF RECOMMENDATION: Staff recommends that the board adopt proposed amendments to the Air Resources Board (ARB) Voluntary Accelerated Vehicle Retirement (VAVR) regulations as follows:

- Staff recommends that ARB's VAVR vehicle eligibility regulations be harmonized with the Bureau of Automotive Repairs' (BAR) vehicle scrappage regulations per Health and Safety Code section 44102.

- Staff recommends that the ARB VAVR regulations be amended to allow recovery of non-emission-related and non-drive train parts from scrapped vehicles.

DISCUSSION: This proposal was developed with a significant amount of public input from stakeholders. At the behest of many interested parties (classic car clubs, after-market parts manufacturers, scrap dealers, and local air districts), the ARB staff re-examined the VAVR vehicle eligibility requirements. Staff concluded that many suggestions to change the eligibility requirements to match the BAR eligibility requirements had merit. Also, the statute specifies that the two programs should be harmonious with each other. Staff considered the impact on air quality to be minimal, so no justification emerged dictating that the ARB regulations be substantially different from BAR's. Only two differences between the two programs exist. The proposed amendments would require that to be eligible for scrapping the vehicles be capable of being driven in reverse and that they be registered for a minimum of 120 days before they are scrapped.

Some stakeholders argue that existing statutes mandate unlimited parts recovery from scrapped vehicles. However, ARB staff believes that the ARB regulations provide a balance between air quality concerns and parts recovery interests by prescribing a mandatory 7-day waiting period before a vehicle can be crushed. This mandatory waiting period provision meets both the intent and letter of the Health and Safety Code. Health and Safety Code section 44120, provides that the VAVR regulations are to "allow for trading, sale, and resale of the vehicles between licensed auto dismantlers or other appropriate parties to maximize the salvage value of the vehicles through the recycling, sales, and use of parts of the vehicles."

During this 7-day period, the regulations require the dismantler to notify the local district and provide a description of the vehicle and the date and approximate time when the vehicle is scheduled to be delivered for final sale to the enterprise operator. In addition, ARB regulations require the district to publish this information to allow car collector enthusiasts and those interested in affordable transportation to examine the vehicle and purchase it before it is sold to the enterprise operator. If the vehicle is sold to the public, the regulations prohibit the dismantler from receiving any emission reduction credits. The proposed amendments would expand opportunities for parts recycling by allowing parts to be recycled from scrapped vehicles themselves, provided that the parts are not emissions-related or are not part of the vehicles' drive trains.

Nevertheless, some interested parties, such as classic car collectors, and aftermarket parts manufacturers want unlimited parts recycling from scrapped vehicles.

SUMMARY AND IMPACTS: The staff recommendation harmonizes ARB/BAR regulations. ARB staff believes that the impact of these changes will make ARB/BAR programs more "seamless" to consumers without any significant air quality or financial impact.

With respect to the two differences between the proposed amendments and the BAR regulations, staff believes that vehicles that cannot be driven in reverse generally drive infrequently, if at all. Therefore, this requirement is needed to ensure that the credits claimed under these programs are real. An increase in emissions can result when an infrequently driven or non-operating vehicle is retired and granted a full credit.

Staff proposes to replace the BAR's limits for registration lapse with a requirement that the vehicle be registered as an operating vehicle for at least the last 120 days prior to retirement. This means that as a registered operating vehicle, the vehicle passes the most recently required smog inspection, if one was required for registration, that the vehicle is insured; and, that all fees have been paid.

The staff also recommends that the VAVR regulations be amended to explicitly allow parts recovery for non-emission-related and non-drive train parts. Existing ARB regulations require a mandatory 7-day waiting period to provide third parties the opportunity to inspect and purchase a vehicle if it is of collector interest. However, if a vehicle is sold to a third party, that vehicle cannot be claimed for emission credits. This provision complies with statutory requirements to "Allow for trading, sale, and resale of the vehicles between licensed auto dismatlers or other appropriate parties to maximize the salvage value of the vehicles through the recycling, sales and use of parts of the vehicles." (Health and Safety Code section 44120(a))

The proposed amendments provide even more opportunities for parts recovery. Specifically, if a vehicle is not sold during the 7-day waiting period, a participating dismantler may recover and sell any non-emission-related or non-drive train parts from the vehicle, and can still claim the vehicle for emission credits. The proposed amendments comply with the Health and Safety Code, have the potential to enhance the economic feasibility of the privately funded vehicle retirement credit programs and encourage more dismantlers to participate in vehicle retirement programs, thus, facilitating consumer convenience. In addition, voluntary dismantler participation ensures that the dismantler can choose and participate if there is sufficient economic incentive for parts recycling.

The staff recommendation for recovery of non-emission-related and non-drive train parts will not significantly affect air quality or cause risk of litigation. The proposed amendments may enhance the financial viability of enterprise-based VAVR programs by creating a more level playing field between the BAR VAVR program and enterprise operated programs.

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER ADOPTION OFAMENDMENTS TO AIR RESOURCES BOARD VOLUNTARY ACCELERATED VEHICLE RETIREMENT REGULATIONS TO MINIMIZE DIFFERENCES BETWEEN ARB AND BAR VAVR REGULATIONS AND ALLOW PARTS RECYCLING AND RESALE OF NON-EMISSION-RELATED AND NON-DRIVE TRAIN PARTS

The Air Resources Board (the "Board" or "ARB") will conduct a public hearing at the time and place noted below to consider adoption of amendments to Air Resources Board Voluntary Accelerated Vehicle Retirement regulations to minimize differences between ARB and BAR VAVR regulations and allow parts recycling and resale of non-emission-related and non-drive train parts.

DATE: January 17, 2002

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
1001 "I" Street
Auditorium, Second Floor
Sacramento, Ca 95814

This item will be considered at a two-day meeting of the Board, which will commence at 9:00 a.m., January 17, 2002, and may continue at 8:30 a.m., January 18, 2002. This item may not be considered until January 18, 2002. Please consult the agenda for the meeting, which will be available at least 10 days before January 17, 2002, to determine the day on which this item will be considered.

This facility is accessible to persons with disabilities. If accommodation is needed, please contact the ARB's Clerk of the Board by January 3, 2002, at (916) 322-5594 or TDD (916) 324-9531 or (800) 700-8326 for TDD calls from outside the Sacramento area to ensure accommodation.

INFORMATIVE DIGEST OF PROPOSED ACTION AND POLICY STATEMENT OVERVIEW

Sections Affected: Proposed amendments to title 13, California Code of Regulations, sections 2601, 2603, 2604, 2606, 2607, 2608, 2609, 2610, and proposed adoption of section 2611 and Appendices C and D.

The 1994 State Implementation Plan (SIP) requires significant emission reductions and most stakeholders believe that achieving these reductions is a significant challenge. In addition, the Legislature believed that it was important to provide maximum flexibility to both private industry and local air quality districts to determine how to achieve required emission reductions. Therefore, at the request of many stakeholders, the Legislature passed Senate Bill 501 (Stats. 1995, ch. 929; Calderon).

This legislation provided for emission reduction credit programs through voluntary accelerated vehicle retirement (VAVR). Designed to be market-based, these programs provide an alternative strategy to achieve emission reductions at a lower cost when compared to traditional emission control strategies, such as stationary source controls.

SB 501, Health and Safety Code sections 44100 – 44122, required the Air Resources Board (ARB) to adopt regulations for VAVR credit programs for use by both public and private entities. In compliance with this directive, the ARB originally adopted the current VAVR regulations on October 22, 1999. This type of VAVR program is commonly referred to as the Mobile Source Emission Reduction Credit (MSERC) program.

Concurrently, to provide a "safety valve" for consumers with vehicles that fail the biennial smog inspection, the Bureau of Automotive Repair (BAR) implemented a VAVR program separate from the MSERC programs operated under the above referenced ARB regulations.

In summary, the important distinction between these two VAVR programs is that the VAVR program operated in compliance with ARB regulations generate emission credits to substitute for other SIP required emission reductions, whereas the program operated under BAR regulations is strictly a safety valve for consumers that fail the biennial smog inspection and is *not* used to generate emission credits.

Until recently, because the price paid to consumers was similar (i.e., $450 to $700 per vehicle), the two types of VAVR programs functioned in relative harmony, even though vehicle eligibility requirements differed between the two programs. However, this changed when BAR more than doubled the price paid to retire a vehicle from $450 to $1000 per vehicle. The BAR payment increase caused the perception that the two programs were in competition. In addition, this caused a closer examination of the vehicle eligibility requirements between the two programs with many stakeholders noting that the BAR vehicle eligibility requirements are less stringent than those established by the ARB VAVR regulations.

Stakeholders then complained that the combined cost differential and vehicle eligibility differences jeopardized MSERC program viability. Additionally, participants noted that the Health and Safety Code requires the ARB to "harmonize the requirements and implementation of this program with the motor vehicle inspection program." Statutes also state: "Insofar as practicable, these programs shall be seamless to the participants and the public."

Finally, stakeholders also noted that the Health and Safety Code requires regulatory provisions to provide for recycling, sales, and use of parts from vehicles offered for retirement. It should also be noted that, on February 26, 1999, Senator Johannessen introduced Senate Bill 1058 to legislate parts recovery limited to non-emission-related parts. However, Senator Johannessen dropped this bill to allow the ARB an opportunity to re-examine and/or revise the VAVR regulations.

In summary, many participants felt that present ARB regulations fall short in meeting the mandates of the Health and Safety Code, i.e., "harmonize" ARB and BAR regulations and provide for parts recovery from retired vehicles.

In response, the ARB staff completed a fact finding study focusing on the differences between the ARB and BAR VAVR regulations, as well as to examine options to provide for parts recovery and re-sale. For this effort, ARB staff conducted several informal workshops with the various stakeholders. Then, based on the workshop results, staff prepared, and released for public comment, a preliminary staff report with recommendations to revise existing regulations and to present parts recovery options.

Finally, interested parties submitted numerous comments regarding the recommendations contained in the staff report. ARB staff evaluated the public comments; and, as a result of the review, ARB staff proposes to amend the ARB VAVR regulations as follows:

- ARB staff recommends a revision to the ARB VAVR regulations to minimize the differences between ARB VAVR regulations and BAR VAVR regulations as required in Health and Safety Code section 44102. *Specifically, with respect to vehicle eligibility, ARB staff recommends that the ARB VAVR regulations be amended to match the BAR regulations with only two exceptions, i.e., staff proposes to retain requirements for driving in reverse and the vehicle registration history.*

- ARB staff recommends a revision to the ARB VAVR regulations to allow limited parts recovery. *Specifically, ARB staff recommends that the ARB VAVR regulations be amended to allow parts recovery for non-emission-related and non-drive train parts.*

COMPARABLE FEDERAL REGULATIONS

U.S. EPA has published a document, "Guidance for the Implementation of Accelerated Retirement of Vehicles Programs," but has not promulgated formal regulations for this program.

AVAILABILITY OF DOCUMENTS AND CONTACT PERSON

The Board staff has prepared a Staff Report: Initial Statement of Reasons (ISOR) for the Proposed Regulatory Action, which includes a summary of the environmental impacts of the proposal.

Copies of the Staff Report and the full text of the proposed regulatory language, in underline and strikeout format to allow for comparison with the existing regulations, may be accessed on the ARB's web site listed below, or may be obtained from the Public Information Office, Air Resources Board, 1001 I Street, Environmental Resources Center, 1st Floor, Sacramento, CA 95814, (916) 322-2990 at least 45 days prior to the scheduled hearing (January 17, 2002). Upon its completion, the Final Statement of Reasons (FSOR) will be available and copies may be requested from the agency contact persons in this notice, or may be accessed on the ARB's web site listed below.

Further inquiries concerning the substance of the proposed regulation may be directed to the designated agency contact persons, Mr. Leon Vann, Smog Check Policy Advisor at (916) 445-8449 or Mr. Chuck Bennett, Air Resources Engineer, at (916) 322-2321.

Further, the agency representative and designated back-up contact persons to who nonsubstantive inquiries concerning the proposed administrative action may be directed are Artavia Edwards, Manager, Board Administration & Regulatory Coordination Unit, (916) 322-6070, or Marie Kavan, Regulations Coordinator, (916) 322-6533. The Board has compiled a record for this rulemaking action, which includes all the information upon which the proposal is based. This material is available for inspection upon request to the contact persons.

If you are a person with a disability and desire to obtain this document in an alternative format, please contact the Air Resources Board ADA Coordinator at (916) 323-4916, or TDD (916) 324-9531, or (800) 700-8326 for TDD calls outside the Sacramento area.

This notice, the ISOR and all subsequent regulatory documents, including the FSOR, when completed, are available on the ARB Internet site for this rulemaking at www.arb.ca.gov/regact/vavr/vavr.htm

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred in reasonable compliance with the proposed regulations are presented below.

The Executive Officer has determined that the proposed regulatory action will not create costs or savings, as defined in Government Code section 11346.5(a)(6), to any state agency or in federal funding to the state, costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code, or other non discretionary savings to local agencies,

In developing this regulatory proposal, the ARB staff evaluated the potential economic impacts on representative private persons or businesses. The ARB is not aware of any cost impacts that a representative private person or business would necessarily incur in reasonable compliance with the proposed action.

The Executive Officer has made an initial determination that the proposed regulatory action will not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states, or on representative private persons.

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action will not affect the creation or elimination of jobs within the State of California, the creation of new businesses or elimination of existing businesses within the State of California, or the expansion of businesses currently doing business within the State of California. An detailed assessment of the economic impacts of the proposed regulatory action can be found in the Staff Report (ISOR).

The Executive Officer has also determined, pursuant to Government Code section 11346.5(a)(3)(B), that the proposed regulatory action will not affect small businesses because this is a change to a regulation that is voluntary with respect to small businesses and there are no mandated requirements and no associated impacts.

In accordance with Government Code sections 11346.3(c) and 11346.5(a)(11), the ARB's Executive Officer has found that the reporting requirements of the regulation which apply to businesses are necessary for the health, safety, and welfare of the people of the State of California.

Before taking final action on the proposed regulatory action, the Board must determine that no alternative considered by the agency or that has otherwise been identified and brought to the attention of the agency would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

SUBMITTAL OF COMMENTS

The public may present comments relating to this matter orally or in writing at the hearing, and in writing or by e-mail before the hearing. To be considered by the Board, written submissions not physically submitted at the hearing must be received **no later than 12:00 noon, January 16, 2001**, and addressed to the following:

Postal mail is to be sent to:

> Clerk of the Board
> Air Resources Board
> 1001 "I" Street, 23rd Floor
> Sacramento, California 95814

Electronic mail is to be sent to: vavr@listserve.arb.ca.gov and received at the ARB **no later than 12:00 noon, January 16, 2001**.

The Board requests but does not require that 30 copies of any written statement be submitted and that all written statements be filed at least 10 days prior to the hearing so that ARB staff and Board Members have time to fully consider each comment. The ARB encourages members of the public to bring to the attention of staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

STATUTORY AUTHORITY AND REFERENCES

This regulatory action is proposed under that authority granted in Health and Safety Code, sections 39600 and 39601, 44101 and 44104. This action is proposed to implement, interpret and make specific SB 501 and Health and Safety Code sections 44100 – 44122.

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, Title 2, Division 3, Part 1, Chapter 3.5 (commencing with section 11340) of the Government Code.

Following the public hearing, the Board may adopt the regulatory language as originally proposed, or with non substantial or grammatical modifications. The Board may also adopt the proposed regulatory language with other modifications if the text as modified is sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action; in such event the full regulatory text, with the modifications clearly indicated, will be made available to the public, for written comment, at least 15 days before it is adopted.

The public may request a copy of the modified regulatory text from the ARB's Public Information Office, Air Resources Board, 1001 "I" Street, Environmental Services Center, 1st Floor, Public Information Office, Sacramento, CA 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

Michael P. Kenny
Executive Officer

Date: November 20, 2001

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs see our Web –site at www.arb.ca.gov.

