California Inspection and Maintenance Review Committee

Smog Check II Evaluation

Part I: Background Information

. . . . . .

Prepared by

Joel Schwartz
Executive Officer

TABLE OF CONTENTS

1. Introduction

1.1. Goals of the IMRC's Smog Check Evaluation

The IMRC has attempted to answer the following four general questions regarding the Smog Check vehicle emissions inspection program:

1. To what extent is the Smog Check Program reducing the emissions of on-road vehicles, and does program effectiveness change over time?
2. What underlying factors make the Smog Check Program more or less effective?
3. What is the cost and cost effectiveness of Smog Check?
4. How can the effectiveness and cost effectiveness of the Smog Check Program be improved?

This report is intended to address many of the most significant program issues, including:

- Emission reduction effectiveness of the "Enhanced Program"
- Relative effectiveness of test-only, test-and-repair, and Gold Shield Smog Check stations
- Extent to which motorists comply with program requirements
- Program costs and cost effectiveness
- Degree to which Smog Check expenditures are efficiently targeted toward detection and repair of high emitting vehicles

Evaluation *findings* are presented in a four-part report. This document is Part I and it includes background and contextual information to aid in interpreting the results of the study. Part II "Overview of Vehicle Emissions" includes information on the emissions of the vehicle fleet and their relationship to Smog Check failure standards. Part III "Evaluation of the Enhanced Smog Check Program" presents the report of the IMRC's contractor from Lawrence Berkeley National Laboratory (LBNL) on program effectiveness and the underlying factors that affect program performance. Part IV "Evaluation of Smog Check Costs and Cost Effectiveness" presents an evaluation of program costs and cost effectiveness. The Executive Summary summarizes all of the report's findings. *Recommendations* that follow from the study will be considered for adoption by the IMRC in May and will be presented as Part V of this evaluation. Thus, Part III answers questions 1 and 2, Part IV answers question 3, and Part V will answer question 4.

1.2. Overview of this Document

This document provides information on the following:

- Context for the IMRC's Smog Check Evaluation
- The IMRC's evaluation process
- The role of the Inspection and Maintenance Review Committee
- The structure of the Smog Check Program
- Regulatory requirements the Smog Check Program must meet

The Table of Contents includes a detailed outline of the topics addressed.

2. Context for the IMRC Smog Check Evaluation

Smog Check is a key part of California's strategy for meeting federal and state air pollution health standards. The IMRC's Smog Check evaluation attempts to determine both how effective the program is in reducing emissions, and, perhaps more important, understand what underlying factors make the program more or less effective. Only by understanding how the program works can one develop appropriate recommendations for making the program more effective and more cost effective.

To achieve this goal, the IMRC analyzed many dimensions of the performance of the Enhanced Smog Check program. These include: (1) emission reductions, (2) motorist avoidance, (3) Smog Check station type performance, (4) effect of vehicle emissions variability on program effectiveness, (5) deterioration of failing and passing vehicles with time after Smog Check, (6) the effect of emission test failure cut point changes on potential program benefits, and (7) the relative cost effectiveness of program components. All of these analyses in our report are based on data that directly measure program performance. The IMRC's goal in taking this approach is to provide policymakers and the public with the tools to make sound decisions about the future of the program.

IMRC and ARB Smog Check Evaluations Serve Two Different Purposes. Both the IMRC and the ARB have generated evaluations of the performance of the Smog Check Program. However, these two separate evaluations serve different purposes. The IMRC attempted to evaluate underlying factors that influence program effectiveness. The ARB had the charge of estimating total program emission reductions, how these reductions compare with California's obligations under its State Implementation Plan (SIP), and what changes to the program will increase the state's ability to meet SIP requirements. The SIP is California's federally enforceable plan for meeting the requirements of the federal Clean Air Act.

Responsibility for evaluating California's SIP compliance rests solely with the ARB. Therefore, the ARB report should be used for purposes of assessing SIP compliance.

SIP requirements are based on modeling rather than actual program data. The vehicle emission models (known as the "EMFAC" series of models) on which SIP requirements are based do not fully or accurately reflect the factors that make the actual Smog Check

program more or less effective. Therefore, policies that receive emission reduction "credit" in the model are not necessarily the policies that would be best for improving actual program performance. It is therefore important to distinguish between how policy changes to Smog Check would affect SIP credit in the model and how such changes would affect the actual effectiveness and costs of the program.

The IMRC report is intended as an assessment of the real-world performance of the Smog Check program and not as an assessment of Smog Check performance in terms of SIP requirements. Table 1 summarizes the program components analyzed by the IMRC and the ARB.

Receipt of Federal Transportation Funds Depends on Meeting SIP Requirements. Although program changes that would help California meet its SIP requirements do not necessarily coincide with program changes that would improve real-world program effectiveness, the importance of meeting the SIP requirements should not be underestimated. According to ARB, $1.5 billion per year in federal transportation funds depend on California's Clean Air Act nonattainment regions showing that their regional transportation plans (RTPs) and transportation improvement programs (TIPs) will not cause these regions to exceed their respective emissions budgets in the SIP. To the extent that Smog Check falls short of its required SIP reductions, transportation funds may be in jeopardy.

The high stakes and legal requirement to demonstrate with apparent certainty SIP compliance means that ARB, local air districts, and metropolitan planning organizations must focus on producing and using a single tons-per-day number for emissions reduced by the Smog Check program. Yet this number is inherently uncertain. During the next few months, the state will need to find a way to both meet the legal requirements of the SIP while ensuring that the Smog Check program meets reasonable criteria for real-world effectiveness and efficiency.

Uncertainties Are Inherent in the Available Data. Although the IMRC evaluation covers a broad range of program components, any evaluation of Smog Check inherently includes uncertainties, particularly in the area of emission reductions. Major sources of uncertainty include (1) unknown deterioration rates of failing vehicles in the absence of Smog Check, (2) limited information on deterioration rates of vehicles repaired due to Smog Check, (3) sampling bias in data used to estimate Smog Check benefits, and (4) uncertainty in the estimation of on-road emissions rates from Smog Check test data.

The IMRC evaluation includes a range of benefit estimates that reflects the uncertainty inherent in estimating tons-per-day emission reductions. The evaluation also includes a "best estimate" within the range of the upper and lower bounds. However, any single number for Smog Check effectiveness should be treated with caution, in to avoid creating an unwarranted impression of certainty.

Table 1. Comparison of Scope of ARB and IMRC Smog Check Analyses

Program Component	ARB	IMRC
Tons-per-day Reduction Estimate	Based on Random Roadside ASM data and EMFAC2000 modeling plus several assumptions and estimates	Based on Random Roadside ASM data, Smog Check test records, and remote sensing data plus several assumptions and estimates
Effect of Cut Point Changes on Potential Emission Reductions	Estimate based on EMFAC7F and EMFAC2000 modeling	Estimate based on Random Roadside ASM and Smog Check test data
Station Performance	Not addressed	Analysis and discussion of relative performance of different station types based on Smog Check test data
Emission Deterioration with Time Since the Last Smog Check Cycle	Not addressed	Analysis of emission deterioration out to one year after Smog Check based on Smog Check test data and remote sensing data. Pending analysis of deterioration over longer periods of time as new data become available.
Extent and Effect of Motorist Avoidance of Smog Check Requirements	Not addressed	Analysis of vehicles that fail and then never pass based on Smog Check test data, Random Roadside ASM data and remote sensing data. Pending analysis of non-registration and re-registration outside of Enhanced areas based on DMV registration data and remote sensing data
Effect of Vehicle Emissions Variability on Program Benefits	Not addressed	Analysis of missed "should-fail" vehicles due to emissions variability based on Smog Check test data
Effect of Fraud on Program Effectiveness	Not addressed	Discussion of fraud and enforcement statistics. No estimate of effect of fraud on program benefits due to lack of appropriate data.
Program Costs and Cost Effectiveness	Not addressed	Estimated program costs using Smog Check data and cost surveys Estimated relative cost effectiveness of program components, such as individual model years and cut point changes Estimated costs to individual motorists
Effect of Adding or Subtracting More Vehicle Model Years to/from Program	Estimate based on EMFAC7F and EMFAC2000 modeling	Estimate based on analysis of Smog Check test data, Random Roadside ASM data and remote sensing data.
Effect of Expanding the Enhanced Program to More Areas of the State	Estimate based on EMFAC7F and EMFAC2000 modeling	Not addressed
Performance of Smog Check Relative to SIP Target	Estimate based on Random Roadside ASM data and EMFAC7F and EMFAC2000 modeling	Not addressed

Data Sources and Their Respective Advantages and Disadvantages. The IMRC had three major data sets available with which to analyze Smog Check benefits. These are the Smog Check test records stored in the Vehicle Information Database (VID), random roadside emissions testing performed by BAR, and on-road remote sensing. All of these data sets have advantages and disadvantages. For example, the VID data allow an assessment of many dimensions of program performance, including deterioration of emissions after Smog Check, vehicle emissions variability, Smog Check station performance, and program avoidance. No other data are currently available that allow an assessment of so many aspects of program performance. However, the VID data also have limitations. The emission deterioration analysis had to be based only on the vehicles that had more than one Smog Check cycle in a year (this would occur due to a change of ownership). The results for these vehicles might not be representative of the fleet as a whole. In addition, the VID data do not capture emission reductions due to repairs performed before the first Smog Check test and are likely also biased by Smog Check test fraud.

The random roadside ASM test data have the advantage of inherently including all factors that affect the outcome of the Smog Check process. These factors include potential pre-Smog Check repairs, motorist avoidance, and fraud. However, by themselves, the roadside data cannot shed light on the relative effect of these factors on program performance. There are also not enough roadside data to assess post-repair deterioration. In addition, data were collected at different locations in the state at different times. This appears to have created a bias that results in overestimation of emission reductions, because fleet-average emissions vary by region in the state. While there is no perfect data set for evaluating the program, the use of multiple sources of data allows both cross-checking of results among data sets, and evaluation of a broader range of program features.

Although data were available on many aspects of the program, it was not possible to evaluate all aspects of the program. For example, there were no data available on emission reductions due to gas-cap pressure testing. ARB predicted reductions from gas-cap testing using the EMFAC emission model. However, as noted earlier, estimates based on the EMFAC model are uncertain. In addition, even for features of the program that could be evaluated, our understanding remains incomplete to one degree or another.

Understanding of the program will improve as additional data become available in the coming months. For example, the IMRC plans a series of focus groups with motorists and mechanics to develop greater knowledge of how people behave in the program and of how the program affects them. In addition, with each passing month, additional Smog Check test records are collected and can then be used to determine emission deterioration rates of vehicles over longer periods of time. Roadside testing of vehicles also continues. These data can be used to measure overall program performance. A large-scale remote sensing program (e.g., more than a million measurements) would be another potential source of data. Such a program would provide information on a wide range of program performance diagnostics, including emission deterioration with time since Smog Check, motorist avoidance, and possibly Smog Check station performance.

3. Evaluation Process

There are two major components to the IMRC's Smog Check evaluation: (1) analysis of vehicle emissions and registration data, and (2) study of motorist and mechanic attitudes and behavior. For the first component, the IMRC contracted with researchers from LBNL to perform the bulk of the data analysis. The IMRC's budget does not include funds for data collection. Instead, the IMRC relied on the Bureau of Automotive Repair (BAR) and other public and private entities to supply the IMRC with data for this study.

Vehicle Emissions and Registration Data Analysis. Data sources used for this component of the project included the following:

- ***Smog Check test data from the Vehicle Information Database (VID).*** Each time a vehicle is tested in the Smog Check Program, a record is entered into the VID. The database is maintained by MCI on behalf of BAR, which manages the Smog Check Program.
- ***On-Road Smog Check Tests.*** BAR collected emissions tests on more than 27,000 cars between February 1997 and October 1999 by pulling cars over at random at roadside sites in Enhanced Program areas around the state. The roadside equipment for these tests is the same as that used in the Smog Check Program.
- ***Remote Sensing Measurements.*** Remote sensors take a "snapshot" of vehicles' emissions as they drive by. Professor Donald Stedman of the University of Denver, and the ESP Corporation provided the IMRC with more than 100,000 measurements of vehicles driving on freeways in the Bay Area, Sacramento, Los Angeles, and Riverside. The Riverside data were collected in July 1999. All other data were collected from late October to early November 1999.[1]
- ***Vehicle Registration Data.*** The Department of Motor Vehicles (DMV) supplied the IMRC with "snapshots" of its registration database from April and October of 1998.
- ***Additional Data.*** Various other types of data contributed to the evaluation, for example: (1) data from BAR's low-income assistance and vehicle retirement programs, and (2) repair effectiveness data from earlier studies.

The committee's vehicle data analysis project began in November 1999 when BAR first began supplying the IMRC with VID and roadside test data. Although BAR was expected to collect more than one million remote sensing measurements in early to mid 1999, BAR elected not to contract for remote sensing data collection. However, the Steven and Michele Kirsch Foundation provided Professor Stedman with funds for a more limited data collection effort that took place in October and November 1999, resulting in the data set described above. DMV has an October 1999 snapshot of its registration database, but has not yet been able to provide it to the IMRC.

[1] The Riverside data collection was funded by the Coordinating Research Council and the Los Angeles, Sacramento, and Bay Area data collection was funded by the Steven and Michele Kirsch Foundation.

Motorist and Mechanic Attitudes and Behavior. This component of the study will include a series of focus groups with motorists and mechanics. Motorists will be asked to discuss (1) how they maintain their vehicles, (2) how convenient they find the Smog Check process and its requirements, and (3) to what extent they comply with or avoid the requirements of Smog Check. Mechanics will similarly be asked to discuss how they behave in the Smog Check Program. The IMRC is contracting with social scientists from California State University Sacramento (CSUS) for this study. The IMRC hopes to complete this study this summer and will report back with results and recommendations at that time.

