

V. SIP ANALYSIS

A. SIP Commitment: Emission Reductions Claimed

As described in Chapter I, California's SIP relies on emission reductions attributed to the Enhanced I/M program to demonstrate attainment in six nonattainment areas. The emission reductions associated with the Enhanced Smog Check program in the SIP are shown in Table V-1. The reader should note that in this report, we use HC and reactive organic gases (ROG) interchangeably. The emission reductions shown represent the additional benefit attributed to the Enhanced I/M program, beyond those benefits already claimed for the Basic I/M program. As Table V-1 shows, the emission benefits attributed to Enhanced I/M in the SIP are highest in 1999. Emission benefits attributed to Enhanced I/M are lower but still sizeable in subsequent years. Because the Enhanced I/M commitment is largest in 1999, some of the tables in this chapter provide data for 1999 rather than for all years.

In 1999, the South Coast Air Quality Management District prepared a revised 1999 SIP for the federal ozone standard based on the EMFAC7G vehicle emissions model. On April 10, U.S. EPA published approval of the revised 1999 SIP. The emission reductions claimed for the South Coast in the 1999 SIP are shown in Table V-1.

B. SIP Commitment: Emission Reductions Achieved

We used roadside data and our current understanding of the emission impacts of the Enhanced I/M program to determine what portion of the reductions claimed in the SIP have been and will be achieved. As mentioned in Chapter I, it is necessary to determine SIP credit in terms of "SIP currency." Since preparation of the SIP, we have learned that the EMFAC models that underlie the SIP underestimate motor vehicle emissions. Thus, to reduce motor vehicle emissions by 1 ton per day in SIP currency, it is necessary to reduce motor vehicle emissions by more than 1 real-world ton per day.

Therefore, the actual tons of pollution reduced calculated from the roadside test results cannot be compared to the tons of emission reductions cited in the SIP.

1. *Effectiveness in Reducing Emissions*

We had two main sources of information available to evaluate the effectiveness of the Enhanced I/M program in reducing exhaust and evaporative emissions: (1) the results of roadside testing conducted in late 1998 and 1999 (which are described in Chapter III), and (2) ARB's EMFAC2000 model (which is described in Chapter IV). Because roadside data is valid only for the years in which it was gathered, we used the draft EMFAC2000 model to estimate the effectiveness of the Enhanced I/M program in reducing both evaporative and exhaust emissions in future years.

**Table V-1
Emission Reductions (tons per day) from Enhanced I/M in the Approved Ozone SIP
by Nonattainment Area for Each Milestone Year¹
(EMFAC7F for all areas except South Coast; EMFAC7G for South Coast)**

| Nonattainment Area | 1999 | | | 2002 | | | 2005 | | | 2008 | | | 2010 | | |
|---------------------------------|-----------|-----------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|
| | HC | NOx | HC+NOx | HC | NOx | HC+NOx | HC | NOx | HC+NOx | HC | NOx | HC+NOx | HC | NOx | HC+NOx |
| San Diego ² | 9.3 | 7.3 | 16.6 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| San Joaquin Valley ³ | 4.3 | 5.0 | 9.3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Sacramento Region | 5.4 | 5.7 | 11.1 | 6.3 | 6.5 | 12.9 | 5.2 | 6.4 | 11.5 | -- | -- | -- | -- | -- | -- |
| Ventura | 1.6 | 1.9 | 3.5 | 1.8 | 2.0 | 3.9 | 1.4 | 1.9 | 3.3 | -- | -- | -- | -- | -- | -- |
| Antelope | 0.5 | 0.4 | 0.9 | 0.6 | 0.5 | 1.1 | 0.5 | 0.4 | 0.9 | -- | -- | -- | -- | -- | -- |
| Coachella | 1.9 | 1.9 | 3.8 | 2.4 | 2.1 | 4.5 | 2.1 | 2.4 | 4.4 | -- | -- | -- | -- | -- | -- |
| South Coast | 32.5 | 32.4 | 64.9 | 33.3 | 25.8 | 59.1 | 32.8 | 18.0 | 50.8 | 32.0 | 11.7 | 43.7 | 31.6 | 8.7 | 40.3 |
| TOTAL | 55 | 55 | 110 | 44 | 37 | 81 | 42 | 29 | 71 | 32 | 12 | 44 | 32 | 9 | 40 |

¹ Numbers may not add due to rounding.