State of California
AIR RESOURCES BOARD

STAFF REPORT – INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

PROPOSED AMENDMENTS TO AIR RESOURCES BOARD VOLUNTARY ACCELERATED VEHICLE RETIREMENT REGULATIONS – MINIMIZE DIFFERENCES BETWEEN ARB AND BAR VAVR REGULATIONS AND ALLOW PARTS RECYCLING AND RESALE OF NON-EMISSION-RELATED AND NON-DRIVE TRAIN PARTS

Date of Release: **November 30, 2001**
Scheduled for Consideration: **January 17, 2002**

Table of Contents

Executive Summary

The 1994 State Implementation Plan (SIP) requires significant emission reductions and most stakeholders believe that achieving these reductions is a significant challenge. In addition, the Legislature believed that it was important to provide maximum flexibility to both private industry and local air quality districts to determine how to achieve required emission reductions. Therefore, at the request of many stakeholders, the Legislature passed Senate Bill 501 (Calderon), statutes of 1995.

This legislation provided for emission reduction credit programs through voluntary accelerated vehicle retirement (VAVR). Designed to be market-based, these programs provide an alternative strategy to achieve emission reductions at a lower cost when compared to traditional emission control strategies, such as stationary source controls.

SB 501 statutes, Health and Safety Code Sections 44100 – 44122, required the Air Resources Board (ARB) to adopt regulations for VAVR credit programs for use by both public and private entities. In compliance, the ARB originally adopted the current VAVR regulations on October 22, 1999. This type of VAVR program is commonly referred to as the Mobile Source Emission Reduction Credit (MSERC) program.

Concurrently, to provide a "safety valve" for consumers with vehicles that ***fail*** the biennial smog inspection, the Bureau of Automotive Repair (BAR) implemented a VAVR program separate from the MSERC programs operated under the above referenced ARB regulations.

In summary, the important distinction between these two VAVR programs is that the VAVR program operated in compliance with ARB regulations generate ***emission credits*** to substitute for other SIP required emission reductions. Whereas, the program operated under BAR regulations is strictly a safety valve for consumers that ***fail*** the biennial smog inspection and is *not* used to generate emission credits.

Until recently, because the price paid to consumers was similar (i.e., $450 to $700 per vehicle), the two types of VAVR programs functioned in relative harmony, even though vehicle eligibility requirements differed between the two programs. However, this changed when BAR more than doubled the price paid to retire a vehicle from $450 to $1000 per vehicle. The BAR payment increase caused the perception that the two programs were in competition. In addition, this caused a closer examination of the vehicle eligibility requirements between the two programs with many stakeholders noting that the BAR vehicle eligibility requirements are less stringent than those established by the ARB VAVR regulations.

Stakeholders then complained that the combined cost differential and vehicle eligibility differences jeopardized MSERC program viability. Additionally, participants noted that the Health and Safety Code requires the ARB to "harmonize the requirements and implementation of this program with the motor vehicle inspection program". Statutes also state: "Insofar as practicable, these programs shall be seamless to the participants and the public."

Finally, stakeholders also noted that the Health and Safety Code requires regulatory provisions to provide for recycling, sales, and use of parts from vehicles offered for retirement. It should also be noted that, on February 26, 1999, Senator Johannessen introduced Senate Bill 1058 to legislate parts recovery limited to non-emission-related parts. However, Senator Johannessen dropped this bill to allow the ARB an opportunity to re-examine and/or revise the VAVR regulations.

In summary, many participants felt that present ARB regulations fall short in meeting the mandates of the Health and Safety Code, i.e., "harmonize" ARB and BAR regulations and provide for parts recovery from retired vehicles.

In response, the ARB staff completed a fact finding study focusing on the differences between the ARB and BAR VAVR regulations, as well as, to examine options to provide for parts recovery and re-sale. For this effort, ARB staff conducted several informal workshops with the various stakeholders. Then, based on the workshop results, staff prepared; and, released for public comment, a preliminary staff report with recommendations to revise existing regulations and to present parts recovery options.

Finally, interested parties submitted numerous comments regarding the recommendations contained in the staff report. ARB staff evaluated the public comments; and, as a result of the review, ARB staff proposes to amend the ARB VAVR regulations as follows:

- ARB staff recommends a revision to the ARB VAVR regulations to minimize the differences between ARB VAVR regulations and BAR VAVR regulations per Health and Safety Code, Section 44102. *Specifically, with respect to vehicle eligibility, ARB staff recommends that the ARB VAVR regulations be amended to match the BAR regulations with only two exceptions, i.e., driving in reverse and the vehicle registration history.*

- ARB staff recommends a revision to the ARB VAVR regulations to allow limited parts recovery. *Specifically, ARB staff recommends that the ARB VAVR regulations be amended to allow parts recovery for non-emission-related and non-drive train parts.*

Background

The Health and Safety Code provides for two types of VAVR programs:

(1) The BAR program which is a "safety valve" for consumers with vehicles that *fail* their smog inspection, but may have difficulty affording repairs and/or deem repair costs not cost effective; and,

(2) MSERC programs to be operated by private enterprises under local district control following ARB regulations. Under this type of program, local districts use the vehicle retirement program's emission benefits ("credits") to substitute for other required emission reductions, such as, trip reduction strategies or additional stationary source reductions.

The fundamental difference between BAR's vehicle retirement program and programs operated under ARB regulations is:

- Only vehicles that have **failed** their most recently required biennial smog inspection (within the last 120 days) are eligible for BAR's VAVR program; whereas,

- Only vehicles that **pass** their biennial smog inspection (or, are exempted from biennial inspection) are eligible for MSERC programs.

This distinction ensures that MSERC emission reductions are "surplus" to the reductions achieved under the Smog Check II program.

To establish operating conditions for these two types of programs, the BAR adopted its VAVR regulations on December 3, 1998; whereas, the ARB adopted its present VAVR regulations on October 22, 1999.

Notwithstanding that the two VAVR programs serve different purposes, the Health and Safety Code requires that the two programs operate in "harmony." Specifically, Section 44102 states:

> "(a) The state board, the Department of Motor Vehicles, and the department shall *harmonize the requirements* (emphasis added) and implementation of this program with the motor vehicle inspection program and other programs contained in this chapter, particularly the provisions relating to gross polluters in Article 8 (commencing with Section 44080) and the repair or removal of high polluters in Article 9 (commencing with Section 44090).
>
> (b) Insofar as practicable, *these programs shall be seamless to the participants and the public* (emphasis added)."

For the most part, the two types of VAVR programs have operated without significant conflict. Specifically, the price offered by BAR to retire a vehicle was generally less than the price offered to retire a vehicle under the local MSERC programs, i.e., $450 versus $500 - $700 per vehicle, respectively. Therefore, enterprise operators and local districts considered the two programs "compatible" and did not complain about the regulatory differences.

However, this situation quickly changed on July 1, 2000, when BAR increased the amount paid to the consumer from $450 per vehicle to $1,000 per vehicle. This action created a substantial differential between the two programs and caused at least the perception that the two programs were in "competition." In reality, BAR's program targets vehicles failing their biennial inspection; whereas, the private sector programs operated under the ARB regulations target vehicles that pass or are exempted from the biennial inspection.

In addition, BAR's increase to $1,000 per vehicle focused attention on the regulatory differences between the two types of programs. In fact, many interested parties consider the BAR vehicle eligibility regulations to be much less stringent than the ARB vehicle eligibility regulations. For example, to be eligible for vehicle retirement, ARB regulations require that a vehicle must have windshield wipers and mirrors present and operable; whereas, BAR regulations are silent on these two items.

As a direct result, many stakeholders believe that the cost differential combined with the regulatory differences, makes the MSERC type VAVR programs NOT competitive with the BAR VAVR program. These stakeholders further complain that the combined cost differential and regulatory differences jeopardize MSERC program viability.

However, it should be noted that the more stringent ARB regulations attempt to ensure that a vehicle is being driven on a regular basis prior to retirement to ensure that emission credit is not given or taken for vehicles that are, in reality, sitting idle and not being driven. On the other hand, vehicles retired under BAR's VAVR program generate no "credits"; therefore, it is less critical to air quality that BAR ensures that the vehicle is actually being driven on the road.

With respect to the cost differential, the market place controls the price offered for vehicles retired under ARB regulations. It is beyond the scope of ARB authority to regulate these prices or the prices offered under BAR's program. On the other hand, ARB does have the authority (and responsibility) to minimize regulatory differences between the two types of programs.

ARB Staff Proposal to "Harmonize" Vehicle Eligibility Requirements

As previously stated, the Health and Safety Code requires that the ARB/BAR VAVR programs operate in "harmony".

At workshops and meetings held this year to review the ARB's VAVR regulations, as well as, in response to the preliminary ARB staff report, several groups (classic car clubs, after-market parts manufacturers, scrap dealers, and local air districts) provided public and written comments about the ARB regulations. In fact, participating districts and dismantlers reported that the present ARB vehicle eligibility requirements impose measurable hardships on the MSERC programs. Finally, almost all interested parties noted that Section 44102(a) of the Health and Safety Code *requires* the ARB VAVR regulations to be harmonious with respect to BAR's VAVR program.

With few exceptions, the participants recommended that ARB revise the ARB regulations to closely follow the vehicle eligibility requirements specified in BAR regulations. However, it should be noted that one reviewer took exception to suggestions urging the ARB to simplify vehicle eligibility regulations to conform to BAR regulations. This reviewer believed that this would have the effect of allowing more vehicles to become eligible for scrappage at the expense of a greater number of such vehicles not having actually been driven on a regular basis. Thus, their reasoning was that MSERC's would be claimed for vehicles, which are not in fact true contributors to the emissions inventory.

The following Table 1 presents a side-by-side comparison of ARB and BAR vehicle eligibility requirements (Appendix 1 presents the actual text of the proposed regulatory changes). Please note that ARB staff proposes to amend current ARB regulations to <u>delete</u> those words shown in strikethrough and add those words underlined. If approved, these regulatory changes will "harmonize" ARB regulations with BAR regulations with only two exceptions as discussed below.

First, the proposed revised ARB regulations still require that a vehicle must drive 25 feet in reverse; whereas, BAR's regulations contain no requirement that the vehicle be capable of driving in reverse. ARB staff believes that vehicles that cannot be driven in reverse, generally drive infrequently, at best. Therefore, this requirement is needed to ensure that the credits claimed under MSERC programs are credible. An increase in emissions can actually result when an infrequently driven or non-operating vehicle is retired (once the credit is used).

Second, ARB proposed vehicle registration requirements continue to differ with BAR regulations. Specifically, BAR regulations do not allow an expired registration greater than 120 days after the postmark on the VAVR application. Essentially, under BAR's regulations, the consumer may allow vehicle registration to lapse for up to 120 days after failing the smog inspection. BAR included this provision to allow the consumer 120 days to decide between repairs versus vehicle retirement.

Table 1

Side-by-Side Comparison of Vehicle Eligibility Requirements ARB Regulations versus BAR Regulations

Category	ARB Regulations	BAR Regulations
Doors	All doors present ~~and operable without tie-downs such as rope, etc~~.	All doors present
Hood	Hood lid present ~~and latched without tie-downs such as bungee cord, etc~~.	Hood lid present
Dashboard	Dashboard present. ~~Warning lights and gauges must be original.~~	Dashboard present
Windshield	Windshield present. ~~No holes or tape over holes. Windshield wipers present and working.~~	Windshield present
Side windows	~~Both~~ One side windows present.	One side window present.
Pedals	Interior Pedals operational ~~present with flat surface~~.	Interior pedals operational
Panels	~~Original~~ All side and/or quarter panels present~~, not cause non-operation~~.	All side and/or quarter panels present
Lights	~~Both~~ One headlights, one taillights, and one brake lights present.	One headlight, one taillight and one brake light present
Trunk	~~Trunk lid closed, no rope, etc.~~	(No requirement)
Seats	Driver's seat present~~, stays up~~.	Driver's seat present
Bumpers and fenders	~~Both original~~ One bumpers~~, not cause non-operation~~ present.	One bumper present
Exhaust	~~Original~~ exhaust system present~~, not cause non-operation~~.	Exhaust system present
Holes	~~No holes in floor or passenger compartment.~~	(No requirement)
Drive-ability/operability	Drive forward and in reverse ≥ 25 feet. ~~Idle and operate ≥ 10 seconds. Drive ≥ 100 feet and stop with brakes. First 60 feet ≥ 5.5 seconds in dry weather, ≥ 8.5 seconds in wet weather. Return to start point.~~	Drive forward ≥ 10 yards under own power. **(ARB regulations will keep driving forward and reverse for 25 feet.)**
Reasons for Rejection	~~No stalling or whine and other sounds. Brake goes to floor.~~	(No requirement)
Double Eligibility Criteria	~~Turn lights, door panels, front windows, and mirrors present and operational. No make-shift brackets. No exterior holes two inches at widest~~	(No requirement)
Ineligible Vehicles	Can not be under Smog Check economic hardship/waiver. ~~Must not be high-emitter or gross polluter.~~	Can be under BAR economic hardship extension/waiver.

On the other hand, current ARB VAVR regulations allow planned non-operation status for up to 2 months and/or a registration lapse of up to 180 days within the last 24 months prior to retirement. However, the vehicle must be registered as operational during the last 3 months of the 24-month period (two complete registration cycles). This provides some level of confidence that the vehicle is truly driven on the road because to be registered, the vehicle must pass the necessary smog inspection and, even more importantly, be currently insured. It is doubtful that a consumer would expend funds to meet these requirements unless they truly intended to drive the vehicle.

Notwithstanding this, the ARB staff proposes to amend regulations to further simplify vehicle registration eligibility requirements. Specifically, staff proposes to replace the limits in registration lapse with a requirement that the vehicle be registered as an operating vehicle for at least the last 120 days prior to retirement. This means, as a registered operating vehicle, the vehicle passes the most recently required smog inspection (if required for registration), the vehicle is insured; and, all fees have been paid.

It should be noted that this represents a substantial change from current regulations in that there is no requirement that the vehicle be registered for two consecutive registration cycles. Therefore, under this proposed revision, it is more possible for a vehicle to be *imported* into the local district and retired for credit than would be possible under current regulations. However, ARB staff believes this risk is minimal given the current economics of MSERC programs, i.e., a vehicle would have to be imported to the district (at some cost), then held for the required 7-day waiting period (at some cost) just to be sold for $500 to $700 with very little or no profit margin.

As previously noted, almost all interested parties agreed that ARB vehicle eligibility regulations should be revised to more closely mimic the BAR regulations. However, notwithstanding this, participants also proposed two interesting alternatives to the eligibility requirements specified in BAR and/or ARB regulations:

The first alternative proposal was to simplify the vehicle eligibility requirements to only one primary requirement, i.e., verification of vehicle odometer information, using BAR Vehicle Information Database (VID) data, to verify that the vehicle being retired traveled a specified average number of miles in a given year. The reviewer opined that this would simplify program administration and reduce costs while also making the program easier for the public to understand and accept. In addition, this approach addresses a primary concern with the MSERC programs, i.e., ensuring that the credits claimed relate to the actual vehicle emissions.

To evaluate feasibility, ARB staff researched available studies performed by BAR to assess the reliability of vehicle specific VID odometer data. ARB staff found that, although BAR uses VID odometer data to calculate *average annual VMT*, the VID data set must be purged to eliminate potentially inaccurate or misleading odometer entries. As example, BAR rejects an odometer reading when it is less than the odometer reading from the previous Smog Check, i.e., the odometer ran backwards. Furthermore, in their annual VMT report[1], BAR stated that out of approximately 10 million vehicle smog check records, they purged nearly 4 million records (40%) for one reason or another (including odometer readings). Consequently, although BAR utilizes the purged VID odometer data to calculate a statistically reliable average annual VMT, ARB staff concluded that VID odometer data was *not* reliable to determine vehicle specific vehicle miles traveled. Therefore, ARB staff rejected this alternative vehicle eligibility proposal.

It should be also noted that, rather than VID odometer data, one reviewer proposed using on-road remote sensing data to verify that a vehicle is actually being driven, as well as, to assess the vehicle's emissions. This proposal has some merit and ARB staff intends to consider this proposal pending the results of BAR's scheduled remote sensing feasibility study.

The second alternative proposal was suggested by one of the local air districts. The district proposed that the vehicle eligibility requirements be consistent with the motor vehicle code. Specifically, under this proposal, it is assumed that if the vehicle meets vehicle code requirements, it is considered to be both road-worthy and being driven; therefore, it is eligible to be retired under MSERC programs. Any vehicle NOT in compliance with the vehicle code, would NOT be eligible for retirement unless and until necessary repairs were performed.

