CHAPTER 7

BENEFITS OF THE HDVIP AND PSIP

7.1 OVERVIEW

Implementation of the HDVIP and PSIP will produce a series of benefits which can be generally classified as follows:

- **A reduction in the number of heavy duty diesel vehicles emitting excess smoke,**
- **A reduction in criteria and toxic air pollutant emissions from heavy duty diesel vehicles,**
- **A reduction in heavy duty diesel vehicle fuel consumption, and**
- **A potential improvement in heavy duty diesel vehicle reliability and performance.**

Reducing the number of excessively smoking heavy duty diesel vehicles is the primary goal of the HDVIP and PSIP. Reductions in criteria and toxic air pollutants, reductions in fuel consumption, and any improvements in vehicle reliability and performance accrue as direct, but secondary, benefits of the smoke reduction repairs.

This chapter presents estimates of the magnitude of excess smoke, criteria pollutant, and fuel consumption reductions which will accrue due to HDVIP and PSIP implementation. Estimates have not been developed for toxic air pollutant reductions or any heavy duty diesel vehicle reliability and performance improvements arising out of program implementation; primarily due to a lack of definitive data on which to quantify the magnitude of such benefits. Studies necessary to determine the magnitude of toxic air pollutant reduction and vehicle performance benefits could be conducted as an integral component of the HDVIP and PSIP programs simultaneous with active program

enforcement. As demonstrated below, the HDVIP and PSIP are very cost effective programs even in the absence of explicit estimates for these secondary program benefits. Section 7.2 presents estimates for the HDVIP- and PSIP-driven reduction in the number of excessively smoking heavy duty diesel vehicles operating in California. Section 7.3 presents estimates for program-driven reductions in criteria pollutant emissions. Finally, Section 7.3 presents estimates for the quantity of diesel fuel saved due to HDVIP and PSIP implementation.

7.2 REDUCTION IN THE NUMBER OF VEHICLES EMITTING EXCESS SMOKE

Generally, the effectiveness of an emissions control program is measured in terms of dollar cost per mass of pollutant reduced. However, since the primary goal of the HDVIP and PSIP is to reduce the level of smoke emissions from heavy duty diesel vehicles, such a metric is of no utility in quantifying primary program benefits. Smoke emissions are not measured on a mass basis and cannot be added across all operating heavy duty diesel vehicles to provide a useful measure of the total quantity of smoke reduced through the HDVIP and PSIP. The most reasonable metric for evaluating HDVIP and PSIP success in reducing smoke emissions is through an estimate of the program-induced decrease in the number of heavy duty diesel vehicles with excess smoke emissions operating in California.

The TSD for the original HDVIP (Section 7.3) presented a detailed theoretical analysis of the expected reduction in the number of heavy duty diesel vehicles with excess smoke emissions operating in California between 1990 and 1995 due to the implementation of that program. While the details of that analysis are not reproduced here, a decline in the fraction of excessively smoky vehicles from 44 percent of the heavy duty diesel fleet in 1990 to 21 percent of the fleet in 1995 was predicted. Section 6.5.2 of this TSD discusses data collected under the original HDVIP that provides a compelling validation of the original HDVIP's TSD excessively smoking vehicle reduction analysis. Moreover, this observational data provides a firm foundation on which to base the expected decline in excess smoke emissions due to implementation of the proposed HDVIP and PSIP.

Data from the original HDVIP indicates that approximately 45 percent of heavy duty diesel vehicles were emitting excess smoke during the first few months of the program in 1991. By the end of 1993, this fraction had declined to 18.5 percent, readily illustrating the effectiveness of that program in reducing the number of vehicles with excess smoke emissions. The recent Random Truck Opacity Survey, conducted in support of the proposed HDVIP and PSIP, indicates that the current failure rate for the same subset of vehicles subject to the original HDVIP (i.e., pre-1993 model year heavy duty diesel vehicles) is approximately 20 percent (for an equivalent stringency opacity standard and adjusting for fleet aging). Therefore, while there apparently has been some backsliding of maintenance practices since the suspension of the original HDVIP, the effects of that program remain strong and the number of heavy duty diesel vehicles emitting excess smoke continues to be well below that which would be observed if the program were never implemented. It seems reasonable, however, to expect that over time, the percentage of heavy duty diesel vehicles with excess smoke emissions will continue to increase if the proposed HDVIP and PSIP are not implemented, eventually stabilizing at a level near that observed at the beginning of the original HDVIP.

