Appendix 7b: Post 2020 Attainment Analysis

7b.1 Uncertainties of Post 2020 Attainment Analysis

Attainment dates will be determined in the future through the SIP process based on criteria in the CAA, future air quality data, and future rulemakings and are not knowable at this time. For analytical simplicity, and in keeping with the proposal analysis, we have chosen to use an analysis year of 2020 and generally assume attainment in that year. The exception is the San Joaquin and South Coast California areas where SIP submittals for the current standard show that they would have current standard attainment dates later than 2020. For these two areas in California, we are assuming a new standard attainment date of 2030. Estimates of the benefits and costs of attaining .075 and the alternate air quality standards for these two areas in 2030 are included below.

There are many uncertainties associated with the year 2030 analysis. Between 2020 and 2030 several onroad mobile and nonroad mobile source federal air quality rules are expected to further reduce emissions of NOx and VOC. Because mobile source rules affect new vehicles and equipment, they reduce inventories over a long period of time, as older vehicles and equipment are gradually scrapped and are replaced by new, regulated, lower-emitting vehicles and equipment. Among the onroad rules that contribute to the expected decline in mobile-source emissions between 2020 and 2030 are the Tier 2 Rule (light-duty cars and trucks) that went into effect in 2004, the 2007 Onroad Heavy-Duty Rule, and the Mobile Source Air Toxics Rule ("MSAT Final", EPA, 2007a and EPA, 2007b) that goes into effect in 2011. Major nonroad rules also contribute to this decline, including the Locomotive Emissions Final Rulemaking (EPA, 1998), the Locomotive-Marine Final Rule (EPA, 2007c), the Clean Air Nonroad Diesel Final Rule—Tier 4 (EPA, 2004), and Control of Air Pollution from Aircraft (EPA, 2005), among others. California has also regulated most of these same categories, often more stringently than the Federal government, resulting in substantial expected inventory decreases between 2020 and 2030. The emission reductions from these programs should lower ambient levels of ozone between 2020 and 2030 across the state of California; this would facilitate the process of reaching attainment with a revised ozone standard in San Joaquin and South Coast by 2030. In addition, activity data beyond 2025 does not exist for aircraft data; therefore, 2030 aircraft emissions are held at year 2025 levels.

However, the onroad mobile and nonroad mobile sectors are the only sectors projected to 2030 in our emission inventories; we do not have 2030 inventories for any stationary sources and therefore do not have a comprehensive estimate of Ozone precursor emissions around which to craft control strategies to determine costs. All stationary source emissions are held at year 2020 levels because of uncertainties in how to project stationary emissions beyond 2020, and the lack of consistent projection methodologies beyond 2020 (e.g., the model used to create future year EGU emissions does not project to year 2030). Without a complete set of future 2030 emission inventories and control strategies, it is not possible to adequately model either baseline air quality or changes from control strategies. Without modeled changes in Ozone ambient concentrations, it is not possible to perform a sophisticated benefits analysis. In order to provide some idea of costs and benefits of attaining 0.075 and the alternate standards in San Joaquin and

South Coast air basins, we've relied on the available data. Due to the previously mentioned limitations, these analysis results do not capture potential economic growth, or changes in emissions beyond 2020.

7b.2 Post 2020 Attainment Analysis

7b.2.1 Air Quality and Emissions Targets

We have used the 2020-based supplemental air quality modeling as a rough indicator of the percent control needed to meet the four alternate standards by 2030. Table 7b.1 shows the NOx targets estimated to get the Los Angeles and San Joaquin Valley areas into attainment by 2030. The supplemental air quality modeling showed (see Fig4-2d) that there was a sharp dropoff in ozone between the 60% and 90% additional NOx control cases. This may be due to the South Coast region transitioning from VOC-limited to NOx-limited conditions at this level of NOx emissions reductions.