4. The Inspection and Maintenance Review Committee (IMRC)

4.1. The IMRC's Role

The California Inspection and Maintenance Review Committee (IMRC) was created by the Legislature and Governor to evaluate the effectiveness of California's Smog Check vehicle emissions inspection program, and to recommend program improvements. The IMRC holds periodic public meetings to evaluate information, receive public input, and adopt policies and recommendations. The committee has an advisory role only and does not have regulatory or enforcement powers.

According to Section 44021 of the Health and Safety Code, the IMRC is expected to "analyze the effect of the improved inspection and maintenance program…on motor vehicle emissions and air quality." In addition, "the review committee shall submit periodic written reports to the Legislature and the Governor on the performance of the program and make recommendations on program improvements at least every 12 months. The review committee's reports shall quantify the reduction in emissions and improvement in air quality attributed to the program." This report is the IMRC's first report to the Legislature and Governor on California's Enhanced Smog Check Program, which was implemented in June 1998.

Statute also requires the Committee to work closely with interested parties, and to seek comments from the Air Resources Board (ARB), BAR, DMV, and the California Highway Patrol (CHP) prior to submitting its evaluation report. In addition, ARB, in cooperation with BAR, is required to submit triennial reports to the committee that include: (1) an assessment of the impact on emissions of continuing the exemption from inspection of motor vehicles newer than five years old, (2) a comparison of the actual mass emission reductions being achieved by the Enhanced Program to those required by the State Implementation Plan, and (3) recommendations to improve the effectiveness and cost effectiveness of the program. The first report from ARB was due to the IMRC on January 1, 2000, but has not been completed as of this writing. Appendix I includes the full text of the statutes governing the IMRC.

4.2. IMRC Composition

IMRC members are appointed for four-year terms. Current members were appointed in 1996 and 1997. Statute requires that some members of the IMRC have specific types of expertise or work in specific kinds of organizations. For example, the committee includes scientists, engineers, economists, business people, representatives from the

Smog Check industry, and representatives from local agencies, including law enforcement and air pollution regulation. Appendix II includes a list of current IMRC members and their affiliations. The IMRC has two full-time staff, including an executive officer and a secretary.

4.3. Public Meetings

The IMRC holds periodic public meetings to gather information, receive testimony from members of the public, and adopt policy positions and recommendations. As required by the Bagley-Keene Open Meeting Act, all IMRC meetings are open to the public, and members of the public may comment on any item on the meeting agenda. Each meeting also includes an additional public comment period during which members of the public may discuss issues not on the agenda. All IMRC meetings are recorded and IMRC staff maintain a record of all documents released by the IMRC or submitted by the public. The committee held five meetings in 1999 and has so far held five meetings in 2000.

4.4. IMRC History

The IMRC was originally created in 1984 at the same time the Smog Check Program in its modern form was adopted. The IMRC's role has not changed appreciably since its inception. However, the composition of the IMRC was substantially altered in 1993. Until 1993 the IMRC consisted of a representative from ARB and an air pollution control officer from each of the air districts in which the Smog Check Program was implemented.[2] In 1993, AB 2018 (Katz) made major changes to the Smog Check Program, including changing the composition of the IMRC to its current form. The shift in committee composition was intended to give the committee greater independence from the agencies directly responsible for managing the program.

4.5. Previous IMRC Recommendations

The IMRC has evaluated and made recommendations on a wide range of issues relating to the Smog Check Program. Previous IMRC recommendations include the following:

- ***Exempt New Vehicles from Biennial Testing.*** Less than 1 percent of vehicles fail a Smog Check during their first four years of operation. The IMRC therefore recommended exemption of new vehicles from scheduled testing. The Legislature and Governor adopted this proposal and the exemption went into effect at the beginning of 1998.

- ***Don't Exempt Old Vehicles.*** The IMRC opposed the Legislature's exemption of vehicles built before the 1974 model year. Although these vehicles are only about 3 to 4 percent of the on-road fleet, they represent a substantially larger portion of repairable emissions. Therefore, exemption of these vehicles reduces the potential effectiveness of the Smog Check Program. In addition, the IMRC also received

[2] See SB 33 (Presley, passed in 1982)

anecdotal reports indicating that some motorists, as a result of the Smog Check exemption, have removed components of their pre-1974 vehicles' emission control systems.

- ***Evaluate Potential Future Exemptions.*** More than 80 percent of vehicles pass their Smog Check. The IMRC recommended that BAR evaluate whether there are other ways to exempt clean vehicles from scheduled testing without inadvertently excusing vehicles with high emissions. Remote Sensing[3] and Emissions Profiling[4] are two techniques with the potential to allow inexpensive identification of clean vehicles without the need for a scheduled Smog Check. Exempting motorists who drive clean vehicles would reduce program costs, and better target Smog Check toward the vehicles that contribute the vast majority of air pollution emissions.

- ***Low-Income Assistance.*** Previous studies have shown that drivers of gross polluting vehicles are disproportionately poor. The IMRC recommended a low-income assistance program that would provide either private loans or state grants to offset some of the costs of vehicle repair. The goals of this recommendation were to reduce some of the burden that Smog Check places on low-income motorists, and also to reduce the incentive to avoid compliance with repair requirements. Based on statutes enacted in 1997, BAR implemented a low-income assistance program that provides repair grants to motorists meeting low-income criteria.

- ***Repair Industry Tax Credit.*** To protect the repair industry's significant investment in new dynamometer equipment, the IMRC recommended a tax credit applied to the cost of test equipment that would be triggered only if the program is radically altered or discontinued at sometime in the future. The potential value of the tax credit would cover only the non-amortized costs of smog testing equipment, decreasing to zero over a five-year period. A bill containing these recommendations failed passage during the 1998 legislative session.

- ***Remote Sensing.*** The IMRC recommended that BAR implement an ongoing program of remote sensing of vehicle emissions. The program would have several goals, including (1) on-road evaluation of Smog Check's effectiveness, (2) evaluation of the potential for "clean screening" to exempt low emitters from scheduled testing, (3) on-road variable message signs to inform drivers when their cars are high emitters as a voluntary public service, and (4) evaluation of the potential for on-road gross polluter identification. Remote sensing is already authorized by statute, and required by the State Implementation Plan (SIP), but BAR has not yet implemented a remote sensing program.

[3] Remote sensors measure vehicle emissions by shooting a light beam through the exhaust stream of a car as the car passes by on the road.

[4] Emissions Profiling is a process in which vehicle-specific factors, such as past Smog Check history and engine type, are used to predict which vehicles are most likely to be high or low emitters.

5. Overview of the Smog Check Program

5.1. Purpose of Smog Check

The Smog Check Program is intended to reduce air pollution emissions from vehicles by ensuring the repair of cars with excessive emissions and broken or tampered emissions control systems. Smog Check focuses on gasoline-powered vehicles. Diesel vehicles are not included in the program.

Smog Check targets three types of pollution from vehicles: hydrocarbons (HC), nitrogen oxides (NOx), and carbon monoxide (CO). HC and NOx contribute to the formation of ozone, a component of urban smog and a lung irritant, while CO inhibits the ability of blood to transport oxygen.[5] NOx also contributes to the formation of particulates, another major component of urban smog.[6]

The Smog Check test includes measurement of cars' tailpipe emissions, as well as various visual and functional checks of cars' emissions control components. Cars with emissions above pre-determined levels known as "cut points" or "emissions standards" fail the test and must be repaired so that their emissions will be below the standards. In addition, tampered, malfunctioning, or missing emissions control components must be replaced or repaired. DMV denies registration for vehicles that do not pass the Smog Check test.

5.2. Summary of the Smog Check Process

Although there are many nuances to Smog Check, at the most basic level motorists go through the following steps to meet program requirements:

- Every two years, motorists who own vehicles eligible for the Smog Check Program receive a notice in their vehicle registration renewal package informing them that they must pass a Smog Check in order to register.[7] This notice also notes whether the car must be tested at a test-only station. Motorists can receive their Smog Check at the station of their choice, subject to the constraint that some cars must receive a test-only test.
- Motorists have the option of receiving a "pretest" before their official Smog Check. The pretest can help motorists determine the condition of their car before seeking an official Smog Check.
- For cars that pass their Smog Check on the first try, the Smog Check process is over. DMV receives an electronic notice that the car has passed its Smog Check and the motorist may proceed to register his or her car. Cars that fail the test must be repaired so that they pass before they can be registered.
- Once a car fails, the motorist has several options within the program, as follows: (1) have the car repaired, (2) seek financial assistance to cover repair costs,

[5] CO also contributes to ozone formation, but to a much smaller extent than HC and NOx.

[6] Data on ozone air quality in California are presented in Appendix III.

[7] A Smog Check is also required upon change of ownership.

(3) seek a two-year economic hardship extension, (4) seek a waiver if repair costs exceed the $450 cap, (5) scrap the car, or (6) file a "planned non-operation" notice with DMV and keep the car garaged.

- The program also includes avenues for consumer assistance: BAR operates a phone center that can provide information to motorists on where they can go for a Smog Check. BAR field office staff can investigate and mediate consumer complaints. "Referee" stations can resolve disputes over whether a car should have failed the test or whether certain repairs were appropriate.

5.3. Agencies Involved in Smog Check

There are four state agencies with major roles in the Smog Check Program. BAR is responsible for day-to-day management and enforcement of the Smog Check Program. ARB implements overall air quality policy for the state and collaborates with BAR in the evaluation of Smog Check and on some aspects of Smog Check policy. As discussed earlier, the IMRC generates an independent evaluation of the program. Finally, DMV is involved in Smog Check through its vehicle registration function.

Federal air pollution policy also affects Smog Check. The Smog Check Program is part of California's efforts to meet the requirements of the federal Clean Air Act. The United States Environmental Protection Agency (USEPA) is the federal agency responsible for enforcing the provisions of the Clean Air Act. Under the Act, California submits to USEPA a "State Implementation Plan" (SIP) that includes all of the measures the state will take to ensure attainment of federal air pollution standards (see Section 5 for a more detailed discussion of these issues).

USEPA has the authority to approve or disapprove the state's SIP. USEPA is also the arbiter of whether the provisions of the SIP have been faithfully implemented and of whether they are as effective as predicted.

5.4. Vehicles Included

Vehicles that meet the following criteria are included in the Smog Check Program:

- Built after the 1973 model year;
- More than four year old;
- Gasoline powered.

In practice, this means that, subject to the age and model-year restrictions, all gasoline-powered cars, pickups, minivans, sport-utility vehicles, campers, and trucks are included in the program (motorcycles are not included).

5.5. Number of Cars Included in the Program

The number of cars included in the Smog Check Program is different from the number tested in the program. There are three reasons for this. First, some vehicles are tested more than once in a year because of a change of ownership. Second, in the Change-of-Ownership Program, some vehicles might not be tested for several years because they do not change ownership. Third, some vehicles that are required to get a

Smog Check do not receive one because they are not registered or because their owners are avoiding the program.

Table 2 displays BAR's estimate for the number of on-road vehicles in the state by model year group and also the estimated percent of total miles traveled accounted for by each model year group. Because newer vehicles travel more miles per year on average, they account for a greater percent of miles traveled than their percentage representation in the fleet. Table 3 lists the percentage of the vehicle fleet in each program region. Table 4 compares the entire fleet to the fraction subject to Smog Check.

5.6. Three Program Types Operate in the State

Three different Smog Check Programs, known as Enhanced, Basic, and Change-of-Ownership, operate in different areas of the state. Under both the Enhanced and Basic Smog Check Programs, motorists must bring their cars in for a test every two years or upon change of ownership. In the Change-of-Ownership program, cars must be tested only upon change of ownership. Figure 1 displays the areas of the state in which each program type operates.

Table 2. Estimated Number of Gasoline-Powered Vehicles by Model Year Group (as of January 2000) [8]

Model Year Group	Number	Percent of Vehicles	Percent of Miles Traveled
66-69	320,000	1%	1%
70-73	470,000	2%	1%
74-79	1,160,000	5%	3%
80-84	2,080,000	9%	6%
85-89	5,160,000	23%	19%
90-94	5,260,000	24%	25%
95-00	7,670,000	35%	46%
Total	22,130,000	100%	100%

***** Values may not add due to rounding.
Source: Bureau of Automotive Repair

[8] Motorcycles are excluded. Note that although values are rounded to the nearest 10,000, the actual number of vehicles in the fleet and their distribution by model year is not known to this level of accuracy. Note also that this estimate is for January 2000. However, the composition of the fleet is constantly changing as new cars are purchased and older ones are scrapped.

Table 3. Fraction of the Smog Check Fleet by Program Area*

Program Area	Number of Cars	Percent of Fleet	Percent of Tests
Enhanced	13,900,000	63%	64%
Basic	7,500,000	34%	35%
Change-of-Owner	730,000	3%	1%

* The Change-of-Ownership Program accounts for fewer tests than its percentage of cars because cars are tested less frequently in that program

Source: Bureau of Automotive Repair

Table 4. Estimated Number of 1966-2000 Vehicles by Smog Check Eligibility (as of January 2000)

Status	Number	Percent
Exempt New Vehicles (most recent four model years)[9]	5,660,000	26%
Exempt Old Vehicles (1966-1973 model years)	800,000	4%
Smog Check Fleet	15,670,000	70%
Total Fleet 1966-2000	22,130,000	100%

The Enhanced Smog Check Program includes two major features intended to make the program more effective than the Basic Program.

- ***"Loaded-mode" Emissions Testing.*** Cars are tested while driving on a treadmill-like machine called a dynamometer. This type of test measures emissions under conditions that resemble actual driving because the engine is in gear and experiences loads similar to what would occur in on-road conditions. Loaded-mode testing is essential in order to measure cars' NOx emissions. In contrast, the Basic Program tests cars using an "idle test" in which cars are tested with the engine out of gear.[10]

[9] Most people think of the first four model years as being exempted by changes that went into effect in January 1998. This is not quite correct. Before January 1998, new vehicles were already exempt from Smog Check for two years. After the January 1998 exemptions new cars were now exempt for four years. Therefore, the January 1998 exemptions removed only an additional two model-year's-worth of cars from testing. In other words, by this accounting, roughly 14% of the fleet was already exempt from Smog Check before January 1998. Extending the exemption to four years removed an additional 12% of the fleet.