In addition to preserving the current gains made through the implementation of the original HDVIP, implementation of the proposed HDVIP and PSIP will promote a renewed emphasis on vehicle maintenance and a corresponding further reduction in the number of excessively smoking vehicles in California. It is estimated that after the first full year of implementation of the proposed HDVIP and PSIP (i.e., 1999), an additional 7 percent decline in the number of excessively smoking heavy duty diesel vehicles will be observed through the renewed promotion of deterrence-based vehicle maintenance (returning such maintenance practice to the same rate of occurrence as observed at the time of suspension of the original HDVIP and avoiding further erosion of the gains of that program). This translates into a estimated 70,472 excessively smoking heavy duty diesel vehicles in California in 1999 as opposed to 74,503 in the State without the proposed HDVIP and PSIP. Similarly, the number of excessively smoking heavy duty diesel vehicles in

California in 2010 is estimated to be 67,657 with the proposed HDVIP and PSIP and 71,526 without the programs.

These reductions should be viewed in a larger perspective in that the indicated decline in excessively smoking heavy duty diesel vehicles (4,030 vehicles in 1999 and 3,869 vehicles in 2010) is but a fraction of the total decline due to HDVIP and PSIP implementation. In the absence of the lingering deterrence effects of the original HDVIP an additional 24,747 excessively smoking heavy duty diesel vehicles would be in operation in 1999 and an additional 33,710 excessively smoking heavy duty diesel vehicles would be in operation in 2010. Therefore, the overall reduction in excessively smoking heavy duty diesel vehicles is 28,778 in 1999 and 37,580 in 2010. These reductions equate to a 29 percent reduction in excessively smoking trucks in 1999 and a corresponding 36 percent reduction in 2010. While the bulk of the original HDVIP-driven share of the reduction for 1999 can be presumed to occur regardless of implementation of the proposed HDVIP and PSIP (given the fact that most of the deterrence-driven reduction is currently in place), there is no assurance that the estimated reduction for 2010 would not erode substantially if smoke standard enforcement is not resumed. Between 1999 and 2010, much, if not all of the lingering deterrence effect of the original HDVIP could be lost without implementation of the proposed HDVIP and PSIP.

7.3 REDUCTION IN CRITERIA POLLUTANT EMISSIONS

Repairs as well as deterrence effects of the HDVIP and PSIP will not only reduce the number of vehicles with excess smoke emissions, but will also reduce mass emissions of criteria pollutants. However, the determination of HDVIP and PSIP impacts on criteria pollutant emissions is complex, involving such factors as: detailed data on emission control system malperformance, the effect of individual malperformances on criteria pollutant emissions, the ability of the HDVIP and PSIP to identify individual malperformances, and the success of vehicle repairs in correcting identified malperformances. This subsection presents an estimate of these factors and the resulting magnitude of the criteria pollutant impact for ROG, NO_x, and PM-10. CO emissions from diesel vehicles are low relative to

their gasoline counterparts (due to excess air combustion conditions) and therefore are not addressed in this analysis. The ARB MVEI7G emissions inventory model indicates that diesels in total are responsible for only about 3.5 percent of vehicular CO emissions in 1999 and about 7.5 percent of vehicular CO emissions in 2010.

Subsequent to the preparation of the TSD for the original HDVIP, the ARB updated their MVEI7G emissions inventory model to estimate the criteria pollutant impacts of a heavy duty diesel vehicle smoke inspection program such as that proposed. Using the MVEI7G model would greatly simplify the determination of criteria pollutant emission impacts since the model represents the State's official emissions inventory estimation tool and would provide a direct link between the analysis of HDVIP and PSIP emission reductions and the overall State emissions inventory. Moreover, since ARB modeling staff indicates that the encoded MVEI7G algorithm to estimate emission reduction impacts was based on the methodology outlined in the TSD for the original HDVIP, the theoretical foundation for the algorithm is both documented and well understood.

Unfortunately, preliminary emissions analyses using MVEI7G indicated problems with practical application of the model algorithm. First, the model did not account for the deterrence effects of the smoke inspection program, instead assuming that only those vehicles which are actually inspected and issued citation make any repairs. As experience with both light duty vehicle inspection programs and the original HDVIP indicate, there is a sizeable deterrence effect due to program implementation which must be accounted for in quantifying program benefits. Second, the MVEI7G model-assumed failure rate for individual model year vehicles is invariant over time. For example, a 1990 model year vehicle fails at the same rate in 2010 (when it is 20 years old) as it did in 1995 (when it was 5 years old). Such an assumption is not consistent with test program data such as that discussed in Section 6.4. Finally, the pollutant-specific impact coefficients encoded in MVEI7G are not consistent with the previous TSD modeling upon which the MVEI7G algorithm was based. In fact, individual repairs would have to reduce emissions by more than 100 percent in some cases for the coefficients encoded in MVEI7G to be accurate.