ARB staff rejected this proposal because compliance with vehicle code requirements does not accurately indicate if a vehicle is actually being operated on the road. More precisely, it is extremely common to see vehicles on the road that are obviously not in compliance with the vehicle code (as example broken tail or head lights). Further ARB staff believes that it would be wasteful to require these vehicles to be brought into compliance, then to immediately retire the vehicle. Finally, ARB staff suggests that, if a vehicle is not in compliance with the vehicle code, then this is an indicator that the vehicle is relatively poorly maintained (even though it may pass smog inspection) and these are the specific vehicles that should be targeted for MSERC programs.

[1] Methodology for Calculating Vehicle Miles Traveled (VMT), Smog Check Performance Evaluation, Report 2000-06, Engineering and Research Branch, Bureau of Automotive Repair, September 30, 2000.

The Parts Recovery Issue

While the VAVR parts recovery issue continues to be controversial, it is important to understand the actual magnitude of current MSERC VAVR programs, Table 2 shows the total number of vehicles retired under MSERC programs for the year 2000. As Table 2 shows, only 6,901 vehicles were retired under these programs, or approximately 0.3% of the State's total 1966 through 1981 vehicle population. Also note that this is only 2.8% of the approximately 250,000 total vehicles annually retired in the state from all sources, not just the MSERC programs.

It should also be noted that while Table 2 shows the total number of vehicles retired under ARB regulations in the year 2000, only two of the districts, the Bay Area and the South Coast, use the "credits" generated under their MSERC programs against other SIP requirements. Both these districts apply the credits generated against "trip reductions" specified in their local plans. None of the credits are currently sold to stationary sources as is commonly believed.

Table 2
Vehicles Retired Under ARB Regulations for Year 2000

District	No. Vehicles
Bay Area	3,821
South Coast	2,626
Santa Barbara	282
San Diego	172
Total	**6,901**

Specifically with respect to parts recovery and resale, under current regulations, neither BAR, nor ARB allows parts recovery. In fact, the CCR, Title 13, §2604, ARB regulations state:

> "...(2) No parts may be removed, for sale or reuse, from any vehicle retired for the purpose of generating emission reduction credits. The only allowable use for any retired vehicle is as a source of scrap metal and other scrap material;
>
> (A) An enterprise operator may separate ferrous and non-ferrous metals prior to vehicle retirement to sell as a source of scrap metal only;
>
> (B) An enterprise operator may sell tires and batteries to an intermediary tire/battery recycler only. All facilities generating or receiving waste tires must use the services of a registered tire hauler/recycler. Battery recyclers must be registered and licensed to handle batteries;..."

Notwithstanding the above, Health and Safety Code, Section 44120, states:

> "44120. Vehicle disposal under the program *(VAVR programs operating under ARB regulations)* shall be consistent with appropriate state board guidance and provisions of the Vehicle Code dealing with vehicle disposal and parts reuse, and shall do both of the following:
> (a) *Allow for trading, sale, and resale of the vehicles between licensed auto dismantlers or other appropriate parties to maximize the salvage value of the vehicles through the recycling, sales, and use of parts of the vehicles,* (emphasis added) consistent with the Vehicle Code and appropriate state board guidelines."

According to several interested parties, including the Legislative Council, ARB's parts recycling prohibition regulation (CCR, Title 13, §2604) appears to conflict with the Health and Safety Code, Section 44120, which provides for parts recovery. In addition, this issue was raised during the public comment period by the Automotive Parts and Accessories Association, Pick-Ups Ltd., the Specialty Equipment Market Association and numerous private parties as follows:

> "Section 44120 of the Health and Safety Code mandates that all scrappage programs allow for parts recycling. This requirement helps make the program more economically viable. It was inserted in Senate Bill 501 to satisfy the concerns of aftermarket parts and service providers and car collectors that only emission-related parts would be destroyed. ARB regulations ignore this legislative mandate."

In the final statement of reasons for rulemaking, ARB staff disagreed with this comment and argued that a conflict between the ARB proposed regulations and the Health and Safety Code, Section 44120 does not exist. Specifically, ARB wrote:

> "Health and Safety Code Section 44120(a) states that the disposal of vehicles retired in accordance with the regulations adopted pursuant to SB 501 shall: *"Allow for trading, sale, and resale of the vehicles between licensed auto dismantlers or other appropriate parties* (emphasis added) to maximize the salvage value of the vehicles through the recycling, sales, and use of parts of the vehicles, consistent with the Vehicle Code and appropriate state board guidelines." First, the Vehicle Code provides the Department of Motor Vehicles mechanisms for "electronically" retiring a vehicle. These mechanisms allow for, but do not require, the resale and reuse of most vehicle components. Second, the VAVR regulations, which prohibit all vehicle parts resale and reuse from vehicles retired to generate mobile source emission reduction credits, do allow for recycling of the vehicle as scrap metal or other scrap material. These regulations represent the "appropriate state board guidelines" referenced in Health and Safety Code Section 44120(a). Third, the Bureau of Automotive Repair (BAR) has adopted the Vehicle Retirement Program. The Vehicle Retirement Program allows for no recycling of parts other than batteries and tires except as scrap metal or other scrap material. Health and Safety Code §44102 mandates that BAR and ARB harmonize the requirements and implementation of the respective vehicle retirement programs. Finally, it is important to note that the

South Coast Rule, 1610, recently came under public scrutiny for allowing dismantlers to sell parts. The sale of parts in this program resulted in parts being used on vehicles that would not have qualified for the scrapping program without being "fixed up", thereby producing emission reduction credits that are not surplus. There is no way to ensure that parts resold and reused once a vehicle has been retired in a VAVR program are not used to keep another high polluter on the road or to "fix up" a vehicle that would have been retired through natural attrition but is, instead, retired in a VAVR program. Thus, in accordance with Health and Safety Code §44121 which states that " The state board shall develop standards for the certification and use of emission reduction credits to ensure that the credits are real, surplus, and quantifiable" the VAVR regulations do not allow for parts reuse."

Finally, ARB staff notes that the Health and Safety Code, Section 44210 (b), requires vehicles with special collector interests to be set aside for resale to the public and current regulations provide for this via a 7-day waiting period before a vehicle can be crushed. Specifically, the CCR, Title 13, §2604, ARB regulations state:

> "There shall be a minimum period of seven (7) days between the time a vehicle is first offered for sale into a VAVR enterprise and the time of completion of the sale..."

Therefore, this mandatory waiting period provision meets both the intent and text of the Health and Safety Code, Section 44120 (a). Specifically, the purpose of the mandatory waiting period is to "allow for trading, sale, and resale of the vehicles between licensed auto dismantlers or other appropriate parties to maximize the salvage value of the vehicles through the recycling, sales, and use of parts of the vehicles".

During this period, the regulations require the dismantler to notify the local district and provide a description of the vehicle and the date and approximate time when the vehicle is scheduled to be delivered for final sale to the enterprise operator. In addition, ARB regulations require the district to publish this information with the intent to allow car collector enthusiasts and those interested in affordable transportation to examine the car and purchase the vehicle before it is otherwise sold to the VAVR enterprise. If the vehicle is sold, the regulations disallow the dismantler to receive any emission reduction credits.

Notwithstanding the mandatory waiting period, it should also be noted that MSERC program operators report that **no licensed dismantler or other appropriate party** has purchased any vehicle submitted for retirement under these programs. This leads these program operators to conclude that these vehicles have little or no parts recovery or collector car value.

It is also important to note that the Office of Administrative Law (OAL) reviewed the ARB regulation proposal and staff's response to public comments regarding the parts recovery prohibition. Importantly, OAL approved the ARB regulation as proposed.

However, the ARB's parts recovery prohibition continues to be an issue with interested parties such as classic car collectors, aftermarket parts manufacturers, local districts and dismantlers. In addition, the perception remains that ARB regulations conflict with existing statutes.

In fact, on February 26, 1999, Senator Johannessen introduced Senate Bill 1058 (SB 1058). This bill would have required MSERC VAVR programs "to be operated in a manner that results in the maximum availability of vehicles and parts of vehicles for sale and reuse for the purposes of recycling, remanufacturing, rebuilding, repair, restoration, voluntary upgrade and maintenance by the public". The bill would require vehicles delivered and processed at the dismantler's facility for the program to be made available for resale, including a requirement that a list of the vehicles be made available to the public. The bill would specify that vehicles shall not be required to be destroyed, and would provide that any funds available to the dismantler under the program would be reduced by the value of parts that are sold from that vehicle. The bill would also provide that whole vehicles, and vehicles from which emission-related parts have been sold, are not eligible for the emission credits or other compensation with public funds.

Ultimately, Senator Johannessen agreed to "table" the bill to provide the ARB an opportunity to re-examine the VAVR regulations. In response, the ARB agreed to revisit their VAVR regulations.

As previously mentioned, to thoroughly re-examine the VAVR regulations, ARB staff conducted several informal workshops and meetings earlier this year, and released a preliminary staff report.

Two opposing parts recovery views summarize the various outlooks presented at the workshops:

1. Promote or facilitate parts recovery to improve VAVR cost-effectiveness; to provide low-cost parts for vehicle repair for low-income consumers; and, to comply with existing statutory mandates; or,

2. Discourage parts recovery to promote the credibility of MSERC programs; and, to prevent the use of parts from retired vehicles to extend the life of other older, high emitting vehicles that would otherwise be taken out of service.

The following is a summary of the positions of the various interest groups:

Classic Car Collectors – The classic car collectors contend that the destruction of parts from older cars causes an irreversible loss of parts that are typically needed and used to restore cars with significant California historical value. As hobbyists, they take much pride in the restoration of older classic cars to near mint condition and contend that these vehicles run as clean as possible. Specifically, they contend that the parts recovery prohibition significantly diminishes parts availability, thus resulting in higher costs to restore classic vehicles.

In addition, these groups argue that classic cars cause an insignificant impact on air quality because owners drive these vehicles very few miles during any given year.

These enthusiasts also contend that the ARB significantly diminishes MSERC program cost effectiveness by not permitting parts recovery and resale. Therefore, since public funds are sometimes used to support the MSERC programs, public funds are being squandered.

Finally, these groups maintain that the ARB regulations do not adhere to the Health and Safety Code, Section 44120, to maximize salvage of parts acquired from VAVR programs.

After-market parts industry – The after-market parts industry maintains that the parts recycling prohibition reduces the number of older cars utilizing parts this industry produces; thus, causing a loss in earnings and profits. They believe parts recovery increases the availability of classic cars; thus, benefiting after-market parts manufacturers.

Alternately, many after-market parts makers propose voluntary vehicle repair and upgrade as an alternative to scrap programs. They claim that such programs dramatically improve emission performance from older vehicles. These manufacturers point to the pilot repair-upgrade program operated by the San Diego Air Pollution Control District (SDPCD) which demonstrates emission reductions through repair/upgrade. Supporters claim the pilot program realizes twice the emissions benefits of vehicle retirement programs. However, please note that the SDPCD (which operated the upgrade program) concluded that the actual cost of the upgrade program is at least four times more expensive than vehicle retirement in terms of dollars per ton of emission reductions.

Dismantlers –Vehicle dismantlers are in two "camps", solely depending on their business structure:

- Enterprise operators primarily retiring vehicles to sell MSERCs view parts recovery as an additional administrative burden lacking cost effectiveness. More specifically, enterprise operators that retire vehicles to sell MSERCs are typically large-scale operators that rotate inventories of vehicles waiting to be crushed in large yards. The removal of recyclable parts slows the movement of scrapped vehicles. In addition, the large yards struggle to track vehicles and maintain data on parts resold. Therefore, these MSERC dismantlers opt not to recycle parts.

- Dismantlers which target vehicles with parts recovery value and who also target the classic car enthusiasts or other consumers performing "self repairs" depend on parts recovery to generate revenue. These dismantlers have similar interests and positions as classic car clubs and after-market parts manufacturers. These dismantlers generate revenue by recycling parts and therefore contend that the prohibition of parts recycling degrades revenue generation for the MSERC program. Since the recycling of parts produces their main source of income, they support parts resale.

Environmentalists – Environmentalists contend that no real emission reductions occur when parts are recycled because upon vehicle retirement, the emissions are "*transferred*" to another vehicle marginally passing Smog Check, thus keeping the second vehicle on the road longer than would otherwise be the case. Therefore, they claim the allowance of parts recovery causes MSERC programs to become a "sham."

In addition, environmentalists believe that worn/damaged recycled parts from retired vehicles may actually cause emissions to increase in the second vehicle compared to no parts recovery which would cause the consumer to replace the part with a new or re-manufactured part.

Traditional environmentalists did not attend the 2001 workshops, and did not submit any comments to the ARB this year on parts recycling. However, at past workshops, environmentalists have opposed parts recovery and support ARB VAVR regulations (CCR, Title 13, §2604) which prohibit parts recycling.

Options for Parts Recovery

The following is a description of the three parts recovery options that were included in the preliminary staff report that was also released for public review and comment.

Option 1 - No parts recycling or resale is allowed (No change to current ARB regulations)

Pros

- Best for air quality. This option minimizes the possibility that recycled parts will be used to prolong the life of other older vehicles.
- Adds credibility to the MSERC programs by ensuring that the credits claimed are real.
- Requires no change to existing ARB regulations.

Cons

- Continues at least the perception that existing ARB regulations violate the provision in the Health and Safety Code, Section 44120(a), which states, "Allow for trading, sale, and resale of the vehicles between licensed auto dismantlers or other appropriate parties to maximize the salvage value of the vehicles through the recycling, sales, and use of parts of the vehicles, consistent with the Vehicle Code and appropriate state board guidelines."

- May decrease cost effectiveness of VAVR programs.

- May affect price and availability of parts to maintain classic cars or vehicles owned by low-income consumers.

Option 2 – Allow parts recovery except for "emission- related" parts[2] and drive train parts*

Under option 2, the engine, emission-related parts, transmission, and drive train parts would be removed and destroyed. The remainder of the vehicle could be resold; however, it is important to note that parts recovery is ***permissive, not mandatory.*** The *enterprise operator* decides whether or not to resell parts from a vehicle being retired under the MSERC program.

Under this option, ARB regulations would specify how emission-related parts and drive train parts are to be removed before the non-emission-related and non-drive train parts are made available for parts recovery. These regulations would also specify the requirements and procedures to be used by the dismantler to destroy the emission-related and drive train parts. Specifically,

> "The part will be considered destroyed when it has been punched, crushed, shredded or otherwise rendered permanently and irreversibly incapable of functioning as originally intended."

---

[2] 13 CCR §1900(b)(3) - "Emissions-related part" means any automotive part, which affects any regulated emissions from a motor vehicle that is subject to California or federal emissions standards. This includes, at a minimum, those parts specified in the "Emissions-Related Parts List," adopted by the State Board on November 4, 1977, as last amended May 19, 1981 (and amended June 1, 1990). (See ARB Emissions-related parts list in Appendix C to Article 1 – Emission/Drive Train-Related Parts List)

* Drive train parts are all parts associated with the drive train such as engine, drive mechanism, transmission, differential, axles and brakes.

To allow time for classic car enthusiasts to examine and/or purchase a VAVR vehicle (before it is sold to the enterprise operator), the ARB VAVR regulations currently require a mandatory 7-day waiting period in which the dismantler provides the vehicle description to the local district. The local district then publicizes the vehicle description so that the vehicle is available for sale to the public for a minimum of 7 days. If the vehicle is sold then MSERCs cannot be claimed for that vehicle.

If the vehicle is not sold, the dismantler inspects the vehicle per ARB VAVR eligibility requirements or more stringent local district regulations. Upon verifying the vehicle passes the eligibility requirements, the dismantler then decides whether or not to recover non-emission-related and non-drive train parts. If the enterprise operator doesn't intend to recover parts, then the vehicle is crushed within 90 days of the sale.

Under option 2, a decision by the dismantler to recover non-emission-related and non-drive train parts requires the dismantler to remove and destroy the emission-related parts (per the ARB Emission-Related Parts List) and the drive train parts before non-emission-related and non-drive train parts are made available for consumer purchase. If the dismantler sells any emission-related or drive train parts, MSERCs are not allowed per ARB VAVR regulations.

ARB staff has created a *preliminary* model checklist (shown in Appendix D to Article 1 – Quality Control Checklist) providing a list of emission-related and drive train parts with check boxes for status, i.e., "removed" and "destroyed." The checklist is designed to be resistant to error yet practical and feasible with respect to the operations of a typical dismantler. The dismantler completes the checklist as the emission-related and drive train parts are destroyed.