Table 7b.1: Estimated Percentage Reductions of NOx beyond the RIA Control Scenario Necessary to Meet the Various Ozone Standards in Los Angeles and the San Joaquin Valley in 2030

All 2030 Extrapolated Cost Areas (NOx only)	2020 Design Value after RIA Control Scenario (ppm)	Additional local control needed to meet various standards				
		0.065	0.070	0.075	0.079	0.084
Los Angeles South Coast Air Basin, CA	0.122	> 90%	88%	83%	79%	75%
San Joaquin Valley, CA	0.096	76%	67%	59%	49%	37%

Table 7b.2 shows the NOx reductions needed to get the Los Angeles and San Joaquin Valley areas, into attainment by 2030. These reductions are based on the NOx targets for Los Angeles South Coast Air Basin in Table 7b.1. The higher reductions for Los Angeles compared to the San Joaquin Valley should enable all of California to attain, even after transport effects. Inventory reductions in 2030 from the onroad mobile, nonroad mobile, and aircraft/locomotive/commercial marine sources were credited to the estimates prior to creating the estimated extrapolated reductions needed in Table 7b.2. This table reveals that the majority of emission reductions are needed for these areas to reach the current ozone standard The reductions also include the Final Loco-Marine controls for 2030 (EPA, 2008). Overall, the loco-marine 2030 inventory contains about 120,000 fewer tons of NOx than the 2020 loco-marines inventory for the geographic area in California being analyzed.

Table 7b.2: Estimated Extrapolated Emissions Reductions of NOx Beyond the RIA Control Scenario Necessary to Meet the Various Ozone Standards in Los Angeles and the San Joaquin Valley in 2030

All 2030 Extrapolated Cost Areas (NOx only)	Additional local emissions reductions [annual tons/year] needed to meet various standards (ppm)				
	0.065	0.070	0.075	0.079	0.084
Los Angeles-San Joaquin Valley, CA[a]	390,000	380,000	350,000	330,000	300,000

[a] The Los Angeles South Coast Air Basin and San Joaquin Valley are included in the Sacramento Metro buffer.

To calculate the incremental costs of attainment for the Los Angeles and San Joaquin Valley areas the reductions to meet the current standard are removed from the reductions needed for the various standards.[1] Table 7b.3 contains the remaining 2030 emissions reductions needed for Los Angeles and the San Joaquin Valley.

Table 7b.3: Additional Local Emissions Reductions [annual tons/year] Needed to Meet Various Standards (ppm) Incremental to the Current Standard

All 2030 Extrapolated Cost Areas (NOx only)	Additional local emissions reductions [annual tons/year] needed to meet various standards (ppm) incremental to the current standard			
	0.065[a]	0.070	0.075	0.079
Los Angeles-San Joaquin Valley, CA[b]	78,000	73,000	45,000	23,000

[a] The 0.065 ppm emission reductions required are incremental to the reductions achieved by Sacramento in 2020 (see Table 4.6a).

[b] The Los Angeles South Coast Air Basin and San Joaquin Valley are included in the Sacramento Metro buffer.

The additional tons of reductions needed to attain the various standards may appear relatively low at first glance. It is important to note that these are incremental to progress made in San Joaquin and South Coast air basins toward attainment of the various standards in Sacramento. Additionally, between 2020 and 2030 other rules are expected to reduce emissions. Among these are the Tier 2 Rule (light-duty cars and trucks) that went into effect in 2004, the 2007 Onroad Heavy-Duty Rule, and the Mobile Source Air Toxics Rule ("MSAT Final", EPA, 2007a and EPA, 2007b) that goes into effect in 2011. Major nonroad rules also contribute to this decline, including the Locomotive Emissions Final Rulemaking (EPA, 1998), the Locomotive-Marine Final Rule (EPA, 2007c), the Clean Air Nonroad Diesel Final Rule—Tier 4 (EPA, 2004), and Control of Air Pollution from Aircraft (EPA, 2005), among others. California has also regulated most of these same categories, often more stringently than the Federal government, resulting in substantial expected inventory decreases between 2020 and 2030. A final factor that influences the total number of tons needed to attain in 2030 is the relatively greater effectiveness in California of NOx reductions that happen in the higher range of percentage reduced from the total NOx inventory. For example, a ton reduced when 80% of the total NOx inventory has already been controlled and reduced has a greater effect on ozone concentrations than a ton reduced when only 30% of the total NOx inventory has been thus far reduced.