To surmount these problems while at the same time retaining the advantages of MVEI7G in terms of overall State inventory consistency (including consistency of overall vehicle counts, model year distributions, and vehicle class distributions), alternative sets of input parameters for use in the MVEI7G emissions impact algorithm were developed to properly consider all HDVIP and PSIP impacts. The MVEI7G algorithm can effectively recognize five distinct HDVIP- and PSIP-related parameters as follows:

- **The calendar year-specific heavy duty diesel vehicle inspection rate,**
- **The model year-specific failure rate within each class of heavy duty diesel vehicles,**
- **The calendar year-specific failed vehicle repair rate,**
- **Model year- and pollutant-specific (TOG, NO_x, and PM) emissions impact factors, and**
- **A calendar year-specific "discount" factor to correct for the phase-in of program benefits during initial inspection years.**

Revised data was developed for each of these five parameters for both 1999 and 2010 to analyze HDVIP and PSIP benefits.

7.3.1 Pollutant-Specific Emissions Impact Factors

As indicated above, the pollutant-specific emissions impact factors encoded in the MVEI7G model imply a greater than 100 percent emission reduction effectiveness of repair in some cases. Therefore, these factors were revised for this analysis to better reflect the actual emission reduction benefits of vehicle repair. The basic smoke program-induced correction algorithm encoded in MVEI7G is:

$$\text{BER} \quad \text{CF}_{ijk} = \left(\frac{\text{IR}_i}{100}\right)\left(\frac{\text{RR}_i}{100}\right)\left[\left(\frac{1}{1+\left(\frac{\text{FR}_{ij}}{100}\right)\left(\frac{\text{PSIF}_{ijk}}{100}\right)}\right)-1\right]+1$$

where: BER CF is the basic emission rate correction factor for vehicle class "i", model year "j", and pollutant "k" due to smoke program implementation,

IR is the smoke program inspection rate for vehicles in class "i" in the calendar year being modeled (in percent),

RR is the fraction of failed vehicles in class "i" repaired in the calendar year being modeled (in percent),

FR is the smoke program failure rate for vehicle class "i" and model year "j" (in percent), and

PSIF is the emissions impact of repairs for vehicle class "i" and model year "j" on pollutant "k" (in percent).

The structure of this algorithm is quite complex, especially the term involving the inverse of the failure rate (FR) and pollutant-specific impact factor (PSIF). Nevertheless, the basic emission rate correction factor (BER CF) should be equivalent to a calculation based on a simple pollutant mass balance as follows:

$$\text{BER} \quad \text{CF} = (\text{Fraction Not Repaired})\,(1) + (\text{Fraction Repaired})\,(\text{ERCF})$$

$$= (1 - \text{Fraction Repaired}) + (\text{Fraction Repaired})\,(\text{ERCF})$$

$$= 1 - \left(\frac{\text{IR}}{100}\right)\left(\frac{\text{FR}}{100}\right)\left(\frac{\text{RR}}{100}\right) + \left(\frac{\text{IR}}{100}\right)\left(\frac{\text{FR}}{100}\right)\left(\frac{\text{RR}}{100}\right)(\text{ERCF})$$

where: ERCF is the fraction of pre-repair emissions left after a smoke program-induced vehicle repair.

The emissions reduction correction factor (ERCF) is the parameter typically measured (or estimated) in any program investigating the effectiveness of vehicle repairs. Such an analysis was undertaken in support of the original HDVIP, the results of which were presented in the TSD (Section 7.4) supporting the original program's adoption. The analysis presented in that TSD continues to represent the state-of-the-art methodology for evaluating the effect of smoke program-induced repairs on criteria pollutant emissions. In fact, the parameters currently encoded in MVEI7G are presumably based on the analysis presented in that TSD. However, since the actual encoded parameters are not consistent with that analysis (or consistent with intuition since repairs of greater than 100 percent effectiveness are not possible), a re-analysis of HDVIP- and PSIP-induced repair impacts was performed.

