7.0. EMISSION REDUCTION AND COST IMPACTS FOR OZONE ALTERNATIVES

7.1 RESULTS IN BRIEF

Based on projected emissions levels for the year 2010, this analysis estimates that 10 nonattainment areas (112 counties) are projected to need additional reductions beyond those currently mandated in the Clean Air Act (CAA) and those needed to partially achieve the current ozone standard, to meet the selected 0.08 4th Max. ozone national ambient air quality standard (NAAQS). The control cost associated with achieving partial nationwide attainment of the selected ozone NAAQS is estimated to be $1.1 billion (1990 dollars). Due to overlap between projected $PM_{2.5}$ nonattainment counties and ozone nonattainment areas, some control measures may produce air quality benefits for both standards that result in cost efficiencies.

7.2 INTRODUCTION

This chapter presents the methodology and results for the ozone NAAQS alternatives emissions and control cost impacts analysis. This analysis projects emission reductions resulting from additional controls needed by the year 2010 to attain the alternative ozone standards presented in Chapter 3. Emissions changes, which are translated into air quality changes, are inputs to the benefits analysis presented in Chapter 12. This analysis also estimates the projected costs (in 1990 dollars) of installing, operating, and maintaining additional controls. These control costs are inputs to the economic impact analysis presented in Chapter 11. Chapter 9 addresses the potential cost of full attainment, including the benefits of technological innovation and flexible implementation strategies. The administrative cost of the promulgated standard is addressed in Chapter 10. The following sections in this chapter cover:

- Methodology for estimating emissions and cost impacts for ozone alternatives;
- Emission reduction and control cost results for ozone alternatives; and
- Analytical uncertainties, limitations, and potential biases.

7.3 EMISSION REDUCTION AND COST IMPACT ANALYSIS METHODOLOGY

This analysis estimates the emission reductions and control costs for achieving air quality improvements necessary to attain alternative ozone NAAQS in projected nonattainment areas. The analysis methodology uses the nonattainment area-specific emissions inventory, the nonattainment area-specific emission reduction targets for volatile organic compounds (VOC) and nitrogen oxides (NOx), and the database of available control measures.

Since the 2010 CAA baseline projection indicates that several areas do not attain the current ozone standard, control measures are applied to address nonattainment of the current ozone standard. The methodology used to assess the impact of the current ozone standard is identical to the methodology used for the new ozone standard alternatives. The results of the current ozone standard analysis are presented and discussed in Appendix C.

Control measure selection for the alternative 8-hour ozone standards is not incremental to the current 1-hour ozone standard, consequently the current and new ozone standards are evaluated incremental to the 2010 CAA baseline. The analysis is designed this way because in some areas, the 8-hour standards are modeled to require significantly different emission reduction targets. For instance, to attain the current ozone standard in at least one of the modeled areas, both VOC and NOx reductions must be achieved from the 2010 CAA baseline. For the least stringent 8-hour standard analyzed, this same area is modeled to require only VOC reductions from the 2010 CAA baseline. For areas like this example, some control measures selected to meet the multiple pollutant goals of the current ozone standard may not be optimal for making progress toward the proposed 8-hour standards. Since both the current and new ozone standards are evaluated incremental to the 2010 CAA baseline, to obtain the incremental cost of the new standards, the cost of area-specific control measures that are duplicated in the 8-hour analysis is subtracted from the cost of the 8-hour standards.

Table 7.1 indicates the number of initial projected ozone nonattainment areas for which control measures are selected for the analysis year 2010. The first set of columns in this table

shows the number of projected areas relative to the 2010 CAA baseline. The third column shows the number of projected nonattainment areas that are not also projected to be nonattainment for the current ozone standard.

Table 7.1 Initial Projected Number of Ozone Nonattainment Areas (and Associated Counties)

Standard	Incremental to 2010 CAA Baseline	Unique to Alternative Standard[a]
0.08 5th Max.	15 (167)	5 (85)
0.08 4th Max.	19 (203)	10 (112)
0.08 3rd Max.	28 (278)	19 (189)

a Number of areas that are not initially projected to be nonattainment for the current ozone standard.

7.3.1 Control Measure Selection in Projected Ozone Nonattainment Areas

Control measure selection in this analysis is modeled using an approach for achieving the ozone standards that simulates current ozone standard implementation practices. Ultimately, state and local air pollution control authorities, in cooperation with federal efforts, will devise implementation strategies that achieve air quality goals in a manner that minimizes negative impacts.