² Enhanced I/M was not needed to demonstrate attainment in San Diego in the 1994 Ozone SIP, but was identified as a contingency measure.

³ The commitments shown for the San Joaquin Valley are based on the 1994 SIP. The Valley must prepare a new SIP showing attainment by 2005.

a. Roadside Testing

We used the roadside test results to determine the effectiveness of Enhanced I/M in 1999 for comparison to our SIP commitments. We interpreted the roadside before/after test results as follows:

- “Before” represents the fleet that had been tested only under the 1990 Basic I/M program; and
- “After” represents the fleet that had been tested under Enhanced I/M in 1998-1999, i.e., the fleet after Enhanced I/M implemented.

We interpreted the percent reduction in emissions from “Before” to “After” as the percent reduction in emissions due to the implementation of Enhanced I/M. Roadside testing included gasoline-powered light-duty passenger cars, light-duty trucks, and medium-duty vehicles. It did not include heavy-duty gasoline-powered trucks (i.e., trucks greater than 8,500 pounds gross vehicle weight) or any diesel-powered vehicles.

The overall percent reduction in fleet average emission rates in gram per mile (g/mi) results from many factors such as fail rate, fraud, repair effectiveness, etc. The emission rates for model years exempted from biennial I/M (i.e., pre-1974 and newest four model years) are the same in the “After” fleet as in the “Before” fleet. Because it compares the entire “Before” fleet to the entire “After” fleet, the roadside data takes into account the effect of model-year exemptions, as well as fraud and repair effectiveness.

Roadside testing was conducted in late 1998 and 1999, when NOx cut points were set higher than their current levels. However, at the tail end of the 1998-1999 roadside testing, BAR lowered NOx cut points to more stringent levels in October 1999. Therefore, the roadside test results represent the effectiveness of the program in 1998 and 1999, but are *not* representative of the effectiveness of the program in reducing NOx after the tightening of the cut points in October 1999. The draft EMFAC2000 model shows that tightening the cut points in October 1999 nearly tripled the NOx emission reductions achieved.

b. EMFAC2000

As discussed in Chapter IV, we used draft EMFAC2000 runs to model the effectiveness of Enhanced I/M in the future years (through 2010). In the draft EMFAC2000 runs for future years, we assumed the current Enhanced I/M program would continue to be implemented in future years. We did not assume any improvements to the design of the Smog Check program in future years or changes to the latest cut points, which were implemented in October 1999. The draft EMFAC2000 model run output used was presented in Chapter IV in Figures IV-1 to IV-9.

c. Evaporative Controls

At the time the 1994 pilot program was conducted, California was considering implementing a combined helium test and gas cap check to test the effectiveness of vehicles' evaporative emission control systems.¹ In the helium test, helium is injected into the fuel tank to confirm that the evaporative system is collecting vapors and routing them to the engine. California envisioned using the helium/gas cap check in lieu of the more intrusive evaporative test procedure which U.S. EPA suggested, i.e., pressure test of the fuel tank and measurement of purge flow from the carbon canister to the engine (pressure-purge test). The 1994 pilot program evaluated the potential effectiveness of the helium/gas cap check versus the potential effectiveness of U.S. EPA's pressure-purge test. To demonstrate that California's proposed Enhanced I/M program would meet the U.S. EPA Performance Standard, ARB relied on the evaporative emission fleet average rates modeled for the helium/gas cap check in its June 1995 and January 1996 submittals to U.S. EPA.