After all emission-related and drive train parts are removed and destroyed, a quality control inspector (designated by the dismantler) performs an inspection of the non-emission-related and non-drive train parts as well as the vehicle body. Upon verification that no emission-related parts or drive train parts have been misplaced with the non-emission-related and non-drive train parts, the quality control inspector signs the checklist. Finally, local districts would be required to audit all aspects of the program.

Pros

- Complies with Health and Safety Code, Section 44120.
- May enhance economic feasibility of MSERC vehicle retirement programs.
- May encourage more dismantlers to participate in MSERC programs, thus, facilitating consumer convenience.

- Voluntary enterprise operator participation ensures that the enterprise operator can choose and participate if there is sufficient economic incentive for parts recycling.

Cons

- More difficult to administer, i.e., effort is required to extract and destroy parts, diminishing the economic return from parts recovery.
- Continues environmental concerns that recycled parts keep older polluting vehicles on the road longer than natural life, thus jeopardizing the credibility of the credits generated under MSERC programs.

Option 3 - Total recycling and resale of all parts, including emission related parts and drive train parts.

A program that allows total recycling would require less administration than either option 1 or 2, since the monitoring of parts resale would not be required. However, vehicle eligibility would still be a requirement, therefore limited auditing by the local districts would be required.

Pros

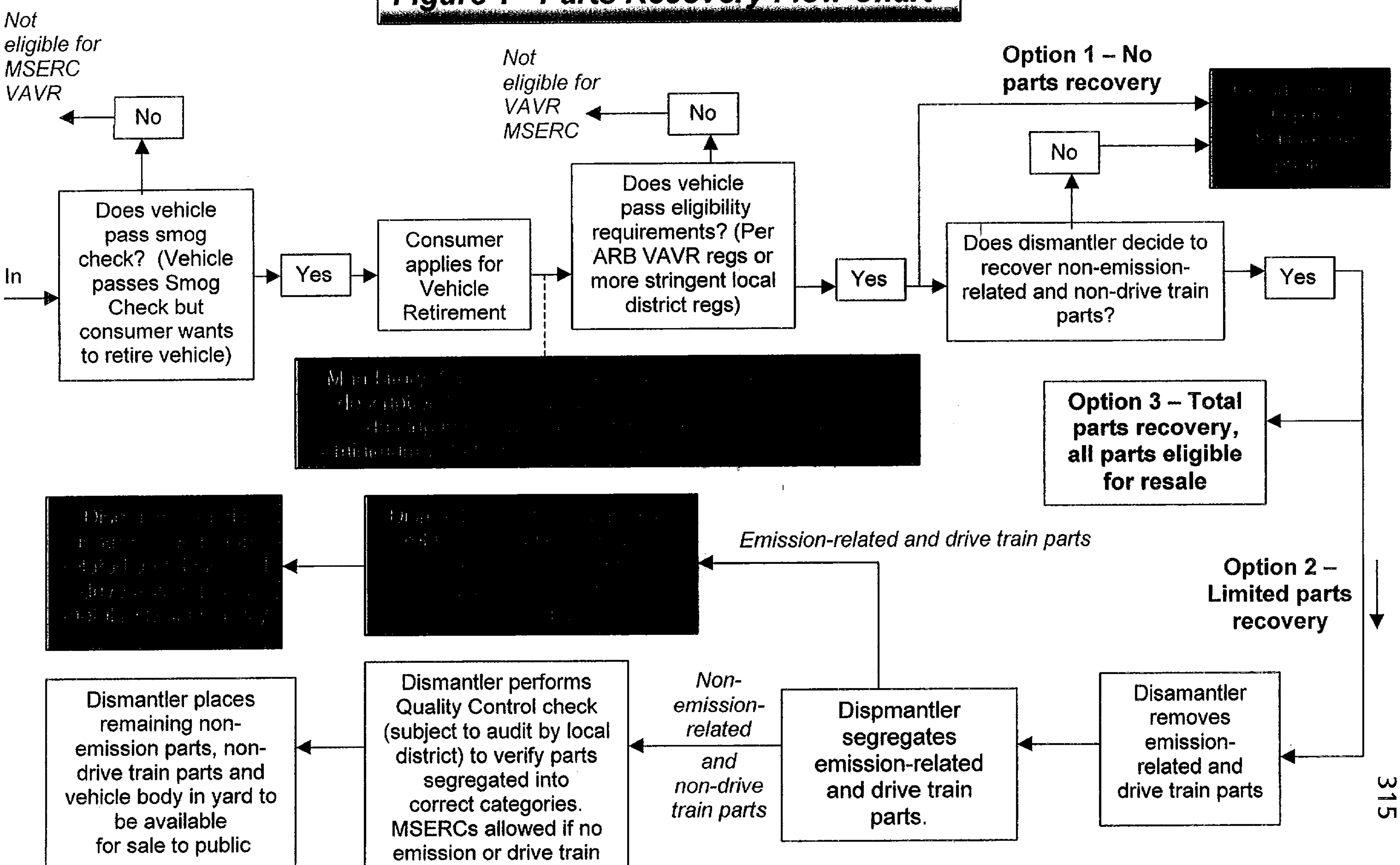
- Maximizes program cost effectiveness.
- Like option 1, easy to administer.

Cons

- May not result in real emission reductions.
- MSERCs difficult to quantify.
- Causes lack of credibility of the credits generated under MSERC programs.

Figure 1 below shows the flow chart for all three options including the basic requirements of the program.

Figure 1 - Parts Recovery Flow Chart



Public Comment to Parts Recovery Options

It should be noted that there is NO clear consensus for a preferred parts recovery option. Generally speaking, a constituent's position correlates directly to the constituent's business or hobby interests. Therefore, ARB staff recommends **Option 2 – Allow parts recovery except for "emission- related" parts and drive train parts.** ARB staff believes that this option provides a reasonable compromise between the interests of the various constituents. The actual text of the proposed/recommended regulatory changes are included in Appendix 1.

The following discussion presents a summary of the many comments received regarding the three parts recovery options presented in the ARB preliminary staff report, as well as, the ARB staff response to the comments. This discussion provides a reasonable representation of the various issues and concerns regarding the options presented in the staff report.

Concerning legislative intent, one reviewer argued that the MSERC programs were intended to provide a *consumer* incentive, including parts recovery. Therefore, the ARB should amend its regulations to provide for maximum parts recycling. Specifically, one reviewer stated:

> "We continue to believe that the legislative intent relative to vehicle retirement programs was solely to incentivize consumers to scrap their vehicles sooner than they otherwise might have. We also believe this was to be done in such a way as to ensure that all parts would be made available for resale to the public and/or for commercial purposes such as rebuilding and remanufacturing. We do not believe the legislature intended to mandate the permanent destruction of vehicles and their parts, as is now required."

ARB staff disagrees with this assertion. Rather than providing a consumer incentive, ARB staff believes that the legislature passed SB 501 to provide flexibility to local air districts and others to use accelerated vehicle retirement as an alternative strategy to achieve SIP required emission reductions in lieu of other specified measures (i.e., trip reduction and/or additional stationary controls).

In addition, ARB staff reviewed the SB 501 legislative history and found nothing stating that the legislative intent was solely to provide a safety valve for consumers. On the contrary, the official California Legislative record contains an analysis presented at hearings on the Senate floor:

> "This bill would achieve needed emissions reductions to comply with the State Implementation Plan, *offset other government-mandated emission reductions, or for other air quality purposes at the lowest possible cost.* (emphasis added)"

Similarly, the legislative record contains an analysis presented to the Assembly floor, which states:

> "This bill attempts to create a privately-operated vehicle scrappage program with emissions reduction credits that can be bought and sold by public or private entities that have mobile emissions reductions requirements under any state or local air quality program."

Notwithstanding the above, ARB staff acknowledge that the legislature also intended to provide flexibility regarding parts recovery to improve program cost effectiveness and to address concerns raised by classic car enthusiasts.

Regarding this specific legislative provision, many interested parties quoted the Health and Safety Code regarding the mandate to maximize recycling as part of the legislative intent for the MSERC programs. Many reviewers argued that this required the ARB to adopt regulations providing for maximum parts recovery. Specifically, one reviewer stated:

> "We would like to emphasize the California Health and Safety Code citation in the Introduction requiring VAVR programs to *"maximize the salvage value of vehicles through recycling, sales and use of parts..."* We believe this clearly indicates the legislative intent to accommodate the interests of car collectors, low-income citizens and commercial interests. We believe the subsequent reference to the Vehicle Code and state guidelines is intended to ensure that no related laws, either current or future, would be overridden by VAVR. We do not believe it was meant to provide an opportunity to reinterpret legislative intent through the mandated destruction of vehicles and parts."

This issue or assertion is adequately earlier in this staff report. In addition, staff points out that the reviewer's comment takes a section of the Health and Safety Code Section 44120(a) out-of-context. This section actually reads that MSERC programs shall "*Allow for trading, sale, and resale of the vehicles between licensed auto dismantlers or other appropriate parties* (emphasis added) to maximize the salvage value of the vehicles through the recycling sales and use of parts…". As previously stated, ARB staff believes that both the intent and text of this language is addressed via the 7-day mandatory waiting period provided for in the ARB MSERC program regulations. This regulatory provision is included specifically to "allow for trading, sale, and resale of the vehicles…to maximize the salvage value of the vehicles…"

In a comment received by ARB staff during the informal review period, one stakeholder suggested to reduce the 7-day waiting period to three days. The reviewer also suggested to lengthen the waiting period for a particular vehicle to 7 days only if a third party shows an interest in purchasing the vehicle. However, ARB staff failed to reach a consensus among other stakeholders so ARB staff declined to adopt the suggestion, i.e., the 7-day waiting period will remain as is.

Even if parts recovery were not "mandated" by statute, some reviewers argued that the ARB should provide for parts recovery if only to ensure parts availability to repair older cars and classic cars. In addressing the merits of parts recycling, one reviewer expounded on the value of recycled parts towards emissions benefits and the difficulty of finding rare parts:

> "The percentage of vehicles retired by VAVR programs is not at issue. Arguments that only a relative few vehicles are scrapped by VAVR programs and that a sufficient supply of desired parts will be available via vehicles scrapped through other means is not accurate. Clearly this does not apply to rare, specific parts which are few in number and are of particular value to a specific vehicle. The simple fact is that mandated destruction of all parts in a VAVR setting will surely cause some number of valuable, rare, or irreplaceable parts to be lost forever. Similar parts from non-VAVR vehicles cannot replace these parts… Lastly, we disagree with the argument that the percentage of vehicles retired through VAVR programs is sufficiently low so as to not be a problem for car collectors and others in terms of the availability of parts. We continue to stress the issue is not one of percentages or of absolute numbers of parts, but rather it is one of specific parts being lost. The loss of even a relative few valuable or rare parts to various parties represents an unnecessary hardship."

In response, ARB staff notes the reviewer's concern about parts availability. However, studies performed by BAR show that auto dismantlers are interconnected via the Internet thus providing more than adequate-parts accessibility even for the most rare parts. In addition, as previously mentioned, only 6,901 vehicles were retired under VAVR MSERC programs. Since this is approximately 0.3% of the State's total 1966 through 1981 vehicle population and only 2.8% of the approximately 250,000 total vehicles annually retired in the state from all sources, ARB staff continues to maintain that parts availability is *not* noticeably affected by the MSERC programs.

Lastly, ARB staff notes that BAR has *not* reported significant parts availability problems to repair older vehicles that fail smog inspection. This is further enforced via consideration of smog check waiver rates. The current smog check waiver rate is less than 0.5%. If parts availability were really an issue, the waiver rate would be much higher.

As previously noted, ARB regulations restrict parts recovery from MSERC vehicles partly due to the assertion that parts recovery facilitates continued operation of a vehicle that would otherwise be retired; thus, degrading air quality. Many participants in the workshops took issue with this assertion. Some went so far as to argue that the MSERC program had no effect on older vehicle populations. Therefore, credits granted for retirement are not "real". Specifically, one reviewer asserted:

> "We reject any assertion that parts resale will keep "another high polluter on the road," thus increasing pollution. We believe the number of vehicles in active/regular use are not affected by VAVR programs. The vast majority of vehicles scrapped are vehicles that were not the primary means of transportation. Data from previous scrappage programs (Unocal, Chevron) support this. The economics of the situation dictate that only the worst and least valuable vehicles will be submitted for retirement. Consequently, the overall size of the fleet of older vehicles in use will not be reduced to any noticeable degree by VAVR programs...
>
> We also believe the number of older vehicles in use will remain fairly constant due to economic factors..."

In responding to the conjecture that the number of "in-use" vehicles will remain constant over time, ARB staff cites data from the BAR Travel Fraction Calculator.[3] It is important to note that the Travel Fraction Calculator is based, in part, on actual Department of Motor Vehicle registration data; therefore, the credibility of the vehicle population data is very good. Using this BAR tool, in June 1997, the 1974-1981 model-year vehicle population was 2,667,019. However, by June 1999, the 1974-1981 model-year vehicle population was

[3] Smog Check Fleet Travel Fraction Calculator, Release Version 2.10, Bureau of Automotive Repairs, June 21, 2000

1,908,152. This clearly shows that the vehicle population is reduced over time. This reduction in vehicle population is due all forms of vehicle retirement, including the MSERC program. Therefor it is *not* valid to assert that "...the overall size of the fleet of older vehicles in use will not be reduced to any noticeable degree by VAVR programs".

Economic Impacts

Participation in credit programs is entirely voluntary with respect to both consumers and businesses. Therefore, there is no mandated financial impact.

References

1. Methodology for Calculating Vehicle Miles Traveled (VMT), Smog Check Performance Evaluation, Report 2000-06, Engineering and Research Branch, Bureau of Automotive Repair, September 30, 2000.

2. "Emissions-Related Parts List," adopted by the State Board on November 4, 1977, as last amended June 1, 1990.

3. Smog Check Fleet Travel Fraction Calculator, Release Version 2.10, Bureau of Automotive Repairs, June 21, 2000.

APPENDIX 1

PROPOSED REGULATION ORDER

Amend Title 13, California Code of Regulations, Chapter 13, Article 1, Sections 2600 – 2610, to read as set forth on the following pages:

Section 2600	- Purpose
Section 2601	- Definitions
Section 2602	- District Responsibility
Section 2603	- Vehicle Eligibility
Section 2604	- Voluntary Accelerated Vehicle Retirement Enterprise Operator Requirements
Section 2605	- Offering Vehicles to the Public
Section 2606	- ~~Advertising~~ Parts Recycling and Resale
Section 260~~6~~7	- ~~Emission Reduction Credits~~ Advertising
Section 260~~7~~8	- ~~Records, Auditing, and Enforcement~~ Emission Reduction Credits
Section 260~~8~~9	- ~~Pilot Program~~ Records, Auditing, and Enforcement
Section 260~~9~~10	- ~~Procurement of Credits for SIP Measure M1~~ Pilot Program
Section 26~~10~~11	- Procurement of Credits for SIP Measure M1

Appendix A to Article 1	Certificate of Vehicle Functional and Equipment Eligibility Inspection List
Appendix B to Article 1	Voluntary Accelerated Light-Duty Vehicle Retirement Program Emission Reductions

Appendix C to Article 1 Emission/Drive Train-Related Parts List

Appendix D to Article 1 Quality Control Checklist

Title 13, California Code of Regulations
Division 3, Air Resources Board
Chapter 13, Voluntary Accelerated Vehicle Retirement Enterprises
Article 1, Voluntary Accelerated Light-Duty Vehicle Retirement Enterprises

§2600 Purpose:
(a) The provisions of this article apply to the generation of emission reduction credits through the accelerated retirement of light-duty on-road motor vehicles, including passenger cars and light-duty trucks.
(b) Within five years from the effective date of adoption or date of implementation, whichever comes later, the Air Resources Board, in consultation with the Secretary for Environmental Protection, shall review the provisions of this chapter to determine whether it should be retained, revised or repealed.

NOTE: Authority cited: Sections 39600, 39601, and 44101 Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 44100 and 44101, Health and Safety Code.