This analysis relies on a combination of national and local control measures to achieve incremental improvements in ozone air quality from the 2010 CAA baseline. Air quality goals are translated into area-specific VOC and NOx emission reduction targets. The targets are established based on air quality modeling and recent ambient ozone monitoring data. The methodology used to establish these emission reduction goals improves upon methods used in the 1996 Regulatory Impact Analysis (RIA) of the proposed ozone NAAQS, and in some areas results in significantly different targets. Emission reduction targets are developed from a series of Regional Oxidant Model (ROM) matrix runs (i.e., simulations of across-the-board VOC and NOx reductions). The targets are expressed in terms of percent reduction in anthropogenic VOC and/or NOx emissions beyond emission levels corresponding to 2007 emission projections and

CAA-mandated controls (U.S. EPA, 1997a). Adjustments are made to these targets to account for the impacts of the regional NOx control strategy (i.e., the OTAG NOx cap and NLEV), and emissions growth and control to the year 2010 (U.S. EPA, 1997b). It should be noted that the solution set of emission reduction targets for projected nonattainment areas is not unique. This RIA models one emission reduction solution among many potential solutions.

A range of national measures that could be applied to reduce VOC and/or NOx on a broad scale were explored. Several VOC-oriented national measures such as more stringent VOC-content limits on consumer solvents and reformulated gasoline (RFG) were considered, but ultimately not included, because the national cost of implementing these measures was very high relative to the VOC reductions achieved in initially projected nonattainment areas. Though not included as national measures, the consumer solvent and RFG control measures are available in this analysis as *local* control measures.

Changes in vehicle or engine emission standards were also explored. These measures are best applied at the national level because it would be expensive and difficult for vehicle and engine manufacturers to comply with a patchwork of standards applied at the local level. Also, because motor vehicles and engines are mobile, much of the benefit of vehicle or engine emissions standards applied at the local level could be lost to immigration of dirtier vehicles or engines into the local area. More stringent Tier 2 light duty truck standards are included as a national control measure to achieve widespread reductions in both VOC and NOx emissions. Chapter 5 contains a detailed discussion of this control measure. This control measure is referred to as the National Ozone Strategy in this RIA. Emission reductions for the National Ozone Strategy are estimated for every county in the nation, including counties in projected nonattainment areas. The reductions occurring in projected nonattainment areas are credited toward achievement of the areas' emission targets.