California has implemented a gas cap check as part of the Enhanced I/M program. Because the gas cap test alone is less effective than the helium/gas cap test, fewer reductions in evaporative hydrocarbon emissions were accomplished than assumed in the SIP. As described in Chapter IV, in later years I/M achieves greater evaporative HC emission reductions due to OBD II working in concert with I/M. In the April 2000 draft report we assumed a constant twelve percent reduction due to the gas cap test. Since the draft report was issued, the California Bureau of Automotive Repair concluded an analysis of roadside gas cap testing effectiveness, which agrees closely with recent improvements made to the adopted EMFAC2000 model. The roadside test is now being used to estimate the benefits of gas cap testing in 1999. Overall, the roadside test shows that in 1999 evaporative emission inspections were only about 55 percent as effective as the SIP assumed they would be.

d. Heavy-Duty Gasoline Vehicles

The 1994 SIP assumed that all gasoline-powered heavy-duty trucks with a gross vehicle weight between 8,500 to 14,000 pounds would be tested under loaded-mode conditions on dynamometers. BAR has legal authority to test heavy-duty gas trucks on dynamometers, but currently performs only two-speed idle testing because inspection standards for heavy-duty trucks have not yet been developed. Therefore, Enhanced I/M has no additional benefit for exhaust emissions from heavy-duty gasoline vehicles beyond the emission reductions achieved by 1990 Basic I/M. Heavy-duty gas vehicles are subject to gas cap testing and thus receive the same evaporative emission benefits as light- and medium-duty vehicles.

¹ Reference: Evaluation of the California Pilot Inspection/Maintenance (I/M) Program, Prepared for BAR, by Klausmeier Consulting and Radian Corporation, March 31, 1995.

e. Success in Reaching Effectiveness Specified in the SIP

We used the following method to estimate the success of the current Enhanced I/M program in reaching the effectiveness specified in the SIP:

- Use draft EMFAC2000 to model the percent reduction in emission rates that would be achieved from the Enhanced I/M program specified in the SIP. Calculate the percent reduction below the gram per mile emission rates for 1990 Basic I/M program for the years 1999 through 2010.
- For 1999, use roadside data to determine the percent reduction in exhaust emission rate due to the current Enhanced I/M program (see Table IV-2). For SIP currency purposes, the roadside test data for each model-year was applied to either the EMFAC7F or 7G travel fractions, rather than the EMFAC2000 travel fractions.
- For subsequent years, use draft EMFAC2000 to model the percent reduction in emission rate due to the current Enhanced I/M program.
- Compare the percent reduction in gram per mile emission rate from the current Enhanced program to the percent reduction in gram per mile emission rate that would be achieved from the program specified in the SIP.

We used draft EMFAC2000 emission rates for each vehicle type, i.e., light-duty gasoline passenger cars, light-duty gasoline trucks, medium-duty gasoline trucks, and heavy-duty gasoline trucks. Using this method, a program that achieved the same reduction in emission rate as the program in the SIP submittals would be 100 percent effective, whereas a program that achieved only half the anticipated reduction in gram per mile emission rate would be only 50 percent effective.

Figure V-1 illustrates the method used to determine the success of the current Enhanced I/M program in reaching the effectiveness specified in the SIP. The arrows drawn on Figure V-1 compare the drop in gram per mile emission rate from 1990 Basic I/M to current Enhanced I/M to the drop from 1990 Basic I/M to the SIP Enhanced I/M.

Figure V-1
Passenger Car Exhaust Hydrocarbon Emission Rates:
Current Enhanced vs. SIP Enhanced, Draft EMFAC2000