7b.2.2 Extrapolated Costs

The same two methodologies (fixed and hybrid) were used to estimate the costs of the additional local emission reductions for this 2030 analysis as were used in the national 2020 analysis. There is even more uncertainty associated with this analysis because there is more time for all types of change. Technological change, change in energy policy, changes in the sources of emissions are all expected to be more important for 2030 than for 2020. Because the South Coast and San

[1] In one case, the 0.065 ppm alternate standard, the reductions for the Sacramento Metro area in 2020 (again, includes Los Angeles and the San Joaquin Valley areas that do not require attainment in 2020) are greater than the reductions required to meet the current standard, and these reductions are the subtracted from the increment needed for California to meet the 0.065 ppm standard..

Joaquin Valley cost area has historically had a difficult time attaining air quality standards, it might be expected that the 2020 cost methodologies might underestimate the costs of the additional local emission reductions. However, the additional time for technological change between 2020 and 2030 might be expected to lower costs and result in an overestimate of costs from using the 2020 methodologies. The net bias of using the methodology employed for 2020 in the 2030 analysis is unknown. Additionally it is important to note, most of the air quality improvement needed for these areas is to reach the 0.08 ozone standard. The cost analysis below represents the incremental costs of attaining alternate ozone standards.

7b.2.2.1 Fixed Cost Approach Results

Table 7b.4 shows the estimated costs using the fixed cost methodology with a $15,000 a ton cost applied to the local emission reductions from Table 7b.3

Table 7b.4: Extrapolated Cost to Meet Various Alternate Standards Using Fixed Cost Approach ($15,000/ton) [a]

All 2030 Extrapolated Cost Areas (NOx only)	Fixed Cost Approach Extrapolated Cost (M 2006$).			
	0.065 ppm	0.070 ppm	0.075 ppm	0.079 ppm
Los Angeles-San Joaquin Valley, CA	$1,200	$1,100	$680	$340

[a] All estimates rounded to two significant figures.

7b.2.2.2 Hybrid Approach Results

Table 7b.6 shows the estimated costs using the fixed cost methodology with the hybrid approach using the average costs shown in Table 7b.5 applied to the local emission reductions from Table 7b.3. The calculations for average cost used for Los Angeles and San Joaquin Valley use the same formulas presented in the Appendix 5a. There are large uncertainties when extrapolating to 2030, therefore keeping the approach consistent yielded the average cost numbers seen in Table 7b.5.

Table 7b.5: Hybrid Approach (Mid) Parameter Values for Various Standards [a, b]

All 2030 Extrapolated Cost Areas (NOx only)	0.065 ppm		0.070 ppm		0.075 ppm		0.079 ppm	
Los Angeles-San Joaquin Valley, CA	R [c]	Average Cost/Ton (2006$)	R [d]	Average Cost/Ton (2006$)	R [d]	Average Cost/Ton (2006$)	R [d]	Average Cost/Ton (2006$)
	1.42	$24,000	1.37	$24,000	1.27	$23,000	1.19	$ 23,000

[a] All estimates rounded to two significant figures.

[b] These estimates assume a particular trajectory of aggressive technological change. An alternative storyline might hypothesize a much less optimistic technological trajectory, with increased costs, or with decreased benefits in 2020 due to a later attainment date.

[c] Los Angeles-San Joaquin Valley, CA did not meet the baseline and therefore has an addition R to reach the current standard of 1.11.

[d] Los Angeles-San Joaquin Valley, CA have an R of 1.13 for the 0.65 ppm standard only, due to the emission reductions from Sacramento being limiting.

Table 7b.6: Extrapolated Cost to Meet Various Standards Using Hybrid Approach (Mid) [a, b]

All 2030 Extrapolated Cost Areas (NOx only)	Hybrid Approach Extrapolated Cost (M 2006$).			
	0.065 ppm	0.070 ppm	0.075 ppm	0.079 ppm
Los Angeles-San Joaquin Valley, CA	$1,900	$1,700	$1,000	$520

[a] All estimates rounded to two significant figures.