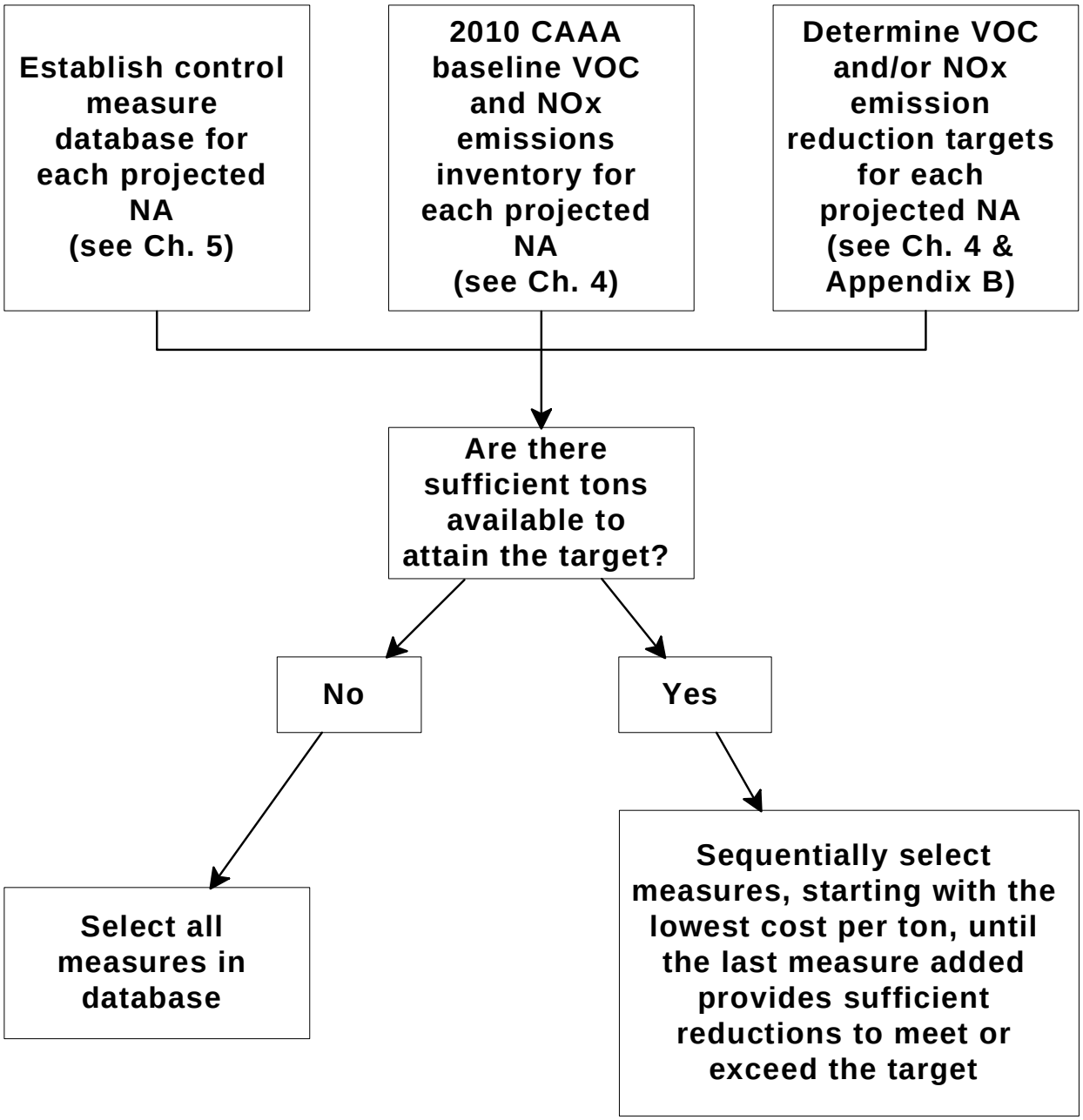
After reductions due to the National Ozone Strategy are credited in each projected nonattainment area, local control measures are applied. Figure 7.1 shows the basic elements of the local nonattainment area control strategy selection process. Local measures are rank ordered

by increasing average annual incremental cost per ton of reduction of the target pollutant[1]. Control measures are restricted to those with an average annual incremental cost of $10,000 per ton or less. Section 7.3.2 provides further discussion of this control measures selection threshold. Control measures are selected from this list until the sum of all reductions meets or exceeds the targeted reductions established for that nonattainment area. In areas with both VOC and NOx targets, both targets must be met. In many instances, for the analysis presented in this chapter, all available measures are selected before the emissions target is reached resulting in *residual nonattainment* of the NAAQS.

After the initial round of control measure selection, areas that achieve their targets are reviewed to determine where over control can be reduced. For areas where the last measure selected results in over control, measures with a higher average annual incremental cost per ton (with less reduction) are evaluated, or less costly measures eliminated in order to minimize over control. Changes to the initial set of selected control measures are only made if the total annual cost for the area also declines.

1 See Chapters 5 and 6 for a discussion of average annual incremental cost per ton and how it relates to control measure selection.

Figure 7.1
Local Ozone Control Strategy Selection Process



In areas with both VOC and NOx reduction targets, a review is also conducted to determine whether unselected measures reducing both VOC and NOx are more cost-effective than selected measures that reduce only one pollutant. Changes to the initial set of selected control measures are only made if the total annual cost for the area also declines.

7.3.2 Control Measure Selection Cost per Ton Threshold

Control measures with an average annual incremental cost per ton of VOC or NOx of $10,000 (1990 dollars) or less are the only ones considered for the analysis results reported in this chapter[2]. Since the ozone cost analysis is generally designed to simulate current implementation practices, this threshold provides a realistic estimate of the highest incremental cost impact that affected entities might face. To date, States generally have not chosen to require existing sources to apply control measures with incremental costs above this threshold. For instance, the South Coast Air Quality Management District (SCAQMD), which manages the most severe ozone nonattainment area in the United States, does not currently apply VOC or NOx control measures with an average annual incremental cost above $11,100 per ton (1990 dollars) (SCAQMD, 1996).