§2601 Definitions:
(a) "voluntary accelerated vehicle retirement" ("VAVR") means the use of cash payments or other incentives to encourage a vehicle owner to voluntarily retire his or her vehicle from service earlier than otherwise would have occurred;
(b) "Inspection and Maintenance Program" ("I/M") or "Smog Check" means the motor vehicle inspection program established by the Health and Safety Code section 44000, et seq.;
(c) "enterprise operator" means a person who conducts a voluntary accelerated vehicle retirement enterprise according to these regulations. The enterprise operator purchases vehicles, arranges for a vehicle's permanent removal from operation, and receives any emission reduction credit generated thereby;
(d) "dismantler" means the person or business, defined and licensed according to the requirements of the California Vehicle Code §220, §221, §11500, et seq., and other business codes and the regulations of the Department of Motor Vehicles, who dismantles or otherwise removes from service those vehicles obtained as part of a voluntary accelerated vehicle retirement enterprise;
(e) "emission reduction credit" means a credit representing the amount of emission reductions from accelerated retirement of vehicles, which can be applied to the emission reduction obligations of another source or to air quality attainment goals. VAVR enterprises can generate emission reduction credits that may be sold on the open market;
(f) "pilot program" means a limited VAVR enterprise to be conducted under contract to

the Air Resources Board ("ARB" or "Board"), to be completed no later than two (2) years following adoption of these regulations, with the intent of assessing the effectiveness of such enterprises and of these regulations;
(g) "SIP" means the State Implementation Plan for ozone attainment, approved by the Board in 1994 and as subsequently amended;
(h) "measure M1" means the mobile source control measure of the SIP that calls for utilizing VAVR enterprises in the South Coast Air Basin for the purpose of achieving needed emission reductions;
(i) "NOx" means oxides of nitrogen, NO and NO_2, measured as NO_2, emitted in automotive exhaust;
(j) "CO" means carbon monoxide, as emitted in automotive exhaust;
(k) "PM" means particulate matter, as emitted in automotive exhaust;
(l) "ROG" means reactive organic gases, as emitted in both automotive exhaust and evaporative emissions;
(m) "district" means local air quality management district or air pollution control district that has responsibility for administering VAVR enterprises within its jurisdiction;
(n) "Executive Officer" means the Executive Officer of the Air Resources Board;
(o) "collector-interest vehicle" means any vehicle purchased by a car collector or car enthusiast primarily for its historic or esthetic value, rather than primarily as a means of transportation;
(p) "gross polluter" means a vehicle failing required emissions testing with emission levels in the gross polluter category, and which has not been repaired and subsequently retested to show its emission levels have been brought into compliance. This includes vehicles registered and operating under the authority of a repair cost waiver or economic hardship extension;
(q) "high emitter" means a vehicle failing required emissions testing with emission levels in the high emitter category, and which has not been repaired and subsequently retested to show its emission levels have been brought into compliance. This includes vehicles registered and operating under the authority of a repair cost waiver or economic hardship extension;
(r) "emissions-related part" means any automotive part, which affects any regulated emissions from a motor vehicle that is subject to California or federal emissions standards. This includes, but is not limited to, those parts specified in the "Emissions-Related Parts List," adopted by the State Board on November 4, 1977, as last amended June 1, 1990.
(s) "drive train parts" are all parts associated with the drive train such as engine, drive mechanism, transmission, differential, axles and brakes.

NOTE: Authority cited: Sections 39600, 39601 and 44101, Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 44081, 44090, 44100, 44101, 44102, 44103, 44105 and 44122, Health and Safety Code.

§2602 District Responsibility
(a) Within six (6) months of the date of adoption of these regulations, each district allowing the operation of VAVR enterprises within its jurisdiction shall implement and enforce these regulations, or shall amend existing rules to comply with these regulations;
(b) All operators of VAVR enterprises shall comply with district rules and these regulations;
(c) Each participating district shall have responsibility, with ARB oversight, for administering and auditing VAVR enterprises conducted within its jurisdiction;
(d) In accordance with all state, federal and local laws, rules and regulations, each participating district shall administer and monitor the use of credits generated by enterprises operated under these regulations and shall, with ARB oversight, certify or reject the accuracy and validity of any credits generated, as required; Each participating district will retain the records received according to subparagraphs §2608(a)(2) and (3) for a period not less than the life of the related credits;
(f) Each participating district shall be responsible for verifying that any vehicle accepted for participation in a VAVR enterprise within sixty-one to ninety (61 - 90) days of its next required Smog Check inspection has not failed the Smog Check inspection during this time frame.

NOTE: Authority cited: Sections 39600, 39601 and 44101, Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 44100 and 44101, Health and Safety Code.

§2603 Vehicle Eligibility
(a) To be eligible for generation of emission reduction credits through a VAVR enterprise, a vehicle shall meet the following criteria:
(1) It shall be voluntarily sold to the enterprise operator for a price mutually agreed between the vehicle seller and the enterprise operator;
(2) It shall be currently registered with the Department of Motor Vehicles as an operable vehicle, and shall have been so registered for ~~twenty-four (24) consecutive months immediately~~ 120 days prior to the final date of sale to the VAVR enterprise, to an address or addresses within the district in which the enterprise is being operated. Smog Checks must be performed as required by the Department of Motor Vehicles in order for the vehicle to be considered registered;
~~(A) A vehicle may also be eligible if the owner of the vehicle placed the vehicle in planned non-operational status per Vehicle Code §4604, et seq., for a total of two (2) months during the continuous twenty-four (24) month registration period, occurring at least three (3) months prior to the date of sale to the VAVR enterprise. Smog Checks must be performed as required by the Department of Motor Vehicles in order for the vehicle to be considered registered;~~
~~(B) A vehicle may also be eligible if the registration has lapsed for a period not to exceed 180 days during the previous twenty-four (24) months and all appropriate registration~~

~~fees and late penalties have been paid to the Department of Motor Vehicles, provided that the vehicle is registered for at least ninety (90) days immediately prior to its date of sale to a VAVR enterprise. A Smog Check inspection must be performed as required by the Department of Motor Vehicles in order for the vehicle to be considered registered;~~
~~(C)~~ <u>(A)</u> If a vehicle owner has sold a vehicle to an enterprise operator within the previous twelve (12) months, any subsequent vehicles offered to the same enterprise operator must have been registered continuously to that owner for the previous twenty-four (24) month period, in addition to meeting all other requirements of this section;
~~(D)~~ <u>(B)</u> Determination of an individual vehicle's registration history shall be based on:
1. registration data for that vehicle obtained from Department of Motor Vehicles records
2. If (A) provides inconclusive results for an individual vehicle, then copies of the applicable vehicle registration certificates ~~or planned non-operation status certificates covering the necessary time period may be used~~;
(3) It shall be a passenger car or a light-duty truck;
(4) It shall be driven to the purchase site under its own power;
(5) It shall not be ~~a high emitter or a gross polluter, and shall not be~~ operating under a Smog Check repair cost waiver or economic hardship extension;
(6) If a vehicle volunteered for retirement is within sixty (60) days of its next required Smog Check inspection, the following criteria must be met:
(A) The vehicle shall pass the Smog Check inspection without receiving a repair cost waiver or economic hardship extension prior to acceptance by a VAVR enterprise operator;
(B) Owners of vehicles requiring Smog Check inspections pursuant to §2603(a)(6) shall be required to submit documentation issued by a licensed Smog Check station demonstrating compliance with §2603(a)(6)(A). The documentation shall be submitted to the person performing the functional and equipment eligibility inspection pursuant to §2603(b).
(b) Each vehicle shall pass a functional and equipment eligibility inspection performed by the VAVR enterprise operator or other ARB-approved inspector (inspector), conducted on-site at the VAVR enterprise location. The following elements shall be included in the inspection:
(1) The candidate vehicle must have been driven to the inspection site under its own power. If an inspector has knowledge that a vehicle was towed or pushed for any portion of the trip to the inspection site, then the inspector shall not approve the vehicle for eligibility in a VAVR program;
(2) The inspector shall inspect the vehicle to ensure it meets the following requirements and shall reject the vehicle for emission reduction credit generation if the vehicle fails any of these requirements;
(A) ~~All doors shall be present and at a minimum the driver's side door shall be operable in a two door vehicle. For a four door vehicle, the driver's side door and one rear door shall be operable. Doors shall be deemed operable if they can open and remain closed~~

~~without the use of ropes, wire, or tape, or any other add-on device or material that was not part of the original design of the vehicle;~~ All doors shall be present and in place.
~~(B) The trunk lid shall remain closed without the use of ropes, wire, or tape, or any other add-on device or material that was not part of original design of the vehicle~~
~~(C)~~ (B) ~~The hood (metal cover providing access to the engine) shall open and shall remain closed utilizing a functional latching mechanism without the use of bungee cords, strapping, ropes, wire, or chains, or any other external device or material that was not part of the original design of the vehicle;~~ The hood shall be present and in place;
~~(D)~~ (C) ~~The dashboard shall contain warning lights and gauges (except clock and/or tachometer) as originally supplied by manufacturer, or functionally equivalent after market replacements;~~ The dashboard shall be in place;
~~(E)~~ (D) ~~Windshield wipers shall be present and operational;~~ Windshield shall be present and in place;
~~(F) The windshield and rear window shall not contain any holes, or holes that are covered by tape or any other external component, or any other defective condition that impairs the driver's vision. In addition, the windshield and rear window shall not be held in place by external components that were not part of the original design of the vehicle;~~
~~(G)~~ (E) The driver's seat must be present and in place;~~and the seat back shall not be reinforced or supported by add-on components such as blocks, tires, boards, or ropes in order to be functional~~;
~~(H)~~ (F) Interior pedals ~~(flat surface attached to a lever(s) controlling the brake, clutch, and accelerators)~~ shall be ~~present~~ operational;
~~(I)~~ (G) ~~The vehicle shall contain bumpers, fenders, exhaust system, and side and quarter panels as originally supplied by the manufacturer or after market part equivalent; these components shall not be damaged to the extent that the operability of the vehicle is impaired.~~ One bumper and all side and/or quarter panels shall be present and in place. Vehicle driveability must not be affected by any body, steering or suspension damage.
~~(J) The vehicle shall not contain any holes in the floorboard or any holes penetrating through the body into the passenger compartment. A hole originally designed into the floorboard by the vehicle manufacturer for drainage shall be exempt from this requirement.~~
~~(K)~~ (H) ~~Headlights as well as tail and brake lights shall be present and operational. Burned out light bulbs shall not result in a failure of this requirement provided that the operability of the above lighting systems can be verified.~~ One headlight, one taillight and one brake light shall be present and in place;
~~(L)~~ (I) ~~Driver's side and opposing side window shall be present, and not supported by any add-on component that was not part of the original design of the vehicle. Other side windows or functional replacements shall be present;~~ One side window glass shall be present and in place;
~~(M)~~ (J)The requirements of §2603(a)(5) and §2603(a)(6) regarding Smog Check status have been met;

~~(N) There should be no obvious indications that the vehicle is not operated on a routine basis for extended periods of time;~~
~~(3) The inspector shall inspect the vehicle to ensure it meets the following requirements and shall reject the vehicle for emission reduction credit generation if the vehicle fails any two of these requirements;~~
~~(A) Turn signal lights shall be present and operational. Burned out light bulbs shall not result in a failure of this requirement provided that the operability of the above lighting system can be verified;~~
~~(B) Driver's side window and opposing side passenger window shall be operational. Operability shall be determined by the inspector raising and lowering the windows using the window handle, crank, or power window switch located inside of vehicle. Inability of windows to be raised and lowered shall result in noncompliance with this requirement;~~
~~(C) Rear-view mirror and left-hand side-view mirror shall be present and operational;~~
~~(D) The vehicle shall contain interior door panels as originally supplied by the vehicle manufacturer or after market equivalent. Interior door panels shall be attached to the door without the use of any external device or material not designed for the vehicle;~~
~~(E) The vehicle body shall not contain any holes that exceed two inches in length at the widest point;~~
~~(4)~~ (3) The inspector shall complete the following functional inspection, and shall reject the vehicle for credit generation if the vehicle fails to complete ~~any one of the requirements. Prior to implementing the functional inspection, the vehicle engine shall be turned off;~~
~~(A);~~ ~~Insert key, vehicle engine shall start using keyed ignition system. In addition to the keyed ignition switch, ignition or fuel kill switch may be activated if required to start engine~~ the following test:
~~(B) Vehicle shall idle without the use of accelerator pedal for a minimum of ten seconds;~~
~~(C) Transmission shall be shifted into forward gear with brake pedal applied. Vehicle engine shall remain operating without use of accelerator pedal for a minimum of ten seconds. Vehicles equipped with manual transmissions shall be exempt from this requirement.~~
~~(D)~~ (A) Insert key, vehicle engine shall start using keyed ignition system. In addition to the keyed ignition switch, ignition or fuel kill switch may be activated if required to start engine. The vehicle must start readily through ordinary means without the use of starting fluids or external booster batteries. The vehicle shall be driven forward for a minimum of 25 feet under its own power. The vehicle shall be driven in reverse for a minimum of 25 feet under it's own power also;
~~(E) Under its own power, the vehicle shall be driven forward for a minimum of 100 feet starting at 0 miles per hour, and the vehicle shall completely stop at the end of this test using the vehicle's braking system. In dry weather conditions, the vehicle shall travel the first 60 feet of this test within 5.5 seconds. In wet weather conditions, the vehicle shall travel the first 60 feet of this test within 8.5 seconds. After 100 feet have been traveled, the vehicle shall turn around and return to its point of origin;~~

~~(5) The inspector shall reject the vehicle for emission reduction credit generation if any of the following occurs during implementation of the functional tests specified in §2603(b)(2), §2603(b)(3), and §2603(b)(4);~~
~~(A) Engine shuts down subsequent to keyed ignition start;~~
~~(B) Emissions of whining, grinding, clanking, squealing, or knocking noises, or noises from engine backfire;~~
~~(C) The brake pedal drops to the floor when the inspector attempts to stop the vehicle.~~
~~(6)~~ (4) Upon satisfactory completion of the inspection, the inspector will issue a certificate of functional and equipment eligibility.
(A) master copy of the certificate of functional and equipment eligibility is included in the document "Voluntary Accelerated Vehicle Retirement Certificate of Functional and Equipment Eligibility Inspection Form", as specified in Appendix A to this Article 1;
~~(7)~~ (5) Vehicles failing the requirements pursuant to §2603(b)(1)~~,~~ and §2603(b)~~(4)~~(3), ~~and §2603(b)(5)~~ may be re-tested by the inspector for compliance with these requirements and issued a certificate of functional and equipment eligibility provided the vehicle has traveled a minimum of 50 miles subsequent to the failure determination. Vehicles with inoperable vehicle odometers must be fixed prior to conducting this test. Vehicles failing the requirements pursuant to §2603(b)(2) ~~and §2603(b)(3)~~ may be re-tested by the inspector for compliance with these requirements and issued a certificate of functional and equipment eligibility at any time after modifications have been made to the vehicle;
(c) Districts may adopt vehicle functional and equipment eligibility inspection requirements that are more stringent than those specified in §2603(b). In doing so, districts may not omit or weaken any of the required functional or equipment tests; they may only add additional tests or adopt a more stringent version of a specified test.

NOTE: Authority cited: Sections 39600, 39601, 44101, and 44102, Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 44100, 44101, 44102, 44103 and 44107, Health and Safety Code.