Following a methodology identical to that described in Section 7.4 of the TSD for the original HDVIP program, the ERCF associated with smoke program-induced repairs was recalculated. Since the methodology is fully documented in the TSD for the original HDVIP, it is not reproduced in this document. However, those portions of Section 7.4 describing the analysis methodology are incorporated herein by reference. The only exception to the identicality of the analysis performed in support of the proposed HDVIP and PSIP and that performed for the original HDVIP is that the assumed particulate trap and oxidation catalyst technology penetration fractions were revised to more accurately reflect current and expected future practices for 1994 and newer vehicles, as presented in Table 7-1. Tables 7-2 and 7-3 present the resulting emission reduction correction factors for average and fully-successful smoke program-induced repairs[1] respectively.

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[1] The impacts of "average" repairs incorporate the emission reduction effects of a proper repair, but also consider the percentage of time the needed repair is either not properly diagnosed or is malperformed. In contrast, a "fully-successful" repair assumes a that proper diagnosis and repair is always made (and, therefore, reflects maximum emission impacts).

TABLE 7-1. CATALYST AND PARTICULATE TRAP DEFECT FREQUENCIES

Defect	Vehicle Class	Frequency of Occurrence in TSD for the Original HDVIP	Frequency of Occurrence for HDVIP and PSIP Analysis
Catalyst Removed	HHDDV	0.00	0.00
	MHDDV	0.00	0.01
	LHDDV	0.00	0.03
	Urban Bus	0.00	0.00
Trap Removed	HHDDV	0.40 / 0.50[1]	0.00
	MHDDV	0.30	0.00
	LHDDV	0.30	0.00
	Urban Bus	0.05	0.00

[1] California-certified engines / Federally-certified engines.

TABLE 7-2. EMISSION REDUCTION CORRECTIONS FOR AVERAGE REPAIRS

Vehicle Class	Model Years	ROG	NO_x	PM
HHDDV	Pre-1987	0.8211	0.9817	0.6411
	1988-1990	0.8349	0.9869	0.6798
	1991-1993	0.7952	1.0008	0.7123
	1994 and Later	0.8046	1.0008	0.6755
MHDDV	Pre-1987	0.8171	0.9934	0.6650
	1988-1990	0.8258	0.9967	0.6990
	1991-1993	0.7464	1.0037	0.6693
	1994 and Later	0.7549	1.0037	0.6243
LHDDV	Pre-1987	0.8432	0.9926	0.7492
	1988-1990	0.8442	0.9939	0.7514
	1991-1993	0.7542	1.0007	0.6772
	1994 and Later	0.7627	1.0007	0.6388
Urban Bus	Pre-1987	0.8914	1.0021	0.8063
	1988-1990	0.9254	1.0041	0.8716
	1991-1993	0.8768	1.0024	0.7887
	1994 and Later	0.8784	1.0024	0.7906

TABLE 7-3. EMISSION REDUCTION CORRECTIONS FOR FULL REPAIRS

Vehicle Class	Model Years	ROG	NO_x	PM
HHDDV	Pre-1987	0.5879	0.9450	0.4257
	1988-1990	0.6201	0.9086	0.4625
	1991-1993	0.5518	0.8488	0.3923
	1994 and Later	0.5482	0.8488	0.2965
MHDDV	Pre-1987	0.5407	0.9309	0.4268
	1988-1990	0.5562	0.9280	0.4552
	1991-1993	0.4376	0.9004	0.3249
	1994 and Later	0.4324	0.8919	0.2173
LHDDV	Pre-1987	0.5474	0.9996	0.5116
	1988-1990	0.5477	0.9908	0.5117
	1991-1993	0.4221	0.9083	0.3278
	1994 and Later	0.4163	0.8961	0.2154
Urban Bus	Pre-1987	0.6761	0.9545	0.5882
	1988-1990	0.7457	0.9885	0.6886
	1991-1993	0.6606	0.9741	0.4514
	1994 and Later	0.6520	0.9741	0.4474

The emission reduction correction factors (ERCF) presented in Tables 7-2 and 7-3 can be converted into MVEI7G-equivalent pollutant-specific impact factors (PSIF) for input into MVEI7G by equating the two expressions for the basic emission rate correction factor (BER CF) shown above. Solving the resulting expression for the pollutant-specific impact factor yields:

$$PSIF = \left(\frac{10{,}000}{FR} \right) \left[\left(\frac{1}{\left(\frac{FR}{100} \right) (ERCF) - \left(\frac{FR}{100} \right) + 1} \right) - 1 \right]$$

Using this relationship, the emission reduction correction factor values presented in Tables 7-2 and 7-3 can be readily converted into an equivalent pollutant-specific impact factor value for any given HDVIP and PSIP failure rate.