Since most areas do not have an ozone problem as severe as the South Coast (i.e., $10,000 may be too high for some areas), and because it is possible that future implementation of more stringent ozone standards may require more costly control measures (i.e., $10,000 may be too low for some areas in the future), Appendix D includes a sensitivity analysis on a range of control measure selection thresholds. Thresholds of $7,000 per ton, $20,000 per ton, and no cut-off are examined. Generally, given the full set of control measures in the control measure database and the target sets for each projected nonattainment area, the level of reductions achieved and progress toward full attainment is relatively insensitive to the alternative cost

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2 The control measure database used in this analysis does contain control measures with an average annual incremental cost per ton greater than $10,000. These are generally measures affecting point sources that have low-concentration pollution streams and/or relatively stringent baseline control levels. The $10,000 average annual incremental cost per ton threshold was not used in the 1996 RIA of the proposed ozone NAAQS.

thresholds.

7.4 EMISSION REDUCTION IMPACT RESULTS

This section presents the emission reduction results for the analysis of alternative ozone standards. Included are estimates of the total emission reductions from each projected ozone nonattainment area resulting from national and local control measures, and the estimated change in the attainment status for the areas initially projected not to attain alternative ozone standards. The costs reported in this analysis *do not* represent the present value of the annual cost of control measures applied on a year-by-year basis from 1997 through 2010. Rather, the costs are derived from a static framework that compares two "states"; the first state being the future year 2010 in the absence of a new ozone standard, and the second state being the year 2010 with actions taken to meet a new ozone standard. The costs reported in this analysis represent the difference in cost between these two states.

Table 7.2 presents the estimated ozone season daily VOC and NOx emission reductions achieved by the National Ozone Strategy (more stringent Tier 2 light duty truck standards) and local control measures for each alternative ozone standard. The National Ozone Strategy provides only a small fraction of the total VOC emission reductions, but a slightly larger fraction (8 to 10 percent) of the total NOx emission reductions.

Table 7.2 Summary of Ozone Season Daily VOC and NOx Reductions in Ozone Nonattainment Areas

Standard	National Ozone Strategy Reductions[a] (ozone season tons per day)		Local Control Measure Reductions (ozone season tons per day)			
			Incremental to 2010 CAA Baseline		Incremental to Current Ozone Standard	
	VOC	NOx	VOC	NOx	VOC	NOx
0.08 5th Max.	16	46	1,146	393	536	111
0.08 4th Max.	18	53	1,422	582	812	297
0.08 3rd Max.	24	71	1,862	803	1,252	518

a Reductions are incremental to the 2010 CAA baseline.

Table 7.3 shows the national summary of ozone nonattainment area emission reduction targets and the reductions achieved in the analysis of each alternative standard. Both the number of projected ozone nonattainment areas increases and the amount of reduction needed in each area increases with the level of stringency of the standard. This table shows that the combination of the National Ozone Strategy and local control measures that meet the average annual incremental cost per ton control measure selection threshold of $10,000 are able to achieve on average from 37 to 43 percent of the VOC reduction target, and 22 to 24 percent of the NOx reduction target. Since areas that are estimated to be in residual nonattainment for the current ozone standard are a subset of the areas included in the 0.08 5th Max. and 0.08 3rd Max. analyses, full attainment of the current ozone standard would increase the average percent reduction achieved for the alternative ozone standards relative to the targets.

Table 7.3 National Summary of Local VOC and NOx Emission Reduction Targets and Reductions Achieved[a]

Standard	2010 CAA Baseline Emissions (tons per day)		Target Reductions (tons per day)		Reductions Achieved Relative to Targets (tons per day)		Percent Achieved Relative to Targets	
	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx
0.08 5th Max.	7,450	5,143	2,667	1,722	1,149	408	43%	24%
0.08 4th Max.	7,913	6,040	3,455	2,529	1,308	582	38%	23%
0.08 3rd Max.	10,278	8,022	4,598	3,648	1,706	803	37%	22%

a Emission reduction targets and achieved reductions are incremental to the 2010 CAA Baseline. Reductions in pollutants not targeted in each area are not included in this table since in the methodology used in this analysis they are not assumed to reduce ozone concentrations. Only control measures with an average annual incremental cost of $10,000 per ton or less are included in this analysis.

Table 7.4 provides more detail on the distribution of reductions achieved as a percent of reductions needed for each alternative standard. For the 0.08 5th Max. standard, 3 out of 15 areas are projected to reach full attainment. For the 0.08 3rd Max. standard, 1 out of 28 areas is projected to reach full attainment. The nonattainment areas represented for the current ozone standard are a subset of the nonattainment areas presented for the set of alternative 0.08 ppm standards. Areas that are in residual nonattainment for the current standard make little or no additional progress under the alternative 0.08 ppm standards.