[10] Some vehicles in the Enhanced Program receive idle tests. These include vehicles that are too large to test on a dynamometer, such as campers and large trucks and four-wheel and all-wheel drive vehicles. In addition, vehicles that are unsafe to test on a dynamometer, such as vehicles with bald tires, also receive an

- ***Targeted Test-Only Testing.*** Fifteen percent of cars in the Enhanced Program are required to be tested at "test-only" stations that test cars, but are not allowed to repair them. Thirteen percent of cars are selected for test-only testing by a process called "high-emitter profiling." The high-emitter profile or HEP is a computer model that combines information about cars in the fleet, such as past Smog Check performance, and vehicle engine family to predict which cars are most likely to fail a Smog Check. The cars with the highest probability of failure, based on the model's prediction, are directed to test-only stations. Policymakers added the test-only component based on the assumption that high-emitting cars tested at test-only stations would be more likely to be detected and properly repaired. Another 2 percent of the fleet is selected at random to be directed to a test-only station. The random 2 percent requirement was included based on the belief that test-only testing provides the best representation of the actual emissions of tested vehicles. BAR currently directs between 70,000 and 80,000 cars to test-only stations each month.

The Enhanced Program is intended to be more stringent and achieve greater emissions reductions than the Basic or Change-of-Ownership programs.

5.7. The Smog Check Test

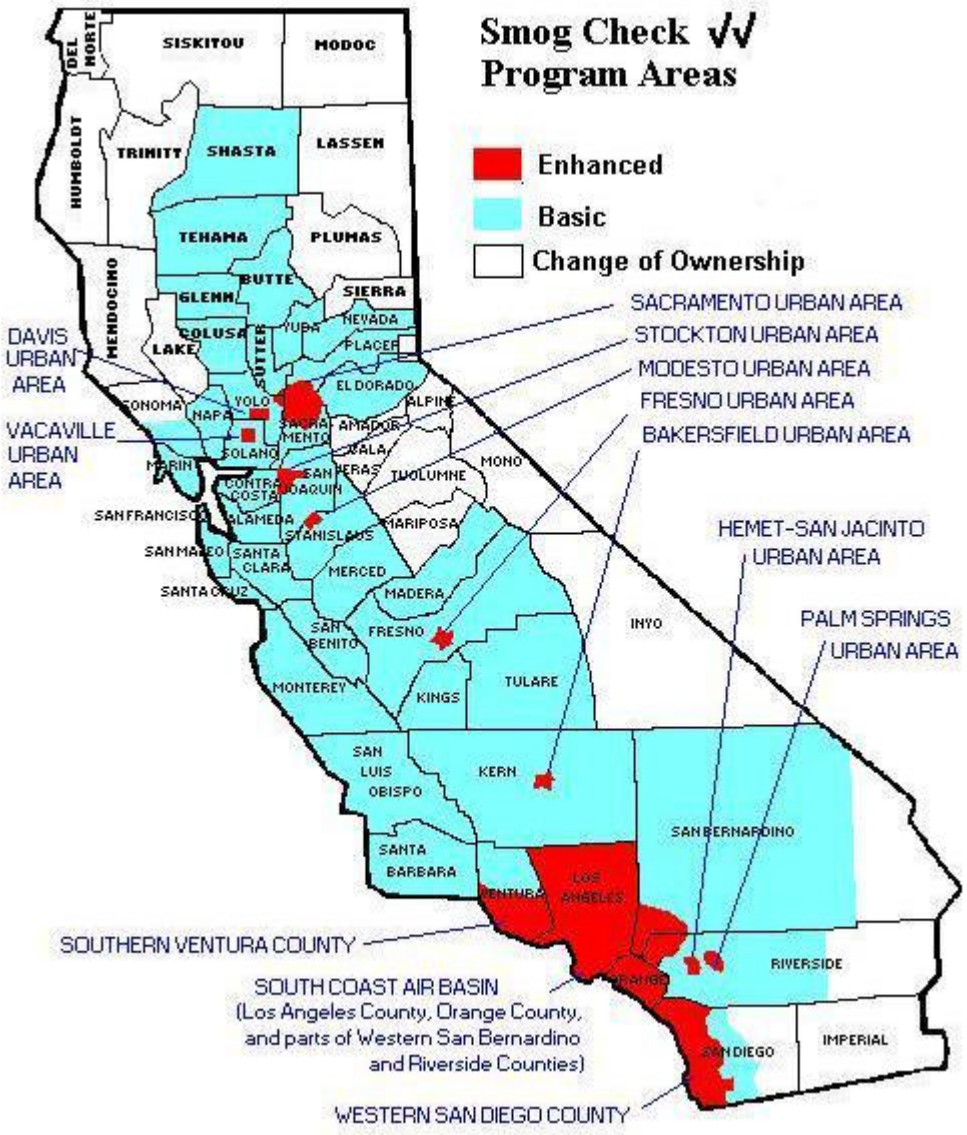
The Smog Check test is used to identify vehicles with excessive emissions. There are two major portions of the Smog Check test. The *emissions test* measures exhaust emissions. The *visual and functional tests* determine whether various components of cars' emissions control systems are present and, in some cases, whether they are functioning properly.

There are a number of differences between the Smog Check tests used in the Enhanced and Basic Programs. The most significant difference, as noted earlier, is that a loaded-mode test is used in the Enhanced Program. The Enhanced Program test is called the Acceleration Simulation Mode (ASM) test. The ASM emissions test is actually two tests, the ASM5015 and the ASM2525. The "5015" signifies that the test is run at a speed of 15 miles per hour at 50 percent of the maximum load experienced on the Federal Test Procedure (FTP) (the FTP is the test USEPA and ARB use to certify that new cars meet required emissions standards). The "2525" signifies that the test is run at a speed of 25 miles per hour at 25 percent of the maximum load experienced on the FTP.

---

idle test. In addition, cars registered in a Basic area can receive an idle test at an Enhanced area station to satisfy Smog Check requirements.

Figure 1. Smog Check Program Areas



Source: Bureau of Automotive Repair

The ASM test is a *steady-state* test because the engine is under a constant load throughout the test. The ASM test is run sequentially at two different loads (the 5015 and then the 2525) in order to test the vehicle under two different conditions. Steady state tests can be contrasted with *transient* tests. In a transient test, engine load varies from moment to moment throughout the test, which simulates acceleration and driving on variable inclines. The IM240 test, which is used in a number of centralized I/M programs

in other states, is a transient test. The FTP is also a transient test. In addition to the variable loading, another difference between the ASM test and the IM240 or FTP is that the ASM test provides only the concentration of pollutants in the exhaust. Transient tests generate emissions results in grams per mile.The Smog Check test also includes visual and functional checks of many emissions control components. The visual checks are intended to determine whether components are present, and, if so, whether they have been modified or tampered. The functional checks are intended to determine whether a component is working properly and/or operating within appropriate specifications. For example, the test includes functional checks of ignition timing and of whether a car's gas cap seals properly. The Basic Program also includes a functional check of the Exhaust Gas Recirculation (EGR) valve. This check was excluded from the Enhanced Program because the ASM test directly measures NOx emissions. Major visual checks include the catalytic converter, air injection system, oxygen sensor, and evaporative emissions canister.

In addition to the test equipment requirements, BAR has developed very detailed specifications for how the test must be performed and what vehicle and test parameters must be measured and recorded during each test. Test equipment manufacturers that sell test equipment for the California Smog Check market must obtain a certification from BAR stating that their equipment meets BAR's specifications. Smog Check shops can use only certified equipment if they wish to participate in Smog Check. The equipment and associated software that meets BAR's specifications is known as "BAR97" equipment. The test used in the Enhanced Program is often referred to as the BAR97 test. Likewise, the idle test equipment used in the Basic and Change-of-Ownership programs is called the BAR90 test, signifying that it meets the specifications BAR developed for that equipment in 1990.[11]

5.8. Transmission and Storage of Smog Check Data

Every Smog Check test automatically generates a test record that is electronically transmitted to a central database. This Vehicle Information Database (VID) is maintained by the MCI Corporation under contract with BAR. Mechanics are also supposed to enter a repair record into the VID each time they repair a car. Entry of repair data is, however, haphazard in practice. The millions of vehicle test records in the VID form one of the major data sources for the IMRC's Smog Check evaluation.

5.9. Types of Smog Check Stations

There are currently four major types of Smog Check stations in the state, as follows:

- ***Test-and-Repair.*** Test-and-repair (TR) stations can both test and repair vehicles. They make up about 65 percent of all Smog Check stations in the state.
- ***Gold Shield Guaranteed Repair.*** Gold Shield Guaranteed Repair (GSGR) stations are test-and-repair stations that meet certain minimum standards set by BAR for station performance. For example, they must guarantee that any car they certify

[11] The software for the BAR90 equipment has, however, been updated by BAR in subsequent years to improve performance and increase functionality.

will pass a reinspection that occurs within 10 days or 1,000 miles. They also must have a "ping-pong" rate of less than 5 percent.[12]

- ***Gross Polluter Certification.*** Gross Polluter Certification (GPC) stations are GSGR stations that are allowed to certify the passing status of cars that were identified as gross polluters. BAR requires GPC stations to meet additional standards. For example, GPC stations must not have been cited by BAR enforcement staff and must have a "no-match" rate of less than 4.5 percent.[13]
- ***Test-Only.*** Test-only (TO) stations can test vehicles but may not perform repairs. As a result of the requirement that at least 15 percent of the fleet subject to Smog Check be tested at a test-only station, the number of test-only stations has greatly expanded since the advent of the Enhanced Program.

Table 5 summarizes the number of Smog Check stations by station type and program region as of November 1999.

Table 5. Number of Smog Check Stations by Program Area and Station Type

	Station Type				
Program Region	**TO**	**TR**	**GPC**	**GSGR**	**Total by Program Region**
Basic	9	2,119	464	419	3,011
Enhanced	342	2,631	212	1,075	4,260
Change-of-Ownership	1	57	72	5	135
Total by Station Type	352	4,807	748	1,499	7,406

TO = Test-Only; TR = Test-and-Repair; GPC = Gross Polluter Certification;
GSGR = Gold Shield Guaranteed Repair

Source: Bureau of Automotive Repair

5.10. Failure Rates and "Cut Points"

Cars have two ways to fail the Smog Check test. First, they can fail one or more of the visual and functional checks. Second, they can fail the emissions test. In order to fail the emissions test, a vehicle's emissions must exceed a pre-determined level for at least one of the three pollutants (HC, CO or NOx) on at least one of the two tests (the

[12] Ping-ponging is the term used to refer to the case where motorists must go back and forth from a test-only station to a test-and-repair station because their cars continue to fail at test-only. Program managers wish to reduce ping-ponging because it creates greater hassle for motorists.

[13] A "no-match" occurs when the vehicle identification number (VIN, which uniquely identifies every vehicle sold in America) entered by the mechanic for a vehicle he is about to test does not match a pre-existing record for that car in the Vehicle Information Database (VID). BAR staff are concerned about no-matches because they can sometimes be an indication of attempted testing fraud.

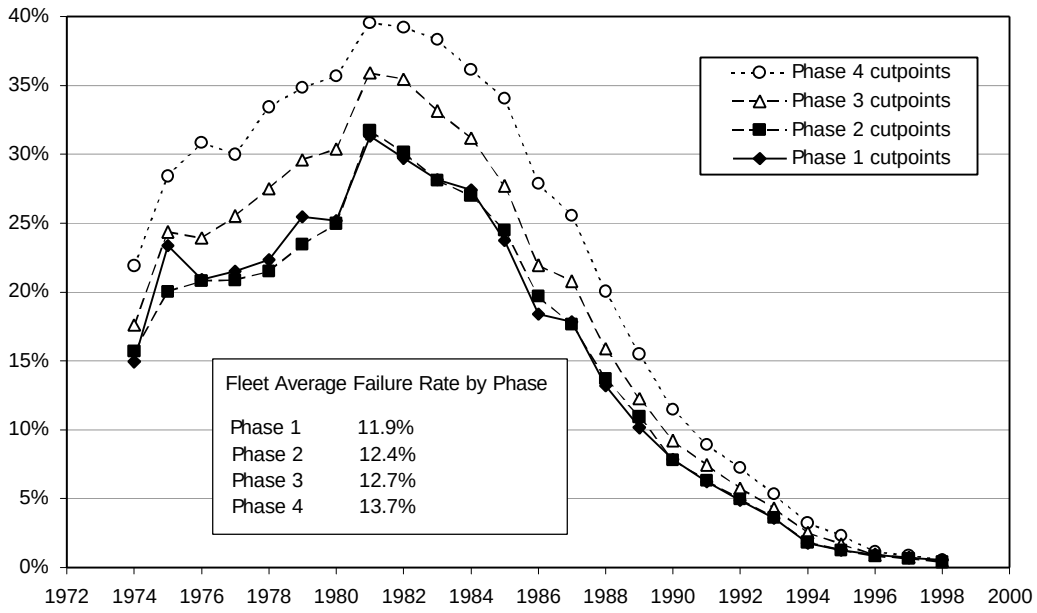
ASM5015 or ASM2525). These pre-determined emissions levels are usually called “cut points” or “emissions standards”.

In order to determine cut points, BAR groups vehicles into categories based on their emission control technology and whether the vehicle is classified as a car or a truck. BAR uses 17 categories, called Emissions Standards Categories (ESC), for this purpose. Within each category, cut points also vary by vehicle weight.