[b] These estimates assume a particular trajectory of aggressive technological change. An alternative storyline might hypothesize a much less optimistic technological trajectory, with increased costs, or with decreased benefits in 2020 due to a later attainment date.

7b.2.2.3 Sensitivity Analysis Results

Extrapolated cost ensitivity results for the fixed cost approach using a lower ($10,000/ton) and a higher ($20,000/ton) are presented in Table 7b.7 and Table 7b.8. Tables 7b.9 and 7b.11 present the average cost/ton for a higher and lower value of M (0.47 for the high and 0.12 for the low in place of the 0.24 used in the mid estimate). The total extrapolated costs for the Hybrid (Low) and Hybrid (High) are presented in Tables 7b.10 and 7b.12.

Table 7b.7: Extrapolated Cost to Meet Various Alternate Standards Using Fixed Cost Approach ($10,000/ton) [a]

All 2030 Extrapolated Cost Areas (NOx only)	Fixed Cost Approach Extrapolated Cost (M 2006$).			
	0.065 ppm	0.070 ppm	0.075 ppm	0.079 ppm
Los Angeles-San Joaquin Valley, CA	$780	$730	$450	$230

[a] All estimates rounded to two significant figures.

Table 7b.8: Extrapolated Cost to Meet Various Alternate Standards Using Fixed Cost Approach ($20,000/ton) [a]

All 2030 Extrapolated Cost Areas (NOx only)	Fixed Cost Approach Extrapolated Cost (M 2006$).			
	0.065 ppm	0.070 ppm	0.075 ppm	0.079 ppm
Los Angeles-San Joaquin Valley, CA	$1,600	$1,500	$900	$450

[a] All estimates rounded to two significant figures.

Table 7b.9: Hybrid Approach (Low) Average Cost/Ton for Various Standards [a, b]

All 2030 Extrapolated Cost Areas (NOx only)	Hybrid Approach Average Cost/Ton (2006$)			
	0.065 ppm	0.070 ppm	0.075 ppm	0.079 ppm
Los Angeles-San Joaquin Valley, CA	$19,000	$19,000	$19,000	$19,000

[a] All estimates rounded to two significant figures.

[b] These estimates assume a particular trajectory of aggressive technological change. An alternative storyline might hypothesize a much less optimistic technological trajectory, with increased costs, or with decreased benefits in 2020 due to a later attainment date.

Table 7b.10: Extrapolated Cost to Meet Various Standards Using Hybrid Approach (Low)[a, b]

All 2030 Extrapolated Cost Areas (NOx only)	Hybrid Approach Extrapolated Cost (M 2006$)			
	0.065 ppm	**0.070 ppm**	**0.075 ppm**	**0.079 ppm**
Los Angeles-San Joaquin Valley, CA	$1,500	$1,400	$860	$430

[a] All estimates rounded to two significant figures.

[b] These estimates assume a particular trajectory of aggressive technological change. An alternative storyline might hypothesize a much less optimistic technological trajectory, with increased costs, or with decreased benefits in 2020 due to a later attainment date.

Table 7b.11: Hybrid Approach (High) Average Cost/Ton for Various Standards [a, b]

All 2030 Extrapolated Cost Areas (NOx only)	Hybrid Approach Average Cost/Ton (2006$)			
	0.065 ppm	**0.070 ppm**	**0.075 ppm**	**0.079 ppm**
Los Angeles-San Joaquin Valley, CA[A]	$33,000	$33,000	$32,000	$31,000

[a] All estimates rounded to two significant figures.

[b] These estimates assume a particular trajectory of aggressive technological change. An alternative storyline might hypothesize a much less optimistic technological trajectory, with increased costs, or with decreased benefits in 2020 due to a later attainment date.