7.3.2 Vehicle Inspection Rate

Conceptually, quantifying the inspection rate for the HDVIP and PSIP is a straightforward calculation of the ratio of the number of vehicles inspected to the number of vehicles in-use. However, because the smoke inspection program correction factor algorithm encoded in the ARB MVEI7G emissions inventory model is fairly simplistic and does not incorporate any explicit mechanism for considering the deterrence-driven maintenance impacts of the HDVIP and PSIP, these impacts must be modeled using the standard "inspection-failure-repair" algorithm presented above. Effectively, the impacts of any smoke inspection program can broken down into two basic components: (1) the impacts of repairs resulting from actual inspection failure and (2) the impacts of deterred tampering and preventive maintenance undertaken to minimize failure risk. The former impacts are limited by the actual number of vehicles inspected while the latter impacts affect a far greater vehicle population. Therefore, a simple encoding of the fundamental HDVIP and

PSIP inspection rate into the MVEI7G model will significantly underestimate overall program impacts.

As discussed in Section 6.5.2, approximately 26 percent of heavy duty diesel vehicles are expected to exhibit reduced emissions due to either deterred tampering or increased maintenance. This estimate is based on actual smoke inspection program experience in California, gleaned from original HDVIP data collected between 1991 and 1993. As stated in Section 6.5.2, this deterrence effect was originally hypothesized in the TSD for the original HDVIP and has subsequently been effectively confirmed in actual practice through the original HDVIP.

Since the MVEI7G smoke inspection correction factor algorithm does not include an explicit mechanism to address this deterrence fraction, it must be modeled through its equivalent impact on the effective vehicle inspection rate, a rate that significantly exceeds the actual inspection rate calculated strictly on the basis of physical inspections performed. The effective inspection rate can be alternatively viewed as that rate of inspection which would bring about the same improved maintenance behavior in a fleet of vehicles which undertook no improved maintenance except in instances of smoke inspection failure.

7.3.3 Vehicle Failure Rate

As was the case with the vehicle inspection rate, quantifying the basic vehicle failure rate for the HDVIP and PSIP is a conceptually straightforward calculation of the ratio of the number of vehicles failed to the number of vehicles inspected. However, the deterrence effect which affects the vehicle inspection rate, as described in Section 7.3.2, carries over to affect the failure rate calculation as well. In effect, 100 percent of vehicles undertaking deterrence-based maintenance are equivalent to inspection "failures". Therefore, the effective HDVIP and PSIP failure rate is the effective inspection population-weighted average of the 1999 and 2010 model year and class-specific failure rates presented in Table 6-6 and an effective failure rate of 100 percent for deterrence-driven repairs. Light-heavy duty diesel vehicle failure rates have been estimated by adjusting the medium-heavy duty

failure rates presented in Table 6-6 by a factor of one-third. This correction factor for light-heavy duty diesel vehicles is derived from the default class-specific smoke program failure rates encoded in the MVEI7G model.

7.3.4 Failed Vehicle Repair Rate

Quantifying the basic vehicle repair rate for the HDVIP and PSIP is a conceptually straightforward calculation of the ratio of the number of vehicles repaired to the number of vehicles failed. But once again, the deterrence effect described in the Sections 7.3.2 and 7.3.3 carries over to affect the vehicle repair rate calculation. Since 100 percent of the malfunctions undertaken through deterrence-based maintenance are corrected, these vehicles exhibit both a 100 percent repair rate and an individual pollutant-specific repair impact that is greater than the aggregate impacts of average defect identification rates and average defect correction rates. The effective HDVIP and PSIP repair rate is the failed vehicle population-weighted average of the 78.5 percent repair rate for physically inspected and failed vehicles as observed in the original HDVIP (and assumed for the proposed HDVIP and PSIP, see Section 6.5.1) and an effective repair rate of 100 percent for deterrence-driven maintenance. Moreover, the average and fully successful pollutant-specific impact factors (PSIF) presented in Tables 7-2 and 7-3 must be aggregated by this same weighting factor to derive appropriate calendar year-specific PSIF values for input into MVEI7G.