The cut points for HC and CO have remained the same since the Enhanced Program began in June of 1998. The cut points for NOx have been reduced three times: September 1998, November 1998, and October 1999. Before September 1998, cars could fail the emissions test only for HC and CO. Figure 2 displays vehicle failure rates by model year under each of the four cut point regimes (dubbed “Phase 1” through “Phase 4”), with Phase 4 being the current one). These phases refer to the four time periods in which the NOx cut points were made progressively more stringent.

Figure 2. Overall Failure Rates by Model Year and Cut Point Phase

Including official pretests, June 98 to Nov 99 California ASM



Gross Polluters. In addition to the failure cut points, BAR created a set of higher cut points (typically two to three times higher than the regular failure cut points) called *gross polluter* cut points. Cars that exceed these higher cut points are dubbed “gross polluters” due to their extremely high emissions. AB 2018 (Katz) required that gross polluters meet more stringent requirements that other failing vehicles. For example, they had to be tested every year instead of every two years, and there was no cost limit above which the motorist could receive a waiver (see below for waiver provisions). However, AB 1492 (Baugh) repealed these provisions. The only remaining additional requirement for gross polluters is that they be certified as passing by either a test-only or a GPC station.

Currently, 4.7 percent of all cars in the Enhanced Program (34 percent of cars that fail) fail Smog Check with emissions in excess of the gross polluter cut points.

5.11. Repair Cost Limits, Financial Assistance, and Other "Safety Valves"

A motorist whose car fails a Smog Check need not spend more than $450 to repair a failing vehicle. If repair costs rise above this level, the motorist can be granted a *waiver* that allows the vehicle to be registered even though it does not meet emissions standards. In addition, motorists with household incomes less than 185 percent of the poverty level ($31,542 for a family of four[14]) can be granted a two-year *economic hardship extension* for a failing vehicle if the repair cost estimate for the vehicle exceeds $250. According to BAR, in 1999, 1,191 vehicles were granted a waiver, and 1,680 motorists were granted an economic hardship extension. Together these numbers amount to 0.3 percent of all vehicles that failed the test in 1999.

5.11.1. Low-Income Assistance

Through the Repair Assistance Program (RAP), the state provides financial assistance for vehicle repair to some motorists who fail their Smog Check. Motorists qualify for low-income assistance by having a household income below 185 percent of the federal poverty level. The program provides financial assistance up to $450 after an initial motorist co-payment of $75. BAR hopes to issue regulations to raise the maximum assistance level to $500 and lower the co-payment to $29.

AB 1105 (Jackson), which was signed into law last year, also makes motorists directed to test-only eligible for financial assistance if their car fails. BAR recently enacted regulations to include these motorists, but plans to require a $250 co-payment for motorists who do not meet the low-income criterion.

In order to obtain financial assistance, motorists must receive approval from BAR and have their car repaired at a station authorized to perform repairs through the low-income assistance program. Only Gross Polluter Certification (GPC) stations are eligible to participate. About 80 GPC stations currently participate in the program.

As of the end of March 2000, more than 4,800 cars have been repaired through the RAP at an average cost per repair of about $440 (including both state and motorist contributions). Figure 3 displays the number of cars repaired through the low-income assistance program by month since March 1999. Participation in the program was initially very low. This was likely due to the fact that the motorist co-payment was initially $250. Participation began to increase after the co-payment was lowered to $75 in May 1999.

GPC stations have been loath to participate in the program due to the low volume of repairs and the significant amount of paperwork involved. RAP program managers are currently taking steps to reduce required paperwork and to market the program to

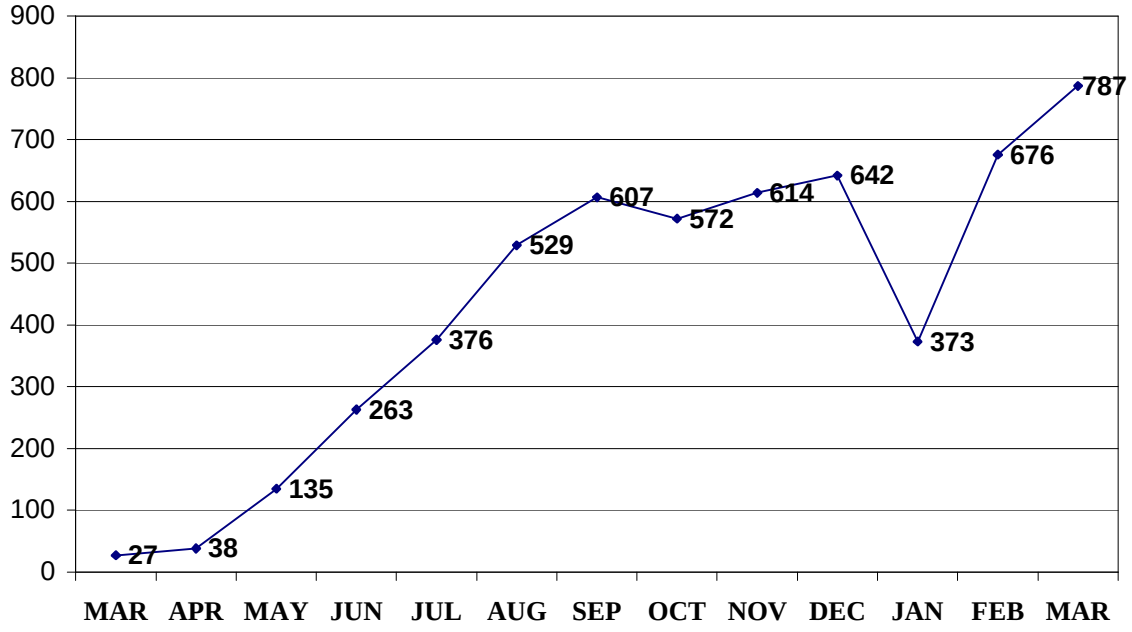
[14] United States Department of Health and Human Services (2000) "The 2000 HHS Poverty Guidelines", on the Web at http://aspe.hhs.gov/poverty/00poverty.htm

potentially eligible motorists. For example, BAR recently received administrative approval for a more streamlined motorist application process and a simpler application form. In addition, BAR currently has a pilot program underway in Fresno in which test-only stations provide every motorist with information on the RAP. BAR is still gathering data on the results of this effort and hopes to be able to report on its effectiveness within a few months.

5.11.2. Vehicle Retirement

Through the Vehicle Retirement Program (VRP), the state will pay $450 to motorists who fail a Smog Check and are willing to scrap their car. As of the end of March 2000, almost 1,900 cars have been scrapped through the program. Figure 4 displays the number of cars scrapped each month through the program. BAR plans to increase to $700 the amount it will offer motorists to scrap their vehicles.

Figure 3. Number of Vehicles Repaired in the Repair Assistance Program
March 1999-March 2000



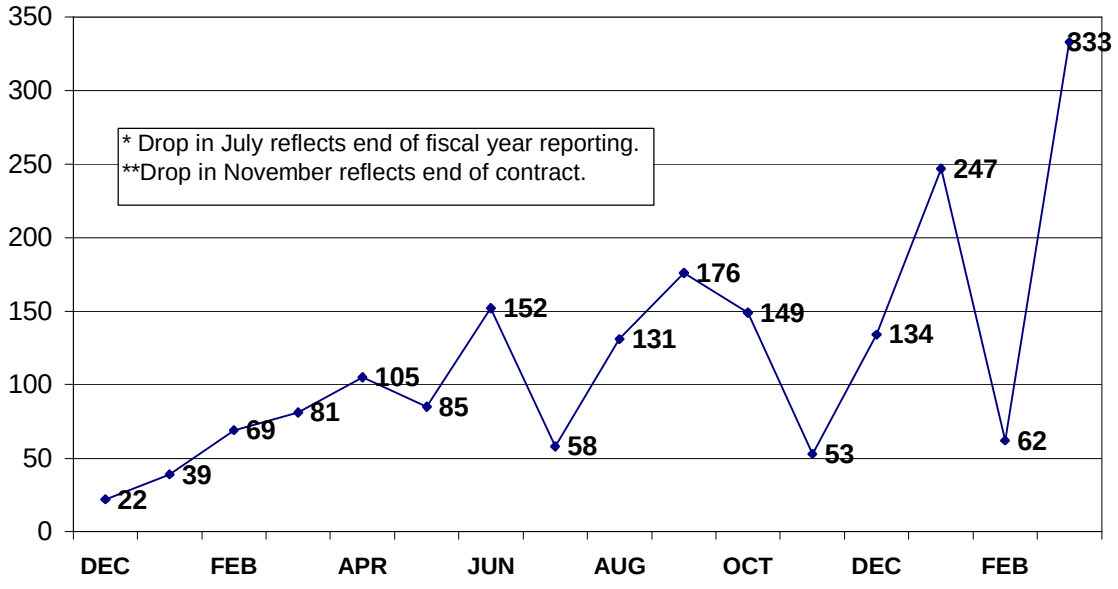
Source: California Bureau of Automotive Repair

RAP and VRP Funding Issues. Until recently the RAP and VRP were funded with revenues from the Smog Impact Fee (SIF). The SIF was the $300 fee paid by motorists who bring in vehicles from out of state that are not certified to California's more stringent emissions standards. SIF funds were deposited in the High Polluter Repair and Removal Account (HPRRA) from which RAP and VRP expenditures are drawn. The fund is expected to have a reserve of $112 million at the end of the 1999-2000 fiscal year.

Last year the SIF was found unconstitutional by an appeals court. Current law requires that the SIF funds be partially supplanted by an increase in the Smog Abatement Fee (SAF), which is paid each year at registration by motorists owning cars four years old and newer. Statute requires that the fee increase from $4 to $6 per year now that the SIF has been invalidated, although the increase will not take effect until DMV updates its software sometime this spring. Of the $6 fee, $2 is deposited into the HPRRA for each registered vehicle two to four years old, and all $6 goes into the HPRRA for each new vehicle registered for the first time. SAF revenues to the HPRRA are expected to total about $22 million in FY 2000-01. Adding these funds to the projected HPRRA reserve of $112 million gives a total of $133 million that could potentially be available in fiscal 2000-2001.

The Governor's Budget for 2000-01 provides $22 million for the RAP and VRP from the HPRRA. The budget also proposes to spend $103 million from the HPRRA to reimburse motorists who previously paid a SIF when they brought a car into the state. On current utilization levels the RAP and VRP would cost only about $4 million per year – much less than projected annual SAF revenues. However, the pool of motorists who are eligible for financial assistance and who are driving cars that would fail a Smog Check is likely large enough to consume many times this amount. In addition, the expansion of financial assistance to all motorists directed to a test-only station will likely add to consumer demand for RAP funds.

Figure 4. Number of Vehicles Scrapped in the Vehicle Retirement Program
December 1998 - March 2000



Source: California Bureau of Automotive Repair

4.11.3. Mediation of Consumer Complaints

Consumers who are dissatisfied with the service they receive from a Smog Check station may file a complaint with BAR. BAR has field office staff who mediate complaints by determining whether vehicles were appropriately failed and whether repairs were properly performed and appropriate for the types of problems identified. Among the 4,059 Smog Check complaints closed in fiscal year 1998-99, 40 percent involved Smog Check repairs (1,633 complaints), and 39 percent involved the inspection/test portion of a Smog Check (1,579 complaints). Allegations in the repair-related complaints included: incompetence, negligence, overselling repairs, making false statements, and fraud. Allegations in the inspection-related complaints included: improper inspection affecting test results, incompetence, and negligence. The 4,059 complaints closed in fiscal year 1998-99 resulted in approximately $696,000 in refunds, adjustments, or re-work.[15]

5.12. Enforcement

BAR's Smog Check enforcement efforts include two major components: quality assurance (QA) inspections, and traditional investigations of negligent or fraudulent activity. BAR launched the QA program in February 1999. The program is designed to give station owners and technicians a chance to improve their performance before invoking potential administrative penalties.

QA inspections involve overt audits of a Smog Check station's performance. During the audit, BAR inspectors check four major aspects of a station's performance. First, they analyze VID test records from a station to look for any anomalies in that station's performance when compared with other stations and with vehicle emissions data collected at random on the road. Second, they ensure that stations meet regulatory requirements for Smog Check-related equipment, manuals and signage. Third, they inspect the station's invoices and vehicle inspection reports to ensure that repairs were appropriate for the problems identified on the Smog Check test and also that the information in the invoice matches the information entered in the VID. Fourth, they ask the station's technicians to perform a Smog Check and demonstrate the use of diagnostic tools to ensure that the technicians have appropriate skills for Smog Check testing and repair.

Stations found deficient on the audit receive follow-up visits to determine if performance has improved. Although citations are rare on the initial audit, stations may be cited on follow-up audits if they fail to remedy deficiencies. BAR expects to perform a QA inspection on every Smog Check station in the state at least once per year. Test-only and GPC stations are given at least two QA inspections per year. More frequent inspections of test-only and GPC stations are intended to improve the probability that HEP and gross polluting vehicles are properly tested and repaired.

BAR also engages in traditional enforcement operations geared toward rooting out negligence and fraud in the Smog Check Program. BAR staff typically target stations for enforcement action based on consumer complaints, anonymous tips, and/or anomalous or

[15] Mediation information provided by BAR Field Operations division.

suspicious activity in the stations' VID data records. These investigations can range from overt fact finding to various covert methods, including surveillance and the use of undercover vehicles. For example, a BAR agent posing as a regular motorist might bring a car that has been adjusted to fail the test to a Smog Check station to see how the station actually performs. These methods are used against those stations that are suspected of Smog Check fraud, including "clean piping", failure to perform visual or functional tests, or unnecessary repairs. [16]

BAR's enforcement efforts can result in actions ranging from fines to license revocation and finally to criminal penalties for technicians or station owners convicted of fraud. Among the 652 investigations closed in fiscal year (FY) 1998-99, 57 percent involved a failure to perform complete visual or functional tests (375 cases), and 12 percent involved clean piping (75 cases). BAR revoked 124 technician and/or station licenses during FY 1998-99. BAR publishes a list of recent enforcement actions in its monthly "Smog Check Advisory" and quarterly "Repair Reporter." In addition, the Department of Consumer Affairs' web site (www.dca.ca.gov) displays disciplinary actions against automotive repair dealers and Smog Check stations.