Table 7.5 indicates the number of projected nonattainment areas that do not reach the target reduction levels after all control measures less than $10,000 per ton are selected. These residual nonattainment areas are counted incremental to both the 2010 CAA baseline and to the nonattainment areas for the current ozone standard.

Table 7.4 Distribution of VOC and NOx Emission Reductions Achieved as a Percent of Reductions Needed[a]

Standard	Number of Initial Nonattainment Areas Achieving the Specified Progress[b]						Total Number of Areas
	< 20%	20 - 40%	40 - 60%	60 - 80%	> 80%	Full Attain-ment	
Current Standard	1	3	3	0	1	1	9
0.08 5th Max.	3	7	2	0	0	3	15
0.08 4th Max.	3	9	2	2	1	2	19
0.08 3rd Max.	6	13	5	1	2	1	28

a Reductions achieved as a percent of reductions needed for target pollutants only (see Table 7.3).
b Number of areas incremental to the 2010 CAA baseline. Only control measures with an average annual incremental cost of $10,000 per ton or less are included in this analysis.

Table 7.5 Number of Residual Ozone Nonattainment Areas

Standard	Incremental to 2010 CAA Baseline	Unique to Alternative Standard[a]
0.08 5th Max.	12	6
0.08 4th Max.	17	10
0.08 3rd Max.	27	19

a Number of areas that are not projected to be residual nonattainment for the current ozone standard.

7.5 COST IMPACT RESULTS

This section presents the incremental annual control cost associated with additional control measures modeled to meet alternative ozone standards. Two components comprise the incremental annual cost. The first component is the cost of the National Ozone Strategy (more stringent Tier 2 light duty truck standards). The second component is the cost associated with application of local VOC and/or NOx control measures in each of the projected ozone nonattainment areas.

Table 7.6 presents the national costs of the alternative ozone standards. These costs are calculated incremental to partial attianment of the current ozone standard. Using the additional control measures modeled for this analysis, not all areas are projected to attain the alternative standards. For this reason, the costs presented in this section are characterized as *partial attainment* costs. The national cost of the National Ozone Strategy (i.e., more stringent Tier 2 light duty truck standards) is estimated to be $300 million (1990 dollars). The total cost of partial attainment of the ozone standards, including both national and local control measures, is estimated to be $890 million to $1.4 billion (1990 dollars).

Table 7.7 National Summary of Partial Attainment Control Cost for Alternative Ozone Standards

Control Measure	Annual Control Cost (Millions 1990$)[a]		
	0.08 5th Max.	0.08 4th Max.	0.08 3rd Max.
National Ozone Strategy	330	330	330
Local Control Measures	560	780	1,000
Total	890	1,100	1,400

a Costs are incremental to partial attainment of the current ozone standard. Only control measures with an average annual incremental cost of $10,000 per ton or less are included in this analysis. Totals may not agree due to rounding.

7.6 ESTIMATING OZONE IMPACTS AFTER ATTAINMENT OF AN ALTERNATIVE $PM_{2.5}$ STANDARD

Many of the VOC and NOx control measures selected in the $PM_{2.5}$ cost analysis can also reduce ozone concentrations. Any $PM_{2.5}$-related VOC and/or NOx reductions occurring both inside and outside ozone nonattainment areas may impact ozone air quality, and the number or stringency of "ozone-specific" emission control measures that must be employed to meet new ozone standards. Therefore, it is possible to reduce the overall cost of addressing the combination of ozone and $PM_{2.5}$ nonattainment if control strategies can be thoughtfully designed to reduce concentrations of both pollutants simultaneously. Table 7.8 indicates the potential for this type of cost savings by showing the projected number of initial ozone nonattainment areas and $PM_{2.5}$ nonattainment counties and the potential overlap. For the 0.08 5th Max. alternative,

from 10 to 13 of the initial 15 ozone nonattainment areas contain at least one county projected to be nonattainment for the $PM_{2.5}$ alternatives listed. For the 0.08 4th Max. alternative, 14 of the initial 19 ozone nonattainmet areas contain at least one county projected to be nonattainment for the selected $PM_{2.5}$ 15/65 alternative. For the 0.08 3rd Max. alternative, from 15 to 20 of the initial 28 ozone nonattainment areas contain at least one county projected to be nonattainment for the $PM_{2.5}$ alternatives listed. Not shown in the table is the fact that several projected $PM_{2.5}$ nonattainment counties are located near (i.e., within a one or two county radius) but not in projected ozone nonattainment areas. The NOx and VOC reductions occurring outside but near ozone nonattainment areas due to $PM_{2.5}$ control may also influence ozone air quality inside ozone nonattainment areas.