§2604 VAVR Enterprise Operator Requirements
(a) The enterprise operator shall either:
(1) be an auto dismantler, licensed according to the requirements of the California Vehicle Code and other business codes and the regulations of the Department of Motor Vehicles, for the purpose of vehicle disposal after purchase, or:
(2) have a binding agreement with a duly authorized auto dismantler, for the purpose of vehicle disposal after purchase;
(b) At least thirty (30) days prior to commencing operations as a voluntary accelerated vehicle retirement enterprise operator, the operator shall notify the local district, in writing, of the intent to conduct such operations;
(1) The notification shall be submitted on forms specified by a district and shall contain information demonstrating the ability to comply with all provisions of this rule. This information shall include, but is not limited to, enterprise operator name and business address, licensed auto dismantler name and business address, anticipated initiation date and duration of vehicle retirement operation, time of vehicle intake, a written statement from the auto dismantler under penalty of perjury certifying compliance with local water conservation regulations, state, county, and city energy and hazardous materials response regulations, and local water agency soil, surface, and ground water contamination regulations, and any other information requested in applicable district rules;
(2) The local district shall have the right to refuse permission to generate emission reduction credits through voluntary accelerated vehicle retirement to any requesting operator deemed by the local district as not meeting the requirements of these regulations or any applicable district rules;
(3) The district may assess an application fee to cover the costs of this approval process;
(c) The enterprise operator shall be required to contract with an ARB-approved inspection entity, to provide inspector services to perform the vehicle functional and equipment eligibility inspection specified in section §2603(b) on-site at VAVR enterprise locations, if the VAVR enterprise operator is unable to or chooses not to perform this function;
(d) For a vehicle purchased as part of a VAVR enterprise and whose accelerated retirement creates emission reductions to be used as the basis for generating emission reduction credits, the enterprise operator shall:
(1) verify that the vehicle meets the vehicle registration eligibility requirements of §2603(a)(2); and
(2) obtain from the vehicle owner the certificate of functional and equipment eligibility issued per §2603(b);
(e) At time of final sale of a vehicle to the VAVR enterprise, the enterprise operator shall verify that the person delivering the vehicle for sale is the legal owner or an authorized representative of the legal owner, properly empowered to complete the sale;
~~(f) A vehicle purchased as part of a VAVR enterprise and whose accelerated retirement creates emission reductions that are to be used as the basis for generating emission reduction credits, shall be permanently destroyed by the enterprise operator, or the~~

~~enterprise operator's duly contracted dismantler, within ninety (90) days of the date it is sold to the enterprise operator, and may not be resold to the public or put into operation in any way, except such a vehicle may be briefly operated for purposes related to the disposal of the vehicle as part of normal disposal procedures;~~

~~(1) For purposes of this regulation, the vehicle will be considered destroyed when it has been crushed or shredded or otherwise rendered permanently and irreversibly incapable of functioning as originally intended, and when all appropriate records maintained by the Department of Motor Vehicles have been updated to reflect that the vehicle has been acquired by a licensed auto dismantler for the purposes of dismantling.~~

~~(2) No parts may be removed, for sale or reuse, from any vehicle retired for the purpose of generating emission reduction credits. The only allowable use for any retired vehicle is as a source of scrap metal and other scrap material;~~

~~(A) An enterprise operator may separate ferrous and non-ferrous metals prior to vehicle retirement to sell as a source of scrap metal only;~~

~~(B) An enterprise operator may sell tires and batteries to an intermediary tire/battery recycler only. All facilities generating or receiving waste tires must use the services of a registered tire hauler/recycler. Battery recyclers must be registered and licensed to handle batteries;~~

~~(3) All vehicles from which emission reduction credits are to be generated must be confined in a holding area separate from other vehicles procured by the enterprise until they are permanently destroyed;~~

~~(4) All activities associated with retiring vehicles, including but not limited to the disposal of vehicle fluids and vehicle components, shall comply with local water conservation regulations, state, county, and city energy and hazardous materials response regulations, and local water agency soil, surface, and ground water contamination regulations;~~

(f) The enterprise operator shall provide to the district, by the 5th day of each month, a list of all vehicles accepted for participation into a VAVR enterprise that are within sixty-one to ninety days (61-90) of their next required Smog Check inspection for the purpose of district compliance with §2602(f). Information to be provided for each vehicle includes, but is not limited to, vehicle identification number (VIN); vehicle license plate number; and vehicle make, model, and model year;

NOTE: Authority cited: Sections 39600, 39601 and 44101, Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 44100, 44101, 44102, 44103, 44105, 44107 and 44120 Health and Safety Code.

§2605 Offering Vehicles to the Public

(a) There shall be a minimum period of seven (7) days between the time a vehicle is first offered for sale into a VAVR enterprise and the time of completion of the sale, unless the vehicle owner represents that waiting a minimum of seven (7) days would impose an undue hardship, in which case the seven (7) day minimum waiting period and the

requirement to provide the vehicle description and scheduled delivery information pursuant to §2605(a)(1) is waived:
(1) During this period, with the vehicle owner's permission, the enterprise operator will submit to the local district a description of the vehicle and the date and approximate time when the vehicle is scheduled to be delivered for final sale to the enterprise operator. The district will, in turn, make this information available to an appropriate segment of the public. The intent is to allow interested third parties, including car collector enthusiasts and those interested in affordable transportation, to be present at the scheduled time of delivery in order to contact the owner, examine the car and to negotiate with the owner for purchase of the vehicle before it is otherwise sold to the VAVR enterprise, should the vehicle be delivered as scheduled;
(A) The description shall include, at a minimum, the vehicle make, model, model year, and VIN, and the date and approximate time when the vehicle is scheduled to be delivered for sale to the VAVR enterprise, but no information identifying the owner will be permitted. When the district makes this information available to the public, the district will emphasize that while a vehicle is scheduled for delivery, there is no guarantee that the vehicle will actually be delivered.
(B) The vehicle owner is free to accept or reject any resulting contact or purchase offer and shall be informed by the enterprise operator explicitly and prominently of such right;
(C) Nothing in this section places the enterprise operator under any obligation to provide space or facilities for such third party contacts, inspections or negotiations to take place;
(2) No emission reduction credits shall be granted for any vehicle resold to the public in this manner;
(b) At the enterprise operator's discretion, the enterprise operator may make a vehicle previously purchased as part of a voluntary accelerated vehicle retirement enterprise available for sale to the general public, provided:
(1) The enterprise operator contacts the seller of the vehicle to be made available for public purchase and receives permission to sell the vehicle to a member of the public. If the VAVR enterprise operator is unable to obtain permission from the seller within 90 days of purchasing the vehicle, it shall not be sold to a member of the public;
(2) The resale of the vehicle shall follow commonly accepted practices and all requirements of law and regulation in effect at time of resale;
(3) No emission reduction credits shall be granted for any vehicle resold to the public in this manner;

NOTE: Authority cited: Sections 39600, 39601 and 44101, Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 44100, 44101, 44102, 44103, 44105, 44107, 44109 and 44120, Health and Safety Code.

<u>§2606 Parts Recycling and Resale</u>
<u>(a) On vehicles used for the generation of emission reduction credits parts recycling and resale is limited to non-emission-related and non-drive train parts per the List of</u>

Emission-Drive Train Related Parts List shown in Appendix C to Article 1 – Emission/Drive Train-Related Parts List;

(1) Parts recycling is at the sole discretion of the VAVR enterprise operator, subject to the limitations included herein;

(b) After the seven-day waiting period and prior to offering non-emission and non-drive train parts for resale, the engine, emission-related parts, transmission, and drive train parts must be removed from a vehicle used for the generation of emission reduction credits and destroyed by the enterprise operator, or the enterprise operator's duly contracted dismantler:

(1) For the purpose of this regulation, a part will be considered destroyed when it has been punched, crushed, shredded or otherwise rendered permanently and irreversibly incapable of functioning as originally intended;

(2) A checklist is provided in Appendix D to Article 1 – Quality Control Checklist with a list of emission-related and drive train parts that has check boxes for recording the status of parts, i.e., "removed" and "destroyed";

(A) The VAVR Enterprise Operator must complete the checklist by adding check marks in the appropriate columns as the emission-related and drive train parts are removed and destroyed;

(B) For a part that appears on the checklist, but is not in the original design of the vehicle, the VAVR Enterprise Operator must enter "N/A" for "not applicable" in lieu of a check mark;

(3) After all emission-related and drive train parts are removed and destroyed, a quality control inspector (designated by the VAVR Enterprise Operator) must perform an inspection of the non-emission-related and non-drive train parts as well as the vehicle body;

(4) Upon verification by the quality control inspector that no emission-related parts or drive train parts have been exchanged with the non-emission-related, and non-drive train parts, the quality control inspector must sign the checklist;

(5) After the quality control inspector signs the check list, the dismantler may place the remaining non-emission parts, non-drive train parts and vehicle body in yard to be available for sale to public;

(b) If the VAV R Enterprise Operator does not recover parts from a vehicle, then the entire vehicle must be crushed within 90 days of acquisition by the operator;

(1) No parts may be removed, for sale or reuse, from any crushed retired vehicle for the purpose of generating emission reduction credits. The only allowable use for any crushed retired vehicle is as a source of scrap metal and other scrap material;

(2) An enterprise operator may separate ferrous and non-ferrous metals from a crushed retired vehicle to sell as a source of scrap metal only;

(3) An enterprise operator may sell tires and batteries from a crushed retired vehicle to an intermediary tire/battery recycler only. All facilities generating or receiving waste tires must use the services of a registered tire hauler/recycler. Battery recyclers must be registered and licensed to handle batteries;

(d) No emission reduction credits or other compensation with public funds shall be granted for any vehicle from which emission-reduction or drive train parts have been sold;
(e) All activities associated with retiring vehicles, including but not limited to the disposal of vehicle fluids and vehicle components, shall comply with local water conservation regulations, state, county, and city energy and hazardous materials response regulations, and local water agency soil, surface, and ground water contamination regulations;
(f) Local districts are required to perform audits of all parts recycling and resale activities;

NOTE: Authority cited: Sections 39600, 39601 and 44101, Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 44100, 44101, 44102, 44103, 44105, 44107 and 44120 Health and Safety Code.

§260~~6~~7 Advertising
(a) Any advertising conducted by an enterprise operator for the purpose of recruiting vehicle owners to sell their cars into a VAVR enterprise shall not contain any language stating that the VAVR enterprise is anything but voluntary for the consumer or that the VAVR enterprise is affiliated with or is operated by the State of California;
(1) Any contracts or agreements between a vehicle seller and an enterprise operator relating to the sale of a vehicle to a VAVR enterprise shall not contain any language stating that the VAVR enterprise is anything but voluntary for the consumer or that the VAVR enterprise is affiliated with or is operated by the State of California;
(b) Any enterprise operator requesting the Department of Motor Vehicles to send notices to vehicle owners as prospective VAVR participants pursuant to Health and Safety Code §44103, shall meet the following requirements:
(1) Prominently display the disclaimer statement as follows: "This voluntary accelerated vehicle retirement enterprise is conducted by a private operator under the auspices of the State of California and your local air pollution control district/air quality management district. It is not operated by the State of California. State funds are not used for the purchase of vehicles. Depending on location and other factors, resulting emission reduction credits may be purchased by the state to result directly in air quality improvements. Your participation is entirely voluntary."
(2) Provide the Department of Motor Vehicles with adequate criteria for selecting as notice recipients those registered vehicle owners who own the desired target vehicles. Such criteria may consist of the desired vehicle makes, models, model years, geographical locales, or any other criteria deemed acceptable or necessary by the Department of Motor Vehicles;

NOTE: Authority cited: Sections 39600, 39601 and 44101, Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 44100, 44101, 44102, 44103, 44105, 44107 and 44109, Health and Safety Code.

§26078 Emission Reduction Credits

(a) Emission reduction credits shall be generated under these regulations for reductions of emissions of NOx, ROG, CO and PM, as provided in this section. The magnitude of the credit for each of these pollutants, as generated by the accelerated retirement of an individual vehicle, shall be based on emission reduction data contained in the document entitled "Voluntary Accelerated Light-Duty Vehicle Retirement Program Emission Reductions" as specified in Appendix be to this Article 1;

(1) The maximum credit amount shall be no greater than the calculated emission reduction on which the credit is based. Districts may apply a discount factor to credits calculated under these regulations, consistent with applicable district and Board credit rules and programs;

(2) Credit usage shall be in accordance with all federal, state and local laws and regulations in effect at time of usage;

(3) The life of emission reduction credits as generated by the accelerated retirement of an individual vehicle is three (3) years;

NOTE: Authority cited: Sections 39600, 39601 and 44101, Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 44100, 44101, 44102, 44121 and 44122, Health and Safety Code.

§26089 Records, Auditing, and Enforcement

(a) The following requirements for records, auditing, and enforcement shall be met:

(1) An enterprise operator shall be responsible for maintaining and storing the following information for each vehicle removed from operation for the purpose of generating emission reduction credits:

(A) Vehicle Identification Number (VIN);

(B) Vehicle license plate number;

(C) Vehicle model year;

(D) Vehicle odometer reading;

(E) Vehicle make and model;

(F) Name, address and phone number of legal owner selling vehicle to the enterprise operator

(G) Name, address and phone number of registered owner if different from (F);

(H) Name and business address of inspector conducting the vehicle's eligibility inspection, if the VAVR enterprise operator contracts with an ARB-approved inspection entity to perform the vehicle functional and equipment eligibility inspection;

(I) Date of purchase of vehicle by enterprise operator;

(J) Date of vehicle retirement;

(K) The emission reduction amount claimed per §2607~~7~~8;
(L) Reproductions of California Certificate of Title and registration, as signed-off be seller at time of final sale to the VAVR enterprise;
(M) Reproductions of California Certificate of Title and registration, as signed-off by seller at time of final sale to the VAVR enterprise;
(N) Reproduction of the applicable Report of Vehicle to be Dismantled and Notice of Acquisition (California Department of Motor Vehicles Registration 42 form);
(O) Reproduction of written documentation from the California Department of Motor Vehicles verifying that a vehicle meets the requirements of §2603(a)(2);
(P) If applicable, reproduction of documentation issued pursuant to §2603(a)(6)(B);
(Q) Any other pertinent data requested by the district;
(2) Upon request of the district, the data contained in records required in §2608~~8~~9(a)(1)(A) through (K) shall be transmitted to the district in an electronic database format, to be determined by mutual agreement between the district and the enterprise operator, in lieu of paper copies;
(3) The enterprise operator will maintain copies of the information listed in §2608~~8~~9(a)(1)(A) through (Q) for a minimum period of time commensurate with the life of the emission reduction credits generated from each vehicle pursuant to §2607~~7~~8, and shall make those records available to the district upon request;
(4) Each district shall be responsible for approving and issuing emission reduction credits generated in accordance with §2607 to VAVR enterprise operators, based on data supplied by each enterprise operator pursuant to §2608~~8~~9(a)(1), §2608~~8~~9(a)(2), and §2608~~8~~9(a)(3). Districts shall not approve and issue emission reduction credits unless a VAVR enterprise operator demonstrates compliance with all applicable provisions in this regulation;
(5) A district shall not approve and issue emission reduction credits for any vehicle retired within sixty-one to ninety (61-90) days of its next required Smog Check inspection until it has verified that the vehicle did not fail its Smog Check inspection during that time frame pursuant to §2602(f). Emission reduction credits shall not be issued for any vehicle failing its Smog Check inspection during the sixty-one to ninety (61 - 90) day time frame.
(6) VAVR enterprise operators may not make emission reduction credits available for purchase until they are approved and issued by the district.
(7) The district may conduct announced and unannounced audits and on-site inspections of VAVR enterprise operations to ensure that enterprises are being operated according to all applicable rules and regulations. The district shall report the results of any such audits and inspections to the Executive Officer, and shall notify any non-compliant enterprise operator of the nature of the violation and shall initiate any enforcement or remedial action necessary;
(A) Enterprise operators and their subcontractors shall allow the district to conduct announced and unannounced audits and inspections and shall cooperate fully in such situations;

(B) Violation of any provision of these regulations, including falsification of any information or data, shall constitute a citable violation making the violator subject to all applicable penalties specified in the California Health and Safety Code. In addition, violation of any provision of §2603 by a VAVR enterprise operator or its subcontractors shall result in the issuance of a Notice of Violation(s). District approval to generate emission reduction credits shall be revoked if a VAVR enterprise operator demonstrates a recurrent pattern of accepting vehicles that do not meet the eligibility requirements pursuant to §2603 or if a VAVR enterprise operator violates §2608(a)(6);

NOTE: Authority cited: Sections 39600, 39601 and 44101, Health and Safety Code. Reference: Sections 39002, 39003, 42400, 42400.1, 42400.2, 42400.3, 42400.4, 42400.5, 42400.6, 42401, 42402, 42402.1, 42402.2, 42402.3, 42402.5, 42403, 43000, 43013, 43016, 44100, 44101, 44102, 44103, 44105, 44106 and 44107, Health and Safety Code.