Table 7b.12: Extrapolated Cost to Meet Various Standards Using Hybrid Approach (High)[a, b]

All 2030 Extrapolated Cost Areas (NOx only)	Hybrid Approach Extrapolated Cost (M 2006$)			
	0.065 ppm	**0.070 ppm**	**0.075 ppm**	**0.079 ppm**
Los Angeles-San Joaquin Valley, CA[A]	$2,600	$2,400	$1,400	$700

[a] All estimates rounded to two significant figures.

[b] These estimates assume a particular trajectory of aggressive technological change. An alternative storyline might hypothesize a much less optimistic technological trajectory, with increased costs, or with decreased benefits in 2020 due to a later attainment date.

7b.2.3 Benefits

The Estimated Benefits of 2030 Attainment with Alternate Ozone Standards

The ozone analysis for San Joaquin and South Coast applies the same methods described elsewhere in the benefits chapter with the exception of: (1) the population year and (2) the year for the income growth adjustment. We updated both to 2030 to be consistent with the attainment year. Table 7b.13 below summarizes the updated benefits estimates.

Table 7b.13: Total Estimated Ozone Benefits of Attaining Alternate Ozone Standards in 2030 in San Joaquin and South Coast (2006$)

Mortality Function or Assumption	*Valuation Estimate*
0.079 ppm	
No Causality	$13,000,000
Bell et al. (2004)	$130,000,000
Bell et al. (2005)	$380,000,000
Ito et al. (2005)	$520,000,000
Levy et al. (2005)	$530,000,000
0.075 ppm	
No Causality	$25,000,000
Bell et al. (2004)	$250,000,000
Bell et al. (2005)	$770,000,000
Ito et al. (2005)	$1,000,000,000
Levy et al. (2005)	$1,100,000,000
0.070 ppm	
No Causality	$64,000,000
Bell et al. (2004)	$530,000,000
Bell et al. (2005)	$1,600,000,000
Ito et al. (2005)	$2,100,000,000
Levy et al. (2005)	$2,200,000,000
0.065 ppm	
No Causality	$97,000,000
Bell et al. (2004)	$800,000,000
Bell et al. (2005)	$2,400,000,000
Ito et al. (2005)	$3,100,000,000
Levy et al. (2005)	$3,300,000,000

Estimating the Monetized Benefit per ton of $PM_{2.5}$ Precursor Reduced

The NOx emission reductions necessary to reach attainment with an alternate revised standard would also reduce levels of $PM_{2.5}$. The process for estimating the $PM_{2.5}$ co-benefit for these two airsheds is very similar to the national co-benefit analysis described in the body of the RIA, with a single exception noted further below. The steps are as follows:

1. *Estimate the number of tons of NOx necessary to attain a baseline of 0.08 ppm.* As noted above, Table 7b.2 includes the estimate of extrapolated NOx tons necessary to attain each standard alternative.

2. *Calculate the benefits of attaining 0.08 ppm incremental to partial attainment of 0.08 ppm.* To estimate the benefits of fully attaining 0.08 ppm incremental to partial attainment of 0.08 ppm, the relevant benefit per ton is simply multiplied by the total number of extrapolated NOx tons abated. Note that this calculation step allows us to net

out the benefits of attaining the current standard, so that all subsequent benefits are incremental to the full attainment of 0.080 ppm.

3. *Calculate the benefits of partially attaining 0.070 ppm incremental to full attainment of 0.08 ppm.* Subtract the benefits of fully attaining 0.080 ppm incremental to the partial attainment of 0.08 ppm to create a new estimate of incremental 0.070 ppm partial attainment.

4. *Calculate the $PM_{2.5}$ benefits of fully attaining 0.070 ppm*. Multiplying the estimate of the extrapolated NOx tons necessary to attain 0.070 ppm fully (Table 7b.3) produces an estimate of the incremental benefits of fully attaining 0.070 ppm incremental to partial attainment of 0.070 ppm. By adding this incremental benefit estimate to the benefits generated in step 3, we derived a total benefit estimate of attaining 0.070 ppm incremental to 0.08 ppm.