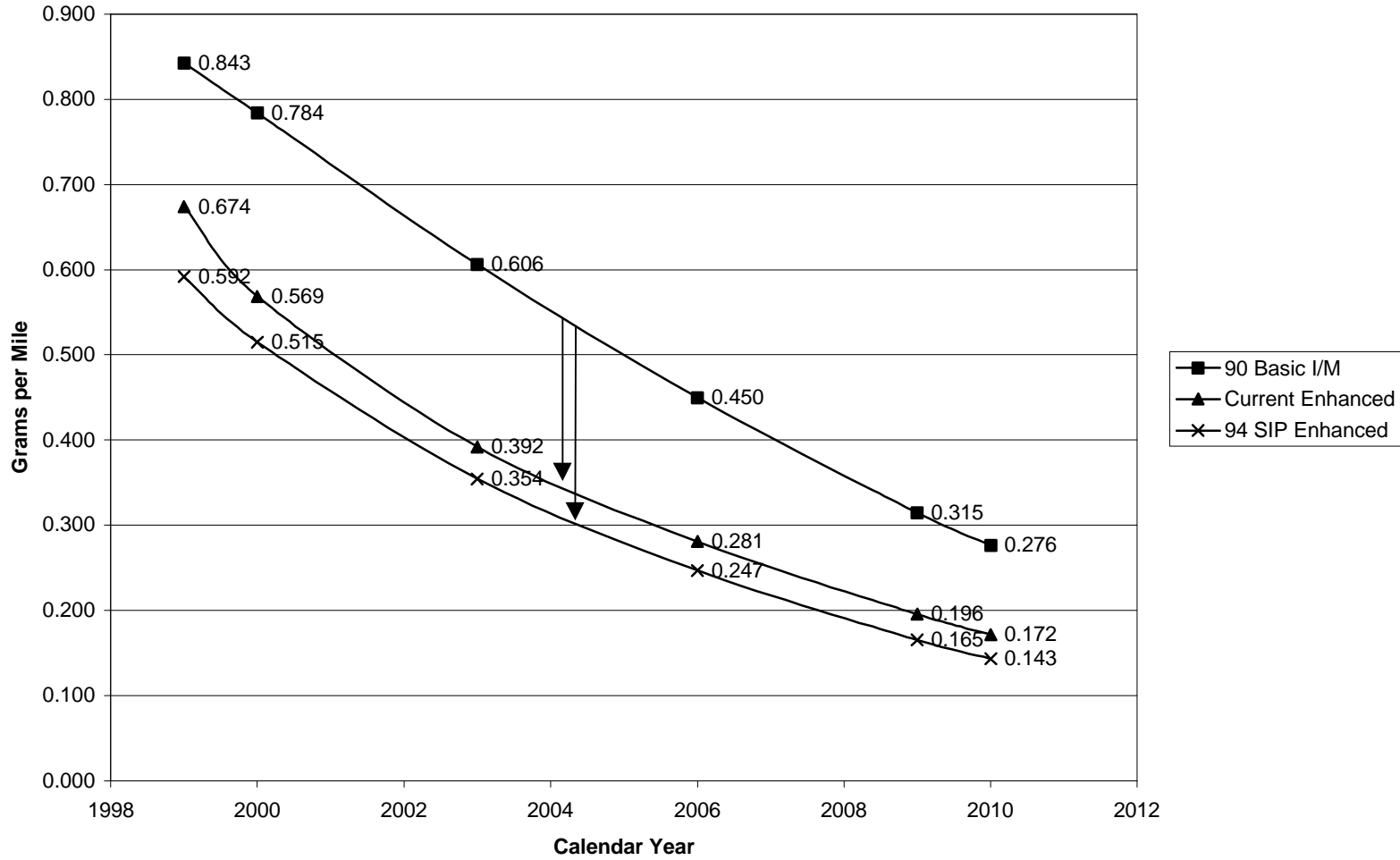


Table V-2 shows how well the Enhanced I/M program fared in 1999 in reaching the effectiveness specified in the SIP for passenger cars. The values in Table V-2 are based on roadside data. Effectiveness of the Enhanced I/M program in 1999 ranges from 24 percent for NOx to 55 percent for evaporative HC. The NOx effectiveness of the Enhanced program has improved significantly since the NOx cut points were lowered in late 1999.

Table V-2
Effectiveness of Enhanced I/M Compared to Program Envisioned in SIP¹
(1999)

| HC_{exhaust} | HC_{evaporative} | NOx |
|-----------------------------|---------------------------------|------------|
| 42% | 55% | 24% |

¹Only includes program effectiveness for passenger cars. The percentages in this table do not represent the overall percentage of the SIP commitment achieved because they do not include the impact of incorrect SIP assumptions (i.e., assuming that more communities participate in Enhanced I/M program).

2. Portion of Fleet Subject to Enhanced I/M

Areas of California that do not attain the federal ozone standard are generally subject to either Basic or Enhanced I/M. Most urbanized areas with population greater than 50,000 that are within nonattainment areas included in the SIP are subject to Enhanced I/M. On the other hand, less densely populated portions of nonattainment areas are subject only to Basic I/M. Basic I/M, which does not utilize loaded-mode testing or Test-Only stations, results in fewer emission reductions than Enhanced I/M.