7.3.5 First Year Program Benefit Discount

The MVEI7G smoke inspection program correction factor algorithm discounts first year emission reduction benefits by 50 percent and assumes zero benefit for calendar years in which no smoke inspection program is in place. While this makes intuitive sense, it is not explicitly correct for calendar years such as 1994 through 1998 where there is residual carryover maintenance impacts associated with a previously operating smoke program (in this case the original HDVIP). However, this is not a concern for the 1999 and 2010 emissions modeling performed in this analysis and has, therefore, not been altered. Full HDVIP and PSIP emission reduction benefits are assumed in both emissions analysis years.

7.3.6 The No HDVIP and PSIP Baseline

In the standard MVEI7G emissions inventory model, emission loads without a smoke program in place cannot be estimated in a calendar year during which a smoke program is in effect. The MVEI7G model assumes that a smoke program either is or is not in place in any given calendar year and cannot be instructed to model the same year both with and without a smoke program. To surmount this problem and derive both "with HDVIP and PSIP" and "without HDVIP and PSIP" emission estimates, a modified version of the MVEI7G smoke program parameter input table was developed which included a vehicle failure rate of zero for all vehicle classes and model years. This input table forces the basic emission rate correction factor to unity, thereby providing an estimate of uncorrected heavy duty diesel vehicle emission rates.

7.3.7 MVEI7G-Estimated HDVIP and PSIP Emission Reductions

Appendix C presents the MVEI7G input parameter files used to model the impacts of the HDVIP and PSIP in 1999 and 2010 respectively. These input files are designed to incorporate both direct failure-driven repair impacts and impacts accruing as a result of deterrence-driven vehicle repair. The Statewide criteria pollutant emission reductions estimated by MVEI7G are presented in Table 7-4. As indicated, the HDVIP and PSIP are expected to reduce 1999 ROG emissions by 6.37 tons per average day, 1999 NO_x emissions by 12.24 tons per average day, and 1999 PM-10 emissions by 5.23 tons per average day respectively. Similar reductions in 2010 of 5.30 tons of ROG per average day, 14.04 tons of NO_x per average day, and 3.20 tons of PM-10 per average day are predicted. (MVEI7G predictions of tons per summer day and tons per winter day were converted to tons per average day by assuming summer emissions are applicable eight months of the year and winter emissions are applicable four months of the year. The net effect of this weighting scheme is negligible since there are no significant differences in estimated summer and winter impacts.)

TABLE 7-4. HDVIP AND PSIP CRITERIA POLLUTANT REDUCTIONS

Calendar Year	Pollutant	Total On-Road Vehicle Emissions (tpd)	Total HDDV Emissions (tpd)	HDVIP and PSIP Emission Reductions (tpd)
1999	ROG	1063.97	48.66	6.37
	NO_x	1597.68	443.16	12.24
	PM-10	52.61	28.96	5.24
	Total	2,714.26	520.78	23.84
2010	ROG	441.09	40.33	5.30
	NO_x	1100.15	404.42	14.03
	PM-10	45.19	17.74	3.19
	Total	1,586.43	462.49	22.53

The considerable difference between the MVEI7G-estimated baseline emission estimates for ROG, NO_x, and PM-10 relative to corresponding estimates derived under the alternative methodology documented in the TSD for the original HDVIP (even after considering the impacts of fleet turnover) raises some concern that MVEI7G may not account for the full level of vehicle malperformance in determining baseline heavy duty diesel vehicle emission rates. Nevertheless, given the standing of the MVEI7G emission inventory model, the estimates presented in Table 7-4 were used without alteration to estimate HDVIP and PSIP costs effectiveness in the "dollars per pound" format commonly used to evaluate other emission control programs. Given the observed differentials between MVEI7G baseline emission estimates and corresponding estimates developed in the TSD for the original HDVIP , the derived cost effectiveness estimates should be viewed as a conservative indicator of program value.

7.4 FUEL CONSUMPTION IMPACTS

The same basic malperformance model used to estimate the impacts of smoke repairs on criteria pollutant emissions (as described in detail in Section 7.4 of the TSD for the original HDVIP) also generates a corresponding estimate of the effect of smoke repairs on diesel fuel consumption. While this impact is modest, it is nevertheless positive and does accrue as a direct result of HDVIP and PSIP implementation. Based on the population-weighted repair impacts predicted by the emissions malperformance model, a net decrease in diesel fuel consumption of 0.69 percent in 1999 and 0.66 percent in 2010 is estimated in response to HDVIP and PSIP implementation. Using the fuel consumption estimates forecast by the MVEI7G model for those years, the net diesel fuel savings expected as a result of HDVIP and PSIP implementation is 16.74 million gallons in 1999 and 19.22 million gallons in 2010.