5. *Repeat step 4 to estimate the benefits of 0.075 ppm, 0.079 ppm and 0.065 ppm*. Step 4 may be repeated by substituting the NOx tons necessary to attain the selected alternative of 0.075 ppm and the remaining alternatives of 0.079 ppm and 0.065 ppm to produce an estimate of total $PM_{2.5}$ co-benefits.

Because this analysis estimates the $PM_{2.5}$ co-benefits of full attainment for these two airsheds in 2030, it was necessary to apply a $PM_{2.5}$ benefit per ton estimate that incorporates this population year. The Technical Support Document for this RIA describes the technique for calculating a benefit per ton estimate that reflected population growth to 2030 (EPA, 2008). Table 7b.14 below summarizes the total monetized $PM_{2.5}$ co-benefits associated with attainment of each standard alternative.

Total Estimate of Combined Ozone Benefits and $PM_{2.5}$ Co-Benefits

Table 7b.15 summarizes the total combined benefits for each standard alternative.

The following tables summarize the costs, benefits, and net benefits of attaining the alternate primary standards for South Coast and San Joaquin.

Table 7b.14: Total Estimated PM2.5 Co-Benefits of Attaining Alternate Ozone Standards in 2030 in San Joaquin and South Coast (2006$)

	Valuation Estimate	
Mortality Function	**3% Discount Rate**	**7% Discount Rate**
0.079 ppm		
ACS Study	$120,000,000	$110,000,000
Harvard Six-City Study	$260,000,000	$240,000,000
Expert K	$54,000,000	$50,000,000
Expert E	$450,000,000	$410,000,000
0.075 ppm		
ACS Study	$240,000,000	$220,000,000
Harvard Six-City Study	$530,000,000	$480,000,000
Expert K	$110,000,000	$100,000,000
Expert E	$900,000,000	$820,000,000
0.070 ppm		
ACS Study	$400,000,000	$360,000,000
Harvard Six-City Study	$860,000,000	$780,000,000
Expert K	$180,000,000	$160,000,000
Expert E	$1,500,000,000	$1,300,000,000
0.065 ppm		
ACS Study	$420,000,000	$380,000,000
Harvard Six-City Study	$910,000,000	$820,000,000
Expert K	$190,000,000	$170,000,000
Expert E	$1,600,000,000	$1,400,000,000

Table 7b.15: Total Combined Ozone Benefits and PM2.5 Co-Benefits of Attaining Alternate Ozone Standards in 2030 in San Joaquin and South Coast (2006$, 3% Discount Rate)

	Alternative Standard and Model or Assumption				
	Bell et al. (2004)	**Bell et al. (2005)**	**Ito et al. (2005)**	**Levy et al. (2005)**	**Assumption of No Causality**
0.079 ppm Alternative					
ACS Study	$250,000,000	$510,000,000	$640,000,000	$650,000,000	$130,000,000
Harvard Six-City Study	$390,000,000	$650,000,000	$780,000,000	$800,000,000	$280,000,000
Expert K	$180,000,000	$440,000,000	$570,000,000	$590,000,000	$67,000,000
Expert E	$580,000,000	$840,000,000	$970,000,000	$990,000,000	$460,000,000
0.075 ppm Selected Alternative					
ACS Study	$500,000,000	$1,000,000,000	$1,300,000,000	$1,300,000,000	$270,000,000
Harvard Six-City Study	$780,000,000	$1,300,000,000	$1,600,000,000	$1,600,000,000	$550,000,000
Expert K	$360,000,000	$870,000,000	$1,100,000,000	$1,200,000,000	$130,000,000
Expert E	$1,200,000,000	$1,700,000,000	$1,900,000,000	$2,000,000,000	$930,000,000
0.070 ppm Alternative					
ACS Study	$930,000,000	$2,000,000,000	$2,500,000,000	$2,600,000,000	$460,000,000
Harvard Six-City Study	$1,400,000,000	$2,400,000,000	$3,000,000,000	$3,100,000,000	$920,000,000
Expert K	$710,000,000	$1,800,000,000	$2,300,000,000	$2,400,000,000	$240,000,000
Expert E	$2,000,000,000	$3,100,000,000	$3,600,000,000	$3,700,000,000	$1,500,000,000
0.065 ppm Alternative					
ACS Study	$1,200,000,000	$2,800,000,000	$3,500,000,000	$3,700,000,000	$520,000,000
Harvard Six-City Study	$1,700,000,000	$3,300,000,000	$4,000,000,000	$4,200,000,000	$1,000,000,000
Expert K	$990,000,000	$2,600,000,000	$3,300,000,000	$3,500,000,000	$280,000,000
Expert E	$2,400,000,000	$3,900,000,000	$4,700,000,000	$4,900,000,000	$1,700,000,000