Table 7.8 Projected $PM_{2.5}$ Nonattainment Counties Located in Projected Ozone Nonattainment Areas

Ozone-$PM_{2.5}$ Standard Combination		Number of Initial Ozone Nonattainment Areas (Counties)[a]	Number of Initial $PM_{2.5}$ Nonattainment Counties[b]	Number of $PM_{2.5}$ Nonattainment Counties Located In Ozone Nonattainment Areas[c]
0.08 5th Max.	**$PM_{2.5}$ 16/65**	15 (167)	70	20 (10)
	$PM_{2.5}$ 15/65	15 (167)	102	25 (11)
	$PM_{2.5}$ 15/50	15 (167)	122	28 (13)
0.08 4th Max.	**$PM_{2.5}$ 15/65**	19 (203)	102	30 (14)
0.08 3rd Max.	**$PM_{2.5}$ 16/65**	28 (278)	70	26 (15)
	$PM_{2.5}$ 15/65	28 (278)	102	35 (18)
	$PM_{2.5}$ 15/50	28 (278)	122	39 (20)

a Number of initial ozone nonattainment areas and counties incremental to the 2010 CAA Baseline.

b Number of initial $PM_{2.5}$ nonattainment counties incremental to partial attainment of the current PM_{10} standard; Tier 1 monitored counties only.

c There may be more than one $PM_{2.5}$ nonattainment county located in an ozone nonattainment area. The number in parentheses indicates the number of projected ozone nonattainment areas containing at least one projected $PM_{2.5}$ nonattainment county.

Appendix D of this report contains an analysis that estimates the potential effect that compliance with the $PM_{2.5}$ 15/50 alternative has on attaining the 0.08 3rd Max. ozone alternative. Reductions occurring inside ozone nonattainment areas from control measures selected in the $PM_{2.5}$ analysis are credited toward each ozone nonattainment areas' targets. The control measures selected in the $PM_{2.5}$ analysis are not available for selection again in the ozone analysis to eliminate double counting of the emission reductions and costs of a control measure. The analysis indicates that some cost savings is likely to accrue, but the level of estimated savings is small (roughly $100 million) due to projected residual nonattainment of the ozone standard. Full attainment of the $PM_{2.5}$ 15/50 alternative is likely to further reduce the incremental cost of control for the 0.08 3rd. Max. ozone alternative.

7.7 ANALYTICAL LIMITATIONS, UNCERTAINTIES, AND POTENTIAL BIASES

Because a quantitative uncertainty cannot be assigned to every input, the total uncertainty in the emission reduction and cost outputs cannot be estimated. Nonetheless, the individual uncertainties can be characterized qualitatively.

Air quality projections to 2010 embody several component uncertainties, such as uncertainties in emission data, emission growth rates, baseline air quality data, and air quality modeling. These uncertainties are addressed in Chapter 4. The application of control measures and their associated costs are affected by the propensity of either the emissions projection methodology or the emission target methodology to overstate or understate initial nonattainment in specific areas.

To model the costs of achieving potential air quality standards, control measures are selected from the control measure database using incremental cost effectiveness as the sole criterion. As noted previously in Section 6.7, cost-effectiveness, as used in this analysis, is a limited metric. Even if these cost per ton figures are adjusted to account for source size differences (as is done for some point source controls), these adjustments do not account for other important cost-determining variables, such as source status (new versus retrofit), annual

operating hours, equipment, materials of construction, and unit prices for utilities, materials, and labor. State and local agencies may use criteria other than cost effectiveness in selecting control measures, and given more time and knowledge of local conditions, should be able to more accurately estimate the costs and emission reductions of the control options modeled in this analysis.

In areas where there is both a $PM_{2.5}$ and an ozone concern, States may recognize solutions that jointly address these problems, thereby reducing the overall cost of implementing both standards. Further, the analysis presented in this chapter does not adequately account for the potential effect on ozone air quality of control measures modeled in the $PM_{2.5}$ analysis. This is due both to shortcomings in available ozone air quality modeling, and the fact that only partial attainment of $PM_{2.5}$ standards is modeled.

7.8 REFERENCES

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