§260~~9~~10 Pilot Program
(a) Plan to Guide Execution of Pilot Program, Assess Results and Formulate Recommendations:
(1) The Board will contract with an interested party to conduct a pilot program in the South Coast Air Basin, to be completed no later than two (2) years after adoption of these regulations;
(2) The pilot program will be designed to test the efficacy of these regulations with regards to the goals of SIP measure M1 and VAVR-for-credit operations in general;
(3) The pilot program will determine a baseline of the current population of vehicles by model year and market value and the current turnover rate of vehicles, and other factors that may be essential to assessing the effectiveness, cost-effectiveness, and market impacts of VAVR enterprises;
(4) The Board will publish a report at the end of each calendar year for which the pilot program is operated. This report will include:
(A) The number of vehicles retired, by model year.
(B) The measured emissions of any retired vehicles tested during the report period;
(C) Costs of the vehicles in terms of amounts paid to sellers, and the cost-effectiveness of voluntary accelerated vehicle retirement expressed in dollars per ton of emissions reduced.
(D) Administrative and testing costs for the program.
(E) Assessments of the replacement vehicles or replacement travel by model year or emission levels, as determined from interviews, questionnaires, diaries, analyses of vehicle registrations in the study region, or other methods as appropriate.
(F) Assessments of the net emission benefits of voluntary accelerated vehicle retirement in the year reported, considering the retired vehicles, the replacement vehicles, and other effects of the program on the mix of vehicles and use of vehicles in the geographical area of the program, including in-migration of other vehicles into the area and any tendencies

to increased market value of used vehicles and prolonged useful life of existing vehicles, if any.
(G) Assessments of whether the M-1 strategy of the 1994 SIP can reasonably be expected to yield the required emission reductions.
(H) Assessments of typical retired vehicle operating condition, historical mileage, and other relevant vehicle data;

NOTE: Authority cited: Sections 39600, 39601, 44101 and 44104.5, Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 44100, 44101, 44104.5 and 44105, Health and Safety Code.

§26~~10~~11Procurement of Credits for SIP Measure M1
(a) The purchase of emission reduction credits by the State of California is dependent on funding allocated for the purpose of achieving the emission reduction goals of measure M1 of the 1994 SIP for ozone attainment;
(1) As funding becomes available, the ARB shall develop and initiate a process for procuring available emission reduction credits. Available emission reduction credits will be purchased by the State of California from enterprise operators meeting all the requirements of this regulation and applicable district rules through an approved state-contracting procedure, such as the issuance of an Invitation for Bid;
(2) All emission reduction credits purchased by the State of California shall be retired to meet the emission reduction goals of measure M1.

NOTE: Authority cited: Sections 39600 and 39601, 44101 and 44104, Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013 44100, 44101 and 44104, Health and Safety Code.

APPENDIX C to Article 1

State of California
Air Resources Board

Emission-Drive Train Related Parts List

Adopted November 4, 1977
Amended May, 1981
Amended June 1, 1990

The following list of components are examples of emission related parts as defined in Section 1900 (b) (3), Chapter 3, Title 13, California Code of Regulations.

I. Carburetion and Air Induction System

A. Air Induction System:

1. Temperature sensor elements
2. Vacuum motor for air control
3. Hot air duct & stove
4. Air filter housing & element
5. Turbocharger or supercharger
6. Intercooler

B. Emission Calibrated Carburetors:

1. Metering jets
2. Metering rods
3. Needle and seat
4. Power valve
5. Float circuit
6. Vacuum break
7. Choke mechanism
8. Throttle-control solenoid
9. Deceleration valve
10. Dashpot
11. Idle stop solenoid, anti-dieseling assembly

12. Accelerating pump
13. Altitude compensator

C. Mechanical Fuel Injection:

1. Pressure regulator
2. Fuel injection pump
3. Fuel injector
4. Throttle-position compensator
5. Engine speed compensator
6. Engine temperature compensator
7. Altitude cut-off valve
8. Deceleration cut-off valve
9. Cold-start valve

D. Continuous Fuel Injection:

1. Fuel pump
2. Pressure accumulator
3. Fuel filter
4. Fuel distributor
5. Fuel injections
6. Air-flow sensor
7. Throttle-position compensator
8. Warm-running compensator
9. Pneumatic overrun compensator
10. Cold-start valve

E. Electronic Fuel Injection:

1. Pressure regulator
2. Fuel distribution manifold
3. Fuel injectors
4. Electronic control unit
5. Engine speed sensor
6. Engine temperature sensor
7. Throttle-position sensor
8. Altitude/manifold-pressure sensor
9. Cold-start valve

F. Air Fuel Ratio Control:

1. Frequency valve
2. Oxygen sensor
3. Electronic control unit

G. Intake Manifold

II. Ignition System

A. Distributor

1. Cam
2. Points
3. Rotor
4. Condenser
5. Distributor cap
6. Breaker plate
7. Electronic components (breakerless or electronic system)

B. Spark Advance/Retard System:

1. Centrifugal advance mechanism:
   a. Weights
   b. Springs

2. Vacuum advance unit

3. Transmission controlled spark system:

   a. Vacuum solenoid
   b. Transmission switch
   c. Temperature switches
   d. Time delay
   e. CEC valve
   f. Reversing relay

4. Electronic spark control system:

   a. Computer circuitry
   b. Speed sensor
   c. Temperature switches
   d. Vacuum switching valve

5. Orifice spark advance control system:

   a. Vacuum bypass valve
   b. OSAC (orifice spark advance control) valve
   c. Temperature control switch
   d. Distributor vacuum control valve

6. Speed controlled spark system:

   a. Vacuum solenoid
   b. Speed sensor and control switch
   c. Thermal vacuum switch

C. Spark Plugs

D. Ignition Coil

E. Ignition Wires

III. Mechanical Components

A. Valve Trains:

1. Intake valves
2. Exhaust valves
3. Valve guides
4. Valve springs
5. Valve seats
6. Camshaft

B. Combustion Chamber:

1. Cylinder head or rotor housing[4]
2. Piston or rotor[1]

IV. Evaporative Control System

A. Vapor Storage Canister and Filter

[4] *Rotary (Wankel) engines only*

B. Vapor Liquid Separator

C. Filler Cap

D. Fuel Tank

E. Canister Purge Valve

V. Positive Crankcase Ventilation System

A. PCV Valve
B. Oil Filler Cap

C. Manifold PCV Connection Assembly

VI. Exhaust Gas Recirculation System

A. EGR Valve:

1. Valve body and carburetor spacer
2. Internal passages and exhaust gas orifice

B. Driving Mode Sensors:

1. Speed sensor
2. Solenoid vacuum valve
3. Electronic amplifier
4. Temperature-controlled vacuum valve
5. Vacuum reducing valve
6. EGR coolant override valve
7. Backpressure transducer
8. Vacuum amplifier
9. Delay valves

VI. Air Injection System

A. Air Supply Assembly:

1. Pump

2. Pressure relief valve
3. Pressure-setting plug
4. Pulsed air system

B. Distribution Assembly:

1. Diverter, relief, bypass, or gulp valve
2. Check or anti-backfire valve
3. Deceleration control part
4. Flow control valve
5. Distribution manifold
6. Air switching valve

C. Temperature sensor

VIII. Catalyst, Thermal Reactor, and Exhaust System

A. Catalytic Converter:

1. Constricted fuel filler neck
2. Catalyst beads (pellet-type converter)
3. Ceramic support and monolith coating (monolith-type converter)
4. Converter body and internal supports
5. Exhaust manifold

B. Thermal Reactor:

1. Reactor casing and lining
2. Exhaust manifold and exhaust port liner

C. Exhaust System:

1. Manifold
2. Exhaust port liners
3. Double walled portion of exhaust system
4. Heat riser valve and control assembly

IX. Miscellaneous Items Used in Above Systems

1. Hoses, clamps, and pipers
2. Pulleys, belts, and idlers

X. Computer Controls

1. Electronic Control Unit (ECU)
2. Computer-coded engine operating parameter (including computer chips)
3. All sensors and actuators associated with the ECU

XI. Drive Train Parts (added to Emission-Related Parts List.

1. Engine
2. Drive mechanism
3. Transmission
4. Differential
5. Axles
6. Brakes

Appendix D to Article 1

(Note: The entire Appendix D to Article 1 is added to the proposed regulation order; however, due to the table format, it is not feasible to underline the added text in Appendix D, therefore, the added text is as below)

Emission-Related and Drive Train Parts Removal and Destruction Quality Control Check List

Date ______________________________
Dismantler ______________________________
Address ______________________________
Quality Control Inspector ______________________________
Vehicle Make ______________________________
Vehicle Model ______________________________
Vehicle Year ______________________________
Vehicle License Number______________________________
Vehicle Odometer Mileage ______________________________

Category	Emission-Related Part	Part Removed	Part Destroyed
Air Induction System	Temperature sensor elements		
	Vacuum motor for air control		
	Hot air duct & stove		
	Air filter housing & element		
	Turbocharger or supercharger		
	Intercooler		
Emission Calibrated Carburetors	Metering jets		
	Metering rods		
	Needle and seat		
	Power valve		
	Float circuit		
	Vacuum break		
	Choke mechanism		
	Throttle-control solenoid		
	Deceleration valve		

Category	Emission-Related Part	Part Removed	Part Destroyed
Emission Calibrated Carburetors (continued)	Dashpot		
	Idle stop solenoid, anti-dieseling assembly		
	Accelerating pump		
	Altitude compensator		
Mechanical Fuel Injection:	Pressure regulator		
	Fuel injection pump		
	Fuel injector		
	Throttle-position compensator		
	Engine speed compensator		
	Engine temperature compensator		
	Altitude cut-off valve		
	Deceleration cut-off valve		
	Cold-start valve		
Continuous Fuel Injection:	Fuel pump		
	Pressure accumulator		
	Fuel filter		
	Fuel distributor		
	Fuel injections		
	Air-flow sensor		
	Throttle-position compensator		
	Warm-running compensator		
	Pneumatic overrun compensator		
	Cold-start valve		
Electronic Fuel Injection:	Pressure regulator		
	Fuel distribution manifold		
	Fuel injectors		
	Electronic control unit		
	Engine speed sensor		
	Engine temperature sensor		
	Throttle-position sensor		
	Altitude/manifold-pressure sensor		
Electronic Fuel Injection:	Cold-start valve		
Air Fuel Ratio Control:	Frequency valve		
	Oxygen sensor		

Category	Emission-Related Part	Part Removed	Part Destroyed
Air Fuel Ratio Control:	Electronic control unit		
Intake Manifold	Intake Manifold Assembly		
Distributor	Cam		
	Points		
	Rotor		
	Condenser		
	Distributor cap		
	Breaker plate		
	Electronic components (breakerless or electronic system)		
Spark Advance/ Retard System	Centrifugal advance mechanism: weights and springs		
	Vacuum advance unit		
	Transmission controlled spark system: vacuum solenoid, transmission switch, temperature switches, time delay, CEC valve, reversing relay		
	Electronic spark control system: computer circuitry, speed sensor, temperature switches, vacuum switching valve		
	Orifice spark advance control system: vacuum bypass valve, orifice spark advance control valve, temperature control switch, distributor vacuum control switch		
Spark Advance/ Retard System (continued)	Speed controlled spark system: vacuum solenoid, speed sensor and control switch, thermal vacuum switch		
Spark Plugs	Spark Plugs		
Ignition Coil	Ignition Coil		

Category	Emission-Related Part	Part Removed	Part Destroyed
Ignition Wires	Ignition Wires		
Drive Train	Engine		
	Flywheel		
	Bell Housing		
	Drive Shaft		
	Transmission		
	Differentials		
	Axles		
	Brakes		
Mechanical Components	Intake valves		
	Exhaust valves		
	Valve guides		
	Valve springs		
	Valve seats		
	Camshaft		
	Cylinder head or rotor housing		
	Piston or rotor		
Evaporative Control System	Vapor Storage Canister and Filter		
	Vapor Liquid Separator		
	Filler Cap		
	Fuel Tank		
	Canister Purge Valve		
Positive Crankcase Ventilation System	PCV Valve		
	Oil Filler Cap		
	Manifold PCV Connection Assembly		
Exhaust Gas Recirculation System	EGR Valve: valve body and carburetor spacer,		
	EGR Valve: internal passages and exhaust gas orifice		
Driving Mode Sensors	Speed sensor		
	Solenoid vacuum valve		
	Electronic amplifier		
	Temperature-controlled vacuum valve		
	Vacuum reducing valve		
	EGR coolant override valve		

Category	Emission-Related Part	Part Removed	Part Destroyed
Driving Mode Sensors (continued)	Backpressure transducer		
	Vacuum amplifier		
	Delay valves		
Air Injection System	Pump		
	Pressure-relief valve		
	Pressure-setting plug		
	Pulsed air system		
	Diverter		
	Relief, bypass, or gulp valve		
	Check or anti-backfire valve		
	Deceleration control part		
	Flow control valve		
	Distribution manifold		
	Air switching valve		
	Temperature sensor		
Catalytic Converter/Thermal Reactor/exhaust	Constricted fuel filler neck		
	Catalyst beads (pellet-type converter),		
	Ceramic support and monolith coating (monolith-type converter),		
	Converter body and internal supports,		
	Exhaust manifold		
	Reactor casing and lining		
	Exhaust manifold and exhaust port liner		
	Manifold		
	Exhaust port liners,		
	Double walled portion of exhaust system,		
	Heat riser valve and control assembly		
Miscellaneous Items Used in Above Systems	Hoses, clamps, and pipers		
	Pulleys, belts, and idlers		

Computer Controls	Electronic Control Unit (ECU)		
	Computer-coded engine operating parameter (including computer chips)		
	All sensors and actuators associated with the ECU		

Quality Control Inspector Final Verification All Emission-Related Parts Removed and Destroyed

Quality Control Inspector Signature:

____

Date:

____

State of California

AIR RESOURCES BOARD

Research Resolutions

Research Division

February 8, 2002

INTRODUCTION

Contained herein for Board review are two resolutions and accompanying summaries from the Extramural Research Program recommended to the Board by the Research Screening Committee.

Item 1 is a research proposal from the University of California, Berkeley, entitled, "Keeping Tahoe Blue through Identifying Nitrogen Transport to Lake Tahoe: Additional Ambient Air Nitrogen Species Measurements". The principal investigator will be Ronald C. Cohen.
Resolution No.

Item 2 is a research proposal from the University of California, Davis, entitled, "Keeping Tahoe Blue through Ambient Air Quality Modeling: Aircraft and Boat Measurements of Air Quality and Meteorology Over Lake Tahoe". The principal investigator will be John J. Carroll and Cort Anastasio.
Resolution No.

PROPOSED

State of California
AIR RESOURCES BOARD

Resolution 02-6

February 21, 2002

Agenda Item No.: 02-1-6

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2506-223, entitled "Keeping Tahoe Blue through Identifying Nitrogen Transport to Lake Tahoe: Additional Ambient Air Nitrogen Species Measurements", has been submitted by the University of California, Berkeley;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2506-223 entitled "Keeping Tahoe Blue through Identifying Nitrogen Transport to Lake Tahoe: Additional Ambient Air Nitrogen Species Measurements", submitted by the University of California, Berkeley, for a total amount not to exceed $175,036.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2506-223 entitled "Keeping Tahoe Blue through Identifying Nitrogen Transport to Lake Tahoe: Additional Ambient Air Nitrogen Species Measurements", submitted by the University of California, Berkeley, for a total amount not to exceed $175,036.
>
> BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $175,036.

ATTACHMENT A

"Keeping Tahoe Blue through Identifying Nitrogen Transport to Lake Tahoe: Additional Ambient Air Nitrogen Species Measurements"

Background

Nutrient loading is believed responsible for loss of clarity in Lake Tahoe. Enrichment of nitrogen and phosphorus in Lake Tahoe has been observed and some researchers have attributed a significant portion of that enrichment to atmospheric sources. However, the estimates of atmospheric (and some non-atmospheric) contributions are uncertain. Better quantification is required to understand what actions would be effective for reducing nitrogen enrichment of the Lake. Through dry and wet deposition, atmospheric nitrogen oxides including NO_X, nitric acid and organic nitrates may contribute to increases in the nitrogen available as a nutrient in the Lake. Sources of atmospheric nitrogen oxides may include direct emissions within the Basin from vehicles and home wood burning as well as natural sources and emissions from combustion, bacterial modification of fertilizers and natural bacterial emissions from the Sacramento Valley and the Bay Area that are transported to the Tahoe Basin.

Objective

The objective of this project is to provide a detailed baseline of observations of the annual cycle of four different types of reactive nitrogen oxides in the Tahoe Basin and advance the understanding of the sources, chemical transformations, surface deposition rates and the dynamical factors that affect the input of atmospheric nitrogen oxides to Lake Tahoe. The project will determine the deposition rates and the origin of deposited nitrogen by measuring ambient concentrations of nitric acid, nitrogen dioxide, peroxy acetyl nitrate, and total organic nitrates at Lake Tahoe.