Table 7b.16: Total Combined Ozone Benefits and PM2.5 Co-Benefits of Attaining Alternate Ozone Standards in 2030 in San Joaquin and South Coast (2006$, 7% Discount Rate)

	Alternative Standard and Model or Assumption				
	Bell et al. (2004)	**Bell et al. (2005)**	**Ito et al. (2005)**	**Levy et al. (2005)**	**Assumption of No Causality**
0.079 ppm Alternative					
ACS Study	$240,000,000	$490,000,000	$630,000,000	$640,000,000	$120,000,000
Harvard Six-City Study	$370,000,000	$620,000,000	$760,000,000	$770,000,000	$250,000,000
Expert K	$180,000,000	$430,000,000	$570,000,000	$580,000,000	$63,000,000
Expert E	$540,000,000	$790,000,000	$930,000,000	$940,000,000	$420,000,000
0.075 ppm Selected Alternative					
ACS Study	$480,000,000	$990,000,000	$1,300,000,000	$1,300,000,000	$250,000,000
Harvard Six-City Study	$730,000,000	$1,200,000,000	$1,500,000,000	$1,500,000,000	$500,000,000
Expert K	$350,000,000	$860,000,000	$1,100,000,000	$1,200,000,000	$130,000,000
Expert E	$1,100,000,000	$1,600,000,000	$1,900,000,000	$1,900,000,000	$840,000,000
0.070 ppm Alternative					
ACS Study					
Harvard Six-City Study	$1,300,000,000	$2,400,000,000	$2,900,000,000	$3,000,000,000	$840,000,000
Expert K	$700,000,000	$1,700,000,000	$2,300,000,000	$2,400,000,000	$230,000,000
Expert E	$1,900,000,000	$2,900,000,000	$3,500,000,000	$3,500,000,000	$1,400,000,000
0.065 ppm Alternative					
ACS Study	$1,200,000,000	$2,800,000,000	$3,500,000,000	$3,700,000,000	$480,000,000
Harvard Six-City Study	$1,600,000,000	$3,200,000,000	$3,900,000,000	$4,100,000,000	$920,000,000
Expert K	$970,000,000	$2,600,000,000	$3,300,000,000	$3,500,000,000	$270,000,000
Expert E	$2,200,000,000	$3,800,000,000	$4,500,000,000	$4,700,000,000	$1,500,000,000

Table 7b.17: Annual Monetized Costs and Benefits in 2030 in San Joaquin and South Coast: 0.075 ppm Standard in Billions of 2006$*

Mortality Function or Assumption	Reference	Total Benefits** 3%	Total Benefits** 7%	Total Costs** 7%	Net Benefits 3%	Net Benefits 7%
NMMAPS	Bell et al. 2004	0.36 - 1.2	0.35 - 1.1	0.68 - 1.0	-0.64 - 0.48	-0.65 - 0.39
Meta-analysis	Bell et al. 2005	0.87 - 1.7	0.86 - 1.6	0.68 - 1.0	-0.13 - 0.99	-0.14 - 0.90
	Ito et al. 2005	1.1 - 1.9	1.1 - 1.9	0.68 - 1.0	0.14 - 1.26	0.13 - 1.2
	Levy et al. 2005	1.2 - 2.0	1.2 - 1.9	0.68 - 1.0	0.17 - 1.29	0.16 - 1.20
Assumption that association is not causal***		0.13 - 0.93	0.13 - 0.84	0.68 - 1.0	-0.87 - 0.25	-0.87 - 0.16