BAR has also used undercover audits as an educational tool to improve station performance. In 1998, shortly after the Enhanced Program was implemented, BAR ran an undercover car through every test-only and GPC station and through a sample of test-and-repair and Gold Shield stations. BAR then invited station owners and technicians to meetings in various parts of the state in order to discuss findings from the audits and to let stations know where they needed to improve. Finally, BAR conducted follow-up audits of those stations where serious violations were revealed in the original audits. Enforcement action was taken if the violations continued.[17]

[16] Clean piping refers to the case where a car that is known to be low emitting is tested but the identification information for another vehicle is entered into the computer. This method of fraud, if undetected, can allow high emitting cars to pass a Smog Check without ever being tested or repaired.

[17] Enforcement data provided by BAR Field Operations division.

5.13. History of Smog Check

Significant milestones in the history of Smog Check include the following:

Date	Event
1960s-1979	Change-of-ownership inspections required at private test-and-repair garages.
1979 to March 1984	Change-of-ownership inspections required at test-only stations in the greater Los Angeles metropolitan area.
March 1984	Implementation of the first "Smog Check" program. A test-and-repair program created by SB 33 (Presley, passed in 1982). Program features included (1) biennial and change-of-ownership testing, (2) the BAR84 idle emissions test plus visual and functional inspections of some emission control components, (3) a $50 repair cost limit, (4) licensing of shops to perform Smog Checks, and (5) mechanic certification for emissions repair competence. This program is generally referred to as the "BAR84" program. IMRC also created with charge of program evaluation.
1990	Implementation of SB 1997 (Presley, passed in 1988). SB 1997 requires significant changes to the Smog Check Program, including: (1) upgrades to the idle emissions test equipment, including addition of a personal computer-based system for operating the equipment, and a modem-based communications system, (2) a sliding repair cost ceiling ranging from $50 for pre-1971 vehicles to $300 for 1990 and newer vehicles, (3) additional visual and functional inspections, and (4) additional mechanic certification requirements. This program is generally referred to as the "BAR90" program.
1990	Congress passes the federal Clean Air Act Amendments of 1990 (CAAA), which requires "enhanced" vehicle inspection and maintenance (I/M) programs (see Section 182(c)(3) of the CAAA for enhanced I/M statutory requirements).
1992	USEPA issues regulations for enhanced I/M (see Code of Federal Regulations, Section 40, Part 51, issued November 5, 1992).
1994	Based on negotiations between California and USEPA, AB 2018 (Katz) creates the blueprint for the current enhanced Smog Check Program, later to be known as "Smog Check II." The program will be a hybrid of both test-only and test-and-repair stations. IMRC membership changed to make committee more independent from the agencies that manage the program.

1996	AB 2515 (Bowler) allows for licensed test-only stations in addition to state-contracted stations. This change allows small independent businesses to operate test-only stations.
January 1998	Four laws passed in 1997 make significant changes to Smog Check II: • AB 57 (Escutia) creates a financial assistance program to help low-income motorists pay for emissions-related repairs. • AB 208 (Migden) provides funding for low-income assistance and vehicle retirement from Smog Impact Fee revenues. • AB 1492 (Baugh): (1) exempts vehicles less than four years old from the biennial testing requirement, (2) repeals requirements that vehicles identified as gross polluters be repaired without a cost limit and be tested annually thereafter. • AB 42 (Kopp) exempts vehicles manufactured before the 1974 model year from Smog Check testing. Requires that vehicles 30 years old and older be exempt from the program starting in 2004.
June 1998	Loaded-mode ASM emissions testing (the BAR97 test) begins in Enhanced areas. However, no cars are failed for NOx emissions.
September 1998	NOx failure cut points implemented at a relatively loose level so that a small number of cars begin failing the emissions test due to high NOx emissions. Overall failure rate increases from 11.9% to 12.4%.
November 1998	NOx failure cut points lowered again, increasing overall failure rate from 12.4% to 12.7%
July 1999	AB 1105 (Jackson), a budget trailer bill, makes the following changes to Smog Check II: • Authorizes, but does not require, BAR to exempt vehicles up to six years old from the biennial inspection requirement. BAR is also authorized to exempt additional vehicles by low-emitter profiling (LEP). • Raises the low-income threshold for repair assistance from 175% of the federal poverty limit to 185% (this translates into an increase from $29,837 to $31,542 for a family of four). • All motorists directed to test-only, regardless of income, would be eligible for financial assistance if their car fails. BAR would be authorized to set a higher co-payment for motorists who do not fall below the low-income threshold. • Provides BAR with increased flexibility to determine how much to pay motorists who scrap their vehicles after failing a Smog Check.
October 1999	NOx failure cut points lowered again, increasing overall failure rate from 12.7% to 13.7%

6. How Smog Check Fits into Federal and State Air Pollution Policy

6.1. Federal Statutory and Regulatory Framework

Federal air pollution policy derives from the federal Clean Air Act Amendments of 1990 (CAAA) and associated USEPA regulations. The goal of the CAAA is for states to attain federal air pollution health standards, known as the National Ambient Air Quality Standards (NAAQS). The pollutants targeted by the CAAA, which include ozone, particulates, and carbon monoxide (CO), are known as *criteria pollutants* under the CAAA.

The goal of Smog Check Program is to reduce emissions of HC, NOx and CO. HC and NOx, and, to a lesser extent, CO are *ozone precursors* because they contribute to the formation of ozone. CO is also a harmful pollutant in its own right. However, in California CO pollution is a less severe problem than ozone. Most areas of the state are already at or near attainment of the CO health standards. Ozone, on the other hand, has been more difficult to reduce and the problem is more widespread. As a result, regulators have used Smog Check principally as an ozone reduction strategy.

6.2. Administration of California Air Pollution Policy

Administration of air pollution policy in California is divided among state and local agencies. Mobile sources such as cars, trucks, and off-road vehicles are generally regulated at the state level, while stationary sources are generally regulated at the local level.

ARB is responsible for most state-level air pollution policy. A major exception is Smog Check, which is administered by BAR. In the area of on-road mobile sources, there are three major components to ARB's emissions reduction strategy in addition to Smog Check.

1. ARB sets fuel standards, such as "reformulated" gasoline. Reformulated fuels are intended to reduce emissions of HC, NOx, CO, and toxic components through changes in fuel composition.
2. ARB determines new-vehicle emissions certification standards. All new vehicles sold in California must meet or exceed the standards for their particular model year. Car manufacturers must certify each of their models each year using the FTP.
3. ARB sets in-use emissions standards with which vehicles must comply after they are sold. ARB monitors the emissions of the on-road vehicle fleet and can impose recalls on vehicle models for which a substantial percentage of cars fail to meet in-use emissions standards.

As noted above, in the case of Smog Check, state-level policy is implemented by BAR, which manages the day-to-day operation and regulation of the program. However,

BAR also relies on ARB for its expertise in automotive emissions testing and mobile source policy. For example, ARB and BAR are working together to evaluate the effectiveness of Smog Check in parallel with the IMRC's evaluation efforts.

At the local level, agencies called Air Pollution Control Districts (APCD) or Air Quality Management Districts (AQMD) are responsible for regional air pollution policy. These agencies mainly regulate emissions from businesses and consumer products, though they also have some role in mobile source emissions. For example, some air districts have regulations to encourage commuters to carpool, or to scrap older, high-emitting vehicles.

6.3. Federal Smog Check Requirements

The Clean Air Act requires "enhanced" I/M programs in all ozone non-attainment areas that have been designated Serious, Severe, or Extreme[18] and that have urbanized populations of 200,000 or more. There are six such areas in California, including South Coast, San Diego, Sacramento, the San Joaquin Valley, the Southeast Desert, and Ventura. California also elected to implement the Enhanced Program in urban areas with populations as low as 50,000 in order to achieve extra reductions believed necessary to reach attainment of the air pollution health standards.

6.4. Due Dates for Federally Required I/M Evaluations

Federal law includes two I/M evaluation milestones. First, states have 18 months from the time of interim approval to submit data showing that an I/M program qualitatively meets USEPA's requirements for enhanced I/M programs. This requirement resulted in creation of the Environmental Council of States or ECOS process.[19] BAR submitted California's ECOS report to USEPA on October 26, 1998.[20] USEPA has not as yet acted on the report.

The second evaluation milestone requires that an I/M program evaluation be submitted within two years after the program start date and every two years thereafter. When EPA approved California's I/M program, the start date was expected to be February 9, 1998. Thus, California had until February 9, 2000 to submit an evaluation to EPA. ARB is the state agency responsible for submitting the required evaluation to USEPA. ARB released a draft evaluation of Smog Check on April 27, 2000.

[18] The federal Clean Air Act includes five non-attainment classifications, reflecting progressively more severe ozone problems. They are: Marginal , Moderate, Serious, Severe, and Extreme.

[19] USEPA created the ECOS process to develop alternative evaluation methods for I/M programs that differ from the annual, centralized, IM240 program that form the basis of USEPA's I/M performance standard. Through ECOS, USEPA developed a protocol by which states could attempt to demonstrate that their I/M program is "equivalent" to the USEPA performance standard.

[20] California Bureau of Automotive Repair (1998) "Interim Short-Term Equivalency Demonstration of the California Enhanced Smog Check Program", Sacramento, California. October.

6.5. How Smog Check Emissions Reductions Affect Compliance with Clean Air Act Requirements

There are three ways in which the effectiveness of Smog Check can affect California's compliance with federal air pollution laws. First, Smog Check must meet USEPA's "performance standard" for vehicle inspection and maintenance (I/M) programs. Second, Smog Check must achieve tons-per-day emissions reduction targets in California's State Implementation Plan (SIP). Third, if the actual reductions achieved by Smog Check are less than planned for in the SIP, some metropolitan areas could fail to meet the "conformity" requirement of the Clean Air Act.

If the state fails to meet either of the first two of these requirements, USEPA could respond in a number of ways. For example, USEPA could choose to impose sanctions on the state. Potential sanctions include withholding federal highway funds and requiring that stationary sources offset emissions increases by a factor of two-to-one (offsets of 1.2 to one are normally required). Another more likely outcome is that USEPA and California would negotiate a plan to remedy the shortfall in emissions reductions to avoid sanctions. If USEPA does choose to seek sanctions, the sanctions could not actually be imposed until 18 months after USEPA officially makes a finding that Smog Check does not meet regulatory requirements. The conformity requirement also includes potential sanctions. Transportation projects that do not meet conformity requirements are ineligible for federal transportation funds. Each of these three requirements is discussed in greater detail below.

6.5.1. USEPA's I/M Performance Standard

USEPA's I/M Performance Standard consists of maximum allowable fleet-average, grams-per-mile emissions level for each pollutant. USEPA asserted that an I/M program with certain characteristics would achieve the maximum emissions reductions available from I/M. Key characteristics of USEPA's Performance Standard program include the following:

- Annual testing;
- Transient mass emissions testing using the IM240 driving cycle;
- Stringent emissions failure cut points;
- A repair cost waiver limit of at least $450, increased annually based on the consumer price index;
- A motorist compliance rate of at least 96 percent;
- A waiver rate of no more than 3 percent of failed vehicles;
- Pressure and purge tests of the evaporative emissions control system.

USEPA included its assumptions about the effectiveness of such a program in its vehicle emissions model, which is known as MOBILE5a. The I/M performance standard is then a fleet-average grams-per-mile emission rate derived by running the model with

USEPA's I/M effectiveness assumptions.[21] An air basin must meet its performance standard for a given year in order for its I/M program to meet USEPA's requirements. California is a special case because it has its own emissions model, the EMFAC model. EMFAC7G, the latest version of the model, has been approved by USEPA for use in California, and California's performance standard is based on EMFAC rather than MOBILE5a. Table 6 lists California's EMFAC7G performance standard target.

Table 6. California's Year 2000 I/M Performance Standard Based on EMFAC7G

	Fleet Average Emissions (grams/mile)			
Pollutant	**$HC_{exhaust}$**	**$HC_{evap.}$**	**CO**	**NOx**
USEPA Performance Standard	0.47	0.29	6.13	0.56

Source: California Bureau of Automotive Repair

6.5.2. SIP Process and Requirements

The federal Clean Air Act and associated USEPA regulations include many detailed requirements that prescribe how states must go about attaining federal health standards for criteria air pollutants. Among these is the requirement that states generate a State Implementation Plan (SIP). The SIP legally commits a state to achieve required emission reductions through specific programs. General steps in the SIP development process include the following:

First, the non-attainment area must develop an inventory of pollution emissions in the region. The inventory is developed through a series of surveys, measurements, and modeling, depending on the particular sources and types of pollution in question. In the case of on-road vehicle pollution, California uses the EMFAC mobile source emissions model to estimate the level of emissions from on-road vehicles.

Second, the non-attainment area must determine the maximum level of emissions that can occur while still remaining within air pollution standards. This is determined through the use of an Urban Airshed Model (UAM). The UAM estimates the combined effects of pollutant emissions in facilitating ozone formation in a given region or "airshed." Note that this modeling process is completely separate from the EMFAC modeling discussed above. EMFAC is used as part of the determination of how much HC and NOx are going into the air. UAMs are used to determine the amount of ozone formed due to the HC and NOx emissions. Thus the output of EMFAC can be an input to a UAM.