The 1994 SIP submittal contained assumptions about which type of Smog Check program each area of the State has. The 1994 SIP submittal was prepared before the implementation of Enhanced I/M program. For most nonattainment areas, the 1994 SIP assumed that a greater percentage of vehicles would be subject to Enhanced I/M than actually are. Table V-3 summarizes the 1994 SIP assumptions and the percent of vehicles that are actually subject to Enhanced I/M. The largest discrepancy between the SIP assumptions for Smog Check program type and reality occurred in the Sacramento nonattainment area. The SIP incorrectly assumed that all portions of the Sacramento nonattainment area would receive Enhanced I/M. Instead, currently only about 79 percent of the Sacramento nonattainment area is subject to Enhanced I/M. Because the SIP overestimated the number of vehicles that would be subject to Enhanced I/M, it also overestimated the emission reductions of the program.

**Table V-3
Percent Vehicles in Enhanced I/M
in the 1994 SIP vs. the Actual Percent
Vehicles in Enhanced I/M¹ (1999)**

| Area | 94 SIP: Percent Vehicles Assumed in Enhanced I/M | Actual Percent Vehicles in Enhanced I/M |
|-------------------------------------|---|--|
| San Diego | 100% | 97% |
| San Joaquin Valley | 71% | 69% |
| Sacramento Region | 100% | 79% |
| Ventura | 100% | 95% |
| Antelope | 100% | 100% |
| Coachella | 100% | 82% |
| South Coast | 100% | 98% |
| TOTAL FOR ALL ENHANCED AREAS | 97% | 93% |

¹Table V-3 is not meant to imply that the California Bureau of Automotive Repair did not implement Enhanced I/M in all areas required by federal regulations. Instead, the discrepancies shown are due to incorrect assumptions in the calculations underlying the SIP submittal.

To adjust for the overestimate in the number of vehicles subject to Enhanced I/M, we multiplied the emission reductions claimed for Enhanced I/M by the ratio of actual percent vehicles in Enhanced I/M to percent vehicles assumed in Enhanced I/M in the SIP. For example, in the case of Sacramento, we multiplied by an adjustment factor of 0.79 to account for the fact that only 79 percent of vehicles in the Sacramento nonattainment area are receiving Enhanced I/M.

3. *Effect of 1997 Legislative Changes on Enhanced I/M*

In 1997, the California Legislature passed legislation that exempted very old and very new vehicles from Smog Check, allowed waivers for the dirtiest vehicles, repealed annual inspections for certain vehicles, and reduced the dollar amount of the repair cost waiver. Until 2003, pre-1974 vehicles are exempted from Smog Check. In and after 2003, vehicles older than 30 years will be exempted.

The SIP did not foresee that these legislative changes would be made. For example, it assumed that all vehicles from model year 1966 and on would be included in Smog Check.

Both the roadside test data and the draft EMFAC2000 model runs that were used to evaluate the effectiveness of Enhanced I/M take into account the impact of the legislative changes on the Enhanced I/M program. For the current Enhanced program scenario, for example, the EMFAC2000 model takes into account that certain model years of vehicles are exempt from the program. In Chapter VI, we evaluate the effect of

model-year exemptions – the most significant legislative change – on the effectiveness of the Enhanced I/M program.

4. Effect of 1997 Legislative Changes on Basic I/M

The primary purpose of our evaluation was to address impacts on the Enhanced I/M program. However, in the course of our evaluation, we also learned information relevant to the effectiveness of the Basic I/M program.