Table7b.18: Annual Monetized Costs and Benefits in 2030 in San Joaquin and South Coast: 0.079 ppm Standard in Billions of 2006$*

Mortality Function or Assumption	Reference	Total Benefits** 3%	Total Benefits** 7%	Total Costs** 7%	Net Benefits 3%	Net Benefits 7%
NMMAPS	Bell et al. 2004	0.18 - 0.58	0.18 - 0.54	0.34 - 0.52	-0.34 - 0.24	-0.34 - 0.20
Meta-analysis	Bell et al. 2005	0.44 - 0.84	0.43 - 0.79	0.34 - 0.52	-0.08 - 0.50	-0.09 - 0.45
	Ito et al. 2005	0.57 - 0.97	0.57 - 0.93	0.34 - 0.52	0.05 - 0.63	0.05 - 0.59
	Levy et al. 2005	0.59 - 0.99	0.58 - 0.94	0.34 - 0.52	0.07 - 0.65	0.06 - 0.60
Assumption that association is not causal***		0.07 - 0.46	0.06 - 0.42	0.34 - 0.52	-0.45 - 0.12	-0.46 - 0.08

Table 7b.19: Annual Monetized Costs and Benefits in 2030 in San Joaquin and South Coast: 0.070 ppm Standard in Billions of 2006$*

Mortality Function or Assumption	Reference	Total Benefits** 3%	Total Benefits** 7%	Total Costs** 7%	Net Benefits 3%	Net Benefits 7%
NMMAPS	Bell et al. 2004	0.71 - 2.0	0.70 - 1.9	1.1 - 1.7	-0.99 - 0.90	-1.0 - 0.76
Meta-analysis	Bell et al. 2005	1.8 - 3.1	1.7 - 2.9	1.1 - 1.7	0.06 - 2.0	0.05 - 1.8
	Ito et al. 2005	2.3 - 3.6	2.3 - 3.5	1.1 - 1.7	0.62 - 2.5	0.60 - 2.4
	Levy et al. 2005	2.4 - 3.7	2.4 - 3.5	1.1 - 1.7	0.67 - 2.6	0.66 - 2.4
Assumption that association is not causal***		0.24 - 1.5	0.23- 1.4	1.1 - 1.7	-1.5 - 0.43	-1.5 - 0.29

Table 7b.20: Annual Monetized Costs and Benefits in 2030 in San Joaquin and South Coast: 0.065 ppm Standard in Billions of 2006$*

Mortality Function or Assumption	Reference	Total Benefits**		Total Costs**	Net Benefits	
		3%	7%	7%	3%	7%
NMMAPS	Bell et al. 2004	0.99 - 2.4	0.97 - 2.2	1.2- 1.9	-0.91 - 1.2	-0.93 - 1.0
Meta-analysis	Bell et al. 2005	2.6 - 3.9	2.6 - 3.8	1.2 - 1.9	0.67 - 2.7	0.65 - 2.6
	Ito et al. 2005	3.3 - 4.7	3.3 - 4.5	1.2 - 1.9	1.4 - 3.5	1.4 - 3.3
	Levy et al. 2005	3.5 - 4.9	3.5 - 4.7	1.2 - 1.9	1.6 - 3.7	1.6 - 3.5
Assumption that association is not causal***		0.28 - 1.7	0.27 - 1.5	1.2 - 1.9	-1.6 - 0.46	-1.63 - 0.31

*Includes ozone benefits, and PM 2.5 co-benefits. Range was developed by adding the estimate from the ozone premature mortality function to both the lower and upper ends of the range of the PM2.5 premature mortality functions characterized in the expert elicitation. Tables exclude unquantified and nonmonetized benefits. All estimates rounded to two significant figures, so totals may not sum across columns.

**Range reflects lower and upper bound cost estimates. Data for calculating costs at a 3% discount rate was not available for all sectors, and therefore total annualized costs at 3% are not presented here.

***Total includes ozone morbidity benefits only.

7b.3 References

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