Third, the non-attainment area must develop control measures that will reduce emissions below the required level by that non-attainment area's attainment deadline for each criteria pollutant. Non-attainment deadlines are set by the CAAA and depend on the severity of a region's air pollution problem. The South Coast Air Basin, which is designated as an "extreme" non-attainment area, the worst classification possible, has

[21] The model also includes inputs for local values of some technical factors such as fuel composition and fleet model year distribution that vary from region to region.

until 2010 to attain the NAAQS for ozone. Deadlines for other areas in the state range from 1999 to 2007.

Fourth, the state must submit a SIP detailing the results of this planning and modeling process. The SIP commits the state to ensuring that the proposed measures are implemented and that air pollution reductions are attained by regulatory deadlines. The SIP purports to show that implementing the proposed measures will result in future emission reductions sufficient to put the region in compliance with the NAAQS.[22] The state periodically submits SIP revisions to USEPA when new information becomes available, when existing programs are altered, or when new programs or plans are developed.

6.5.3. Components of California's I/M SIP

California committed to implement the following measures in its SIP submittal to USEPA:[23]

- A hybrid testing program in which 15 percent of vehicles subject to the program would be tested at test-only stations.
- A remote sensing-based, on-road gross polluter detection and repair program.
- Increased enforcement and penalties against fraud.
- Real-time computer monitoring of test stations.
- Repair assistance and vehicle scrap programs.

With the exception of the remote sensing program, all of these measures have been implemented.

6.5.4. SIP Tons-Per-Day Target

ARB submitted California's SIP revision for Enhanced Smog Check to USEPA on January 22, 1996. Table 7 displays the emissions reductions required by the SIP from the Enhanced Smog Check Program broken out by air basin and year.[24] As the table indicates, California will be required to show reductions of about 96 tons per day in HC and NOx from the Enhanced Smog Check Program in 1999.[25]

---

[22] The SIP must meet other CAAA requirements as well. For example, the CAAA and associated USEPA regulations include a "reasonable further progress" provision that requires states to demonstrate reductions in NOx and HC of at least 15 percent each between 1990 and 1996 and every three years thereafter until the NAAQS are attained.

[23] Cal-EPA (1994) "The California State Implmentation Plan for Ozone. Volume III: Status of Enhanced Motor Vehicle Inspection & Maintenance and Pesticide Control Measures - The California State Implementation Plan for Ozone", Air Resources Board, Sacramento, California.

[24] Table 1 comes from the Federal Register, Vol. 62, No. 5, January 8, 1997. The years chosen represent the three-year periods in which California must demonstrate "reasonable further progress" as described in footnote #1.

[25] Most people who follow I/M issues in California are familiar with a value of 112 tons per day for the reductions required in California's SIP. The 112-ton figure arises when the SIP number (96 tons per day) is added to the Enhanced I/M reductions ARB estimated for the San Diego Air Quality Management District (15.8 tons per day). San Diego did not need these reductions to show attainment of the federal

Generating the SIP I/M Effectiveness Targets. Like the USEPA Performance Standard, the SIP tons-per-day reduction requirement is generated by running the EMFAC emissions model. For a given future year, the model is run for two scenarios. The first assumes no implementation of Enhanced I/M, which serves as the "base case". The second assumes that Enhanced I/M is implemented, and the model includes assumptions about how effective the Enhanced I/M program will be. The difference between the two scenarios is the SIP target for emissions reductions that must be achieved.

EMFAC7G was not originally designed to predict the results of the hybrid program[26] that California adopted. As a result, consultants from Radian were hired to modify the model to include features such as high emitter profiling and partial test-only testing.[27] The results of this modified version of the model are the basis of both California's SIP commitment to USEPA and the state's I/M Performance Standard target. The average grams-per-mile target for the Performance Standard is generated from running the model for the case that includes Enhanced I/M implementation.

Table 7. Tons Per Day Reduction in HC and NOx Required by California's SIP for Enhanced Inspection and Maintenance*

	1999		2002		2005		2008		2010	
	HC	NOx	HC	NOx	HC	NOx	HC	NOx	HC	NOx
South Coast	34.8	32.4	40.3	35.6	32.5	33.0	30.2	34.8	26.2	31.1
Southeast Desert	2.4	2.3	3.0	2.6	2.8	2.6				
Ventura	1.6	1.9	1.8	2.0	1.4	1.9				
Sacramento	5.4	5.7	6.3	6.5	5.2	6.4				
San Joaquin	4.3	5.0								
Total	48.5	47.3	51.4	46.7	41.9	43.9	30.2	34.8	26.2	31.1
Total HC + NOx	95.8		98.1		85.8		65.0		57.3	

* Calculations for reductions required in future years extend out only to the year in which the air district in question is required to attain the federal air pollution standards, as determined by the air district's non-attainment status under the Clean Air Act.

standards in its air plan. Therefore, the reductions due to Enhanced I/M in San Diego were not included in California's I/M SIP submission to USEPA. One should also note that the SIP specifies reductions by pollutant and air basin, rather than a statewide total. California is legally required to meet the individual reduction targets for each pollutant in each air basin.

[26] "Hybrid" means a program that includes both test-and-repair and test-only testing of vehicles.

[27] Radian (1995) "Evaluation of the California Pilot Inspection/Maintenance (I/M) Program," prepared for the California Bureau of Automotive Repair, Sacramento, California. March.

6.6. Clean Air Act "Conformity" and Its Relationship to Smog Check

The Clean Air Act and the provisions of federal transportation legislation and regulations are intended to ensure that non-attainment areas integrate transportation and air quality planning. The analytical process that must be performed by metropolitan planning organizations (MPOs), or in some cases the state, to ensure consistency between these planning processes is called *transportation conformity*. States must meet transportation conformity requirements in order to expend federal transportation funds or to obtain federal approval on a transportation project.[28] Roughly $1.5 billion in federal funds depend on meeting transportation conformity requirements.[29]

Transportation conformity must be assessed for regional transportation plans (RTPs), transportation improvement programs (TIPs), and individual transportation projects (project-level conformity determinations are performed during the project development process). The RTP is a 20-year plan for the development of integrated transportation facilities in a metropolitan area. The TIP is a three-year program for implementation of new transportation facilities and operation of the existing facilities as identified in the RTP. The RTP and TIP are products of the metropolitan transportation planning process carried out by MPOs. MPOs are generally regional associations of local governments in an urbanized area (for example, the Southern California Association of Governments (SCAG) in the South Coast Air Basin, and the Sacramento Area Council of Governments (SACOG) in the Sacramento Air Basin).

A conformity analysis proceeds in non-attainment areas with a SIP as follows:

- Through the SIP process, an allowable mobile source emissions budget for future years has already been determined by the local air pollution control district, in cooperation with the MPO. The emissions budget is the maximum amount of a given pollutant (e.g., HC, NOx, or CO) that may be emitted into the air for a given future year. The mobile source emissions budgets are developed with consideration to both projected traffic demand and the emissions control measures identified in the SIP.
- The MPO uses a type of model called a transportation demand model (TDM) to forecast the total number of trips and vehicle miles traveled (VMT) resulting from the projects and policies proposed in the RTP and TIP. Given the forecasted number of trips and VMT, the EMFAC emissions model is then used to predict total emissions. The vehicle emissions control measure assumptions used in the conformity assessment must be consistent with the measures included in the SIP.
- The result is a total level of emissions that can be compared with the emissions budget. To demonstrate conformity, projected emissions with the new RTP or TIP must not exceed the pre-determined emissions budgets for future years.

[28] Transportation projects that are considered to have no emissions impact are exempt from the conformity requirement. These include projects such as re-paving roads or widening a road shoulder.

[29] The exact amount of funds is uncertain because which specific projects are subject to conformity requirements is open to interpretation.

Federal transportation planning regulations require that TIPs be updated every two years. Unless the update includes only projects exempt from the transportation conformity requirements, a transportation conformity analysis is required with the update. Most MPOs in non-attainment areas will be updating their TIPs and RTPs, as necessary, for the federal fiscal year beginning October 1, 2000. Given the time required to perform the technical conformity assessment, provide opportunity for public comment, and obtain the appropriate approvals, the MPOs will likely begin their updates in Spring 2000.

The pending results of the Smog Check Program evaluation are a critical element for these upcoming conformity assessments. The mobile source emissions assumptions for areas with the Enhanced Smog Check Program were developed assuming a certain level of program effectiveness. However, if a control measure has not been fully implemented, as defined in the SIP, the conformity determination can only assume the emissions credit from the control measure as implemented. If an evaluation of Smog Check shows it to be less effective than required by the SIP, there will be a shortfall in emissions reductions that will need to be made up elsewhere in order to stay within the emissions budget. In the short term, the shortfall could be offset using other control measures (that have the appropriate regulatory commitment) or by making significant changes to the RTPs and TIPs. However, making the required changes to the RTPs and TIPs could take a substantial amount of time. In the longer term, the emissions budgets in the SIP could be revised to reflect the changes to the Smog Check Program.

If the MPOs cannot demonstrate conformity on the updated TIP and have no other TIP in place, the metropolitan area would be in a conformity lapse. Only three types of projects may proceed during a conformity lapse if they are funded with federal funds: (1) exempt projects, (2) approved SIP transportation control measures,[30] and (3) projects that have already received federal authorization for construction. However, no new transportation projects could begin and on-going right-of-way acquisition and active design of transportation projects would have to stop. For example, Atlanta, Georgia has been in a conformity lapse for over two years while trying to develop a conforming RTP and TIP.

A coalition of environmental groups has already filed a lawsuit over the conformity determination on SACOG's TIP and RTP on the presumption that the Enhanced Smog Check Program will not achieve the reductions required by the SIP.[31] The plaintiffs allege that the emissions credit used in the conformity determination did not reflect the legislative changes to the program as well as the operational changes made to the vehicle failure cut points.

In summary, the effect of the Smog Check Program evaluation on that state's receipt of federal transportation dollars will depend on the following: (1) the magnitude of the emissions reduction shortfall, if any, (2) whether ARB already has measures in place to compensate for any shortfall, and (3) how close the emissions estimates resulting from the RTP and TIP are to their allowable budgets.

[30] These are measures, such as carpooling, that are intended to reduce total vehicle travel.

[31] Environmental Council of Sacramento, et al. vs. Rodney Slater, et. al. No. CV-00-409 LEK DAD

6.7. The Relationship of Smog Check Reductions to the Overall Emissions Inventory

Table 8 displays the predicted emissions inventory for the South Coast Air Basin (SCAB) in the year 2000.[32] This inventory includes the predicted effect of all air pollution reduction measures that had been implemented or adopted when the plan was approved by the South Coast Air Quality Management District board in 1997, including the effect of Enhanced Smog Check. Table 8 also displays the EMFAC7G prediction for reductions due to Basic and Enhanced I/M.

Table 8. Official Emissions Inventory for the South Coast Air Basin in 2000 (in tons per day)

Source Category	HC	NOx	CO
Stationary Sources[33]	**468**	**109**	**295**
On-Road Vehicles	**326**	**555**	**2,795**
Smog Check Fleet[*]	*302*	*355*	*2,615*
Light and Medium Duty Diesels	2	21	20
Heavy Duty Trucks	18	169	143
Buses	0.8	7.9	0.8
Motorcycles	3.3	1.5	16
Off-Road Vehicles	**135**	**298**	**1,549**
TOTAL	**929**	**962**	**4,847**
Inventory w/o Enhanced I/M[+]	**960**	**999**	**5,017**
Inventory w/o Any I/M[+]	**1,025**	**1,072**	**6,688**

\+ Based on EMFAC7G results.
* Includes gasoline-powered cars and trucks.

Sources: California Air Resources Board and South Coast Air Quality Management District

Note that the "On-Road Vehicles" category is broken out by individual sources of pollution. Gasoline-powered cars and trucks are the vehicles targeted by Smog Check. This group is highlighted in italics. The Smog Check universe of vehicles accounts for

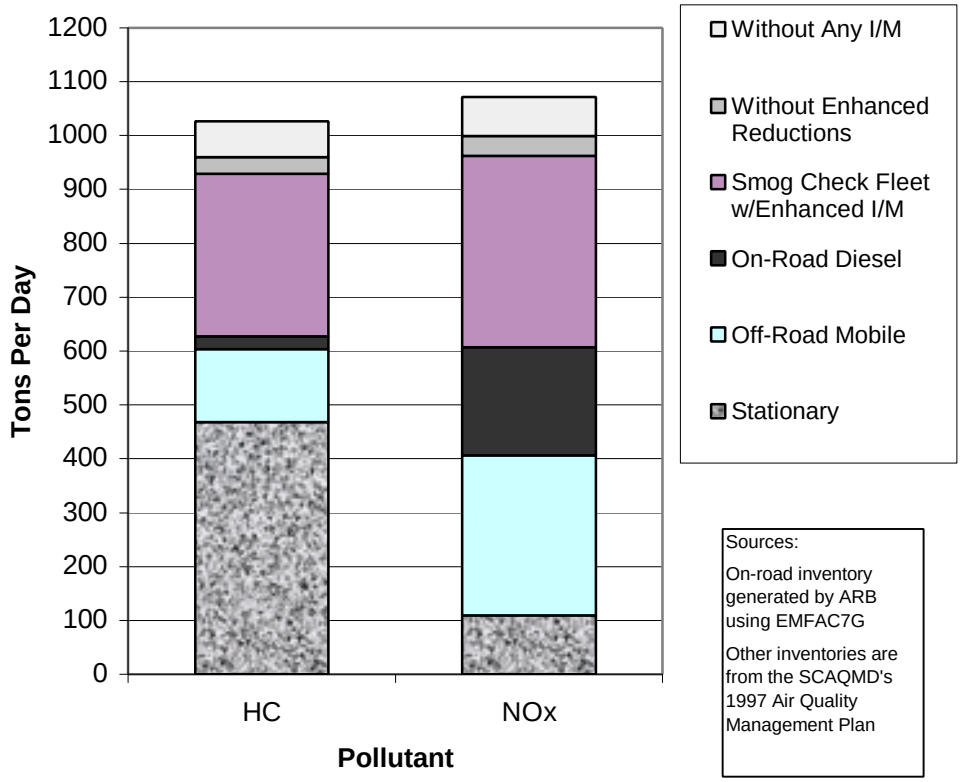
[32] On-road mobile source inventory figures are from ARB model runs of EMFAC7G dated June 8, 1998, available on the ARB web site at http://www.arb.ca.gov/msei/pubs/sw_scab.pdf. All other inventory figures are from SCAQMD (1996) "1997 Air Quality Management Plan", South Coast Air Quality Management District, Diamond Bar, California. November.