We used the draft EMFAC2000 model to evaluate whether the legislative changes in 1997 caused a loss in benefits from the Basic I/M program. We considered this effect both for vehicles subject to the Basic I/M program and for the portion of Basic benefits claimed for vehicles subject to the Enhanced I/M program. We ran the draft EMFAC2000 model for the 90 Basic I/M program described in Chapter IV and for the Basic program as currently implemented (i.e., biennial testing, model-year exemptions for very new and very old vehicles, repair cost waiver at \$450, or \$250 through economic hardship extension, repair assistance and vehicle retirement programs, gross polluters eligible for repair cost waiver, electronic transmission of smog-check results, current cut points, gas cap testing for evaporative emissions, etc.). We compared the fleet average emission rates from draft EMFAC2000 for the current Basic program to those for 90 Basic I/M. For the Basic program, we found that there is no net loss in HC or NO_x emission reductions (from the 90 Basic I/M program) due to the legislative changes and, in fact, a small benefit. For hydrocarbon, the addition of gas cap testing reduces HC emissions and more than offsets the increase from vehicle exemptions. There is a small NO_x benefit from exempting old cars from two-speed idle testing because two-speed idle testing can lead to repairs that lower HC and CO, but raise NO_x emissions. We therefore concluded that we did not need to apply further adjustments to account for the effect of the legislative changes on the Basic I/M program.

C. Summary of Enhanced I/M Emission Reductions Achieved

We derived the overall SIP currency reductions achieved for each area taking into account the actual effectiveness in reducing emissions and the portion of each area's fleet subject to Enhanced I/M, as described in Section B. Table V-4 shows the SIP emission reductions claimed in each nonattainment area for Enhanced I/M for the year 1999, and the SIP currency emission reductions achieved. We estimate that overall we achieved about 40 tons per day of the 110 ton per day HC and NO_x SIP commitment, leaving about a 70 ton per day combined HC plus NO_x shortfall. As seen from the table, we achieved about 51 percent of the HC commitment and (based on the gross polluter cut points in place during most of 1999) about 22 percent of the NO_x commitment.

Table V-5 shows the SIP currency emission reductions achieved from Enhanced I/M in each nonattainment area for the milestone years 1999 through 2010.

Table V-4
Emission Reductions Achieved in SIP Currency (tons per day)
From Enhanced I/M in Each Nonattainment Area, EMFAC7F (EMFAC7G for the South Coast)¹
(1999)

| Area | SIP Commitment for 1999 | | Emission Reductions Foregone | | | | | | | | Net Reductions for 1999 | |
|---------------------------------|-------------------------|-------------|--|------------|--|------------|-------------------------------|-------------|---------------|-------------|-------------------------|-------------|
| | | | Portion of Fleet Subject to Enhanced I/M | | No Loaded-Mode Testing for Heavy-Duty Trucks | | Effectiveness of Enhanced I/M | | Net Shortfall | | | |
| | HC | NOx | HC | NOx | HC | NOx | HC | NOx | HC | NOx | HC | NOx |
| South Coast | 32.5 | 32.4 | 0.0 | 0.0 | 0.0 | 0.0 | 15.0 | 24.7 | 15.0 | 24.7 | 17.4 | 7.7 |
| Ventura | 1.6 | 1.9 | 0.0 | 0.1 | 0.0 | 0.2 | 0.8 | 1.2 | 0.8 | 1.5 | 0.7 | 0.4 |
| Sacramento Region | 5.4 | 5.7 | 0.4 | 1.0 | 0.1 | 1.0 | 2.5 | 2.8 | 3.1 | 4.8 | 2.4 | 0.9 |
| San Joaquin Valley ² | 4.3 | 5.0 | -1.2 | 0.0 | 0.1 | 1.2 | 2.9 | 2.8 | 1.8 | 4.0 | 2.5 | 0.9 |
| Antelope | 0.5 | 0.4 | 0.0 | 0.0 | 0.0 | 0.1 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 | 0.1 |
| Coachella | 1.9 | 1.9 | 0.1 | 0.3 | 0.0 | 0.4 | 1.0 | 0.9 | 1.1 | 1.6 | 0.8 | 0.3 |
| San Diego ³ | 9.3 | 7.3 | 0.1 | 0.2 | 0.1 | 0.9 | 4.9 | 4.7 | 5.1 | 5.8 | 4.2 | 1.5 |
| Total | 55.5 | 54.6 | -0.6 | 1.5 | 0.4 | 3.7 | 27.5 | 37.5 | 27.3 | 42.7 | 28.2 | 11.8 |
| Total-HC+NOx | 110 | | 1 | | 4 | | 65 | | 70 | | 40 | |

¹ This table is based on roadside test data converted to the appropriate SIP currency. It does not reflect current, more stringent NOx cut points. Numbers may not add due to rounding.