Methods

State-of-the-art laser induced fluorescence (LIF) instrument, designed and built by Dr. Cohen, will be used to measure the target species.

Expected Results

Atmospheric measurements will be made of nitric acid, nitrogen dioxide, peroxyacetyl nitrate, total alkyl nitrates, and total organic nitrates at the upwind boundary of the Lake Tahoe Basin. Fluxes of nitrogen species may also be measured near Lake level to estimate deposition to the Lake. These measurements will be analyzed to determine: 1) the factors that control the mixing ratios of total reactive nitrogen in the Lake Tahoe Basin, 2) the factors that control partitioning among nitrogen species, 3) the contribution alkyl nitrates make to the atmospheric nitrogen oxides deposited to the Lake Tahoe Basin, and 4) the fractions of NOy in the Tahoe Basin contributed by the global background, sources in regions of California to the West, and local sources.

Significance to the Board

Ambient data, including fluxes, will provide inputs and validation databases for the Board's Lake Tahoe air quality modeling exercises. It is expected that these modeling exercises will characterize any enrichment from the atmosphere to the lake and evaluate required control measures to reduce the enrichment.

Contractor:
University of California, Berkeley

Contract Period:
30 months

Principal Investigator:
Ronald C. Cohen

Contract Amount:
$175,036

Cofunding:
This research at Lake Tahoe is funded by the California Air Resources Board. However, it is part of a larger cooperative research effort that includes funding of various aspects by the California State Water Quality Control Board, U. S. EPA, Tahoe Regional Planning Agency (TRPA), and the U. S. Forest Service.

Basis for Indirect Cost Rate:
The State and UC System have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
This Principal Investigator has performed very successfully on past contracts, including making similar measurements at Blodgett Forest Research Station using the proposed instrument.

Prior Research Division Funding to the University of California, Berkeley:

Year	2001	2000	1999
Funding	$	$0	$3,992,027

BUDGET SUMMARY

University of California, Berkeley

"Keeping Tahoe Blue through Identifying Nitrogen Transport to Lake Tahoe: Additional Ambient Air Nitrogen Species Measurements"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$104,032	
2.	Subcontractors	$	
3.	Equipment	$	
4.	Travel and Subsistence	$ 17,010[1]	
5.	Electronic Data Processing	$	
6.	Reproduction/Publication	$ 1,000	
7.	Mail and Phone	$ 1,000	
8.	Supplies	$ 26,975[2]	
9.	Analyses	$	
10.	Miscellaneous	$ 9,917	
	Total Direct Costs		$159,934
INDIRECT COSTS			
1.	Overhead	$ 15,102	
2.	General and Administrative Expenses	$	
3.	Other Indirect Costs	$	
4.	Fee or Profit	$	
	Total Indirect Costs		$ 15,102
TOTAL PROJECT COSTS			**$175,036**

[1]The travel cost consists of 70 roundtrips from Berkeley to Lake Tahoe to maintain measurement instruments.

[2] The costs for supplies are based on costs incurred during the Blodgett Forest project which is comparable in scope and duration. The supplies required for the proposed laboratory operations include laboratory chemicals, gases, optics, and laser repairs.

PROPOSED

State of California
AIR RESOURCES BOARD

Resolution 02-5

February 21, 2002

Agenda Item No.: 02-1-6

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2504-223, entitled "Keeping Tahoe Blue through Ambient Air Quality Modeling: Aircraft and Boat Measurements of Air Quality and Meteorology Over Lake Tahoe", has been submitted by the University of California, Davis;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2504-223 entitled "Keeping Tahoe Blue through Ambient Air Quality Modeling: Aircraft and Boat Measurements of Air Quality and Meteorology Over Lake Tahoe", submitted by the University of California, Davis, for a total amount not to exceed $133,382.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2504-223 entitled "Keeping Tahoe Blue through Ambient Air Quality Modeling: Aircraft and Boat Measurements of Air Quality and Meteorology Over Lake Tahoe", submitted by the University of California, Davis, for a total amount not to exceed $133,382.
>
> BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $133,382.

ATTACHMENT A

"Keeping Tahoe Blue through Ambient Air Quality Modeling: Aircraft and Research Vessel Measurements of Air Quality and Meteorology Over Lake Tahoe"

Background
Nutrient loading is believed responsible for loss of clarity in Lake Tahoe. Enrichment of nitrogen and phosphorus in Lake Tahoe has been observed and some researchers have attributed a significant portion of that enrichment to atmospheric sources. However, the estimates of atmospheric (and some non-atmospheric) contributions are uncertain. Better quantification is required to understand what actions would be effective for reducing nitrogen enrichment of the Lake. Through dry and wet deposition, atmospheric nitrogen oxides including NO_X, nitric acid and organic nitrates may contribute to increases in the nitrogen available as a nutrient in the Lake. Sources of atmospheric nitrogen oxides may include direct emissions within the Basin from vehicles and home wood burning as well as natural sources and emissions from combustion, bacterial modification of fertilizers and natural bacterial emissions from the Sacramento Valley and the Bay Area that are transported to the Tahoe Basin. To understand this type of enrichment, the Board's staff will conduct modeling of Lake Tahoe air quality. This proposal will provide input and validation databases for these modeling exercises by developing and delivering vertical profiles of meteorological parameters and ambient concentrations.

Objective
This project's objectives are to obtain, during spring, summer and fall,:

1) Vertical profiles of wind, relative humidity, and temperature over Lake Tahoe to determine proper wind characteristics for deposition estimation,
2) Vertical profiles of nitric acid and ammonia,
3) Vertical profiles of concentrations of aerosols bigger than 0.3μm and bigger than 3μm in equivalent optical diameter,
4) Vertical profiles of ozone, NO, and NO_Y

This project's objective during winter is to collect an equivalent suite of measurements onboard a research vessel.

UC Davis may also perform transactions across the Lake when the on-board measurements would indicate high concentrations or on their way to the proper altitude for spirals.

Methods
UC Davis will use a dedicated aircraft during three seasons and a research vessel during the winter. The investigators will measure wind and relative humidity, aerosol concentrations (channel 1 measures particles bigger than 0.3 μm and channel 2 bigger than 3vμm in equivalent optical diameter), and concentrations of ozone, NO, NO_Y, (~1 ppbv detection limits). Gas phase ammonia, nitric acid, particulate phosphorous nitrate and ammonium will be collected through an annular denuder-filter system. In spring,

summer and fall, these instruments will be flown on board a Cessna airplane flown over and across Lake Tahoe. In winter, these instruments will be installed in a research vessel, which will make dedicated cruises on the Lake.

Expected Results

The contractor will supply vertical profiles of meteorological and air quality parameters. These will be analyzed to show the degree of mixing of concentrations aloft and near Lake level. This information on thermal stratification and vertical mixing will be important to assessing when and to what degree upwind concentrations and local emissions will impact concentrations at Lake level. These observations and information will be used in the air quality analysis and modeling efforts to assess the relative importance of local and upwind sources to the deposition of nitrogen and phosphorus to the Lake Tahoe Basin.

Significance to the Board

Analyses and modeling of the air quality and deposition in the Lake Tahoe area will rely on the meteorological and air quality data supplied by this contractor. The analyses and modeling of air quality and deposition at Lake Tahoe is expected to characterize any enrichment from the atmosphere to the Lake and evaluate required control measures to reduce that enrichment.

Contractor:

University of California, Davis

Contract Period:

27 months

Principal Investigators:

John J. Carroll and Cort Anastasio

Contract Amount:

$133,382

Cofunding:

This research at Lake Tahoe is to be funded by the California Air Resources Board. However, it is part of a larger cooperative research effort that includes funding of various aspects by the California State Water Quality Control Board, U. S. EPA, Tahoe Regional Planning Agency (TRPA), and the U. S. Forest Service.

Basis for Indirect Cost Rate:

The State and UC System have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigators:

The Principal Investigators and the UCD aircraft group successfully contributed to a number of air quality studies including SCOS 97-NARSTO and CCOS 2000 with the

ARB sponsorship. More recent work, using the denuder systems, has been sponsored by the U. S. EPA through the UC Davis Center for Ecologic Health Research.

Prior Research Division Funding to University of California, Davis:

Year	2001	2000	1999
Funding	$314,998	$315,037	$567,529

BUDGET SUMMARY

University of California, Davis

Keeping Tahoe Blue through Ambient Air Quality Modeling: Aircraft and Boat Measurements of Air Quality and Meteorology Over Lake Tahoe

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 66,327	
2.	Subcontractors	$	
3.	Equipment	$	
4.	Travel and Subsistence	$ 9,580	
5.	Electronic Data Processing	$ 450	
6.	Reproduction/Publication	$ 400	
7.	Mail and Phone	$ 1,190	
8.	Supplies	$ 900	
9.	Analyses	$	
10.	Miscellaneous	$ 33,500[1]	
	Total Direct Costs		$ 112,347
INDIRECT COSTS			
1.	Overhead	$ 11,235	
2.	General and Administrative Expenses	$	
3.	Other Indirect Costs	$ 9,800	
4.	Fee or Profit	$	
	Total Indirect Costs		$ 21,035
TOTAL PROJECT COSTS			**$ 133,382**

[1] The miscellaneous cost (of $33,500) consists entirely of charges for use of a research aircraft (150 hours at $200 per hour) and research vessel John LeConte (35 hours at $100 per hour). These rates are based on operating costs including fuel, maintenance and insurance. Both are integral to the proposal.

SUMMARY OF BOARD ITEM

ITEM # 02-1-7: **PUBLIC MEETING TO CONSIDER REALLOCATING $100,000 OF FISCAL YEAR 1999-2000 RICE STRAW DEMONSTRATION PROJECT FUND GRANT MONIES TO BROKEN BOX RANCH**

STAFF RECOMMENDATION: Adopt Resolution 02-7 approving reallocating $100,000 of Fiscal Year 1999-2000 Rice Fund monies to Broken Box Ranch.

DISCUSSION: Senate Bill 318 (1997, Thompson) created the Rice Straw Demonstration Project Fund (the Rice Fund) and directed the California Air Resources Board (ARB or Board) to administer it. The goal of the Rice Fund is to help create a commercial market for Sacramento Valley rice straw. The Rice Fund was established to provide cost-sharing grants for projects that use significant amounts of rice straw.

On May 25, 2000, the Board awarded approximately $1.2 million to five Rice Fund projects for Fiscal Year 1999-2000. One of the projects recently withdrew from the Rice Fund, making $100,000 available for other ARB approved projects. The Rice Fund grant criteria contained in the document entitled "Rice Straw Demonstration Project Fund Invitation for Grant Requests" adopted by the ARB in 1998, and revised in 1999, specify the criteria ARB is to use for reallocating Rice Fund money. Per the Rice Fund criteria, four active Fiscal Year 1999-2000 grant recipients were invited to submit grant augmentation proposals to ARB for review and consideration.

One augmentation proposal was received from Broken Box Ranch for $100,000. Broken Box Ranch received a $298,000 grant award in May 2000 to develop a commercial-scale rice straw compost production plant. The plant has been established and is producing compost. The grant augmentation would allow Broken Box to immediately hire a marketing and product development specialist, develop and disseminate marketing materials, and educate ranchers in the use of rice straw compost. It would also allow them to generate marketing data demonstrating crop yields associated with rice straw compost. This money would help them achieve and surpass their original straw usage goals of 15,000 tons of compost by June 2002.

The augmentation request was reviewed by technical and business experts from the ARB, Department of Food and Agriculture, Department of Trade and Commerce, and the California Rice Commission.

Staff will present its evaluation of Broken Box Ranch's grant augmentation proposal, and recommend that the Board approve reallocating $100,000 of Fiscal Year 1999-2000 Rice Fund monies to Broken Box Ranch.

SUMMARY AND IMPACTS:

No new money is being appropriated; rather, existing funds are being reallocated. Augmenting the Broken Box Ranch grant with an additional $100,000 will allow the project to improve manufacturing and marketing efforts thereby increasing the introduction of rice straw compost into the market.

CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC MEETING TO CONSIDER REALLOCATING RICE STRAW DEMONSTRATION PROJECT FUNDS

The Air Resources Board (the "Board" or "ARB") will conduct a public meeting at the time and place noted below to consider reallocating $100,000 of fiscal year 1999-2000 Rice Straw Demonstration Project Fund Grant Monies to Broken Box Ranch.

DATE: February 21, 2002

TIME: 9:00 a.m.

PLACE: California EPA Headquarters Building
Coastal Hearing Room
1001 "I" Street
Sacramento, California 95814

This item will be considered at a meeting of the Board, which will commence at 9:00 a.m., February 21, 2002, and may continue at 8:30 a.m., February 22, 2002. This item may not be considered until February 22, 2002. Please consult the agenda for the meeting, which will be available at least 10 days before February 21, 2002, to determine the day on which this item will be considered.

This facility is accessible to persons with disabilities. If accommodation is needed, please contact the Clerk of the Board at (916) 322-5594, or Telephone Device for the Deaf (TDD) at (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area at least 14 days before the hearing to ensure accomodation.

The Rice Straw Demonstration Project Fund (Rice Fund) was created to help establish a commercial market for Sacramento Valley rice straw in order to develop alternatives to burning. The Rice Fund provides cost-sharing grants for projects which would use significant quantities of rice straw, a byproduct of rice grain production.

On May 25, 2000, the Board awarded about $1.2 million to five Rice Fund projects for fiscal year 1999-2000. One of the projects withdrew from the Rice Fund, making $100,000 available for other ARB approved projects. The Rice Fund grant criteria contained in the document entitled "Rice Straw Demonstration Project Fund Invitation for Grant Requests" adopted by the ARB in 1998, and revised in 1999, specify the criteria ARB is to use for reallocating Rice Fund money.

Per the Rice Fund criteria, four existing recipients of Fiscal Year 1999-2000 grant allocations were invited to submit grant augmentation proposals to ARB for review and consideration. One augmentation proposal was received from Broken Box Ranch. Broken Box Ranch received a $298,000 grant award in May 2000 to develop a commercial-scale rice straw compost production plant. The grant augmentation would allow Broken Box to immediately hire a marketing and product development specialist, develop and disseminate marketing materials, and educate ranchers in the use of rice straw compost. The augmentation request was reviewed by technical and business experts from the ARB, Department of Food and Agriculture, Department of Trade and Commerce, and the California Rice Commission.

At the February 21, 2002, public meeting, staff will present its evaluation of Broken Box Ranch's grant augmentation proposal, and recommend that the Board approve reallocating $100,000 of Fiscal Year 1999-2000 Rice Fund monies to Broken Box Ranch. This is a non-regulatory item.

Copies of this notice may be obtained from the ARB Public Information Office, 1001 "I" Street, 1st Floor, Environmental Services Center, Sacramento, CA 95814, (916) 322-2990, or on the ARB internet site at http://www.arb.ca.gov/smp/activity/activity.htm prior to the scheduled meeting (February 21, 2002).

Interested members of the public may present comments orally or in writing at the meeting, and in writing or by e-mail before the meeting. To be considered by the Board, written submissions not physically submitted at the meeting must be received **no later than 12:00 noon, February 20, 2002,** and addressed to the following:

Postal mail is to be sent to:

Clerk of the Board
Air Resources Board
1001 "I" Street, 23rd Floor
Sacramento, California 95814

Electronic mail is to be sent to ricedemo@listserv.arb.ca.gov and received at the ARB **no later than 12:00 noon, February 20, 2002.**

Facsimile submissions are to be transmitted to the Clerk of the Board at (916) 322-3928 and received at the ARB **no later than 12:00 noon February 20, 2002.**

The Board requests but does not require 30 copies of any written submission. Also, the ARB requests that written and e-mail statements be filed at least 10 days prior to the meeting so that ARB staff and Board members have time to fully consider each comment.

Further inquiries regarding this matter should be directed to Bruce Oulrey, Staff Air Pollution Specialist, by phone at (916) 322-6155, or in writing at 1001 "I" Street, Sacramento, California 95814.

CALIFORNIA AIR RESOURCES BOARD

Michael P. Kenny
Executive Officer

Date: January 30, 2002

"The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Web-site at www.arb.ca.gov."