[33] Stationary sources of pollution include *point sources* such as oil refineries and power plants, as well as *area sources* such as paints and coatings and solvents used in consumer products.

about one-third of HC and NOx and about two-thirds of CO in the official SCAB emissions inventory.[34]

Figure 5 graphically displays the data in Table 8 for HC and NOx. The top two sections of each bar show the effect on the EMFAC7G inventory of not implementing Enhanced I/M and of having no I/M at all. Note that according to the EMFAC7G prediction, Enhanced Smog Check should reduce the overall inventory by about 10 percent and the Smog Check Fleet inventory by about 25 percent for both HC and NOx in the year 2000, when compared with Basic I/M.[35]

Figure 5. EMFAC7G Year 2000 SCAB Emissions Inventory Showing Effect of Basic and Enhanced Smog Check



[34] The official emissions inventory underestimates actual HC and CO emissions from the Smog Check fleet by a substantial margin (see below for more on this issue). Although there is significant uncertainty in the actual emissions inventory, the Smog Check fleet likely accounts for closer to half of total HC emissions and three-quarters of CO (assuming the other parts of the inventory are accurate).

[35] This analysis assumed a 1996 implementation of the Enhanced Program.

6.8. Federal I/M Evaluation Requirements

USEPA regulations are somewhat vague regarding what constitutes an acceptable I/M evaluation. USEPA published amendments to its I/M rule in 1998 that require states to "use a sound evaluation methodology capable of providing accurate information about I/M effectivness." Current USEPA I/M evaluation requirements include the following:[36]

- Test data obtained from a representative, random sample consisting of a minimum of 0.1 percent of the vehicles subject to inspection in a given year. The test data must be obtained prior to performance of I/M-triggered repairs. USEPA has interpreted this requirement to allow on-road pullover testing as well.
- Surveys that assess the effectiveness of repairs performed on failing vehicles.
- Measurement of actual tampering rates and their change over time.
- Results of undercover surveys of inspector effectiveness.

These items constitute data collection requirements, not an evaluation methodology. USEPA has not yet provided *formal* guidance on what methodologies it would find acceptable for measuring actual emissions reductions achieved. However, in October 1998, USEPA issued an *informal* guidance document summarizing its then current thinking on I/M evaluation.[37] In this document, USEPA considered two methods of I/M evaluation.

The first method, known as the Sierra Research Method (after the California consulting firm that designed the method under a USEPA contract), would compare fleet-average emissions of vehicles in Phoenix, Arizona with fleet average emissions of vehicles in another I/M area that is to be evaluated, in this case, California. ASM test data from California would be converted to IM240 equivalents for this purpose. Average emissions relative to Phoenix, Arizona would determine whether California is meeting USEPA's performance standard.[38] USEPA has informally approved of states using this method to evaluate their I/M programs.

The second method would use remote sensing data to measure I/M emission reductions. USEPA has not yet approved this evaluation method. However, USEPA has convened a working group of scientists and engineers to develop guidance on conducting

---

[36] See *Federal Register*, November 5, 1992, Page 52950, and *Federal Register*, January 9, 1998, page 1362.

[37] The distinction between *formal* and *informal* guidance is that the former has the force of law, while the latter does not.

[38] The Sierra Research Method suffers from serious problems that make it unsuitable for measuring I/M effectiveness. For example, the method assumes that all differences in average emissions between two areas are due solely to the effect of the I/M program. But many factors could cause differences in emissions besides I/M, including types of cars in the fleet (more expensive cars have lower emissions and stay cleaner longer), average miles driven per year (higher mileage cars have higher emissions, on average), and socioeconomic factors such as wealth (studies have shown that even when comparing cars of the same model year, cars of wealthier people have lower emissions than cars of poorer people). The Sierra Method accounts for none of these factors. Most importantly, the method never actually measures emissions reductions achieved by an I/M program, but merely compares post-I/M emissions in two different regions. USEPA commissioned two peer reviews of the method. Although both peer reviews were critical of the method, USEPA chose to ignore its peer reviewers and recommend the Sierra Research Method anyway.

remote-sensing based I/M evaluations. It is likely that USEPA will initiate formal changes to its evaluation policy sometime this year based on its continuing consideration of the Sierra Research Method, remote sensing and other potential means of evaluating I/M effectiveness.

6.9. EMFAC2000 Makes Major Changes in the Official On-Road Emissions Inventory and Modeled Smog Check Effectiveness

As already noted, the regulatory process is closely tied to the output of the EMFAC emissions model. ARB recently released a new version of the EMFAC model in draft form. EMFAC2000, as this latest update is called, will generate the new official on-road mobile source emissions inventory and the amount of emissions reduction credit attributed to the Smog Check Program. EMFAC2000 makes major changes to the official emissions inventory when compared with EMFAC7G. These changes include the following:[39]

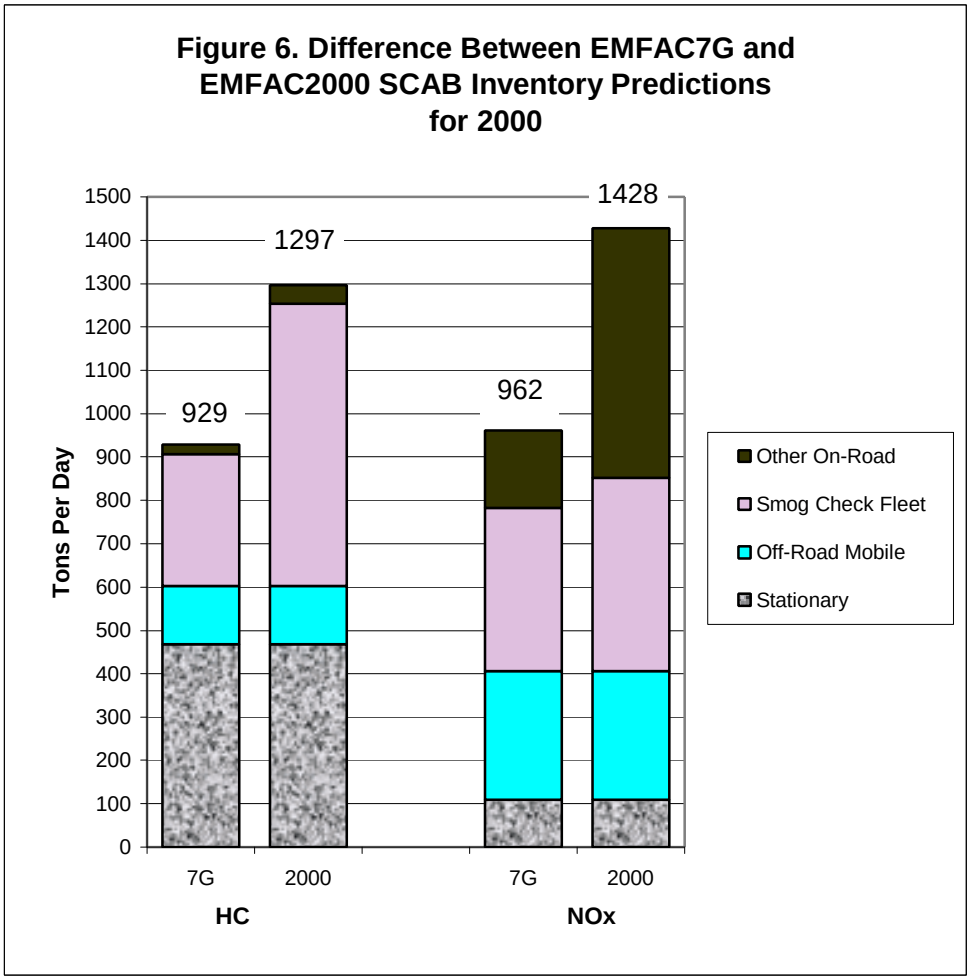
- Increase the official on-road HC inventory by 113 percent in 2000. The increase is due to significant increases in the assumed levels of both exhaust emissions and "hot soak" and "running loss" non-tailpipe emissions.[40]
- Increase the official on-road NOx inventory by 84 percent in 2000. The main source of this increase is a 240 percent increase in the assumed level of NOx from heavy-duty diesel trucks. Figure 6 compares the EMFAC7G and EMFAC2000 inventory predictions. Note that the official inventories for stationary and off-road mobile sources do not change because neither of these is affected by the output of EMFAC.
- Decrease the presumed HC benefits of the BAR90 Smog Check Program by about 50 percent.
- Decrease the presumed NOx benefits of the BAR90 program by more than 100 percent. That is, the BAR90 program is now presumed to have *increased* NOx emissions by 2 percent.
- Increase the presumed marginal benefits of the enhanced Smog Check Program (that is, the benefits over and above those already achieved by the Basic Program) in 2010 from 58 to 110 tons per day (HC + NOx).

The estimated Smog Check benefits changed in EMFAC2000 for two major reasons. First, ARB concluded that the BAR90 Smog Check Program did not achieve the emissions benefits that ARB originally attributed to it. This is why ARB reduced the emissions reduction credit for the BAR90 program. Second, ARB significantly increased the predicted HC inventory. Both of these changes created a larger pool of potential emissions reductions for the Enhanced Program to achieve.

---

[39] Note that these are changes to the model output only. The amount of pollution actually going into the air and the real-world effectiveness of Smog Check are unaffected by the output of the model.

[40] Running loss emissions are non-tailpipe (sometimes also called "evaporative") HC emissions that occur while a car is being driven. Hot soak emissions occur right after a car is turned off as the engine cools.



Sources: California Air Resources Board and South Coast Air Quality Management District

Ideally, one would like to make a direct quantitative comparison between the I/M predictions of EMFAC2000 and EMFAC7G to see if they have changed when compared under the same conditions. This is not yet possible because ARB assumed in EMFAC2000 that the Enhanced Program would not be fully implemented until sometime in 2000. To compare with EMFAC7G on an equal footing, one would need to assume that the Enhanced Program is implemented in 1996 (which is the assumption that was used to determine the SIP reduction targets). It will be possible to gain a better understanding of these issues once ARB distributes documentation detailing all of the specific assumptions that go into EMFAC2000's inventory and I/M predictions.

EMFAC2000 will likely become the new official state standard for emissions inventory and I/M modeling. However, before this can happen, the model must be approved by the governing board of ARB as well as by USEPA. Once these occur, both the tonnage reduction requirements and the I/M performance standard for Smog Check could be changed through a SIP revision using the new model results.

6.10. The Limitations of Vehicle Emissions Models

Vehicle emissions models are central to the regulatory process. The EMFAC model (and in the case of other states, USEPA's MOBILE model) is used to (1) determine the official mobile source emissions inventory in current and future years, (2) determine the regulatory targets that Smog Check must meet, and (3) determine the emissions budget for conformity analyses for transportation planning. Emissions models are sometimes also used by state and federal agencies to "evaluate" the effectiveness of I/M programs such as Smog Check. The output of the emissions models is thus the arbiter of high-stakes regulatory requirements.

While vehicle emissions models carry great weight in legal matters, it is important to recognize that the output of these models is well understood to be very approximate and uncertain. A series of studies over the last 13 years has shown that the vehicle emissions models used by regulatory agencies do not accurately predict actual vehicle emissions or the real-world effect of emissions reduction measures. For example:

- The 1987 Southern California Air Quality Study (SCAQS) included direct measurements of vehicle emissions in the Van Nuys tunnel in the San Fernando Valley. Measured CO and HC emissions were, respectively, almost 3 and 4 times higher than predicted by EMFAC.[41] SCAQS also included measurements of the ratios of CO to NOx and HC to NOx in ambient air near roadways.[42] These ratios were, respectively, 2.5 and 1.5 times higher than the corresponding ratios predicted by the EMFAC model.
- Subsequent tunnel studies during the 1990s in urban tunnels in California and elsewhere have also found that both EMFAC and MOBILE continue to underestimate CO and HC emissions by wide margins.[43, 44] Table 9 shows the percentage by which actual emissions differ from EMFAC predictions. Positive percentages indicate that actual emissions are higher than the model prediction.

[41] Ingalls, M. N. (1989) "On-Road Vehicle Emission Factors From Measurements in a Los Angeles Area Tunnel," 82nd Annual Meeting & Exhibition, Anaheim, California, Air & Waste Management Association; Pierson, W. R., A. W. Gertler, et al. (1990) "Comparison of the SCAQS Tunnel Study with Other On-Road Vehicle Emission Data," *J. Air & Waste Management Association*, vol. 40 no. 11, pp. 1495-1504.

[42] Fujita, E. M., B. E. Croes, et al. (1992) "Comparison of Emission Inventory and Ambient Concentration Ratios of CO, NMOG, and NOx in California's South Coast Air Basin." *J. Air Waste Management Association*, vol. 42 no. 3, pp. 264-276.

[43] The models tend to do a better job in predicting emissions outside of urban areas. For example, the models do a reasonably good job of predicting emissions in tunnels on interstate highways. The lower emissions in these tunnels may be due to three factors. First, cars driving on interstates are younger on average than in urban areas. Second, driving in interstate tunnels is more likely to be a relatively constant-speed cruise, which likely results in lower emissions than stop-and-go driving. Third, motorists may be more likely to drive their most reliable and best-maintained cars on longer trips.