² The commitments shown for the San Joaquin Valley are based on the SIP. The emission benefit (i.e., negative emission reduction foregone) shown under "Portion of Fleet Subject to Enhanced I/M" represents the benefits of gas cap testing in the basic portion of San Joaquin Valley. The Valley must prepare a new SIP showing attainment by 2005.

³ San Diego relied on Enhanced I/M only as a contingency measure.

**Table V-5
Emission Reductions Achieved in SIP Currency (tons per day)
From Enhanced I/M in Each Nonattainment Area for Each Milestone Year¹**

| Nonattainment Area | 1999 | | | 2002 | | | 2005 | | | 2008 | | | 2010 | | |
|---------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|-----------|----------|-----------|
| | HC | NOx | HC+NOx | HC | NOx | HC+NOx | HC | NOx | HC+NOx | HC | NOx | HC+NOx | HC | NOx | HC+NOx |
| San Diego ² | 4.2 | 1.5 | 5.7 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| San Joaquin Valley ³ | 2.5 | 0.9 | 3.4 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Sacramento Region | 2.4 | 0.9 | 3.2 | 4.0 | 3.5 | 7.5 | 3.7 | 3.4 | 7.1 | -- | -- | -- | -- | -- | -- |
| Ventura | 0.7 | 0.4 | 1.1 | 1.2 | 1.3 | 2.6 | 1.1 | 1.2 | 2.3 | -- | -- | -- | -- | -- | -- |
| Antelope | 0.2 | 0.1 | 0.3 | 0.4 | 0.3 | 0.7 | 0.4 | 0.3 | 0.7 | -- | -- | -- | -- | -- | -- |
| Coachella | 0.8 | 0.3 | 1.1 | 1.5 | 1.1 | 2.6 | 1.5 | 1.1 | 2.6 | -- | -- | -- | -- | -- | -- |
| South Coast ⁴ | 17.4 | 7.7 | 25.2 | 25.3 | 20.6 | 45.9 | 27.1 | 14.1 | 41.2 | 24.9 | 8.7 | 33.6 | 24.2 | 6.1 | 30.3 |
| TOTAL | 28 | 12 | 40 | 32 | 27 | 59 | 34 | 20 | 54 | 25 | 9 | 34 | 24 | 6 | 30 |

¹ Numbers may not add due to rounding.

² Enhanced I/M was not needed to demonstrate attainment in San Diego in the 1994 Ozone SIP, but was used as a contingency measure.

³ The commitments shown for the San Joaquin Valley are based on the 1994 SIP. The Valley must prepare a new SIP showing attainment by 2005.

⁴ South Coast reductions based on EMFAC7G. All other areas based on EMFAC7F.

Chapter VI discusses a number of options we have evaluated for improving the Smog Check II program. For transportation conformity purposes, ARB has also identified a number of measures that may provide extra emission reductions to offset some of the shortfall from Enhanced I/M. They are as follows:

- Phase 2 reformulated gasoline: the full benefits from this regulation were not claimed in the SIP;
- Limits on combustion chamber deposits: additives used to meet our fuel regulations provided unanticipated emission reductions;
- Phase 3 reformulated gasoline: this measure was adopted in 1999;
- Emission standards for on-road motorcycles: this measure was not anticipated in the SIP and provides additional emission reductions; and
- Measures that were originally credited only in the South Coast Air Basin but which were adopted statewide. Regulations to reduce emissions from light- and medium-duty vehicles in the future (Low-Emission Vehicle II) and off-road diesel equipment will provide additional emission reduction benefits in San Diego, the San Joaquin Valley, Ventura, Sacramento, and the Southeast Desert.

Because for some years in some areas, we have already used the additional reductions from these measures to offset other SIP shortfalls, credit toward offsetting the Enhanced I/M shortfall will vary by area and by year.