[44] Gertler, A. W., et al. (1998) "Assessing Real-World Vehicle Emissions Using Roadway Tunnels," Paper presented at the 11th World Clean Air and Environmental Congress, Durban, SA, Sept. 13-18, 1998.

- Researchers have estimated total HC and CO emissions from vehicles in southern California using on-road remote sensing data collected by ARB in 1997.[45] Actual emissions exceeded EMFAC's prediction by a factor of 2.4 for CO and 3.5 for HC.

Table 9. Percentage by which Actual Emissions Differ from EMFAC Model Predictions in California Tunnel Studies

(positive percentages indicate actual emissions higher than model prediction)

Tunnel	Year	CO	HC	NOx
Van Nuys	1987	180%	288%	7%
Van Nuys	1995	68%	3%	-9%
Sepulveda	1995	86%	82%	-7%
Sepulveda	1996	73%	93%	-13%

Source: Gertler (1998) (see footnote #45)

EMFAC and MOBILE do not accurately predict actual emissions or the effect of I/M programs for two major reasons. First, the input data used to develop the models do not adequately represent the real fleet of on-road vehicles. These models include dozens of input parameters to represent vehicle emissions. For EMFAC, Pollack, et al. (1999) estimated the uncertainties in these input factors at anywhere from 20 percent to up to 300 percent, depending on the particular parameter in question.[46]

USEPA and other agencies have typically predicted emissions reductions on the order of 10 percent to 30 percent from I/M programs. Because the uncertainties in the models' output are larger than this, the models are essentially incapable of accurately predicting the effect of I/M programs. For example, looking again at Table 8, the model misses actual NOx emissions by only about plus or minus 10 percent. But the model prediction for the NOx emissions reductions from Smog Check is of roughly the same magnitude. Thus, the size of the error in the model result is comparable to the size of the Smog Check effect that it is used to predict.

Second, both EMFAC and MOBILE have a static structure that cannot account for the dynamic behavior of both vehicles and people. Both EMFAC and MOBILE use input assumptions, such as a repair-effectiveness factor, a high-emitter identification rate, and a motorist compliance rate to predict the effectiveness of I/M programs. Pollack, et al. (1999) note that "the I/M emission model is based largely on assumptions. No data which actually assess emissions reductions from the current I/M program are used." The models are only as good as the hard-wired assumptions put into the models by the modelers. But

[45] Singer, B.C. and R.A. Harley (2000) "A fuel-based inventory of motor vehicle exhaust emissions in the Los Angeles area during summer 1997," *Atmospheric Environment*, vol. 34, no. 11, pp. 1783-1795.

[46] Pollack, A. K., et al. (1999) "Investigation of Emission Factors In the California EMFAC7G Model - Final Report," prepared for the Coordinating Research Council, Atlanta, Georgia.

the real world is dynamic and complex, making it difficult to capture the results of actual behavior in a real program through a limited set of fairly static assumptions.

EMFAC2000 makes major increases in EMFAC's prediction for both the HC and NOx inventories. This will likely bring the official HC inventory closer into line with the real amount of HC pollution going into the air (but it may overestimate NOx because overall NOx levels are more accurately predicted by the previous model). However, the model still includes large uncertainties in its basic input values and structural flaws in the way the model generates outputs from the inputs.[47] This suggests that even a more accurate prediction for the overall emissions inventory will likely result for the wrong underlying reasons.

Although vehicle emissions models will continue to be used for regulatory purposes for the foreseeable future, policymakers should be aware that these models do not generate a fully accurate representation of actual emissions, or of the actual effect of I/M programs.

[47] Ibid.

Appendix I

Statutes Governing the

Inspection and Maintenance Review Committee

Section 44021 of the California Health and Safety Code

(a) (1) The **Inspection and Maintenance Review Committee** is hereby created to analyze the effect of the improved inspection and maintenance program established by this chapter on motor vehicle emissions and air quality. The functions of the **review committee** shall be advisory in nature and primarily pertain to the gathering, analysis, and evaluation of information.

(2) The members of the **review committee** shall receive no compensation, but shall be reimbursed by the department for their reasonable expenses in performing committee duties. The state board and the department shall provide the **review committee** with any necessary technical and clerical support in its evaluation and study.

(3) (A) The **review committee** shall consist of 13 members, nine to be appointed by the Governor, two by the Senate Committee on Rules, and two by the Speaker of the Assembly. All members shall be appointed to four-year terms, and the Governor shall appoint from among his or her appointees the chairperson of the **review committee**.

(B) The appointees of the Governor shall include an air pollution control officer from an Enhanced Program nonattainment area, three public members, an expert in air quality, an economist, a social scientist, a representative of the inspection and maintenance industry, and a representative of stationary source emissions organizations.

(C) The appointees of the Senate Committee on Rules shall include an environmental member with expertise in air quality, and a representative from the inspection and maintenance industry.

(D) The appointees of the Speaker of the Assembly shall include an environmental member with expertise in air quality, and a representative of a local law enforcement agency charged with prosecuting violations of this chapter in an Enhanced Program nonattainment area.

(4) In preparing its evaluations of program effectiveness as provided in paragraph (1), the **review committee** shall consult with the Department of the California Highway Patrol, the Department of Motor Vehicles, and any other appropriate agencies, as well as the department and the state board, shall schedule and conduct periodic meetings in the performance of its duties, and shall meet and consult with local, state, and federal officials involved in the evaluation of motor vehicle inspection and maintenance programs. At the request of the committee, the department or the state board may, on behalf of the committee, contract with independent entities to assist in the committee's evaluations.

(b) The **review committee** shall submit periodic written reports to the Legislature and the Governor on the performance of the program and make recommendations on program improvements at least every 12 months. The **review committee**'s reports shall quantify the reduction in emissions and improvement in air quality attributed to the program. Any reports, other than those required by this section, that the **review committee** is required to provide pursuant to this chapter shall also be transmitted to the Secretary for Environmental Protection and the Secretary for State and Consumer Services.

(c) The **review committee** shall work closely with all interested parties in preparing the information required by subdivisions (a) and (b) and shall consider the reports provided pursuant to subdivision (e). The **review committee** shall hold at least one public hearing on its findings and recommendations prior to submitting its reports. The reports shall include statutory language to implement its recommendations, and shall recommend the timeframe for making any changes to the program. The **review committee** shall seek comments from the department, the Department of Motor Vehicles, the Department of the California Highway Patrol, and the state board prior to submitting its reports, and those comments shall be published as an appendix to the report.

(d) The **review committee** shall participate in the demonstration program authorized by Section 44081.6, as provided by that section.

(e) The state board, in cooperation with the department, shall periodically submit reports to the **review committee**. The reports shall include an assessment of the impact on emissions of continuing the exemption from inspection of motor vehicles newer than five years old; a comparison of the actual mass emission reductions being achieved by the Enhanced Program to those required by the State Implementation Plan; and recommendations to improve the effectiveness and cost-effectiveness of the program, including specific recommendations addressing any discrepancy between emissions achieved and those in the State Implementation Plan. The first report shall be submitted not later than January 1, 2000, and reports shall be submitted triennially thereafter. In preparing the reports, the state board shall use data collected during inspections and repair, and data collected using roadside measurements, and may conduct additional testing, as determined to be necessary, to accurately quantify the mass emissions reduced.

Appendix II

Members of the Inspection and Maintenance Review Committee

Member	Affiliation	Statutory Slot	Appointing Authority
Lynn Scarlett, Chair	Director, Reason Public Policy Institute	Social Scientist	Governor
Donald Bea	Senior Staff Planner (Retired), Chevron	Stationary Source Representative	Governor
Norm Covell	Air Pollution Control Officer, Sacramento Metropolitan Air Quality Management District	Air Pollution Control Officer	Governor
Elizabeth Deakin	Professor of City and Regional Planning, UC Berkeley	Environmental Member with Expertise in Air Quality	Senate Rules Committee
Dennis DeCota	Executive Director, California Service Station and Automotive Repair Association	Representative of the Inspection and Maintenance Industry	Governor
Robert Gannon	Supervising Deputy District Attorney, Orange County	Representative of Local Law Enforcement	Speaker of the Assembly
Richard Kesterke	Manager, Automotive Technical Services (Retired), California State Automobile Association	Public Member	Governor
Steven Moss	Partner, M.Cubed, Consultants in Resource Economics and Public Policy Analysis	Economist	Governor
Joseph Norbeck	Professor of Environmental Engineering, UC Riverside	Expert in Air Quality	Governor
Jonathan Sanchez	Chief of Operations, Eastern Group Publications, Inc.	Public Member	Governor
Richard Skaggs	President, Omstar Environmental Products and CalTest Instrument, Inc.	Environmental Member with Expertise in Air Quality	Speaker of the Assembly
(Vacant)		Public Member	Governor
(Vacant)		Representative of the Inspection and Maintenance Industry	Senate Rules Committee

Appendix III

Air Quality in California

ARB has divided California into regions known as "air basins" based on meteorology and geography. Figure III-1 is a map showing the boundaries of each air basin.[48] Each air basin has a number of pollution monitoring stations spread throughout the region. These monitoring stations measure pollution levels at their locations. Data from these sites is used to determine whether an area exceeds federal and state air pollution health standards.

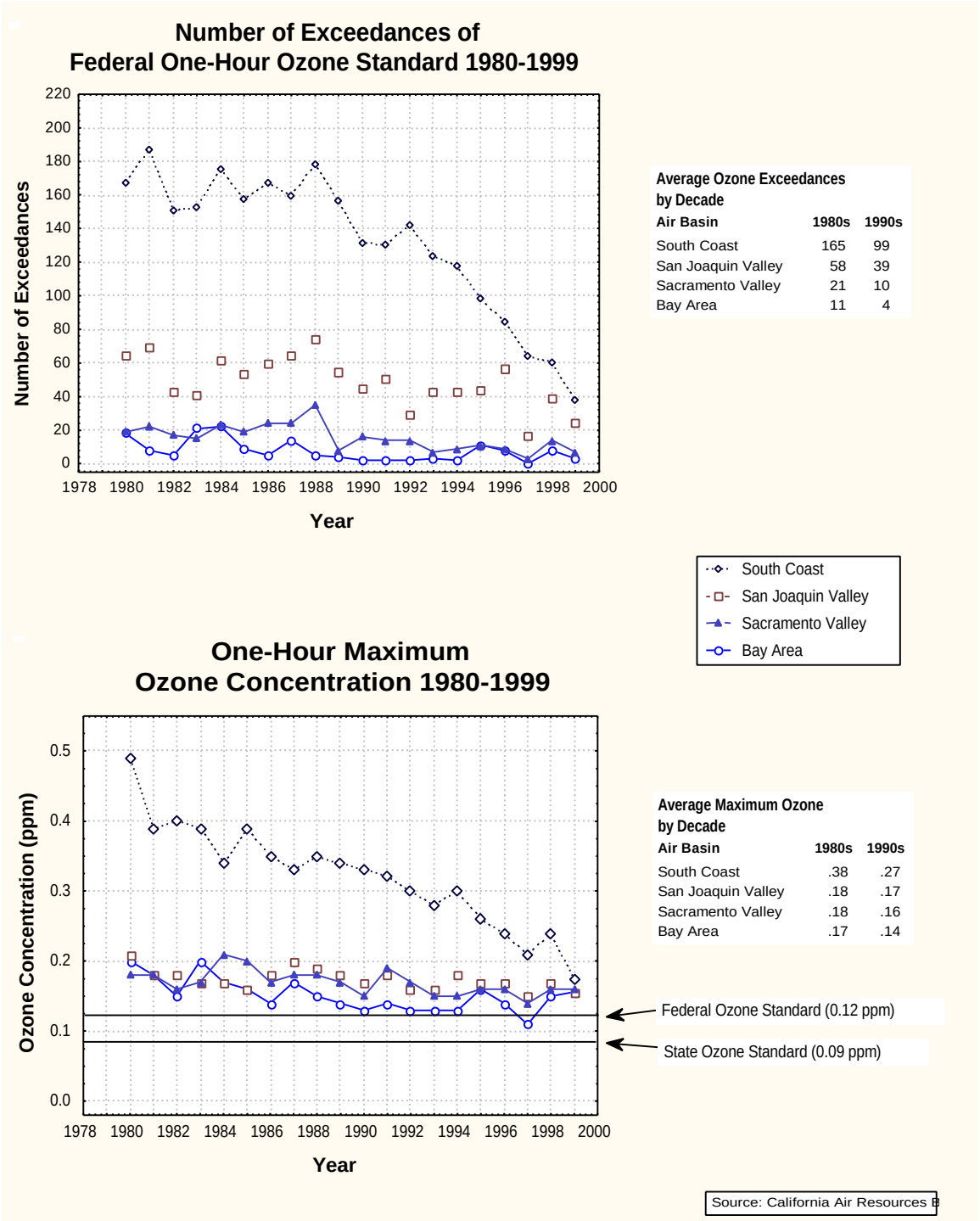
Figure III-2 displays ozone air quality from 1980 to 1999 in four of California's most populous air basins – the South Coast, San Joaquin Valley, Sacramento Valley and Bay Area. The upper chart shows the number of days in which ozone levels exceeded the federal standard at at least one of the air basin's pollution monitoring sites. The lower chart shows the peak ozone level measured in each air basin. As the charts show, air quality has improved a great deal in the South Coast Air Basin and by smaller degrees in the other three air basins during the last 20 years.

Figure III-1. Map of California Air Basins

Source: California Air Resources Board

[48] Some air basins contain more than one air pollution control district.

Figure III-2. Ozone Air Quality in California, 1980-1999



Average Ozone Exceedances by Decade

Air Basin	1980s	1990s
South Coast	165	99
San Joaquin Valley	58	39
Sacramento Valley	21	10
Bay Area	11	4

Average Maximum Ozone by Decade

Air Basin	1980s	1990s
South Coast	.38	.27
San Joaquin Valley	.18	.17
Sacramento Valley	.18	.16
Bay Area	.17	.14